MAPC Community Greenhouse Gas Inventory Tool

Community Greenhouse Gas Inventory

This workbook serves to document the calculations associated with the community-wide greenhouse gas inve
for the City/Town of _____ for the year of _____ . The inventory is designed according to the Global Pr
Community-Scale Greenhouse Gas Emission Inventories (GPC) and includes raw data, assumptions, and calcu
in each of the following GPC emission sectors:

1. Stationary Energy
2. Transportation
3. Waste

Version 6.0: February 2025
Created by DNV GL, with support from MAPC
Maintained by MAPC

Using this tool

Users should download and review the accompanying guide to this workbook, which can be found on MAPC's
Greenhouse Gas Inventories webpage: https://www.mapc.org/resource-library/community-ghg-inventory-res

The guide includes a Data Collection Checklist and Worksheet for users to have a single location to collect all d
and document data sources. The worksheet correlates directly with the INPUTS tab of this workbook. Please r
inventory year is being updated, users should only enter data or edit cells on the INPUTS tab. All of the other
workbook perform calculations based on the Inputs and should not be edited.

Updating the tool for other inventory years

If this workbook is to be used for creating emissions inventories for any year other than 2022, the "Adjust Inv
of the workbook will need to be updated. This section includes instructions on where to collect and input dat
years. The inputs in this section populate the data in the tables throughout the workbook to update all calcul
alternative inventory year.

Comparing municipal emissions and community-wide emissions

In the All Emissions Summary and Multi-year Emissions trend there are tables where communities may enter
Energy Insight to compare emissions from municipal operations energy use and fleet vehicles with the overal
emissions. The tables are shown in GREEN. Please note, these emissions are included in the community-wide
not to in addition to the community-wide emissions.

entory completed
rotocol for
lations for the Town

s Community
sources/.

of the information
note, unless the
tabs in this

entory Year" section
a for alternative
atations to the

data from Mass
l community-wide
e emissions and are

Data Input

**Please enter community-specific data below using the instructions provided. Green cells must b
function properly. Blue cells are not applicable to all communities or data may be input by other**

Legend:
- Required input
- Optional input

Links to Input Tables:
Energy Data
Transportation Data
Waste Data

Select your city or town from the drop down menu:	Abington
Inventory year:	2022

Energy Data

ELECTRICITY AND NATURAL

Which investor-owned utility or utilities provide(s) electricity in your community? *(Use drop down menu to select)*	Eversource
If not served by an investor-owned utility, which municipally-owned utility supplies electricity in your community? *(Use drop down menu to select)*	Not served by municipal utility

Optional Question Instructions:
1) **If your community's electricity is provided by both Eversource & NGRID**, please indicate below the estimated percentage of electricity that is provided by each investor-owned utility. Total must add up to 100%. This information will be used to estimate the utility-specific weighted electricity emission factor.

2) **If your community's electricity is provided by only one investor-owned utility (either Eversource or NGRID) or is served by a municipal utility**, skip this table.

Investor Owned Utility Electricity Service Coverage	
Electricity Rate	**% of Community Served by Utility**
Eversource (Eastern or Western)	100%
NGRID	0%

Mandatory Question Instructions:
Use the hyperlink to the right to access the "MassSaveData" website. Click on the "Geographic" button in the top right and select "Usage By Month." Use the drop-downs in the top left to select "Electricity" or "Gas" and the appropriate year. Find your community and enter the "Annual" total on the far right for both the "Residential" and "Commercial & Industrial" sectors in the table below. If your community obtains electricity and/or gas through a municipal utility, do not enter that consumption data in this table. See below table for municipal utilities.

MassSave Electricity and Natural Gas Consumption Data

Sector	Total Annual Electricity Consumption (MWh / Year)
Residential:	
Commercial & Industrial:	
Combined Total:	**0**

Optional Question Instructions:
Communities may use this table to enter electricity, natural gas, and heating oil consumption data from MassEnergyInsight. Note that the electricity and natural gas consumption data for municipal operations is also included in the MassSaveData. We break them out here so that communities may track emissions from municipal operations separately. The emissions associated with MassEnergyInsight data do not get added to MassSaveData for building energy consumption, otherwise they will be double counted.

To find usage data by fiscal year in MassEnergyInsight, click 'view reports', and then the tab labeled 'use and cost table'. Note that delivered fuels and vehicle fleet may not align if not monthly entries.

MassEnergyInsight Municipal Electricity, Natural Gas, and Hea

	Total Annual Electricity Consumption (kWh / Year)
Municipal Operations	
Service Provider:	IOU
If municipal facilities are enrolled in the CCA, which program rate are they are subscribed to?	N/A

Optional Question Instructions:
1) **If you do have community choice aggregation** in your community, contact your community choice electricity provider to obtain data on the annual electricity consumption for the inventory year by rate (e. "50% Green", "100% Green") and by sector (e.g. "Residential" and "Commercial & Industrial"). The nun community to community. For example, some communities will have three residential rates while others rates. If, for example, your community only has three residential rates, in the "Residential Rate 4" row s Rate in Calculations?" column. For each rate, you will also need to obtain information from your commu retail provider on the percent of "Class I Voluntary RECs" associated with each rate. Enter the appropri

2) **If you do not have community choice aggregation** in your community, skip this table.

Community Choice Electricity Consumption Data

Electricity Rate	Include This Rate in Calculations?
Residential Rate 1	No
Residential Rate 2	No

Residential Rate 3	No
Residential Rate 4	No
Total CCA Residential	
C&I Rate 1	No
C&I Rate 2	No
C&I Rate 3	No
C&I Rate 4	No
Total CCA Commercial & Industrial	
Total CCA Residential, Commercial & Industrial	

Mandatory Question Instructions:
1) **If your electricity or gas is provided by a municipal utility**, contact your municipal utility to obtain consumption and/or natural gas consumption for the inventory year by sector (e.g. "Residential" and "C Enter the appropriate data in the table below.

2) **If you do not have a municipal utility** in your community, skip this table.

Municipal Utility Electricity and/or Natural Gas Consumption Data

Sector	Total Annual Electricity Consumption (kWh / Year)
Residential	0
Commercial & Industrial	0
Total	**0**

HEATING OIL

Mandatory Question Instructions:
Use the hyperlink to the right to access the Massachusetts Executive office of Labor and Workforce Development (EOLWD) Employment and Wages (ES-202) data.
1) "Select Area Type" drop-down: Select "City or Town"
2) "Select Specific Geogrpahic Area" drop-down: Select your community
3) "Select a Year" drop-down: Select your inventory year
4) "Select the Time Period" drop-down: Select "Annual Report"
5) "Select the Ownership" drop-down: Select "All ownership types"
6) "Select an Industry or Industry Sector" drop-down: Select "Total, All Industries"
7) "Select the Category" option: Select "Category and all sub-categories"
8) Select the link to "Download and save the data as a Comma Separated Value (CSV) File". Open the CSV.
9) Sort Column A ("NAICS") to "Sort smallest to largest"
10) Only include data that has a 3-digit NAICS code in column A. Take data from Column A ("NAICS"), Column C ("No. of Establishments") and column Q ("Average Monthly Employment") for all rows of data with a 3-digit NAICS code and paste it in the table below.

The number of NAICS codes in each community will vary considerably. It is very likely that the below table will have blank rows after it is populated with your community's data.

Number of Establishments and Monthly Employment by NAICS Code

Column A - NAICS	Column C - No. of Establishments

Mandatory Question Instructions Part 1:

Use the hyperlink to the right to access ACS data for Housing Tenure by Units in Structure on MAPC's DataCommon

1) Select the applicable five year estimate range (for 2022, this is 2018-2022).
2) Click the "CSV" button in the top right of the display to download the data, or simply view in the browser.
3) Navigate to the appropriate row of data for your municipality. Enter the number of households in your community for each "Units in Structure" category below. The applicable meta data field name is provided in parantheses.

Mandatory Question Instructions Part 2:

Use the hyperlink to the right to access ACS data for Housing Tenure by Fuel Type on MAPC's DataCommon

1) Select the applicable five year estimate range (for 2022, this is 2018-2022).
2) Click the "CSV" button in the top right of the display to download the data, or simply view in the browser.
3) Navigate to the appropriate row of data for your municipality. Enter the value for "% of households heated by Oil" below.

Households in Community by Housing Type & Percent of Homes Using Fuel Oil

Housing Type	Number of Households in Community
1-unit, detached (u1d)	
1-unit, attached (u1a)	
2 units (u2)	
3 or 4 units (u3_4)	
5 to 9 units (u5_9)	
10 to 19 units (u10_19)	
20 or more units (u20ov)	
Mobiles homes (mobl)	
House Heating Fuel	**Percent Occupied Housing Units in Community**
Fuel oil, kerosene, etc. (oil_p)	

OFF ROAD

Mandatory Question Instructions Part 1: Total Employment

County Data:
Use the hyperlink to the right to access the U.S. Census Data search.
1) Enter "S2405" into the search bar and select "Search"
2) Select the table titled "Industry by Occupation for the Civilian Employed Population 16 Years and Over"
3) Under the "Geos" dropdown select "County" > "Massachusetts" > your county.
4) Under the "Dataset" dropdown select the ACS 5-year estimates for your inventory year.
5) Under the "Year" dropdown, select your inventory year.
6) For the top row ("Civilian employed population 16 years and over") find the "Total" Estimate column. Enter this data as total employment for the county in the below table.

City/Town Data:
Use the hyperlink to the right to access the Massachusetts Department of Economic Research Employment and Wages Data.
1) Select "City or Town" for Area Type
2) Select your city or town for Specific Geographic Area
3) Select appropriate inventory year for Year
4) Select "Annual Report" for Time Period
5) Select "All ownership types" for Ownership
6) Select "Total, All Industries" for Industry or Industry Sector
7) Select "Category Only"
8) Select "View and Print the Data" or download the CSV file and input the average of the monthly values

Mandatory Question Instructions Part 2: Manufacturing Employment

County Data:
Use the hyperlink to the right to access the U.S. Census Data search.
1) Enter "S2405" into the search bar and select "Search"
2) Select the table titled "Industry by Occupation for the Civilian Employed Population 16 Years and Over"
3) Under the "Geos" dropdown select "County" > "Massachusetts" > your county.
4) Under the "Dataset" dropdown select the ACS 5-year estimates for your inventory year.
5) Under the "Year" dropdown, select your inventory year.
6) Find the "Manufacturing" row and enter the value in the "Total" Estimate column as Manufacturing Employment for the county in the below table.

City/Town Data:
Use the hyperlink to the right to access the Massachusetts Department of Economic Research Employment and Wages Data.
1) Select "City or Town" for Area Type
2) Select your city or town for Specific Geographic Area
3) Select appropriate inventory year for Year
4) Select "Annual Report" for Time Period
5) Select "All ownership types" for Ownership
6) Select "Manufacturing" for Industry or Industry Sector
7) Select "Category Only"
8) Select "View and Print the Data" or download the CSV file and input the average of the monthly values

Mandatory Question Instructions Part 3: Square Feet of Developed Open Space
Use the hyperlink to the right to access estimated landscaped area square footage data on MAPC's DataCommon.
1) Click the "CSV" button in the top right of the display to download the data, or simply view in the browser.
2) Navigate to the appropriate row of data for your municipality. Enter the values for developed open space at the county and municipal level.

Note: This data is from the National Land Cover Database, which is only updated every 2-3 years. As of when this tool was published, the most recent year available was 2021.

Mandatory Question Instructions Part 4: Square Feet of Commercial Development Under Construction
1) MAPC can provide this data from the commercial real estate database, CoStar. To request this data from MAPC, send an email to MAPC's Analytical Services Manager (listed on the Data Services webpage at the link to the right) and to MAPC's Clean Energy Team at CleanEnergy@mapc.org.
2) Enter the values for Square Feet of Commercial Development Under Construction for your county and city/town.

Total & Manufacturing Employment

Employment Description	County Data
Total Employment	
Manufacturing Employment	
Square Feet of Developed Open Space	
Square Feet of Commercial Development Under Construction	

Mandatory Question Instructions:
Use the hyperlink to the right to access the MOVES emissions data on MAPC's DataCommon.
1) Select the applicable year (available years are 2017, 2021, and 2022)
2) Click the "CSV" button in the top right of the display to download the data, or simply view in the browser.
3) Navigate to the appropriate rows of data for your county. Enter the CO2 and CH4 emissions for your county below.

County Off-Road Transportation Emissions

County in which your community located:	Barnstable
Emissions Source	**CO2 Emissions (lbs)**
Industrial	
Lawn / Garden	
Commercial	
Construction	

Transportation Data

Mandatory Question Instructions:
Use the hyperlink to the right to access the Massachusetts Vehicle Census emissions data on MAPC's DataCommon.
1) Select the applicable year (available years are 2020, 2021, and 2022).
2) Click the "CSV" button in the top right of the display to download the data, or simply view in the browser.
3) Filter the data for your municipality and the appropriate vehicle use type (Passenger / Commercial / Municipal). Enter the Annual Vehicle Miles Traveled (VMT) and Annual Fuel Consumption (gal) for each vehicle fuel type.

Note: The previous version of this tool did not include the following vehicle fuel types: Compressed Natural Gas, Propane, Hydrogen Fuel Cell, and Other. These vehicles are included in this tool to align with the data reported in the MA Vehicle Census. The annual fuel consumptions for these vehicle fuel types are reported as gallons of gasoline equivalents.

Private On-road Passenger Vehicles: VMT and Fuel Consumption

Vehicle Fuel	Annual Vehicle Miles Traveled (VMT)
Passenger Vehicles	**0**
Gasoline	
Diesel	
FlexFuel	
Hybrid Electric Vehicle	
Plug-in Hybrid Electric Vehicle	
Compressed Natural Gas	
Propane	
Hydrogen Fuel Cell	
Other	
Electric	

Private On-road Commercial Vehicles: VMT and Fuel Consumption

Vehicle Fuel	Annual Vehicle Miles Traveled (VMT)
Commercial Vehicles	**0**
Gasoline	
Diesel	
FlexFuel	
Hybrid Electric Vehicle	
Plug-in Hybrid Electric Vehicle	
Compressed Natural Gas	
Propane	
Hydrogen Fuel Cell	
Other	
Electric	

Municipal On-road Vehicles: VMT and Fuel Consumption Data	
Vehicle Fuel	**Annual Vehicle Miles Traveled (VMT)**
Municipal Vehicles	**0**
Gasoline	
Diesel	
FlexFuel	
Hybrid Electric Vehicle	
Plug-in Hybrid Electric Vehicle	
Compressed Natural Gas	
Propane	
Hydrogen Fuel Cell	
Other	
Electric	

Note: The previous version of the tool instructed users to source Municipal Vehicle data from MassEne previous version of the MA Vehicle Census did not separate municipal vehicles from commercial vehicl Census data identifies municipal vehicles separately, so users no longer need to access MassEnergyIn data.

State On-road Vehicles: VMT and Fuel Consumption Data	
Vehicle Fuel	**Annual Vehicle Miles Traveled (VMT)**
State Vehicles	**0**
Gasoline	
Diesel	
FlexFuel	
Hybrid Electric Vehicle	
Plug-in Hybrid Electric Vehicle	
Compressed Natural Gas	
Propane	
Hydrogen Fuel Cell	
Other	
Electric	

Note: The previous version of the tool did not include State vehicles because the previous version of th separate State vehicles from commercial vehicles. The updated MA Vehicle Census data identifies Sta are now included here.

Mandatory Question Instructions:
Use the hyperlink to the right to access MBTA Route Distance data on MAPC's DataCommon.
1) Select the applicable year (available years are 2017, 2021, and 2022).
2) Click the "CSV" button in the top right of the display to download the data, or simply view in the browser.
3) Navigate to the appropriate row of data for your municipality. Enter the values called for below for each On-Road Public Transit Type serving your municipality.

MBTA Public Transportation City/Town Frequency-weighted Route Distance	
Public Transit Type	**City/Town Frequency-weighted Route Distance (miles/year)**
MBTA Silver Line	
Trackless Trolley	
All MBTA Bus (Excluding Silver Line)	
Blue Line (Heavy Rail)	
Orange Line (Heavy Rail)	
Red Line (Heavy Rail)	
Green Line (Light Rail)	
Mattapan Trolley	
Commuter Rail	

Waste Data

Do you know what percent of waste collected in your community (excluding separated organics) is sent to landfill vs. incineration? *(Use drop down menu to select)*	No

Optional Question Instructions:
1) **If you answered "Yes"** to previous question, complete below table.
2) **If you answered "No"** to the previous question, skip below table.

City-Specific Disposed Waste Destination	
Final Destination of Collected Waste Material	**Percent of Waste**
Landfill	10%
Incineration	90%

If your community has curbside organics collection, do you know what percent of collected organic material is sent to a compositing facility vs. an anaerobic digestion facility? *(Use drop down menu to select)*	N/A - We don't have curbside composting

Optional Question Instructions:
1) **If you answered "Yes"** to previous question, complete below table.
2) **If you answered "No" or "N/A"** to the previous question, skip below table.

City-Specific Organic Recycling Destination	
Final Destination of Collected Organic Material	**Percent of Waste**
Composting Facility	50%
Anaerobic Digestion Facility	50%

Has your community completed a waste characterization study that you would prefer to use in this inventory instead of the default State waste characterization study? *(Use drop down menu to select)*	No

Optional Question Instructions:

1) **If you answered "Yes"** to previous question, complete below table. If your community has a waste characterization study, the categories in your community's waste characterization study may not "map" exactly to the waste categories used by the GPC. For example, instead of "garden waste and plant debris," your community's waste characterization study may have categories such as "branches and stumps" and "prunings, trimmings, leaves and grass". In the below table, include the sum of all categories in your community's inventory (e.g. "branches and stumps" and "prunings, trimmings, leaves and grass") that you think appropriately "map" to the GPC waste category (e.g. "garden waste and plant debris").

2) **If you answered "No"** to the previous question, skip below table.

City-Specific Waste Characterization

GPC Waste Category	Percent of Total Disposed Waste in Category
Food	21.6%
Garden Waste and Plant Debris	8.0%
Paper	21.8%
Wood	6.4%
Textiles	5.2%
Industrial Waste	0.0%

Mandatory Question Instructions:

1) Use the hyperlink to the right to access MassDEP's Municipal Solid Waste & Recycling Data. Downlc & Recylcing Survey Responses for the inventory year. Navigate to the appropriate row of data for your Disposal Tonnage into the "Mass of Solid Waste Disposed by Landfill and Incineration - Short Tons" ce *If data for your municipality is not reported, obtain the tonnage of municipally collected waste from the a input it in the table below.*

2) If your community has municipally-collected organics recycling, determine the mass of organic recyc waste hauler. Enter the data into the "Mass of Solid Waste Disposed by Composting and Anaerobic Dig the below table.

Tonnage of Solid Waste Collected: Municipal Haulers

Waste Collection Type	Mass of Solid Waste Disposed by Landfill and Incineration - Short Tons
Municipally Collected	0

Do you know the mass of solid waste collected by private haulers? *(Use drop down menu to select)*	No

Optional Question Instructions:
1) **If you answered "Yes"** to previous question, complete the table below by entering the mass of wast
2) **If you answered "No"** to the previous question, skip below table.

Tonnage of Solid Waste Collected: Private Haulers	
Waste Collection Type	**Mass of Solid Waste Disposed by Landfill and Incineration - Short Tons**
Private Hauler Collected	

Mandatory Question Instructions:
Use the hyperlink to the right to access MassDEP's Municipal Solid Waste & Recycling Data
1) Download the Municipal Solid Waste & Recylcing Survey Responses for the inventory year.
2) Navigate to the appropriate row of data for your municipality. Enter the total number of households and the number of households served by the municipal trash program in the table below.

Households Served by Municipal Trash Program	
Total Number of Households	
Households Served by Municipal Trash Program	

Do you know which landfill your community's waste is sent to? *(Use drop down menu to select)*	No

Optional Question Instructions:
1) **If you answered "Yes"** to previous question, select the landfill from the list below.
2) **If you answered "No" or "N/A"** to the previous question, skip below table.

Landfill Waste Destination	
Which landfill does your community send waste to? *(Use drop down menu to select)*	None of these landfills

Wastewater Treatment: Wastewater Treatment Plant (WWTP)	
Which wastewater treatment plant does your community send wastewater to? *(Use drop down menu to select)*	Deer Island WWTP
If you selected a specific WWTP above, what is the estimated percent of your total community's population served by this WWTP?	100%

Note: the percent of your total community's population on septic systems is calculated as 100% minus the percent of the population served by a WWTP.

Population Data

Mandatory Question Instructions:

Community population estimates from the U.S. Census can be accessed through MAPC's DataCommon. Select the appropriate year for your inventory and navigate to the rows for your municipality and the Massachusetts total to find population values.

What is the population of your community?	30,000
What is the population of Massachusetts	6,981,974

**e updated for the tool to
s (i.e. MAPC).**

GAS

MassSaveData Source

Annual Natural Gas Consumption (Therms / Year)
0

MassEnergyInsight Data

ting Oil Consumption Data	
Annual Natural Gas Consumption (Therms / Year)	Annual Heating Oil Consumption (Gallons / Year)
IOU	

e aggregation or retail
.g. "Traditional", "5% Green",
nber of rates will vary from
s will have four residential
elect "No" in the "Include This
unity choice aggregation or
ate data in the table below.

Total Annual Electricity Consumption (kWh / Year)	% of Class I Voluntary RECs

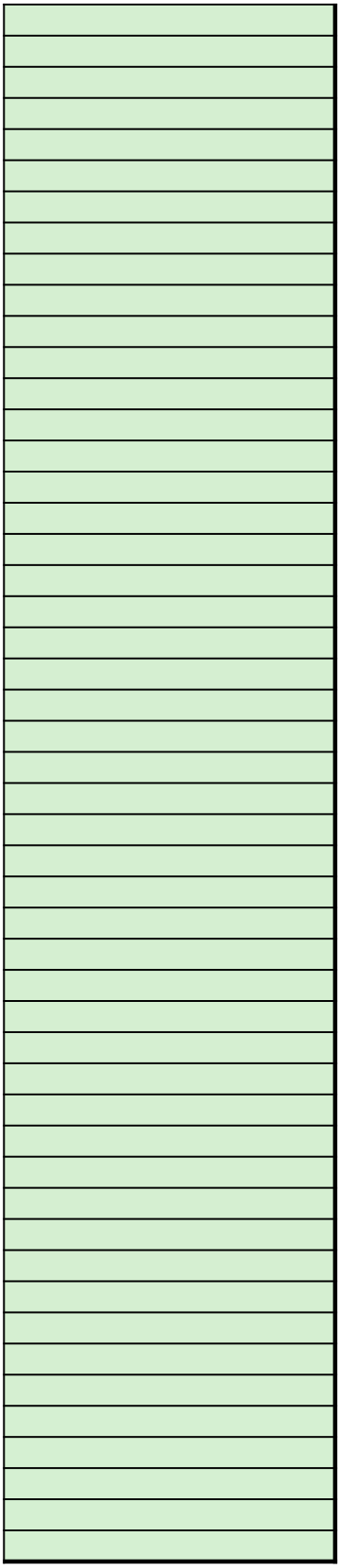
0	
0	
0	

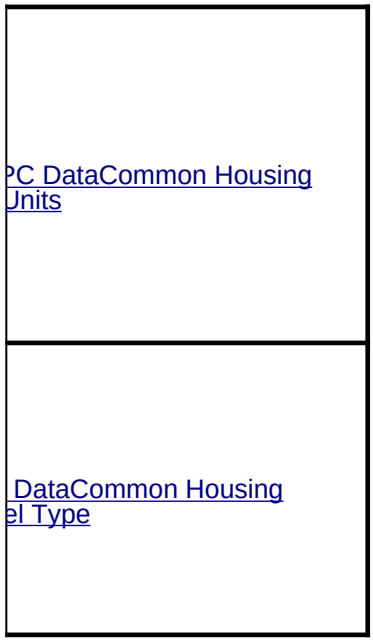
data on the annual electricity
ommercial & Industrial").

Total Natural Gas Consumption (therms / Year)
0
0
0

EOLWD Source

Column Q - Average Monthly Employment




PC DataCommon Housing
Units
DataCommon Housing
el Type

U.S. Census Data	onomic nt and

U.S. Census Data	onomic nt and
aCommon - Estima caped Area	
MAPC Data Services	
City/Town Data	

aCommon - MOVE
d Estimates

CH4 Emissions (lbs)

mmon - MA Ve
mmary Statist

Data
Annual Fuel Consumption (gal)
0

Data

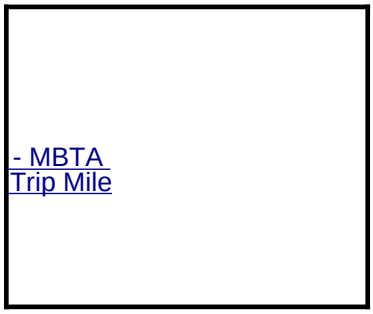
Annual Fuel Consumption (gal)
0

Annual Fuel Consumption (gal)
0

rgyInsights because the
es. The updated MA Vehicle
nsights for municipal vehicle

Annual Fuel Consumption (gal)
0

e MA Vehicle Census did not
te vehicles separately, so they


- MBTA
Trip Mile

oad the Municipal Solid Waste municipality. Enter the Trash ll in the below table. *appropriate municipal staff and* ling collected by the municipal gestion - Short Tons" cell in	Municipal Solid Wa ycling Data

Mass of Solid Waste Disposed by Composting and Anaerobic Digestion - Short Tons
0

te collected by private haulers.

Mass of Solid Waste Disposed by Composting and Anaerobic Digestion - Short Tons

Municipal Solid Wa
ycling Data

Common - US Ce
ion Estimates

Adjusting the Inventory Year

This version of MAPC's tool is auto populated to support the completion of an inventory for the year 2 would like to complete an inventory for an alternate year, the following additional inputs will need to b the appropriate year. See Appendix C of MAPC's Step-by-Step Guide for additional guidance.

Please note that, at the time of publishing this Tool, 2022 was the most recent year where the necessa available. Data availability from the sources listed below may vary depending on the alternate inventor

Inventory year:	2022

Update Emissions Factors

Instructions:

Depending on the inventory year selected, new or revised emissions factors may be available for combusted fuels like natural gas and fuel oil. Emissions factors can be sourced from US EPA.

Inputs for Emissions Factors - Table 1

Fuel Type	kg CO2/MMBTU	MT CO2/MMBTU
Natural Gas	53.06	
Distillate Fuel Oil No. 2.		0.07

Instructions:

In order to update the electricity emissions factors calculations, go to the MassDEP link provided and access the Massachusetts GHG Emissions Report for Retail Sellers of Electricity for the inventory year.

1) Download the report and navigate to "Table 2: GHG Emission Factors for Electricity Consumed in Massachusetts, prior to and after accounting for Unit-Specific Generation (lb CO2e/MWh)" and input the value for the Massachusetts-based approach, non-biogenic, after accounting for unit-specific generation in lbs CO2e/MWh.
2) Within Appendix 3, you will also need to input the values from "Table 12: Electricity Consumers Retail-Level Massachusetts-based GHG Emissions Factors by Individual Gas" for lbs/retail MWh for CO2, CH4, and N2O.

Inputs for Emissions Factors - Table 3

Greenhouse Gas	Combined Retail Level Electricity Emission Factor (lbs CO2e/MWh)	Non-Biogenic Retail Level Electricity Emission Factor (lbs CO2e/MWh)
CO2	540	
CH4	0.043	
N2O	0.006	

CO2e		637

Instructions:
In order to update the electricity emissions factors calculations, go to the MassDEP link provided and access the Massachusetts GHG Emissions Report for Retail Sellers of Electricity for the inventory year.

1) For Eversource, NGRID, and Unitil: Navigate to Appendix 2B, "Table 9: Individual Electric Utility and Competitive Supplier Percent of Sales Claimed as Unit-Specific Generation". For each Utility, input the value of the MWh claimed as unit-specific generation, non-emitting divided by the MWh reported as retail sales.

2) For Municipal Light Plants: Navigate to Appendix 2 and input the values from "Table 7. Individual MED Percent of Sales Claimed as Unit-Specific Generation" for the % of sales claimed as unit-specific generation for each Electric Utility and Municipal Electric Department listed below. *Note: If the MWH claimed as unit-specific generation, emitting is non-zero, subtract the emitting MWh from the non-emitting MWH and divide by the MWh resported as retail sales to get the % of sales claimed as non-emitting MWh.*

Inputs for Emissions Factors - Table 6 and Table 9

Investor-owned Utility / Municipal Utility
Eversource
NGRID
Unitil
Ashburnham Muni. Light Dept.
Belmont Municipal Light Department
Boylston Municipal Light Dept.
Braintree Electric Light Dept.
Chester Municipal Electric Light Dept.
Chicopee Electric Light Dept.
Concord Municipal Light Plant
Danvers Electric Division
Georgetown Municipal Light Department
Groton Electric Light Dept.
Groveland Municipal Light Dept.
Hingham Municipal Lighting Plant
Holden Municipal Light Dept.
Holyoke Gas & Electric Dept.
Hudson Light & Power Dept.
Hull Municipal Lighting Plant
Ipswich Municipal Light Department
Littleton Electric Light & Water
Mansfield Municipal Electric Dept.
Marblehead Municipal Light Dept.
Merrimac Municipal Light & Water Dept.
Middleborough Gas & Electric Dept.
Middleton Municipal Electric Dept.
North Attleboro Electric Dept.
Norwood Municipal Light Dept.
Paxton Municipal Light Dept.

Peabody Municipal Light Plant
Princeton Municipal Light Dept.
Reading Municipal Light Dept.
Rowley Municipal Lighting Plant
Russell Municipal Light Department
Shrewsbury Electric & Cable Ops.
South Hadley Electric Light Dept.
Sterling Municipal Light Dept.
Taunton Municipal Lighting Plant
Templeton Municipal Light & Water
Wakefield Municipal Gas & Light Dept.
Wellesley Municipal Light Plant
West Boylston Municipal Lighting Plant
Westfield Gas & Electric

Instructions:

If your community has a green municipal aggregation program (see Question 1C of the Guide), you will also need to update the minimum compliance percentage for Class I under the Massachusetts Renewable Portfolio Standard.

1) Use the link to the right to navigate to the Annual Compliance Information for Retail Electric Suppliers webpage.
2) Navigate to the RPS and APS Minimum Standards section and click the link to dowload the Minimum Standards through 2030
3) Input the Minimum Standard for RPS Class I (including Solar Carve-Outs) for the inventory year.

Inputs for Emissions Factors - Table 7

	Class I (with carve outs)
RPS minimum compliance percentage	20%

Instructions:

Occasionally, the numbers used to assess Global Warming Potential (GWP) will be updated or revised. This change can be due to updated scientific estimates of the energy absorption or lifetime of the gases or to changing atmospheric concentrations of GHGs that result in a change in the energy absorption of 1 additional ton of a gas relative to another. The Tool defaults to use the GWP values provided by the Intergovernmental Panel on Climate Change in the Sixth Assessment Report (2021). The GWP values for AR4, AR5, and AR6 are provided by the Greenhouse Gas Protocol in the link to the right. The Global Protocol recommends using the most recent GWP values available.

These inputs should only be adjusted if a more recent Assessment Report has been released by the IPCC with revised GWP values, or if this Tool is being used for a historic inventory requiring the use of older GWP values.

Inputs for Emissions Factors - Table 11

Methane (CH4)	Nitrous Oxide (N2O)
29.8	273

Instructions:
Depending on the inventory year selected, new or revised emissions factors may be available for vehicle fuels like diesel, gasoline, and compressed natural gas. To update emissions factors:

1) Identify CO2 emissions factors (MT CO2/gallon) for Diesel, Gasoline, and Compressed Natural Gas from the EPA's GHG Emissions Factors Hub for the inventory year (Table 2 in the Excel or PDF files).
2) Identify CH4 and N2O emissions factors (MT CH4/gallon and MT N2O/gallon) from the Maine Department of Environmental Protection's Mobile Greenhouse Gas Emission Factors spreadsheet on the Conversion table (CH4) and Conversion table (N2O) tabs. (Note: as of the publication of this tool, the required emissions factors in the correct units were not identified in EPA or MA sources. When updating emissions factors, first try to identify federal or MA-specific data before resorting to the Maine DEP or alternative source)

Inputs for Emissions Factors - Table 12

Fuel Type	CH4	CO2
Diesel	0.000000414	0.01021
Gasoline	0.000000375	0.00878
Compressed Natural Gas		0.05444

Update Stationary Energy Defaults

Instructions:
A Massachusetts-specific electricity transmission and distribution grid loss factor was calculated per U.S. Energy Information Administration instructions. To adjust your inventory year, you will need to collect the data below from U.S. EIA's electricity profile for Massachusetts using the link provided.

1) Select your inventory year from the drop down menu located in the top right of the webpage.
2) Scroll to the bottom of the page and click the link "Full data tables 1-17"
3) Download the Excel spreadsheet to access all of the data tables for Massachusetts.
4) Navigate in the spreadsheet to "Table 10: Supply and Disposition of Electricity" and input the values for the fields below associated with the inventory year.

Inputs for Stationary Energy - Buildings - Table 7

Total Disposition (MWh)	Direct Use (MWh)
54,237,623	838,517

Update Transportation Defaults

Instructions:
The fuel efficiency of electric vehicles is rapidly progressing from year to year. To increase the accuracy of your GHG inventory for alternate years, you will need to update the data supporting the average vehicle efficiency applied to electric vehicles in the Tool's calculations.
1) Input the seven top selling electric vehicles (by make, model, and year) in Massachusetts. The top selling electric vehicles in Massachusetts can be estimated via data from the MOR-EV Program Statistics, which reports the number of EV rebates distributed by make, model, and model year. The MOR-EV data can be downloaded at the link to the right. To identify the top selling vehicles through the inventory year, filter the data to include rebate applications through the end of the inventory year. Combine the vehicle model and vehicle year and calculate the total number of rebate applications for each make, model, and year. Input the Make, Model, and Year for the top 7 most popular vehicles in the table below
2) Input the Vehicle Efficiency (in kWh/mile) for the top selling electric vehicles. The vehicle efficiency can be found on the FuelEconomy.gov website using the "Search by Make" tool. Select the Year and Make and scroll down to identify the correct model. Input the efficiency in kWh/mile and the full name of the vehicle from the fuelconomy.gov website.

Inputs for Transportation - Onroad - Table 6

Make	Model	Year
Tesla	Model 3	2021
Toyota	Prius Prime	2019
Chevrolet	Bolt	2019
Toyota	Rav4 Prime	2021
Chevrolet	Volt	2017
Honda	Clarity PHEV	2018
Tesla	Model X	2017

Mandatory Question Instructions:
Use the hyperlink to the right to access MBTA Fuel Consumption and Route Distance data on MAPC's DataCommon.
1) Select the applicable year (the years available are 2017, 2021, 2022).
2) Click the "CSV" button in the top right of the display to download the data, or simply view in the browser.
3) Enter the values called for below for each On-Road Public Transit Type.

Inputs for Transportation - Onroad - Table 7

Public Transit Type	Line Annual Diesel Consumption (gallons/year)*	Line Annual CNG Consumption (MMBTU/year)
MBTA Silver Line	260,488	
Trackless Trolley		
All MBTA Bus (Excluding Silver Line)	4,379,315	200,323
Blue Line (Heavy Rail)		
Orange Line (Heavy Rail)		
Red Line (Heavy Rail)		
Green Line (Light Rail)		
Mattapan Trolley		
Commuter Rail	13,761,972	

Update Waste Defaults

Instructions:
This Tool assumes default State-level percent of disposed waste sent to landfill and combusted unless local data is entered on the "Inputs" tab of this workbook. To adjust your inventory year, use the link provided to access MassDEP's Solid Waste Data update for the appropriate year.

1) Navigate the report to "Table 2: Solid Waste Tonnage and Percent Change Summary". Input the mass of statewide waste reported in the inventory year by waste type and disposal method.

Inputs for Waste - Solid Waste - Table 3

Waste Type	Mass of Waste (short tons)
Landfilled - Municipal Solid Waste (MSW)	410,000
Landfilled - Construction & Demolition Waste (C&D)	0
Landfilled - Other Waste	80,000
Combusted - Municipal Solid Waste (MSW)	2,900,000
Combused - Non-Municipal Solid Waste (MSW)	20,000
Exported - Municipal Solid Waste (MSW)	1,380,000
Exported - Non-Municipal Solid Waste	1,500,000

Instructions:
The wastewater emissions analysis follows the approach used by the Massachusetts Department of Environmental Protection (DEP) to estimate wastewater treatment emissions for wastewater treatment plants and septic systems. The analysis is available on the "Wastewater" tab of Appendix C: Massachusetts Annual Greenhouse Gas Emissions Inventory.

To adjust inventory year, use the link provided to download the most recent version of Appendix C, navigate to the "Wastewater" tab, and input the following values:

1) Variables to calculate the CH4 emissions from Septic (cells C40-44 of the June 2024 version)

2) Variables to calculate the CH4 emissions from Non-MWRA WWTP (cells G40-44 of the June 2024 version)

3) Variable to calculate the N2O emissions from WWTP (cell K40 of the June 2024 version)

4) Variables to calculate the N20 Effluent emissions (first three values in cells K43-45 of the June 2024 version; Protein Consumption and Effluent Fraction are provided for each year in rows 35-36 of the June 2024 version)

Inputs for Waste - Wastewater - Table 3

Data Description	Data
Septic Biochemical Oxygen Demand (BOD) (kg/cap/day)	0.085
Septic Maximum CH4 Producing Potential (Bo) (kg CH4/kg BOD)	0.6
Septic Methane Correction Factor (MCF)	0.5

Fraction of population managing their septic tank in compliance with the sludge removal instruction of their septic system (F)	0.75

Inputs for Waste - Wastewater - Table 4	
Data Description	**Data**
WWTP Biochemical Oxygen Demand (BOD) (kg/cap/day)	0.090
WWTP Maximum CH4 Producing Potential (Bo) (kg CH4/kg BOD)	0.6
WWTP Methane Correction Factor (MCF)	0.03

Inputs for Waste - Wastewater - Table 5	
Data Description	**Data**
WWTP N20 Process Emissions (g N2O / cap / year)	4.0

Inputs for Waste - Wastewater - Table 6	
Data Description	**Data**
Effluent Fraction of nitrogen in protein (F_NPR) (kg N/kg protein)	0.16
Effluent Factor for nitrogen in non-consumed protein disposed in sewer system (F_NonCon) (kg N/kg N)	1.75
Effluent Emision factor for biosolids EF_biosolids (kg N2O-N/kg sewage-N produced)	0.005
Annual Per Capita Protein Consumption (kg/person/year)	34.4
Effluent Fraction for nitrogen in fertilizer (F_Fertilizer)	0.40

022. If your community
e updated to datasets from

ry data was widely
ry year you have selected.

EPA Emissions Factors

MT CH4/MMBTU	MT N2O/MMBTU
0.0000030	0.0000006

sDEP Reported Emissio
actors

sDEP Reported Emissio
actors

% Of Sales Reported to MA DEP as "Non-emitting MWh"
42.1%
44.2%
42.5%
33.5%
38.4%
38.8%
57.0%
8.6%
4.7%
92.7%
50.2%
44.0%
27.4%
12.5%
44.2%
53.0%
34.7%
88.4%
51.0%
21.8%
7.5%
47.7%
35.5%
21.4%
63.4%
34.9%
27.0%
29.3%
54.2%

35.2%
8.0%
26.7%
9.1%
7.5%
35.4%
83.5%
39.4%
26.9%
44.2%
40.7%
55.2%
51.1%
39.0%

husetts Renewable
Standard

Global Warming Poten
alues

EPA Emissions Factors

cle Em
nhous

N2O	Units
0.0000000828	MT gas/gallon
0.0000000750	MT gas/gallon
	kg CO2/SCF

US EIA MA Electricity Profile

Estimated Losses (MWh)
2,757,769

MOR-EV Data	conomy.gov Sear Make

Vehicle Efficiency (kWh/mile)	Vehicle Year, Make, and Model from Fueleconomy.gov
0.24	*2021 Tesla Model 3 Standard Range Plus RWD*
0.25	*2019 Toyota Prius Prime*
0.28	*2019 Chevrolet Bolt EV*
0.36	*2021 Toyota Rav4 Prime 4WD*
0.31	*2017 Chevrolet Volt*
0.30	*2018 Honda Clarify PHEV*
0.37	*2017 Tesla Model X AWD - 90D*

Line Annual Electricity Consumption (MWh/year)*	MBTA Frequency-weighted Vehicle Miles Traveled (miles/year)*
465	1,337,819
652	82,649
	21,499,857
26,622	3,375,435
43,279	5,487,367
83,027	10,526,961
38,645	4,899,785
3,017	382,526
	23,707,249

ssDEP Solid Waste Data
lates

DEP Annual GHG Inve
Report

All Emissions

Sector:	
Subsector/s:	
Inventory year:	

Summary of Methodology Used

This worksheet provides an overall summary of emissions from the three main GPC sectors - the sector specific emissions summaries. This tool does not include emissions from the Indus (AFOLU) sectors due to lack of available data. Emissions are broken out by sector, subsecto

Table 1: Community-wide Emissions Summary by Sector & Scope

Sector
Stationary Energy
Transportation
Waste
All

Table 2: Municipal Operations Emissions Summary

Sector
Stationary Energy
Transportation
All

* Combustion of fuels (natural gas, fuel oil, gasolene or diesel) within the municipal boundary

** Emissions from municipal electricity consumption

*** Emissions from electricity transmission and distribution system losses

Table 3: Community-wide Emissions Summary by Sector, Subsector, & Scope

Sector	Subsector
Stationary Energy	Residential Buildings
	C&I Buildings & Manufacturing Industries
	Construction
Transportation	On-road
	Railways (MBTA)
Waste	Solid Waste Disposal
	Biological Treatment of Waste
	Incineration and Open Burning
	Wastewater Treatment and Discharge
All Sectors & Subsectors	

Table 4: Community-wide Emissions Summary by Sector, Subsector, Source &

Sector	Subsector
	Residential Buildings

Stationary Energy	
	Commercial & Institutional Buildings & Manufacturing Industries
	Construction
Transportation	On-road
	Rail (MBTA)
Waste	Solid Waste Disposal
	Biological Treatment of Waste
	Incineration and Open Burning
	Wastewater Treatment and Discharge

Table 5: Community-wide Emissions Summary by Sector, Subsector, Source, S

Sector	Subsector
Stationary Energy	Residential Buildings
	Commercial & Institutional Buildings & Manufacturing Industries
	Construction
Transportation	On-road
	Rail (MBTA)
	Solid Waste Disposal

Waste	Biological Treatment of Waste
	Incineration and Open Burning
	Wastewater Treatment and Discharge

Table 6: Community-wide Summary of Building Energy Use by Sector and Sou

Subsector	Source
Residential Buildings	Res. Electricity
	Res. Natural Gas
	Res. Fuel Oil
Commercial & Institutional Buildings and Facilities + Manufacturing Industries*	Comm. & Man. Electricity
	Comm. & Man. Natural Gas
	Comm. & Man. Fuel Oil
All Buildings	Electricity
	Natural Gas
	Fuel Oil

The above energy consumption and emissions data excludes electricity transmission and distribution lo
Energy - Summary" worksheet for a detailed breakdown of transmission and distribution losses.

Table 7: Enery Industries Emissions - For Informational Purposes Only

Subsector	Source
Energy Industries *	Multiple Fuels

Emissions from Energy Industries (power plants) are part of the Stationary Energy Sector and fall into o
table are provided for informational purposes only.

Category 1) If the electricity generated from these facilities is consumed directly within the city (e.g. co-
plant should be captured under BASIC/BASIC+ GPC reporting guidelines. The natural gas consumptior
power plants is captured in the Mass Save energy data on the "Stationary Energy - Buildings" tab and i
Energy Industries emissions to the community total would constitute double counting of emissions.

Category 2) If the electricity generated from these facilities is sent to the regional electricity grid (e.g. lar
be captured under BASIC/BASIC+ GPC reporting guidelines.

Table 8: Total Community-wide Emissions by Subsector

Residential Buildings	#DIV/0!
C&I Buildings & Manufacturing Industries	#DIV/0!
Construction	#DIV/0!
On-road	#DIV/0!
Railways (MBTA)	#DIV/0!
Solid Waste Disposal	#DIV/0!
Biological Treatment of Waste	#DIV/0!
Incineration and Open Burning	#DIV/0!
Wastewater Treatment and Discharge	#DIV/0!

Table 9: Community-wide Emissions Summary by Sector, Subsector, & Scope disaggregated)	
Sector	**Subsector**
Stationary Energy	Residential Buildings
	C&I Buildings & Manufacturing Industries*
	Municipal Buildings
	Construction
Transportation	Passenger Vehicles
	Commercial Vehicles
	Municipal Vehicles
	State Vehicles
	On-road Buses and Trolleys (MBTA)
	Railways (MBTA)
Waste	Solid Waste Disposal
	Biological Treatment of Waste
	Incineration and Open Burning
	Wastewater Treatment and Discharge
	All Sectors & Subsectors

*Municipal electricity and natural gas usage has been subtracted from C&I usage to disaggre

Table 10: Total Community-wide Emissions by Subsector (with municipal emissions disaggregated)	
Residential Buildings	#DIV/0!
C&I Buildings & Manufacturing Industries	#DIV/0!
Municipal Buildings	#DIV/0!
Construction	#DIV/0!
Passenger Vehicles	#DIV/0!
Commercial Vehicles	#DIV/0!
Municipal Vehicles	#DIV/0!
State Vehicles	#DIV/0!
MBTA Public Transportation (Buses, Trolleys, & Railways)	#DIV/0!
Waste (Landfill, Biological Treatment, & Incineration & Open Burning)	#DIV/0!
Wastewater Treatment and Discharge	#DIV/0!

*Subsectors have been added together in places to support visualization of the data in "Repo

s: Summary

All Sectors
All Subsectors
2022

- Stationary Energy, Transportation, and Waste - based on the information calculated for
strial Process and Product Use (IPPU) and Agriculture, Forestry and Other Land Use
r, source and scope.

Total Emissions (MT CO2e)	Scope 1 Emissions (MT CO2e)	Scope 2 Emissions (MT CO2e)
0	0	0
#DIV/0!	0	#DIV/0!
1,945	0	0
#DIV/0!	**0**	**#DIV/0!**

Total Emissions (MT CO2e)	Scope 1 Emissions (MT CO2e)*	Scope 2 Emissions (MT CO2e)**
0	0	0
#DIV/0!	0	#DIV/0!
#DIV/0!	**0**	**#DIV/0!**

Total Emissions (MT CO2e)	Scope 1 Emissions (MT CO2e)	Scope 2 Emissions (MT CO2e)
0	0	0
0	0	0
0	0	0
#DIV/0!	0	#DIV/0!
0	0	0
819	0	0
0	0	0
721	0	0
405	0	0
#DIV/0!	**0**	**#DIV/0!**

Scope

Source	Scope	Emissions (MT CO2e)
Electricity	2	0
Electricity T&D Losses	3	0
Fuel Oil	1	0

Natural Gas	1	0
Nat. Gas. Dist. Losses	1	0
Electricity	2	0
Electricity T&D Losses	3	0
Fuel Oil	1	0
Natural Gas	1	0
Nat. Gas. Dist. Losses	1	0
Off-Road (Various Fuels)	1	0
Off-Road (Various Fuels)	1	0
CNG	1	0
Diesel	1	0
Electricity	2	#DIV/0!
Electricity T&D Losses	3	0
Gasoline	1	0
Diesel	1	0
Electricity	2	0
Electricity T&D Losses	3	0
Methane Commitment	3	819
Direct Emissions	3	0
Incineration	3	721
Effluent	3	405
All Sectors & Subsectors:		**#DIV/0!**

Scope & Gas

Source	Scope	Methane Emissions (MT CH4)
Electricity	2	0.0
Electricity T&D Losses	3	0.0
Fuel Oil	1	0.0
Natural Gas	1	
Nat. Gas. Dist. Losses	1	0
Electricity	2	0
Electricity T&D Losses	3	0
Fuel Oil	1	0.0
Natural Gas	1	
Nat. Gas. Dist. Losses	1	0
Off-Road (Various Fuels)	1	0.0
Off-Road (Various Fuels)	1	0.0
CNG	1	
Diesel	1	0.0
Electricity	2	#DIV/0!
Electricity T&D Losses	3	0.000
Gasoline	1	0.0
Diesel	1	0.00
Electricity	2	0.0
Electricity T&D Losses	3	0.00
Methane Commitment	3	27

Direct Emissions	3	0
Incineration	3	0.004
Effluent	3	0
	All Sectors & Subsectors:	**#DIV/0!**

urce

Consumption (mmBtu)	Emissions (MTCO2e)	% of Total Energy Emissions
0	0	#DIV/0!
0	0	#DIV/0!
0	0	#DIV/0!
0	0	#DIV/0!
0	0	#DIV/0!
0	0	#DIV/0!
0	0	#DIV/0!
0	0	#DIV/0!
0	0	#DIV/0!

sses associated with electricity and natural gas. See "Stationary

Scope	Emissions (MTCO2)
1	0

ne of two categories. In both instances, the emissions in the above

generation facility at large business), the emissions from this power
and associated emissions required to generate electricity at these
ncluded in the total reported emissions. Therefore, adding the above

ge coal power plant), the emissions from this power plant should not

(with municipal emissions
Total Emissions (MT CO2e)
0
0
0
0
#DIV/0!
#DIV/0!
#DIV/0!
#DIV/0!
0
0
819
0
721
405
#DIV/0!

gate municipal usage for the purposes of this Table.

Scope 3 Emissions (MT CO2e)
0
0
1,945
1,945

Scope 3 Emissions (MT CO2e)***
0
0
0

Scope 3 Emissions (MT CO2e)
0
0
0
0
0
819
0
721
405
1,945

Carbon Dioxide Emissions (MT CO2)	Nitrous Oxide Emissions (MT N2O)	Carbon Dioxide Equivalent Emissions (MT CO2e)
0	0	0
0	0	0
0	0.0	0
0		0
0		0
0	0	0
0	0	0
0	0.00	0
0		0
0		0
0		0
0		0
0		0
0	0.0	0
#DIV/0!	#DIV/0!	#DIV/0!
0	0.000	0
0	0.0	0
0.00	0.00	0
0	0.0	0
0	0.00	0
		819

	0.0	0
463	0.9	721
	1.5	405
#DIV/0!	**#DIV/0!**	**#DIV/0!**

All Emissions: Multi-Ye

Sector:	
Subsector/s:	
Inventory year:	

Summary of Methodology Used

This worksheet provides an overall summary of emissions from the three main GPC sectors -
calculated for the sector specific emissions summaries. The purpose of this worksheet is to p
should copy/paste values from an inventory year not covered in this inventory tool into the be
version of the tool covers inventory year 2022, but the community has also used a separate v
copy/pasted into the below table.

Table 1: Community-wide Emissions Summary by Sector & Scope: YYYY - YY

Sector
Stationary Energy
Transportation
Waste
All

Table 2: Municipal Operations Emissions Summary by Sector & Scope: YYYY -

Sector
Stationary Energy
Transportation
All

Table 3: Community-wide Emissions Summary by Sector, Subsector, & Scope:

Sector	Subsector
Stationary Energy	Residential Buildings
	C&I Buildings & Manufacturing Industries
	Construction
Transportation	On-road
	Railways
Waste	Solid Waste Disposal
	Biological Treatment of Waste
	Incineration and Open Burning
	Wastewater Treatment and Discharge
	All Sectors & Subsectors

ear Comparison

All Sectors
All Subsectors
Multiple

- Stationary Energy, Transportation, and Waste - based on the information rovide a multi-year comparison across multiple inventory years. Communities low tables in order to track emissions trends over time. For example, if this ersion of the tool to calculate 2017 emissions, those 2017 emissions can be

YY

YYYY Total Emissions (MT CO2e)	YYYY Total Emissions (MT CO2e)	YYYY Total Emissions (MT CO2e)	2022 Total Emissions (MT CO2e)
			0
			#DIV/0!
			1,945
0	**0**	**0**	**#DIV/0!**

YYYY

YYYY Total Emissions (MT CO2e)	YYYY Total Emissions (MT CO2e)	YYYY Total Emissions (MT CO2e)	2022 Total Emissions (MT CO2e)
			0
			#DIV/0!
0	**0**	**0**	**#DIV/0!**

YYYY - YYYY

YYYY Total Emissions (MT CO2e)	YYYY Total Emissions (MT CO2e)	YYYY Total Emissions (MT CO2e)	2022 Total Emissions (MT CO2e)
			0
			0
			0
			#DIV/0!
			0
			819
			0
			721
			405
0	**0**	**0**	**#DIV/0!**

Percent Change from YYYY --> YYYY

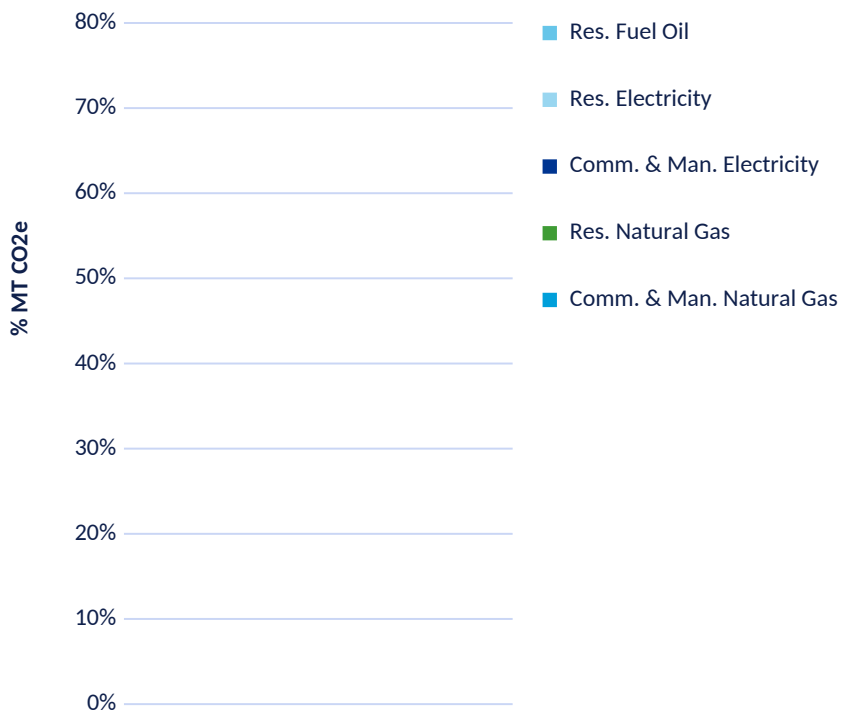
Percent Change from YYYY --> YYYY

Percent Change from YYYY --> YYYY

Summary Figures

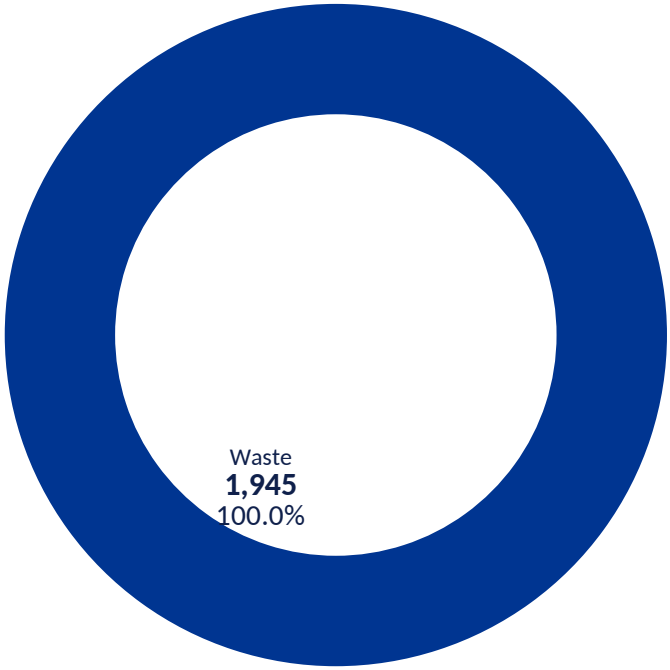
Percent of Total Community-wide Emissions by Subsector

Percent of Total Building Energy Emissions b Customer Type and Fuel



Percent of Total Community-Wi
(with Municipal Emissi

Community-wide Emissions (MT CO2e) by Sectc



y

Percentage of Building Energy Emissions by Source Energy

ide Emissions by Subsector
ons Disaggregated)

or

Emission Factors & Conversion Fa

*Emissions factors need to be checked annually to confirm conformance with latest standards

Summary of Methodology Used

Emission factors in terms of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) are
oxide (N2O) and common conversion factors are also included on this worksheet. In accordanc
time horizon from the IPCC 5th Assessment Report are used throughout this report.

Table 1: Stationary Fuel Emission Factors

Fuel Type	kg CO2/MMBTU
Natural Gas*	53.06
Fuel Type	**kg CO2/MMBTU**
Distillate Fuel Oil No. 2.	N/A

*CCAR and TCR do not include CH4 or N2O in emissions from natural gas because these emissions are

Table 2. Fugitive Emission Factor for Distribution Sector Natural Gas

Description	Data
Volume of Natural Gas per Heat Energy (m3 gas /therm gas)	2.83
Density of Natural Gas at Standard Temperature and Pressure (kg gas/m3 gas)	0.7
Mass of Natural Gas per Therm of Natural Gas (kg gas/therm gas)	1.98
Mass of Natural Gas per Therm of Natural Gas (MT gas/therm gas)	0.00198
Methane Content in Distribution Sector Natural Gas (%)	93.4%
Carbon Dioxide Content in Distribution Sector Natural Gas (%)	1.0%
Methane Mass per Therm of Natural Gas (MT CH4/therm)	0.002
Carbon Dioxide Mass per Therm of Natural Gas (MT CO2/therm)	0.00001981
Fugitive Natural Gas Emission Factor (MT CH4/therm)	0.00185
Fugitive Natural Gas Emission Factor (MT CO2/therm)	0.00002

Table 3. MA DEP Massachusetts-based Retail Level Electricity Emission Factor

Greenhouse Gas
CO2
CH4
N2O
CO2e

In order to determine the utility-specific and CCA-specific emission factors, Table 1 from the MassDEP GH year was referenced. Per guidance from DEP, and in accordance with the State's GHG inventory, the "Ma particular generating units from Table 2 was used as the base assumption. The Massachusetts-based con are used to estimate the breakdown of different gases.

Table 4. Investor-owned Utility Electricity Emission Factor: Community

Rate Option	DEP Generic "Massachusetts-based" CO2 Electricity Emission Factor (lbs CO2/MWh)
Selected Investor-owned Utility	634

The above electricity emission factor is used to calculate electricity emissions associated all electricity con the community.

Table 5. Investor-owned Utility Electricity Emission Factor: Regional Public Trans

Rate Option	DEP Generic "Massachusetts-based" CO2 Electricity Emission Factor (lbs CO2 / MWh)
Average Investor-owned Utility	634

The above electricity emission factor is only used to calculate electricity emissions associated with regiona

Table 6. List Investor-owned Utilities and % Non-emitting Sales

Investor-owned Utility	% Of Sales Reported to MA DEP as "Non-emitting MWh"
Eversource	42.1%
NGRID	44.2%
Unitil	42.5%
Eversource & NGRID	42.1%

Retail electricity providers and IOUs can voluntarily report the percent of sales reported as "non-emitting MWh" to DEP. For Eversource, NGRID, and Unitil: Navigate to Appendix 2B, "Table 9: Individual Electric Utility and Competitive Supplier Percent of Sales Claimed as Unit-Specific Generation". For each Utility, input the value of the MWh claimed as unit-specific generation, non-emitting divided by the MWh reported as retail sales. The "Eversource & NGRID" data in the above table represents a weighted average between the two utilities based on the percent of electricity provided by each utility in a given community. This information is only applicable to communities in which electricity is provided by both Eversource & NGRID.

Table 7. Community Choice Aggregation Electricity Emission Factors

Rate Option	Include this Rate in Calculations?
CCA Rate Option 1	No
CCA Rate Option 2	No
CCA Rate Option 3	No
CCA Rate Option 4	No

In order to determine the utility-specific and CCA-specific emission factors, Table 1 from the MassDEP GH year was referenced. Per guidance from DEP, and in accordance with the State's GHG inventory, the "Ma particular generating units from Table 2 was used as the base assumption. The Massachusetts-based con are used to estimate the breakdown of different gases.

Retail electricity providers can voluntarily report the percent of sales reported as "non-emitting MWh" to DE
base percentage of "non-emitting MWh" for retailers is equal to the RPS Class I (including carve-outs) min
compliance. In addition to this minimum compliance, some CCAs offer rates that include a set percentage
Voluntary RECs associated with the electricity rates offered in their community on the "Inputs" tab.

Table 8. Municipal Utility Electricity Emission Factor

Rate Option	DEP Generic "Massachusetts-based" CO2 Electricity Emission Factor (lbs CO2/MWh)
Selected Municipal Utility	634

In order to determine the utility-specific and CCA-specific emission factors, Table 1 from the MassDEP GH
year was referenced. Per guidance from DEP, and in accordance with the State's GHG inventory, the "Ma
particular generating units from Table 2 was used as the base assumption. The Massachusetts-based con
are used to estimate the breakdown of different gases.

Municipal utilities can voluntarily report the percent of sales reported as "non-emitting MWh" to DEP. Since
"non-emitting MWh" for retailers is equal to the RPS Class I (including carve-outs) minimum requirement f
Table 9 below for more details.

Table 9. List of Municipal Utilities % Non-emitting Sales

Municipal Utility	% Of Sales Reported to MA DEP as "Non-emitting MWh"
Ashburnham Muni. Light Dept.	33.5%
Belmont Municipal Light Department	38.4%
Boylston Municipal Light Dept.	38.8%
Braintree Electric Light Dept.	57.0%
Chester Municipal Electric Light Dept.	8.6%
Chicopee Electric Light Dept.	4.7%
Concord Municipal Light Plant	92.7%
Danvers Electric Division	50.2%
Georgetown Municipal Light Department	44.0%
Groton Electric Light Dept.	27.4%
Groveland Municipal Light Dept.	12.5%
Hingham Municipal Lighting Plant	44.2%
Holden Municipal Light Dept.	53.0%
Holyoke Gas & Electric Dept.	34.7%
Hudson Light & Power Dept.	88.4%
Hull Municipal Lighting Plant	51.0%
Ipswich Municipal Light Department	21.8%
Littleton Electric Light & Water	7.5%
Mansfield Municipal Electric Dept.	47.7%
Marblehead Municipal Light Dept.	35.5%
Merrimac Municipal Light & Water Dept.	21.4%
Middleborough Gas & Electric Dept.	63.4%
Middleton Municipal Electric Dept.	34.9%
Not served by municipal utility	#N/A
North Attleboro Electric Dept.	27.0%
Norwood Municipal Light Dept.	29.3%
Our municipality is not listed	#N/A
Paxton Municipal Light Dept.	54.2%
Peabody Municipal Light Plant	35.2%
Princeton Municipal Light Dept.	8.0%

Reading Municipal Light Dept.	26.7%
Rowley Municipal Lighting Plant	9.1%
Russell Municipal Light Department	7.5%
Shrewsbury Electric & Cable Ops.	35.4%
South Hadley Electric Light Dept.	83.5%
Sterling Municipal Light Dept.	39.4%
Taunton Municipal Lighting Plant	26.9%
Templeton Municipal Light & Water	44.2%
Wakefield Municipal Gas & Light Dept.	40.7%
Wellesley Municipal Light Plant	55.2%
West Boylston Municipal Lighting Plant	51.1%
Westfield Gas & Electric	39.0%

Retail electricity providers and IOUs can voluntarily report the percent of sales reported as "non-emitting MWh" to DEP. This data for reporting municipal utilities is from the MassDEP GHG Reporting Program Summary Report For Retail Sellers of Electricity Emissions for the inventory year

Table 10. Weighted Average Electricity Emission Factors by Building Subsector

Subsector	Electricity Consumption (kWh)
Residential Buildings	0
Commercial & Institutional Buildings & Manufacturing Industries	0

The above electricity emission factor is only used to calculate electricity emissions associated with electric
on the weighted average electricity emission factor by building subsector including all electricity providers

Table 11: IPCC AR6 100-Year Global Warming Potentials without Climate-carbon

Methane (CH4)	Nitrous Oxide (N2O)
29.8	273

Table 12: Transportation Fuel Emission Factors

Fuel Type	Unit
Diesel	Gallon
Gasoline	Gallon
Compressed Natural Gas	MMBTU
Compressed Natural Gas	SCF

Table 13: Conversion Factors

Conversion From:	Conversion To:
Gallon Distillate Fuel Oil No. 2	MMBTU
Gram (g)	Metric Ton (MT)
Kilogram (kg)	Metric Ton (MT)
kWh	MMBTU
Megawatt-hour (MWh)	Kilowatt-hour (kWh)
Million Metric Tons (MMT)	Metric Ton (MT)
Pound (lb)	Metric Ton (MT)
Short Ton	Metric Ton
Short Ton	Kilogram (kg)

Short Ton	Gigagram (Gg)
Standard Cubic Foot (SCF) Natural Gas	Million British Thermal Units (MMBTU)
Therm	Million British Thermal Units (MMBTU)
Pound (lb)	Kilograms (kg)

ıctors*

summarized on this worksheet. Global warming potentials of methane (CH_4) and nitrous
e with the GPC, the most recent global warming potential (GWP) values on a 100-year

MT CO2/Therm	MT CH4/Therm
0.00530	
MT CO2/MMBTU	**MT CH4/MMBTU**
0.07	0.0000030

considered to be de minimis

Source
Universal Conversion
Protocol Calculation Tool for Direc ssions
Calculated
Calculated
bleum Systems in t nnex 3.6, Table 3.6
bleum Systems in t nnex 3.6, Table 3.6
Calculated
Calculated
Calculated
Calculated

Legend:

Linked to data on “inputs” ta

Not applicable cell

Combined Retail Level Electricity Emission Factor (lbs CO2e/MWh)	Non-Biogenic Retail Level Electricity Emission Factor (lbs CO2e/MWh)
540	634
0.043	0.050
0.006	0.007
543	**637**

HG Reporting Program Summary report for Retail Sellers of Electricity Emissions in the inventory
ssachusetts-based approach" non-biogenic electricity emissions factor after accounting for
ısumer retail level combined electricity factors for CO2, CH4, and N2O from Appendix 3, Table 12,

DEP Generic "Massachusetts-based" CH4 Electricity Emission Factor (lbs CH4/MWh)	DEP Generic "Massachusetts-based" N2O Electricity Emission Factor (lbs N2O/MWh)
0.050	0.00704

sumed by buildings in the community that is procured from the investor-owned utility that serves

sit

DEP Generic "Massachusetts-based" CH4 Electricity Emission Factor (lbs CH4 / MWh)	DEP Generic "Massachusetts-based" N2O Electricity Emission Factor (lbs N2O / MWh)
0.050	0.00704

al public transportation. The emission factor is based on the IOU average emission factor.

MassDEP Reported Emissions Factors

DEP Generic "Massachusetts-based" CO2 Electricity Emission Factor (lbs CO2 / MWh)	DEP Generic "Massachusetts-based" CH4 Electricity Emission Factor (lbs CH4 / MWh)
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A

HG Reporting Program Summary report for Retail Sellers of Electricity Emissions in the inventory
ssachusetts-based approach" non-biogenic electricity emissions factor after accounting for
ısumer retail level combined electricity factors for CO2, CH4, and N2O from Appendix 3, Table 12,

EP. Since this information is not available for all retailers, the above analysis assumes that the
imum requirement for the inventory year. This assumes retailers comply with the minimum RPS
of Class I Voluntary Renewable Energy Credits (RECs). Users should input the % of Class I

DEP Generic "Massachusetts-based" CH4 Electricity Emission Factor (lbs CO2/MWh)	DEP Generic "Massachusetts-based" N2O Electricity Emission Factor (lbs N2O/MWh)
0.050	0.00704

HG Reporting Program Summary report for Retail Sellers of Electricity Emissions in the inventory
ssachusetts-based approach" non-biogenic electricity emissions factor after accounting for
isumer retail level combined electricity factors for CO2, CH4, and N2O from Appendix 3, Table 12,

e this information is not always available, the above analysis assumes that the base percentage of
or the inventory year. This assumes retailers comply with the minimum RPS compliance. See

MassDEP Reported Emissions Factors

Electricity CH4 Emissions (MT CH4)	Electricity CO2 Emissions (MT CO2)
0.00	0.00
0.00	0.00

vehicle charging and electricity transmission and distribution losses. The emission factor is based (investor-owned utilities, municipal utilities and community choice aggregators).

Feedbacks
Source
IPCC Global Warning Potential Values

MT CH4/Unit	MT CO2/Unit
0.0000004	0.01
0.0000004	0.01
	0.05337
	0.00005444

Multiply By:	Source
0.138	EPA Emissions Factors
0.000001	Universal Conversion
0.001	Universal Conversion
0.00341214	Universal Conversion
1,000	Universal Conversion
1,000,000	Universal Conversion
0.000453592	Universal Conversion
0.907185	Universal Conversion
907.19	Universal Conversion

0.000907	Universal Conversion
0.00102	Universal Conversion
0.09998	Universal Conversion
0.45359	Universal Conversion

MT N2O/Therm	**Source**
	EPA
MT N2O/MMBTU	**Source**
0.0000006	EPA

b

DEP Reported Emissions
ctors

% Of Sales Reported to MA DEP as "Non-emitting MWh"	Emissions Rate (MT CH4/kWh)	Emissions Rate (MT CO2/kWh)
42.1%	0.00000001	0.00017

% Of Sales Reported to MA DEP as "Non-emitting MWh"	Emissions Rate (MT CH4/kWh)	Emissions Rate (MT CO2/kWh)
42.9%	0.00000001	0.00016

DEP Generic "Massachusetts-based" N2O Electricity Emission Factor (lbs N2O / MWh)	Base Assumption % Of Sales Reported to MA DEP as "Non-emitting MWh"	% of Class I Voluntary RECs
N/A	N/A	0.0%
N/A	N/A	0.0%
N/A	N/A	0.0%
N/A	N/A	0%

DEP Reported Emissions
ctors

MA RPS Information

% Of Sales Reported to MA DEP as "Non-emitting MWh"	Emissions Rate (MT CH4/kWh)	Emissions Rate (MT CO2/kWh)
#N/A	0.00000000	0.00000

DEP Reported Emissions
ctors

Electricity N2O Emissions (MT N2O)	Emissions Rate (MT CH4/kWh)	Emissions Rate (MT CO2/kWh)
0.00	#DIV/0!	#DIV/0!
0.00	#DIV/0!	#DIV/0!

MT N2O/Unit	Units	Sources
0.0000001	MT CO2e/gallon	EPA Emissions Factors
0.0000001	MT CO2e/gallon	
	MT CO2/MMBTU	
	MT CO2/SCF	

Emissions Rate (MT N2O/kWh)	Overall Emission Factor (MT of CO2e/kWh)	Overall Emission Factor (lbs of CO2e/MWh)
0.0000000018	0.0001672337	369

Emissions Rate (MT N2O/kWh)
0.0000000018

Combined % of Sales from "Non-emitting MWh"	% of Total Residential CCA Electric Load Enrolled in Rate	% of Total Non-Residential CCA Electric Load Enrolled in Rate	Emissions Rate (MT CH4/kWh)
0.0%	#DIV/0!	#DIV/0!	0.00000000
0.0%	#DIV/0!	#DIV/0!	0.00000000
0.0%	#DIV/0!	#DIV/0!	0.00000000
0.0%	#DIV/0!	#DIV/0!	0.00000000
		Residential Weighted	**#DIV/0!**
		Non-Residential Weighted	**#DIV/0!**

Emissions Rate (MT N2O/kWh)	Overall Emission Factor (MT of CO2e/kWh)	Overall Emission Factor (lbs of CO2e/MWh)
0.000000000	0.0000000000	0

Emissions Rate (MT N2O/kWh)
#DIV/0!
#DIV/0!

cle Em nhous

Emissions Rate (MT CO2/kWh)	Emissions Rate (MT N2O/kWh)	Overall Emission Factor (MT of CO2e/kWh)	Overall Emission Factor (lbs of CO2e/MWh)
0.00000	0.000000000	0.0000000000	0
0.00000	0.000000000	0.0000000000	0
0.00000	0.000000000	0.0000000000	0
0.00000	0.000000000	0.0000000000	0
#DIV/0!	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**
#DIV/0!	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**

Stationary Energy: Community-wide Energy & Emis Summary

Sector:	Stationary Energy
Subsector/s:	All Stationary Energy Subsectors

Summary of Methodology Used

This worksheet provides a summary of energy consumption and emissions in the Stationary Energy Sec electricity and natural gas were calculated based on guidance in the GPC, Appendix C: Built Environme on method BE1.1, and emissions from electricity were calculated based on method BE.2.2. Emission fa

Table 1: Summary of Energy Emissions from Residential Buildings, Commercial & Institutional Buildin

Subsector	Energy Category	Natural Gas (Therms)	Natural Gas CH4 Emissions (MT CH4)	Natural Gas CO2 (MT CO2)
Residential Buildings	IOU Residential	0		0
	CCA Residential			
	Muni Residential	0		0
	All Res. T&D Losses	0	0	0.0
	Fuel Oil			
	EV Adjustment			
	Res. Buildings Total	**0**	**0**	**0**
Commercial & Institutional Buildings & Manufacturing Industries	IOU Non-Residential	0		0
	CCA Non-Residential			
	Muni Non-Residential	0		0
	All C&I T&D Losses	0	0	0
	Fuel Oil			
	EV Adjustment			
	Off-road			
	C&I Buildings Total	**0**	**0**	**0**
Construction	Off-road			
	Construction Total			
All Stationary Energy Subsectors		**0**	**0**	**0**

Table 2: Summary of Emissions from Energy Industries Subsector

Subsector	Emissions (MT CO2e)
Energy Industries	0

Emissions from energy generation supplied to the grid (which make up all emissions from the Energy Industries Sector in this inventory) are required for territorial total but not for BASIC/BASIC+ reporting under GPC guidelines.

ssions

ctor. This includes electricity, natural gas, fuel oil and off-road emissions. The emissions from
nt Activities and Sources. Emissions from stationary combustion of natural gas were calculated based
ctors are explained on the "Emission Factors" worksheet.

gs and Manufacturing Industries & Construction Subsectors

Electricity Consumption (kWh)	Electricity Consumption CH4 Emissions (MT CH4)	Electricity Consumption CO2 Emissions (MT CO2)	Electricity Consumption N2O Emissions (MT N2O)	Electricity T&D Losses (kWh)	Electricity T&D Losses CH4 Emissions (MT CH4)
0	0.0	0	0.0		
0	#DIV/0!	#DIV/0!	#DIV/0!		
0	0.0	0.0	0.0		
				0	#DIV/0!
0	#DIV/0!	#DIV/0!	#DIV/0!		
0	**0**	**0**	**0**	**0**	**0**
0	0	0	0.0		
0	#DIV/0!	#DIV/0!	#DIV/0!		
0	0	0	0.0		
				0	#DIV/0!
0	#DIV/0!	#DIV/0!	#DIV/0!		
0	**0**	**0**	**0**	**0**	**0**
0	**0**	**0**	**0.0**	**0**	**0**

Electricity T&D Losses CO2 Emissions (MT C02)	Electricity T&D Losses N2O Emissions (MT N2O)	Fuel Oil (gal)	Fuel Oil CH4 Emissions (MT CH4)	Fuel Oil CO2 Emissions (MT CO2)	Fuel Oil N2O Emissions (MT N2O)
#DIV/0!	#DIV/0!				
		0	0.0	0.0	0.0
0	**0**	**0**	**0**	**0**	**0**
#DIV/0!	#DIV/0!				
		0	0.0	0.0	0.0
0	**0**	**0**	**0.0**	**0**	**0**
0	**0**	**0**	**0.0**	**0**	**0.00**

Off-road CH4 Emissions-Various Fuels (MT CH4)	Off-road CO2 Emissions-Various Fuels (MT CO2)	Total CH4 Emissions (MT CH4)	Total CO2 Emissions (MT CO2)	Total N2O Emissions (MT N2O)
		0.0	0	0.0
		#DIV/0!	#DIV/0!	#DIV/0!
		0.0	0	0.0
		#DIV/0!	#DIV/0!	#DIV/0!
		0.00000	0	0.0
		#DIV/0!	#DIV/0!	#DIV/0!
0	**0**	**0.0**	**0**	**0.0**
		0.0	0	0.0
		#DIV/0!	#DIV/0!	#DIV/0!
		0.0	0	0.0
		#DIV/0!	#DIV/0!	#DIV/0!
		0.0	0	0.0
		#DIV/0!	#DIV/0!	#DIV/0!
0.0	0	0.0	0	0.0
0.0	**0**	**0.0**	**0**	**0.0**
0.0	0	0.0	0	0.0
0.0	**0**	**0.0**	**0**	**0.0**
0.0	**0**	**0.0**	**0**	**0.0**

Stationary Energy: Community-wide Building Energy & En

Sector:	Stationary Energy
Subsectors:	Res. Buildings, C&I Buildings, + Manuf. Industries & Const.

Summary of Methodology Used

Total community-level electricity and natural gas consumption is provided through Mass Save Data. For communities that have municipal utilities or consumption data from these providers is also included. Utility-specific and rate-specific electricity emission factors were applied to the electricity co factor was used to calculate natural gas emissions. Fuel oil consumption was estimated using U.S. Energy Information data on average fuel oil cons Executive office of Labor and Workforce Development (EOLWD) data on employment by sector, and American Community Survey data on resident and electricity consumption for the community is summed in a separate worksheet titled "Stationary Energy - Summary."

Table 1. Community Electricity & Natural Gas Consumption & Emissions by Subsector

Subsector	Building Type	Electricity Consumption (kWh)
Residential Buildings	IOU Residential	0
	CCA Residential	0
	Muni Residential	0
	EV Adjustment	0
	Residential Total	**0**
Commercial & Institutional Buildings & Manufacturing Industries	IOU Non-Residential	0
	CCA Non-Residential	0
	Muni Non-Residential	0
	EV Adjustment	0
	Comm./Inst./Manu. Total	**0**
All Building Subsectors		**0**

Accounting for electric vehicle charging emissions: Electric vehicles owned by residents are accounted for in the Transportation Sector of this inventory. However, tl vehicles is also bundled into the overall electricity consumption data provided by utilities. To account for this, electricity consumption associated with VMT from pass combination of the "Residential Buildings" and "Commercial & Institutional Buildings & Manufacturing Industries" subsectors above. See Table 10 below for a more

While "Commercial & Institutional Buildings" and "Manufacturing Industries" are considered two distinct subsectors by the GPC, they were combined for this invento provided by MassSave was grouped as "Commercial & Industrial," thus making it impossible to separate consumption into the suggested GPC categories.

Table 1a: Municipal Electricity & Natural Gas Consumption and Emissions

Subsector		Electricity Consumption (kWh)
Municipal Buildings	IOU Municipal	0
	CCA Municipal	0
	Muni Municipal	0
	Municipal Total	**0**

Emissions from municipal buildings associated with electricity and natural gas are calculated for informational purposes only and are not included in the aggregatior aggregated consumption data. Municipalities served by municipal utilities should make sure municipal consumption is included within the commercial and industrial

Table 2. Fuel Oil Consumption & Emissions by Subsector

Subsector	Annual Fuel Oil Use (gal)	Annual Fuel Oil Use (MMBtu)
Residential Buildings	0	0
Commercial & Institutional Buildings	0	0
Manufacturing Industries & Construction	0	0
Municipal Buildings	0	0
All Building Subsectors:	0	0

Table 3. Residential Fuel Oil Consumption & Emissions

Housing Type	U.S. Average Site Energy Consumption of Fuel Oil (Gallons/Year)	Millions Housing Units in MA
Single-Family- Detached	581	1.4
Single-Family- Attached	407	0.2
Multi-Family, 2-4 Units	343	0.5
Multi-Family, 5+ Units	224	0.6
Mobile Homes	309	0.0
Residential Total:		**2.7**

U.S. Average Residential Site Energy Consumption of Fuel Oil adjusted based on MA Housing Stock (Gallons / Year / Site)	443

Massachusetts Average Residential Site Energy Consumption of Fuel Oil (Gallons / Year / Site)	619
Adjustment Ratio	**140%**

Data on U.S. average site energy consumption of fuel oil by residential building type is from EIA Table CE2.1 Annual Household Site Fuel Consump

Data on Massachusetts number of housing units by building type is from American Community Survey data on Housing Tenure by Units in Structur estimates for 2018-2022.

Data on Massachusetts average fuel oil consumption is from EIA 2020 RECS Dashboard, filtered to Massachussets and Fuel oil consumption per h

Table 4. Commercial Fuel Oil Consumption & Emissions

Primary Building Activity	Average Monthly Employment	Number of Employer Establishments Within the Primary Building Activity
Education	0	0
Food Sales	0	0
Food Service	0	0
Health Care Inpatient	0	0
Health Care Outpatient	0	0
Lodging	0	0
Mercantile Retail (other than mall)	0	0
Mercantile Enclosed and Strip Malls	0	0
Office	0	0
Public Assembly	0	0
Public Order And Safety	0	0
Religious Worship	0	0
Service	0	0
Warehouse And Storage	0	0
Other	0	0
Commercial Total:		

Average monthly employment data and number of employer establishments (i.e. buildings) by "Primary Building Activity" is from Massachusetts Exe (EOLWD) Employment and Wages (ES-202) data. North American Industry Classification System (NAICS) codes and titles were matched to "princi the U.S. Energy Information Administration (EIA). Average monthly employment per employer establishment (i.e. building) for each primary buildin

Fuel oil consumption per employer establishment (i.e. building) is from the U.S. Energy Information Administration (EIA) 2018 CBECS Survey Data Consumption and Expenditures. For some primary building activities (including Food Sales, Food Service, Health Care Outpatient, Mercantile Enclo For this building types, data from EIA Table C24: US Commercial Building Natural Gas Consumption and Expenditures was used to estimate fuel o building type. For example, the average Food Sales building uses 10% more natural gas than the average Office building and the above analysis al uses 10% more fuel oil than the average Office building.

The Percent of buildings in community using fuel oil as heating fuel is from the U.S. Energy Information Administration (EIA) 2018 CBECS Survey D Buildings, 2018. Data for New England showing that of the 274,000 commercial buildings using any energy source, 103,000 (or 37.59%) of them us

Table 5. Industrial Fuel Oil Consumption & Emissions

Principal Building Activity	Average Monthly Employment	Number of Employer Establishments Within the Primary Building Activity
Food	0	0
Beverage and Tobacco Products	0	0
Textile Mills	0	0
Textile Product Mills	0	0
Apparel	0	0
Leather and Allied Products	0	0
Wood Products	0	0
Paper	0	0
Printing and Related Support	0	0
Petroleum and Coal Products	0	0
Chemicals	0	0
Plastics and Rubber Products	0	0
Nonmetallic Mineral Products	0	0
Primary Metals	0	0
Fabricated Metal Products	0	0
Machinery	0	0
Computer and Electronic Products	0	0
Electrical Equip., Appliances, and Components	0	0
Transportation Equipment	0	0
Furniture and Related Products	0	0
Miscellaneous	0	0
Industrial Total:		

Average monthly employment data and number of employer establishments (i.e. buildings) by "Primary Building Activity" is from Massachusetts Exe (EOLWD) Employment and Wages (ES-202) data. North American Industry Classification System (NAICS) codes and titles were matched to "princi the U.S. Energy Information Administration (EIA). Average monthly employment per employer establishment (i.e. building) for each primary buildin

Fuel oil consumption per employee by primary building activity is from U.S. Energy Information Administration (EIA) 2018 Manufacturing Energy Co Consumption Ratios of Fuel. Data for the northeast region was use in most cases. For some primary building activities (including Textile Mills, Texti northeast data was not available and national data was used.

Total U.S. energy consumption by primary building activity is from U.S. Energy Information Administration (EIA) 2018 Manufacturing Energy Consu Energy for all Purposes (Fuel and Nonfuel).

Total U.S. distillate fuel oil and diesel fuel energy consumption by primary building activity is from U.S. Energy Information Administration (EIA) 201 (MCES) Table 5.4: End Uses of Fuel Consumption. Where 2018 data is unavailable, 2014 data from Table 5.4 is used. Data on distillate fuel oil and distillate fuel oil makes up 100% of this combined total.

Table 6. Commercial & Industrial Fuel Oil: Employment & Establishments by NAICS Code and Business Activity VLookup

North American Industry Classification System (NAICS) Code	EIA Principal Business Activity	Subsector
111	Crop production	Other
112	Animal production and aquaculture	Other
113	Forestry and logging	Other
114	Fishing, hunting and trapping	Other
115	Agriculture and forestry support activities	Other
212	Mining, except oil and gas	Other
213	Support activities for mining	Other
221	Utilities	Other
236	Construction of buildings	Other
237	Heavy and civil engineering construction	Other
238	Specialty trade contractors	Other
311	Food	Industrial
312	Beverage and Tobacco Products	Industrial

313	Textile Mills	Industrial
314	Textile Product Mills	Industrial
315	Apparel	Industrial
316	Leather and Allied Products	Industrial
321	Wood Products	Industrial
322	Paper	Industrial
323	Printing and Related Support	Industrial
324	Petroleum and Coal Products	Industrial
325	Chemicals	Industrial
326	Plastics and Rubber Products	Industrial
327	Nonmetallic Mineral Products	Industrial
331	Primary Metals	Industrial
332	Fabricated Metal Products	Industrial
333	Machinery	Industrial
334	Computer and Electronic Products	Industrial
335	Electrical Equip., Appliances, and Components	Industrial
336	Transportation Equipment	Industrial
337	Furniture and Related Products	Industrial
339	Miscellaneous	Industrial
423	Warehouse/ Storage	Commercial
424	Warehouse/ Storage	Commercial
425	Electronic markets and agents and brokers	Other
441	Retail (non-mall)	Commercial
442	Retail (non-mall)	Commercial
443	Retail (non-mall)	Commercial
444	Retail (non-mall)	Commercial
445	Food Sales	Commercial
446	Retail (mall)	Commercial
447	Service	Commercial
448	Retail (mall)	Commercial
451	Retail (non-mall)	Commercial
452	Retail (non-mall)	Commercial
453	Retail (non-mall)	Commercial
454	Office	Commercial
481	Office	Commercial
482	Public Assembly	Commercial

483	Service	Commercial
484	Service	Commercial
485	Public Assembly	Commercial
486	Pipeline transportation	Other
487	Public Assembly	Commercial
488	Service	Commercial
491	Service	Commercial
492	Service	Commercial
493	Warehouse/ Storage	Commercial
511	Office	Commercial
512	Public Assembly	Commercial
515	Public Assembly	Commercial
516	Office	Commercial
517	Office	Commercial
518	Office	Commercial
519	Office	Commercial
521	Office	Commercial
522	Office	Commercial
523	Office	Commercial
524	Office	Commercial
525	Office	Commercial
531	Office	Commercial
532	Retail (non-mall)	Commercial
533	Office	Commercial
541	Office	Commercial
551	Office	Commercial
561	Office	Commercial
562	Other	Commercial
611	Education	Commercial
621	Outpatient Health Care	Commercial
622	Inpatient Health Care	Commercial
623	Lodging	Commercial
624	Office	Commercial
711	Public Assembly	Commercial
712	Public Assembly	Commercial
713	Public Assembly	Commercial

721	Lodging	Commercial
722	Food Service	Commercial
811	Service	Commercial
812	Service	Commercial
813	Religious Worship	Commercial
814	Private Households	Other
921	Office	Commercial
922	Public Order/ Safety	Commercial
923	Office	Commercial
924	Office	Commercial
925	Office	Commercial
926	Office	Commercial
927	Other	Commercial
928	Office	Commercial

Above data is from Massachusetts Executive office of Labor and Workforce Development (EOLWD) Employment and Wages (ES-202) data. North codes and titles were matched to "principal business activities" of buildings as defined by the U.S. Energy Information Administration (EIA).

Table 7. Massachusetts Electricity Transmission & Distribution Grid Loss Factor

Total Disposition (MWh)	Direct Use (MWh)	Total Disposition Excluding Direct Use (MWh)
54,237,623	838,517	53,399,106

A Massachusetts-specific electricity transmission and distribution grid loss factor was calculated per U.S. Energy Information Administration instruct divide estimated losses by the result of total disposition minus direct use. Direct use electricity is the electricity generated mainly at non-utility faciliti transmission and distribution grid, and therefore direct use electricity does not contribute to T&D losses." This data is provided by EIA in Massachus Electricity.

Table 8. Electricity Transmission & Distribution Losses

GPC Subsector	Total Electricity Consumption (kWh)	Grid Loss Factor (%)
Residential Buildings	0	5.16%
Comm./Inst./Manu. Buildings	0	5.16%
All Building Subsectors:	**0**	**5.16%**

Table 9. Fugitive Emissions from Natural Gas Distribution System Losses

GPC Subsector	Natural Gas Consumption (Therms)	Est. Annual Loss Rates from Natural Gas from Transmission, Distribution and End Use (%)
Residential Buildings	0	2.5%
Comm./Inst./Manu. Buildings	0	2.5%
All Building Subsectors:	**0**	**2.5%**

Estimated natural gas loss rates from a study by Sargent et al., 2021 titled "Majority of US urban natural gas emissions unaccounted for in inventori
entering the urban region is lost during transmission and distribution.

Table 10. Allocating Electric Vehicle Electricity Consumption to Building Subsectors

Vehicle Type	Electricity Consumption per Year (kWh)	Percent of Electricity Consumption Allocated to "Residential (Res. Data)" Subsector
Passenger Vehicles	0	80%
Commercial Vehicles	0	0%
All Vehicles	0	

Percent of passenger vehicle electricity consumption attributable to the Residential Subsector based on data from the Department of Energy and N
80% of electric vehicle charging occurs at home. It was assumed that the remainder of passenger vehicle charging and all of commercial vehicle ch
Institutional Buildings & Manufacturing Industries Subsector.

nissions

Legend:

Linked to data on “inputs” tab

Not applicable cell

community choice aggregations, electricity
onsumption. A universal EPA natural gas emission
sumption by building type, Massachusetts
tial building types. The total natural gas, fuel oil

Natural Gas Consumption (Therms)	Electricity CH4 Emissions (MT CH4)	Electricity CO2 Emissions (MT CO2)	Electricity N2O Emissions (MT N2O)	Natural Gas Emissions (MT CO2)
0	0.00	0	0.00	0
	#DIV/0!	#DIV/0!	#DIV/0!	
0	0.00	0	0.00	0
	#DIV/0!	#DIV/0!	#DIV/0!	
0	**0.00**	**0.00**	**0.00**	**0**
0	0.00	0	0.00	0
	#DIV/0!	#DIV/0!	#DIV/0!	
0	0.00	0	0.00	0
	#DIV/0!	#DIV/0!	#DIV/0!	
0	**0.00**	**0.00**	**0.00**	**0**
0	**0.00**	**0**	**0.00**	**0**

he electricity consumption associated with these
senger and commercial vehicles was subtracted from a
detailed description of methodology used.

ory. Electricity and natural gas consumption data

Natural Gas Consumption (Therms)	Electricity CH4 Emissions (MT CH4)	Electricity CO2 Emissions (MT CO2)	Electricity N2O Emissions (MT N2O)	Electricity CO2e Emissions (MT CO2e)
0	0.00	0	0.00	0.00
	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	0.00	0	0.00	0.00
0	**0.00**	**0.00**	**0.00**	**0.00**

ıs in Table 1. This is to avoid double counting with the MassSaveData which includes municipal accounts in its commercial and industrial totals to avoid under counting emissions.

Fuel Oil CH4 Emissions (MT CH4)	Fuel Oil CO2 Emissions (MT CO2)	Fuel Oil N2O Emissions (MT N2O)	Fuel Oil CO2e Emissions (MT CO2e)
0.0	0	0.0000	0.00
0.0	0	0.0000	0.00
0.0	0.0	0.0000	0.00
0.0	0.0	0.0000	0.00
0.0	0	0.0	0.00

Percent of Total Housing Units in Massachusetts	MA Average Site Energy Consumption of Fuel Oil (Gallons / Year / Site)	Number of Households in Community	Percent of Homes in Community Using Fuel Oil as Heating Fuel (%)	Annual Fuel Oil Consumption (Gallons/Year)
51%	812.6	0	0.00%	0
6%	569.2	0	0.00%	0
20%	479.7	0	0.00%	0
22%	313.3	0	0.00%	0
1%	432.1	0	0.00%	0
100%				**0**

ɔtion in the U.S. - totals and averages, 2020.	EIA Table CE2.1
e (B25032). Data for 2022 is from the five-year	B25032 (MAPC Dat ɯmon)
ɯousehold using fuel oil data.	2020 RECS Dashboard

Average Monthly Employment Per Employer Establishment (Employees/ Employer Establishment)	Fuel Oil Consumption Per Employer Establishment (Gallons/ Employer Establishment / Year)	Fuel Oil Consumption Per Employee (Gallons/ Employee / Year)	Natural Gas Consumption Per Building (Thousand cubic feet/ Building / Year)	Percent Difference in Natural Gas Consumption Compared To Office Buildings (%)
N/A	6,322	112		
N/A	909	#VALUE!	511	10%
N/A	1,280	#VALUE!	719	55%
N/A	7,315	18		
N/A	222	4		
N/A	1,421	40		
N/A	1,022	#VALUE!	312	-33%
N/A	2,719	#VALUE!	1,528	230%
N/A	824	7	463	
N/A	1,095	44		
N/A	1,475	#VALUE!	829	79%
N/A	1,388	#VALUE!		
N/A	692	112		
N/A	651	#VALUE!	366	-21%
N/A	1,839	#VALUE!		

ecutive office of Labor and Workforce Development ipal business activities" of buildings as defined by g activity was calculated using this data.	EOLWD Source

Table C34: US Commercial Building Fuel Oil ose and Strip Malls) this data was not available. il use in these buildings relative to the office lso assumes that the average Food Sales building	EIA Table C34
Data Table B19. Energy Sources, Number of se heating oil.	EIA Table B19

Energy Consumption Per Employee - Northeast (MMBTU/ employee/ year)	Total Energy Consumption - United States (Trillion BTU / year)	Distillate Fuel Oil and Diesel Fuel Energy Consumption (Trillion Btu / year)	Percent of Total Energy Consumption from Fuel Oil and Diesel Fuel (%)	Distillate Fuel Oil Energy Consumption (Gallons / Year)
360	1161	14	1.2%	0
411	118	0	0.0%	0
681	64	0	0.0%	0
219	22	0	0.0%	0
70	4	0	0.0%	0
111	2	0	0.0%	0
922	388	11	2.8%	0
3786	2041	4	0.2%	0
163	60	0	0.0%	0
13765	4245	14	0.3%	0
1006	7141	6	0.1%	0
316	257	0	0.0%	0
1317	846	20	2.4%	0
2055	1511	6	0.4%	0
132	257	2	0.8%	0
71	148	2	1.4%	0
116	110	0	0.0%	0
191	85	0	0.0%	0
267	348	4	1.1%	0
72	37	0	0.0%	0
97	61	0	0.0%	0
				0

ecutive office of Labor and Workforce Development ipal business activities" of buildings as defined by g activity was calculated using this data.	EOLWD Source
nsumption Survey (MCES) Table 6.1: le Product Mills, and Transportation Equipment)	EIA Table 6.1
mption Survey (MCES) Table 1.1: First Use of	EIA Table 1.1
8 Manufacturing Energy Consumption Survey l diesel fuel was combined. This analysis assumes	EIA Table 5.4

Number of Employer Establishments	Average Monthly Employment
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A

N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A

N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A

N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
American Industry Classification System (NAICS)	EOLWD Source

Estimated Losses (MWh)	Grid Loss Factor (%)
2,757,769	5.16%
tions: "To calculate T&D losses as a percentage, es and that is not put onto the electricity setts Table 10: Supply and Disposition of	US EIA MA Electricity Profile

Total Elec Grid Loss (kWh)	Electricity T&D CH4 Emissions (MT CH4)	Electricity T&D CO2 Emissions (MT CO2)	Electricity T&D N2O Emissions (MT N2O)
0	#DIV/0!	#DIV/0!	#DIV/0!
0	#DIV/0!	#DIV/0!	#DIV/0!
0	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**

Total Nat. Gas Distribution Losses (Therms)	Natural Gas Distribution Losses CH4 Emissions (MT CH4)	Natural Gas Distribution Losses CO2 Emissions (MT CO2)
0	0	0.0
0	0	0.0
0	**0**	**0.0**

es". The study found that 2.5% ± 0.5% of the gas

PNAS Article

Percent of Electricity Consumption Allocated to "Commercial" Subsector	Electricity Consumption Allocated to Residential Buildings Subsector per Year (kWh)	Electricity Consumption Allocated to Comm./Inst./Manu. Buildings Subsector per Year (kWh)
20%	0	0
100%	0	0
	0	0

ational Renewable Energy Lab (NREL) indicates
harging occurs at buildings in the Commercial &

NREL Source

Natural Gas Emissions (MT CO2)
0

Annual Fuel Oil Use (MMBtu)	Fuel Oil CH4 Emissions (MT CH4)	Fuel Oil CO2 Emissions (MT CO2)	Fuel Oil N2O Emissions (MT N2O)
0	0.00	0	0.000
0	0.00	0	0.000
0	0.00	0	0.000
0	0.00	0	0.000
0	0.000	0	0.000
0	**0.0**	**0**	**0.0**

Percent of Buildings in Community Using Fuel Oil as Heating Fuel (%)	Annual Fuel Oil Consumption (Gallons/Year)	Annual Fuel Oil Use (MMBtu)	Fuel Oil CH4 Emissions (MT CH4)	Fuel Oil CO2 Emissions (MT CO2)	Fuel Oil N2O Emissions (MT N2O)
37.45%	0	0	0.00	0	0.000
37.45%	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
37.45%	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
37.45%	0	0	0.00	0	0.000
37.45%	0	0	0.00	0	0.000
37.45%	0	0	0.00	0	0.000
37.45%	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
37.45%	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
37.45%	0	0	0.00	0	0.000
37.45%	0	0	0.00	0	0.000
37.45%	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
37.45%	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
37.45%	0	0	0.00	0	0.000
37.45%	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
37.45%	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
	0	**0**	**0.00**	**0**	**0.00**

Annual Fuel Oil Use (MMBtu)	Fuel Oil CH4 Emissions (MT CH4)	Fuel Oil CO2 Emissions (MT CO2)	Fuel Oil N2O Emissions (MT N2O)
0.0	0.000	0	0.0000
0.0	0.000	0	0.0000
0.0	0.000	0	0.0000
0.0	0.000	0	0.0000
0.0	0.000	0	0.0000
0.0	0.000	0	0.0000
0.0	0.000	0	0.0000
0.0	0.000	0	0.0000
0.0	0.000	0	0.0000
0.0	0.000	0	0.0000
0.0	0.000	0	0.0000
0.0	0.000	0	0.0000
0.0	0.000	0	0.0000
0.0	0.000	0	0.0000
0.0	0.000	0	0.0000
0.0	0.000	0	0.0000
0.0	0.000	0	0.0000
0.0	0.000	0	0.0000
0.0	0.000	0	0.0000
0.0	0.000	0	0.0000
0.0	0.000	0	0.0000
0	**0.000**	**0**	**0.0000**

Stationary Energy: Community-wide Off-road E

Sector:	Stationary Energ
Subsectors:	C&I Buildings + Manuf. Indust

Summary of Methodology Used

The method for estimating emissions from off-road emissions sources uses the Motor Vehicle E NONROAD tool. This is a publicly available EPA emission modeling system that estimates emis national and county level for criteria air pollutants, greenhouse gases, and air toxics. Proportiona county-level data through the most applicable ratios available.

Table 1: Summary of Off-road Emissions in County and City/Town by Equipment

	County Off-road Tra		
Emissions Source	**CO2 Emissions (lbs)**	**CH4 Emissions (lbs)**	**CO2 Emissions (kg)**
Industrial Equipment	0	0	0
Lawn and Garden Equipment	0	0	0
Light Commercial Equipment	0	0	0
Construction Equipment	0	0	0

County-level data on CO2 and CH4 emissions from industrial equipment, lawn and garden equipment and light commercial equipment is from the EPA Motor Vehicle Emission Simulator (MOVES Model).

nergy & Emissions

y
tries & Const.

mission Simulator (MOVES) v4.0
sions for mobile non-road sources at the
al emissions data was extracted from the

Legend:

Linked to data on “inputs” tab

Not applicable cell

Type Using Allocation Methodology				
nsportation Emissions			Allocation of County-Lev	
CH4 Emissions (kg)	CO2 Emissions (MT)	CH4 Emissions (MT)	County-Level Emissions Allocated to City/Town By:	County Allocation Category Count
0	0	0.0	Manufacturing Jobs	0
0	0	0.0	Square Feet of Landscaped Area	0
0	0	0.0	All Sectors Jobs Excl. Manufacturing	0
0	0	0.0	Square Feet of Construction	0

Off-road

Off-road Emissions

EPA Source

el Emissions to City/Town		City/Town Off-road Emissions		
City/Town Allocation Category Count	Percent of County Allocation Category in City/Town	GPC Subsector	Off-road CH4 Emissions (MT CH4)	Off-road CO2 Emissions (MT CO2)
0	0.00%	Manufacturing Industries	0.0	0
0	0.00%	Comm. & Inst. Buildings	0.00	0
0	0.00%	Comm. & Inst. Buildings	0.0	0
0	0.00%	Construction	0.0	0
Emissions Attributable to Manufacturing Industries Subsector:			0.0	0.0
Attributable to Commercial & Institutional Buildings Subsector:			0.0	0.0
Off-road Emissions Attributable to Construction Subsector:			0.0	0.0
All Off-Road Emission Sources			0.0	0.0

Sector:
Subsector:

Summary of Methodol

Data on emissions genera
excluding landfills that do r
both instances, the emissi

Category 1) If the electrici
captured under BASIC/BA
Save energy data on the "
consitute double counting

Category 2) If the electricit
BASIC/BASIC+ GPC repo

Table 1. Energy Industries

Town/City
Abington

Table 2. Energy Industries

Facility Id
1000056
1001298
1004865
1010498
1005136
1004343
1001207
1006864
1006657
1002274
1002497
1000092
1000580
1005277
1000665
1000383
1000657
1001289
1000656
1000653

1001307
1009333
1009167
1001294
1006452
1005037
1003769
1005970
1006872
1005179
1007435
1001021
1001200
1000655
1006775
1006267
1004101
1004817
1001068
1004797
1005731
1005710
1012869
1000658
1004287
1002299
1000667
1006651
1001410
1009982
1003759
1009735
1003037
1006902

The above data is from the
excluding landfills that do r

Stationary Energy: Energy I

Stationary Energy
Energy Industries

ogy Used

tion by the energy industry for each community was provided by the EPA's Greenhouse
not generate electricity, are included. Emissions from Energy Industries (power plants) a
ons in the below tables are provided for informational purposes only.

ty generated from these facilities is consumed direclty within the city (e.g. co-generation
SIC+ GPC reporting guidelines. The natural gas consumption and associated emissions
Stationary Energy - Buildings" tab and included in the total reported emissions. Therefor
of emissions.

y generated from these facilities is sent to the regional electricity grid (e.g. large coal pov
rting guidelines.

Emissions Summary

Energy Industry Non-biogenic CO2 Emissions (MT CO2)
0

Emissions by Facility in Massachusetts

Facility Name
SPECIALTY MINERALS
Berkshire Power
COMMUNITY ECO SPRINGFIELD LLC
TGP Station 261 Agawam
UMASS PHYSICAL PLANT BUILDING
Pfizer
Bellingham
Bellingham Power Generation LLC
Blackstone Power Generation LLC
Boston University
GILLETTE CO
Kneeland Station
MEDICAL AREA TOTAL ENERGY PLANT
NORTHEASTERN UNIVERSITY
Potter
BIOGEN INC
Kendall Green Energy
MIT Central Utility Plant
The President and Fellows of Harvard University (Cambridge Allston Blackstone)
Mystic

Millennium Power
TGP Station 264 Charlton
Dartmouth Power
Dighton
MASSPORT LOGAN AIRPORT
ERVING PAPER MILLS INC
DISTRIGAS OF MASSACHUSETTS LLC
NEWARK AMERICA
U S AIR FORCE HANSCOM AFB
COVANTA HAVERHILL INC
MASSPOWER
Stony Brook
General Electric Aviation
Medway Station
Milford Power, LLC
WHEELABRATOR MILLBURY INC
WHEELABRATOR NORTH ANDOVER INC.
Wyman-Gordon Company
Rousselot Peabody, Inc.
COMMUNITY ECO PITTSFIELD LLC
Pittsfield Generating
SEMASS PARTNERSHIP RESOURCE RECOVERY FACILITY
Salem Harbor Station NGCC
Canal Station
Wheelabrator Saugus Inc.
SOLUTIA INC - INDIAN ORCHARD PLANT
Cleary Flood
WELLESLEY COLLEGE
Fore River Energy Center
Analog Devices Inc
Analog Devices, Inc./ Wilmington Manufacturing
Skyworks Solutions, Inc.
SAINT-GOBAIN ABRASIVES and SAINT-GOBAIN CERAMICS & PLASTICS, INC.
UMASS MEDICAL SCHOOL

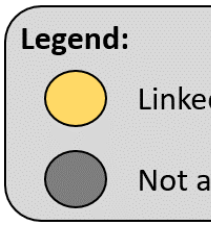
e EPA's Greenhouse Gas Reporting Program (GHGRP) "Summary GHG Data 2022". Da
not generate electricity, are included in the above table.

ndustries

Gas Reporting Program (GHGRP). All facilities included in the database ,
re part of the Stationary Energy Sector and fall into one of two categories. In

facility at large business), the emissions from this power plant should be
requried to generate electricity at these power plants is captured in the Mass
e, adding the below Energy Industries emissions to the community total would

wer plant), the emissions from this power plant should not be caputred under



City	Address	Non-biogenic CO2 Emissions (MT CO2/year)
ADAMS	260 COLUMBIA STREET	133,066
AGAWAM	36 MOYLAN LANE	211,346
AGAWAM	188 M ST	8,214
Agawam	1615 Suffield St	28,035
AMHERST	360 CAMPUS CENTER WAY	105,207
ANDOVER	1 BURTT RD.	46,230
BELLINGHAM	92 DEPOT ST	102,219
BELLINGHAM	155 MAPLE ST	944,613
BLACKSTONE	204 ELM ST	1,045,782
Boston	120 Ashford Street	46,991
BOSTON	1 GILLETTE PARK	47,614
Boston	165 Kneeland St.	111,955
BOSTON	474 BROOKLINE AVE	271,576
BOSTON	360 HUNTINGTON AVENUE	26,764
BRAINTREE	150 POTTER ROAD	20,955
CAMBRIDGE	225 Binney Street	29,725
CAMBRIDGE	265 FIRST ST	676,903
CAMBRIDGE	59 VASSAR ST	168,318
Cambridge	46 Blackstone Street	76,288
CHARLESTOWN	173 ALFORD ST	648,305

CHARLTON	10 SHERWOOD LANE	443,818
Charlton	196 Carpenter Hill Rd	31,221
DARTMOUTH	1 ENERGY RD.	30,013
DIGHTON	1450 SOMERSET AVE	108,307
EAST BOSTON	ONE HARBORSIDE DRIVE	19,168
ERVING	97 EAST MAIN STREET	34,861
EVERETT	18 ROVER ST	17,294
FITCHBURG	100 NEWARK WAY	28,629
HANSCOM AFB	66 ABG/CE, 120 Grenier Street	31,935
HAVERHILL	100 RECOVERY WAY	235,561
INDIAN ORCHARD	750 WORCESTER ST	108,817
LUDLOW	327 MOODY ST	64,123
LYNN	1000 WESTERN AVE	27,456
MEDWAY	9 SUMMER ST	126,975
MILFORD	108 NATIONAL ST	70,511
MILLBURY	331 SOUTHWEST CUTOFF	204,889
NORTH ANDOVER	285 HOLT ROAD	168,053
North Grafton	244 Worcester Street	24,151
PEABODY	227 WASHINGTON ST.	42,195
PITTSFIELD	500 HUBBARD AVENUE	6,436
PITTSFIELD	235 MERRILL ROAD	29,571
ROCHESTER	141 CRANBERRY HIGHWAY ROUTE 28	473,809
Salem	24 Fort Ave	222,950
SANDWICH	9 FREEZER ROAD	376,171
SAUGUS	100 SALEM TURNPIKE	127,138
SPRINGFIELD	730 WORCESTER STREET	76,963
TAUNTON	1314 SOMERSET AVE	16,734
WELLESLEY	106 CENTRAL ST	11,882
WEYMOUTH	9 BRIDGE ST	1,409,985
Willmington	One Analog Way	5,115
Wilmington	1 Analog Way, MS-424	5,476
Woburn	20 Sylvan Road	4,152
WORCESTER	1 NEW BOND STREET	51,896
WORCESTER	55 LAKE AVE NORTH	85,045

ıta was pulled from the "Direct Emitters" tab. All facilities in Massachusetts,

EPA GHGRP Source

d to data on “inputs” tab

pplicable cell

Transportation: Community-wide Energy & Emis Summary

Sector:	Transportation
Subsector/s:	All Transportation Subsectors

Summary of Methodology Used

This worksheet provides a summary of energy consumption and emissions in the Transportation Sector transportation emissions are based on VMT estimates for vehicles registered in a community according Massachusetts Vehicle Census (MAVC). This approach is compliant with the GPC's "resident activity m estimating on-road VMT. The MAVC contains data on the fuel type required for each vehicle, the locatic vehicle's registration, and the annual miles travelled by the vehicle. For vehicles that change registratior the year, their VMT is assigned proportionally to each location based on the number of days in the year was registered in that location. On-road public transportation (i.e. bus, trackless trolley) fuel consumptio attributable to an individual community are calculated using the frequency-weighted route distance in th total system-wide frequency-weighted route distance and the total system-wide fuel consumption. See t - On Road" tab for more details. Rail transportation emissions were also accounted for using a similar m road public transportation. See the "Transportation-Rail" tab for more details. Emission factors are expla "Emission Factors" tab.

Table 1: Summary of On-road and Rail Transit Emissions by Fuel Type

Subsector	Fuel Type	Fuel Consumption (gal)	Fuel Consumption (MMBTU)	Electricity Consumption (kWh)
On-road	CNG		0	
	Diesel	0		
	Electricity			0
	Electricity (T&D Losses)			
	Gasoline	0		
				All On-ro
Rail	Diesel	0		
	Electricity			0
	Electricity (T&D Losses)			
				All R

sions

. On-road
to the
ethod" for
on(s) of the
n location during
that the vehicle
n and emissions
e community, the
he "Transportation
ethodology for on-
ained on the

Electricity T&D Losses (kWh)	CH4 Emissions (MT CH4)	CO2 Emissions (MT CO2)	N2O Emissions (MT N2O)
		0	
	0.0	0	0.0
	#DIV/0!	#DIV/0!	#DIV/0!
0	0.00	0	0.000
	0.0	0	0.0
ad Transportation:	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**
	0.0	0	0.00
	0.0	0	0.0
0	0.0	0	0.00
ail Transportation:	**0.0**	**0**	**0.0**
All Transportation:	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**

Transportation: Community-wide On-road Energy & Er

Sector:	Transportation
Subsector:	On-road

Summary of Methodology Used

Private vehicle on-road transportation emissions were estimated using the GPC's resident activity methoc
uses municipality-specific data on annual distance travelled, fuel type and fuel efficiency from the Massac
Census (MAVC). On-road public transportation, including buses and trackless trolleys, was also accounte
distance travelled, route frequency, and energy consumption provided by the MBTA. The MBTA provided
use by mode and fuel type and annual vehicle miles traveled by mode. The MBTA conducts its analysis b
(July 1-June30), so calendar year estimates for 2022 are calculated as 50% of the value for FY22 and 50
FY23. On-road public transportation for buses operated by other Regional Transit Authorities (RTAs) ma
Table 7.

Table 1: Summary of On-road Energy Use and Emissions by Fuel Type

Fuel Type	Fuel Consumption (gal)	Fuel Consumption (MMBTU)
CNG		0
Diesel	0	
Electricity		
Electricity (T&D Losses)		
Gasoline	0	
All On-Road Transit:	**0**	**0**

The above table assumes that all fuel consumed by "flex-fuel" vehicles is gasoline, as opposed to E-85, due to the lack of E-85 fueling stations in the region. Table includes municipal vehicle fuel use.

Table 2: Summary of Private Vehicle Miles Travelled, Fuel Consumption, Efficiency, and E

Fuel Type	Total Annual Vehicle Miles Travelled (VMT)	Fuel Consumption per Year (gal)
Gasoline	0	0
Diesel	0	0
Electricity (Including T&D)	0	

Gasoline includes the following Vehicle Fuel Types: Gasoline, FlexFuel, Hybrid Electric Vehicle, Plug-In Hybrid Electr
Natural Gas, Propane, Hydrogen Fuel Cell, Other.

Table 3: Summary of Private On-road Passenger, Commercial, Municipal, and State Vehic

Vehicle Fuel Type	Total Annual Vehicle Miles Travelled (VMT)	Fuel Consumption per Year (gal)
Passenger and Commercial Vehicles	0	
Gasoline	0	0
Diesel	0	0
FlexFuel	0	0
Hybrid Electric Vehicle	0	0

Plug-in Hybrid Electric Vehicle	0	0
Compressed Natural Gas	0	0
Propane	0	0
Hydrogen Fuel Cell	0	0
Other	0	0
Electric	0	

Data on the annual distance travelled and fuel consumption for all vehicles, segmented by fuel type and ownership ty
Metropolitan Area Planning Council (MAPC) through the Massachusetts Vehicle Census (MAVC) for all vehicles gara
above table assumes that all fuel consumed by "flex-fuel" vehicles is gasoline, as opposed to E-85, due to the lack of
city/town and the surrounding region. MAVC reports the Fuel Consumper per Year for the following vehicle fuel types
gasoline: Gasoline, Hybrid Electric Vehicle, Plug-In Hybrid Electric Vehicle, Compressed Natural Gas, Propane, Hydr
Other. Thus gasoline emissions factors are used to calculate the emissions for these vehicle fuel types.

Table 4: Private On-road Passenger Vehicles VMT, Fuel Consumption, and Emissions by

Passenger Vehicles: Vehicle Fuel Type	Total Annual Vehicle Miles Traveled (VMT)	Average Fuel Efficiency (kWh/Mile)
Gasoline	0	
Diesel	0	
FlexFuel	0	
Hybrid Electric Vehicle	0	
Plug-in Hybrid Electric Vehicle	0	
Compressed Natural Gas	0	
Propane	0	
Hydrogen Fuel Cell	0	
Other	0	
Electric	0	0.30

Data on the annual distance travelled and fuel consumption for all vehicles, segmented by fuel type and ownership ty
Metropolitan Area Planning Council (MAPC) through the Massachusetts Vehicle Census (MAVC) for all vehicles gara
above table assumes that all fuel consumed by "flex-fuel" vehicles is gasoline, as opposed to E-85, due to the lack of
city/town and the surrounding region. MAVC reports the Fuel Consumper per Year for the following vehicle fuel types
gasoline: Gasoline, Hybrid Electric Vehicle, Plug-In Hybrid Electric Vehicle, Compressed Natural Gas, Propane, Hydr
Other. Thus gasoline emissions factors are used to calculate the emissions for these vehicle fuel types.

Table 5: Private On-road Commercial Vehicles VMT, Fuel Consumption, and Emissions by

Commercial Vehicles: Vehicle Fuel Type	Total Annual Vehicle Miles Travelled (VMT)	Average Fuel Efficiency (kWh/Mile)
Gasoline	0	
Diesel	0	
FlexFuel	0	
Hybrid Electric Vehicle	0	
Plug-in Hybrid Electric Vehicle	0	
Compressed Natural Gas	0	
Propane	0	
Hydrogen Fuel Cell	0	
Other	0	
Electric	0	0.30

Data on the annual distance travelled and fuel consumption for all vehicles, segmented by fuel type and ownership ty
Metropolitan Area Planning Council (MAPC) through the Massachusetts Vehicle Census (MAVC) for all vehicles gara
above table assumes that all fuel consumed by "flex-fuel" vehicles is gasoline, as opposed to E-85, due to the lack of
city/town and the surrounding region. MAVC reports the Fuel Consumper per Year for the following vehicle fuel types
gasoline: Gasoline, Hybrid Electric Vehicle, Plug-In Hybrid Electric Vehicle, Compressed Natural Gas, Propane, Hydr
Other. Thus gasoline emissions factors are used to calculate the emissions for these vehicle fuel types.

Table 5a: Municipal On-Road Commercial Vehicles Fuel Consumption, and Emissions by

Municipal Vehicles: Vehicle Fuel Type	Total Annual Vehicle Miles Travelled (VMT)	Average Fuel Efficiency (kWh/Mile)
Gasoline	0	
Diesel	0	
FlexFuel	0	
Hybrid Electric Vehicle	0	
Plug-in Hybrid Electric Vehicle	0	
Compressed Natural Gas	0	
Propane	0	
Hydrogen Fuel Cell	0	
Other	0	
Electric	0	0.30

Data on the annual distance travelled and fuel consumption for all vehicles, segmented by fuel type and ownership ty
Metropolitan Area Planning Council (MAPC) through the Massachusetts Vehicle Census (MAVC) for all vehicles gara
above table assumes that all fuel consumed by "flex-fuel" vehicles is gasoline, as opposed to E-85, due to the lack of
city/town and the surrounding region. MAVC reports the Fuel Consumper per Year for the following vehicle fuel types
gasoline: Gasoline, Hybrid Electric Vehicle, Plug-In Hybrid Electric Vehicle, Compressed Natural Gas, Propane, Hydr
Other. Thus gasoline emissions factors are used to calculate the emissions for these vehicle fuel types.

Table 5b: State On-Road Commercial Vehicles Fuel Consumption, and Emissions by Fuel

State Vehicles: Vehicle Fuel Type	Total Annual Vehicle Miles Travelled (VMT)	Average Fuel Efficiency (kWh/Mile)
Gasoline	0	
Diesel	0	
FlexFuel	0	
Hybrid Electric Vehicle	0	
Plug-in Hybrid Electric Vehicle	0	
Compressed Natural Gas	0	
Propane	0	
Hydrogen Fuel Cell	0	
Other	0	
Electric	0	0.30

Data on the annual distance travelled and fuel consumption for all vehicles, segmented by fuel type and ownership ty
Metropolitan Area Planning Council (MAPC) through the Massachusetts Vehicle Census (MAVC) for all vehicles gara
above table assumes that all fuel consumed by "flex-fuel" vehicles is gasoline, as opposed to E-85, due to the lack of
city/town and the surrounding region. MAVC reports the Fuel Consumper per Year for the following vehicle fuel types
gasoline: Gasoline, Hybrid Electric Vehicle, Plug-In Hybrid Electric Vehicle, Compressed Natural Gas, Propane, Hydr
Other. Thus gasoline emissions factors are used to calculate the emissions for these vehicle fuel types.

Table 6: Private On-road Electric Vehicles Fuel Efficiency

Make	Model	Vehicle Efficiency (kWh/mile)
Tesla	Model 3	0.24
Toyota	Prius Prime	0.25
Chevrolet	Bolt	0.28
Toyota	Rav4 Prime	0.36
Chevrolet	Volt	0.31
Honda	Clarity PHEV	0.30
Tesla	Model X	0.37
	Average of All Vehicles:	**0.301**

The Massachusetts Vehicle Census does not provide emissions rates or fuel efficiencies for electric vehicles. In orde efficiency of electric vehicles, data on fuel efficiency from FuelEconomy.gov for the top seven selling electric vehicles top sevevn selling electric vehicles were identified via data from the MOR-EV Program Statistics, which reports the nu distributed by make, model, and model year.

Table 7: Public Transit On-road Route Distance, Fuel Consumption & Emissions by Mode

Allocating MBTA Fuel Use to City/Town

Public Transit Type	MBTA Frequency-weighted Route Distance (miles/year)*	City/Town Frequency-weighted Route Distance (miles/year)*
Silver Line	1,337,819	0
Trackless Trolley	82,649	0
All MBTA Bus (Excluding Silver Line)	21,499,857	0

*** =** MBTA and City/Town Frequency-weighted Route Distance is estimated by MAPC based on GIS mapping inform schedules. Above analysis assumes 50% of silver line buses are battery electric and 50% are diesel hybrid.

Table 9: Public & Private Transit On-road Electricity Transmission & Distribution Losses

Transit Mode	Electricity Consumption (kWh)	Grid Loss Factor (%)*
Silver Line	0	5.16%
Trackless Trolley	0	5.16%
Private Passenger Electric Vehicles	0	5.16%
Private Commercial Electric Vehicles	0	5.16%
Municipal Vehicles	0	5.16%
State Vehicles	0	5.16%
All On-road Transit**	**0**	5.16%

*** =** The grid loss factor used to estimate emissions from Electric T&D losses is applied to all electricity consumption, consumption estimates. Please note that the EIA grid loss factor may not be representative of actual losses from the system. The Grid Loss Factor is calculated using data provided via the link to the right.

** The total does not include the Silver Line or Trackless Trolley as those are included in the State Vehicles.

nissions

Legend:

Linked to data on “inputs” tab

Not applicable cell

l. This methodology
husetts Vehicle
d for utilizing data on
data on annual fuel
ased on fiscal year
% of the value of
y be accounted for in

Electricity Consumption (kWh)	Total CH4 Emissions (MT CH4)	Total CO2 Emissions (MT CO2)	Total N2O Emissions (MT N2O
		0	
	0.0	0	0.0
0	#DIV/0!	#DIV/0!	#DIV/0!
0	0.000	0	0.000
	0.0	0	0.0
0	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**

missions by Fuel Type

Average Fuel Efficiency (MPG)	Electricity Consumption per Year (kWh)	Average Fuel Efficiency (kWh/mile)	CH4 Emissions (MT CH4)	CO2 Emissions (MT CO2)
#DIV/0!			0.0	0.0
#DIV/0!			0.0	0
	0	#DIV/0!	#DIV/0!	#DIV/0!

ic Vehicle, Compressed

les VMT, Fuel Consumption, and Emissions by Fuel Type

Electricity Consumption per Year (kWh)	CH4 Emissions (MT CH4)	CO2 Emissions (MT CO2)	N2O Emissions (MT N2O)
	0.0	0	0.0
	0.0	0	0.0
	0.0	0	0.0
	0.0	0	0.0

	0.0	0	0.0
	0.0	0	0.0
	0.0	0	0.0
	0.0	0	0.0
	0.0	0	0.0
0	#DIV/0!	#DIV/0!	#DIV/0!

pe, was provided by the
ıged in city/town. The
E-85 fueling stations in
as equivalent gallons of
ogen Fuel Cell, and

Fuel Type

Fuel Consumption per Year (gal)	Electricity Consumption per Year (kWh)	CH4 Emissions (MT CH4)	CO2 Emissions (MT CO2)	N2O Emissions (MT N2O)
0		0.0	0	0.00
0		0.0	0	0.00
0		0.0	0	0.00
0		0.0	0	0.00
0		0.0	0	0.00
0		0.0	0	0.00
0		0.0	0	0.00
0		0.0	0	0.00
0		0.0	0	0.00
nodata	0	#DIV/0!	#DIV/0!	#DIV/0!

pe, was provided by the
ıged in city/town. The
E-85 fueling stations in
as equivalent gallons of
ogen Fuel Cell, and

y Fuel Type

Fuel Consumption per Year (gal)	Electricity Consumption per Year (kWh)	CH4 Emissions (MT CH4)	CO2 Emissions (MT CO2)	N2O Emissions (MT N2O)
0		0.00	0	0.00
0		0.00	0	0.00
0		0.00	0	0.00
0		0.00	0	0.00
0		0.00	0	0.00
0		0.00	0	0.00
0		0.00	0	0.00
0		0.00	0	0.00
0		0.00	0	0.00
nodata	0	#DIV/0!	#DIV/0!	#DIV/0!

pe, was provided by the
ıged in city/town. The
E-85 fueling stations in
as equivalent gallons of
ogen Fuel Cell, and

Fuel Type

Fuel Consumption per Year (gal)	Electricity Consumption per Year (kWh)	CH4 Emissions (MT CH4)	CO2 Emissions (MT CO2)	N2O Emissions (MT N2O)
0		0.00	0	0.00
0		0.00	0	0.00
0		0.00	0	0.00
0		0.00	0	0.00
0		0.00	0	0.00
0		0.00	0	0.00
0		0.00	0	0.00
0		0.00	0	0.00
0		0.00	0	0.00
nodata	0	#DIV/0!	#DIV/0!	#DIV/0!

pe, was provided by the
ıged in city/town. The
E-85 fueling stations in
as equivalent gallons of
ogen Fuel Cell, and

Type

Fuel Consumption per Year (gal)	Electricity Consumption per Year (kWh)	CH4 Emissions (MT CH4)	CO2 Emissions (MT CO2)	N2O Emissions (MT N2O)
0		0.00	0	0.00
0		0.00	0	0.00
0		0.00	0	0.00
0		0.00	0	0.00
0		0.00	0	0.00
0		0.00	0	0.00
0		0.00	0	0.00
0		0.00	0	0.00
0		0.00	0	0.00
nodata	0	#DIV/0!	#DIV/0!	#DIV/0!

pe, was provided by the
ıged in city/town. The
E-85 fueling stations in
as equivalent gallons of
ogen Fuel Cell, and

Data Source
FuelEconomy.Gov
FuelEconomy.Gov
FuelEconomy.Gov
FuelEconomy.Gov
FuelEconomy.Gov
FuelEconomy.Gov
FuelEconomy.Gov

r to estimate fuel
of 2022 was used. The
umber of EV rebates

	Diesel Energy Use & Emissions			
Portion of Total MBTA Energy Use Attributable to Town/City	Line Annual Diesel Consumption (gal/year)	City/Town Annual Diesel Consumption (gal/year)	Diesel CH4 Emissions (MT CH4)	Diesel CO2 Emissions (MT CO2)
0.0%	260,488	0	0.00	0
0.0%				
0.0%	4,379,315	0	0.00	0

ation and route

Total Elec Grid Loss (kWh)	CH4 Emissions (MT CH4)	CO2 Emissions (MT CO2)	N2O Emissions (MT N2O)	CO2e Emissions (MT CO2e)
0	0.000	0.0	0.000000	0.00
0	0.000	0.0	0.000000	0.00
0	0.0000	0.0	0.000000	0.00
0	0.0000	0.0	0.000000	0.00
0	0.0000	0.0	0.000000	0.00
0	0.0000	0.0	0.000000	0.00
0	**0.00**	**0.00**	**0.00**	**0.00**

including MBTA
MBTA distribution

ssachusetts El
y Profile

N2O Emissions (MT N2O)	CO2e Emissions (MT CO2e)	CO2e Emissions / Gallon (MT CO2e / Gallon)	CO2e Emissions / kWh (MT CO2e / kWh)
0.0	0	#DIV/0!	
0.0	0	#DIV/0!	
#DIV/0!	#DIV/0!		#DIV/0!

CO2e Emissions (MT CO2e)
0.00
0.00
0.00
0.00
0.00
0.00
0.00
0.00
0.00
#DIV/0!

CO2e Emissions (MT CO2e)
0.00
0.00
0.00
0.00
0.00
0.00
0.00
0.00
0.00
#DIV/0!

CO2e Emissions (MT CO2e)
0.00
0.00
0.00
0.00
0.00
0.00
0.00
0.00
0.00
#DIV/0!

CO2e Emissions (MT CO2e)
0.00
0.00
0.00
0.00
0.00
0.00
0.00
0.00
0.00
#DIV/0!

		CNG Energy Use & Emissions		
Diesel N2O Emissions (MT N2O)	Diesel CO2e Emissions (MT CO2e)	Line Annual CNG Consumption (MMBTU/year)	City/Town CNG Consumption (MMBTU/year)	CNG CO2 Emissions (MT CO2)
0	0.00			
0	0.00	200,323	0	0

	Electricity Energy Use			
CNG CO2e Emissions (MT CO2e)	Line Annual Electricity Consumption (MWh/year)	System Annual Electricity Consumption (kWh/year)	City/Town Electricity Consumption (kWh/year)**	Electricity CH4 Emissions (MT CH4)
	465	465,155	0	0.0000
	652	651,862	0	0.0000
0				

& Emissions

Electricity CO2 Emissions (MT CO2)	Electricity N2O Emissions (MT N2O)	Electricity CO2e Emissions (MT CO2e)
0.0	0.00000	0.00
0.0	0.00000	0.00

Transportation: Rail Energy & Emissions

Sector:	Transportation
Subsector:	Rail

Summary of Methodology Used

Emissions from rail public transportation services include regional rail (commuter rail) and urban rail (hea
NOT include commercial freight rail and long-distance passenger rail (i.e. Amtrak). All rail data on freque
consumption was provided by the MBTA. The MBTA provided data on annual fuel use by mode and fuel
traveled by mode. The MBTA conducts its analysis based on fiscal year (July 1-June30), so calendar ye
as 50% of the value for FY22 and 50% of the value of FY23.

Table 1: Rail Transit Energy Consumption & Emissions by Fuel Type

Fuel Type	Fuel Consumption (Gallons)	Electricity Consumption (kWh)	CH4 Emissions (MT CH4)
Diesel	0		0.00
Electricity		0	0.00
Electricity (T&D Losses)		0	0.00
		All Rail Transit:	**0.00**

Table 2: Rail Route Distance, Energy Consumption & Emissions by Mode

Allocating MBTA Fuel Use to City/Town

Public Transit Type	MBTA Frequency-weighted Route Distance (miles/year)*	City/Town Frequency-weighted Route Distance (miles/year)*	Portion of Total MBTA Energy Use Attributable to City/Town
Blue Line (Heavy Rail)	3,375,435	0	0.0%
Orange Line (Heavy Rail)	5,487,367	0	0.0%
Red Line (Heavy Rail)	10,526,961	0	0.0%
Green Line (Light Rail)	4,899,785	0	0.0%
Mattapan Trolley	382,526	0	0.0%
Commuter Rail	23,707,249	0	0.0%
			All Rail Transit:

* = MBTA and City/Town Frequency-weighted Route Distance is estimated by MAPC based on GIS mapping information and route schedules.

Table 3. Rail Transit Electricity Transmission & Distribution Losses

Public Transit Mode	Total Electricity Consumption (kWh)	Grid Loss Factor (elec)*	Total Elec Grid Loss (kWh)
Blue Line (Heavy Rail)	0	5.16%	0
Orange Line (Heavy Rail)	0	5.16%	0
Red Line (Heavy Rail)	0	5.16%	0
Green Line (Light Rail)	0	5.16%	0

All Rail Transit	0	5.16%	0.0

*** =** The grid loss factor used to estimate emissions from Electric T&D losses is applied to all electricity consumption, including MBTA consumption estimates. Please note that the EIA grid loss factor may not be representative of actual losses from the MBTA distribution system. The Grid Loss Factor is calculated using data provided via the link to the right.

Legend:

Linked to data on “inputs” tab

Not applicable cell

avy and light rail). This sector does ncy-weighted route miles and fuel type and annual vehicle miles ar estimates for 2022 are calculated

CO2 Emissions (MT CO2)	N2O Emissions (MT N2O)
0	0.00
0	0.00
0	0.00
0	**0.00**

Diesel Energy Use & Emissions					
Line Annual Diesel Consumption (gallons/year)	City/Town Annual Diesel Consumption (gallons/year)	City/Town Annual Diesel Emissions (MT CH4)	City/Town Annual Diesel Emissions (MT CO2	City/Town Annual Diesel Emissions (MT N2O)	Line Electricity Consumption (MWh/year)
					26,622
					43,279
					83,027
					38,645
					3,017
13,761,972	0	0.00	0	0.00	
13,761,972	**0**	**0.00**	**0**	**0.00**	**194,591**

Emissions (MT CH4)	Emissions (MT CO2)	Emissions (MT N2O)
0.0	0	0.00
0.0	0	0.00
0.0	0	0.00
0.0	0	0.00

0.0	0.0	0.0
sachusett ity Profil		

Electricity Energy Use & Emissions				
System Electricity Consumption (kWh/year)	City/Town Electricity Consumption (kWh/year)**	City/Town Annual Electricity Emissions (MT CH4)	City/Town Annual Electricity Emissions (MT CO2)	City/Town Annual Electricity Emissions (MT N2O)
26,622,441	0	0.00	0	0.000
43,279,492	0	0.00	0	0.000
83,027,344	0	0.00	0	0.000
38,645,166	0	0.00	0	0.000
3,017,025	0	0.00	0	0.000
194,591,468	**0**	**0.0**	**0**	**0.0**

Summary: Community-wide Waste Emiss

Sector:	Waste
Subsectors:	All Waste Subsectors

Summary of Methodology Used

This worksheet provides a summary of weight disposed of and emissions from the Waste Sec
of waste, biological treatment of waste, incineration of waste and wastewater. Collected waste
Collected organic waste is either sent to a compositing facility or an anaerobic digestion facilit
Massachusetts Water Resources Authority (MRWA's) Wastewater Treatment Plant or treated
plant.

Table 1: Summary of Waste Activity Data & Emissions by Subsector

Subsector	Est. Total Waste to Landfill (short tons)	Est. Mass of Waste Incinerated (tons)
Solid Waste Disposal	3,345	
Biological Treatment of Waste		
Incineration and Open Burning		30,041
Wastewater Treatment and Discharge*		

ions

ctor. The Waste Sector accounts for disposal
e is either sent to landfill or incinerated.
y. Wastewater is either sent to the
at a local, municipal wastewater treatment

Est. Mass of Organics Sent to Compositing Facility (tons)	Est. Mass of Organics Sent to Anaerobic Digester (tons)	CH4 Emissions (MT CH4)	CO2 Emissions (MT CO2)	N2O Emissions (MT N2O)
		27		
0	0	0		0
		0.004	463	0.9
		0.0		1.5
	All Waste:	**27**	**463**	**2.4**

Waste: Community-v

Sector:

Subsector:

Summary of Methodology Used

Methane emissions associated with landfilled waste were calculated using GPC equ
sent to landfill. This equation assigns emissions to a community based on the amou
waste that is incinerated versus sent to landfill and the composition of waste. These
community-specific data is available.

Table 1: Methane Commitment Estimate for Solid Waste Sent to Landfil

Description of Variable
GPC Equation 8.4 Variable Corresponding Letter
Data

In accordance with Equation 8.3:
1) The Fraction of Methane Recovered in Landfill is from the EPA's FLIGHT data. If the user l
value of all landfills in Massachusetts is used.
2) An Oxidation Factor (OX) of 0.1 was selected because the landfills that most cities/towns s

Table 1a: Fraction of Methane Recovered at Landfills in Massachusetts

Landfill
Northampton Landfill
Granby Sanitary Landfill
Chicopee Sanitary Landfill
Martone Landfill & Gas Generating Facility
Southbridge Recycling & Disposal Park
Fitchburg Westminster Landfill Recycling Center
Plainville Landfill
Taunton Sanitary Landfill
Carver-Marion-Wareham Landfill
Middleborough Landfill
Halifax Landfill
Haverhill Landfill
Average

Data is from the EPA's Facility Level Information on GreenHouse gases Tool (FLIGHT). FLIG
Municipal Landfills and Industrial Landfills. The Gas Collection System Efficiency is included i

Equation 8.3 Methane commitment estimate for solid waste sent to landfill

$$CH_4 \text{ emissions} = MSW_x \times L_0 \times (1\text{-}f_{rec}) \times (1\text{-}OX)$$

Description			Value
CH_4 emissions	=	Total CH_4 emissions in metric tonnes	Computed
MSW_x	=	Mass of solid waste sent to landfill in inventory year, measured in metric tonnes	User input

Equation 8.3 Methane commitment estimate for solid waste sent to landfill

$$CH_4 \text{ emissions} = MSW_x \times L_0 \times (1\text{-}f_{rec}) \times (1\text{-}OX)$$

Description			Value
CH_4 emissions	=	Total CH_4 emissions in metric tonnes	Computed
MSW_x	=	Mass of solid waste sent to landfill in inventory year, measured in metric tonnes	User input
L_0	=	Methane generation potential	Equation 8.4 Methan potential
f_{rec}	=	Fraction of methane recovered at the landfill (flared or energy recovery)	User input
OX	=	Oxidation factor	0.1 for well-manage unmanaged landfills

Source: Adapted from *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*

Table 2: Weight of Waste and Organic Waste Collected by Collection Ty

Waste Collection Type
Municipally Collected
Private Hauler Collected
Community Total

If the mass of waste collected by both Municipal and Private Haulers is unknown, a default va exports) is used.

Table 3: Proportion of Massachusetts In-state Waste Disposed: Landfil

Waste Category
All Waste Disposed of In-state
Landfilled Waste
Combusted Waste

All Waste Exported
Exported Waste

This table assumes default State-level percent of disposed waste sent to landfill and combust
weight of Massachusetts waste disposed of in-state and weight of total in-state waste sent to
Table 2: Solid Waste Tonnage and Percent Change Summary.

Table 4: Weight of Waste Sent to Landfill by Collection Type and Waste
Waste Collection Type
Municipally Collected
Private Hauler Collected
All Categories

The table above estimates the amount of waste sent to landfill based on 1) The mas
calculated percent of disposed waste sent to landfills.

Table 5: Methane Generation Potential (GPC Equation 8.4) and Degrada
Description of Variable
GPC Equation 8.4 Variable Corresponding Letter
Data

In accordance with Equation 8.4:
1) A value of 1.00 was input for Methane Correction Factor (MCF) since landfills waste is sen
2) A default value of 0.6 was input for Fraction of Degradable Organic Carbon Degraded (DO
3) A default value 0.5 was input for Fraction of Methane in Landfill Gas (F).
4) The default fraction of 16/12 was input for Stoichiometric Ratio Between Methane and Carl

Equation 8.4 Methane generation potential, L_0

$$L_0 = MCF \times DOC \times DOC_F \times F \times 16/12$$

Description			V
L_0	=	Methane generation potential	C
MCF	=	Methane correction factor based on type of landfill site for the year of deposition (managed, unmanaged, etc., fraction)	M U U U
DOC	=	Degradable organic carbon in year of deposition, fraction (tonnes C/tonnes waste)	E
DOC_F	=	Fraction of DOC that is ultimately degraded (reflects the fact that some organic carbon does not degrade)	A
F	=	Fraction of methane in landfill gas	D 0
16/12	=	Stoichiometric ratio between methane and carbon	

Source: IPCC Good Practice Guidance and Uncertainty Management in National Greenho

Table 6: Waste Characterization Allocation by GPC Equation 8.1 Categ

Equation 8.1 Waste Category
Food
Garden Waste and Plant Debris
Paper
Wood
Textiles
Industrial Waste

This table assumes default State-level composition of waste unless local data is entered on th
of how each waste type was allocated to the appropriate GPC waste category.

Table 7: Overall Waste Composition By Detailed Material Category Map

Waste Category/Sub-category
Paper
Uncoated Corrugated Cardboard/Kraft Paper
Waxed Cardboard

High Grade Office Paper
Magazines/Catalogs
Newsprint
Other Recyclable Paper
Compostable Paper
Remainder/Composite Paper
Plastic
PET Beverage Containers (non-MA deposit containers)
PET Containers other than Beverage Containers
Plastic MA Deposit Beverage Containers
HDPE Bottles, colored and natural
Plastic Tubs and lids (HDPE, PP, etc.)
#5 PP Bottles & Containers
Plastic Containers #3-#7 (which originally contained non-hazardous material)
Other Plastic Bottles & Containers
Expanded Polystyrene Food Grade
Expanded Polystyrene Non-food Grade
Bulk Rigid Plastic Items
Film (non-bag clean commercial and industrial packaging film)
Grocery and other Merchandise Bags
Other Film means plastic film
Remainder/Composite Plastic
Metal
Aluminum Beverage Containers (non-MA deposit containers)
Aluminum MA Deposit Beverage Containers
Tin/Steel Containers
Other Aluminum
Other Ferrous and non-ferrous
White Goods
Remainder/Composite Metal
Glass
Glass Beverage Containers (non-MA deposit containers)
Other Glass Packaging Containers (non-MA deposit containers)
Glass MA Deposit Beverage Containers
Remainder/Composite Glass
Organic Materials
Food Waste
Branches and Stumps
Prunings, Trimmings, Leaves and Grass
Manures
Remainder/Composite Organic
Construction and Demolition (in the MSW stream)
Asphalt Pavement, Brick, and Concrete
Aggregates, Stone, Rock
Wood – Treated
Wood – Untreated
Asphalt Roofing
Drywall/Gypsum Board
Carpet and Carpet Padding
Remainder/Composite Construction and Demolition

Household Hazardous Waste
Ballasts, CFLs, and Other Fluorescents
Batteries – Lead Acid
Batteries – Other
Paint
Bio-Hazardous
Vehicle and Equipment Fluids
Empty Metal, Glass, and Plastic Containers
Other Hazardous or Household Hazardous Waste
Electronics
Computer-related Electronics
Other “brown goods”
Televisions and Computer Monitors
Other Materials
Tires and other rubber
Textiles
Bulky Materials
Mattresses
Restaurant Fats, Oils and Grease
Other Miscellaneous
Total

The above data is from the Massachusetts's Department of Environmental Protectio
Combustor Class II Recycling Program Waste Characterization Studies (Includes 2(
Data)". Data from the "2022 Detailed Fall & Winter" tab of the workbook was used. F
"N/A" in 2022, the 2019 Spring/Summer value was used. This data provides a weigh
material category based on the amount of waste that each incineration facility burne

wide Solid Waste Disposal

Waste
Solid Waste Disposal

iations 8.1, 8.3 and 8.4. Equation 8.3 estimates methane emissions resulting from solid waste nt of waste disposed in a given year. State default values are available for the amount of default values can be replaced with community-specific values on the "Inputs" worksheet if

l (GPC Equation 8.3)

Mass Solid Waste Sent to Landfill (MT)	Methane Generation Potential	Fraction of Methane Recovered at Landfill
MSWx	Lo	frec
3,035	0.07	0.86

knows which landfill the community's waste is sent to, the value of that landfill is used. If not, the average

end waste to in Massachusetts are managed.

Estimated Gas Collection System Efficiency HH3	EPA Flight Link
95%	https://ghgdata.epa.gov/ghgp/service/html/2022?id=100
95%	https://ghgdata.epa.gov/ghgp/service/html/2022?id=100
95%	https://ghgdata.epa.gov/ghgp/service/html/2022?id=100
95%	https://ghgdata.epa.gov/ghgp/service/html/2022?id=100
95%	https://ghgdata.epa.gov/ghgp/service/html/2022?id=100
87%	https://ghgdata.epa.gov/ghgp/service/html/2022?id=100
95%	https://ghgdata.epa.gov/ghgp/service/html/2022?id=100
95%	https://ghgdata.epa.gov/ghgp/service/html/2022?id=100
95%	https://ghgdata.epa.gov/ghgp/service/html/2022?id=100
86%	https://ghgdata.epa.gov/ghgp/service/html/2022?id=101
95%	https://ghgdata.epa.gov/ghgp/service/html/2022?id=100
0%	https://ghgdata.epa.gov/ghgp/service/html/2022?id=100
86%	

HT can be accessed at https://ghgdata.epa.gov/ghgp/main.do. Select Massachusetts, the inventory year,
in the reported data for each facility.

ste sent to landfill

issions =

$(1-f_{rec}) \times (1-OX)$

	Value
	Computed
ntory year,	User input

ste sent to landfill

nissions =

$(1-f_{rec}) \times (1-OX)$

	Value
	Computed
ntory year,	User input
	Equation 8.4 Methane generation potential
dfill (flared or energy	User input
	0.1 for well-managed landfills; 0 for unmanaged landfills

eenhouse Gas Inventories

ype

Mass of Waste Collected - Excluding Separated Organic Waste (short tons)	Mass of Separated Organic Waste Collected (short tons)	Mass of Waste Collected - Excluding Separated Organic Waste (MT)
0	0	0
33,386	0	30,287
33,386	**0**	**30,287**

alue equal to the statewide average tons of waste per capita (including

led vs. Combusted by Waste Type

Waste Type	Mass of Waste (short tons)	Percent of Total City/Town Waste Disposed In-state
All Waste Disposed of In-state	**4,890,000**	**63%**
Municipal Solid Waste (MSW)	410,000	
Construction & Demolition Waste (C&D)	0	
Other Waste	80,000	
Total Landfilled Waste	**490,000**	**10.0%**
Municipal Solid Waste (MSW)	2,900,000	
Non-Municipal Solid Waste (MSW)	1,500,000	

Total Combusted Waste	**4,400,000**	**90.0%**
All Waste Exported	**2,880,000**	
Municipal Solid Waste (MSW)	1,380,000	
Non-Municipal Solid Waste (MSW)	1,500,000	

ted unless local data is entered on the "Inputs" tab of this workbook. Data on landfill vs. combusted by waste type is from MA DEP Solid Waste Update,

DEP Solid Waste Updates

e Type

Mass of Total Waste Landfilled (short tons)	Mass of Total Waste Landfilled (MT)
0	0
3,345	3,035
3,345	**3,035**

ss of waste collected (excluding separated organic waste) and 2) The

able Organic Carbon (Equation 8.1)

Methane Correction Factor	Degradable Organic Carbon (tonnes C/tonnes waste)	Fraction of Degradable Organic Carbon Degraded
MCF	DOC	DOCf
1.00	0.18	0.6

t to are actively managed.
Cf).

bon.

alue
omputed
Managed = 1.0 Unmanaged (≥5 m deep) = 0.8 Unmanaged (<5 m deep) = 0.4 Uncategorized = 0.6
quation 8.1
ssumed equal to 0.6
Default range 0.4-0.6 (usually taken to be .5)
use Gas Inventories (2000)

Equation 8.1 Degradable orga

$$DOC = (0.15 \times A) + (0.2 \times B) + (+ (0.24 \times E) +$$

A	=	Fraction of solid waste
B	=	Fraction of solid waste and other plant debris
C	=	Fraction of solid waste
D	=	Fraction of solid waste
E	=	Fraction of solid waste
F	=	Fraction of solid waste

ories

Equation 8.1 Corresponding Variable	City/Town Data: Percent of Total Disposed Waste in Category	State Data: Percent of Total Disposed Waste in Category
A	Default to State Data	21.6%
B	Default to State Data	8.0%
C	Default to State Data	21.8%
D	Default to State Data	6.4%
E	Default to State Data	5.2%
F	Default to State Data	0.0%

he "Inputs" tab of this workbook. See Table 7 below for a detailed explanation

pped to GPC Waste Categories

Weighted Average	GPC Waste Category
5.8%	Paper
0.5%	Paper

0.5%	Paper
0.4%	Paper
0.3%	Paper
3.9%	Paper
7.2%	Paper
3.2%	Paper
0.8%	Other
0.5%	Other
0.1%	Other
0.6%	Other
0.4%	Other
0.9%	Other
0.9%	Other
0.3%	Other
0.4%	Other
0.2%	Other
1.8%	Other
1.0%	Other
0.3%	Other
5.7%	Other
2.5%	Other
0.1%	Other
0.3%	Other
0.8%	Other
0.4%	Other
1.6%	Other
0.1%	Other
1.5%	Other
0.8%	Other
0.5%	Other
0.4%	Other
0.5%	Other
21.6%	Food
0.4%	Garden Waste and Plant Debris
1.3%	Garden Waste and Plant Debris
0.2%	Garden Waste and Plant Debris
6.0%	Garden Waste and Plant Debris
0.1%	Other
0.6%	Other
3.4%	Wood
3.0%	Wood
0.3%	Other
0.9%	Other
1.8%	Other
2.1%	Other

0.0%	Other
0.0%	Other
0.1%	Other
0.1%	Other
3.5%	Other
0.0%	Other
0.1%	Other
0.1%	Other
0.1%	Other
0.2%	Other
0.0%	Other
0.4%	Other
5.2%	Textiles
2.2%	Other
0.1%	Other
0.0%	Food
2.3%	Other
100%	
n (DEP) "Summary of Waste 010, 2013, 2016, 2019, and 2022 For data that was entered as nted average composition by d in calendar year 2022.	MA DEP Waste Source

Legend:

Linked to data on “inputs” tab

Not applicable cell

Oxidation Factor	CH4 Emissions (MT CH4)
OX	
0.1	27.5

2593&et=undefined
7685&et=undefined
7669&et=undefined
3587&et=undefined
5254&et=undefined
7753&et=undefined
4557&et=undefined
3532&et=undefined
5715&et=undefined
0391&et=undefined
7550&et=undefined
5213&et=undefined
and filter the sector for

	Mass of Separated Organic Waste Collected (MT)
	0
	0
	0

Fraction of Methane in Landfill Gas	**Stoichiometric Ratio Between Methane and Carbon**	**Methane Generation Potential**
F	16/12	Lo
0.5	1.33	0.07

nic carbon (DOC)[52]

=

(0.4 × C) + (0.43 × D)

+ (0.15 × F)

e that is food

e that is garden waste

s

e that is paper

e that is wood

e that is textiles

e that is industrial waste

Selected Data: Percent of Total Disposed Waste in Category	Equation 8.1 Default Carbon Content Value (tonnes C/tonnes waste)
21.6%	0.15
8.0%	0.20
21.8%	0.40
6.4%	0.43
5.2%	0.24
0.0%	0.15

Waste: Community-wide Biological

Sector:	Waste
Subsector:	Biological Treatment of Solid Waste

Summary of Methodology Used

Methane and nitrous oxide emissions associated with biological treatment of
resulting from two treatment types - compositing and anaerobic digestion. S
anaerobically digested. These default values can be replaced with communit

Table 1. Biologically Treated Waste by Treatment Type

Mass of Separated Organic Waste Collected (short tons)	Percent of Organic Waste Sent to Compositing Facility
0	50%

This table assumes default State-level percent of organic waste sent to compositing f
unless local data is entered on the "Inputs" tab of this workbook.

Table 2. Direct Emissions From Biologically Treated Solid Waste

Biological Treatment Type	Mass of Organic Waste Treated (kg/year)
Compositing Facility	0
Anaerobic Digestion Facility	0

In accordance with GPC Equation 8.5:
1) The default biological treatment emission factors from GPC Table 8.3 wer
both compositing and anaerobic digestion at biogas facilities.
2) The estimated percent of CH4 recovered at compositing facilities and ane
methane recovery for compositing facilities and 100% methane recovery for

Equation 8.5 Direct emissions from biologically treated solid waste

$$\text{CH}_4 \text{ Emissions} = (\sum_i (m_i \times F\_CH4_i) \times 10^{-3} - R)$$

$$\text{N}_2\text{O Emissions} = (\sum_i (m_i \times EF\_N2O_i) \times 10^{-3})$$

Description			V
CH_4 emissions	=	Total CH_4 emissions in tonnes	C
N_2O emissions	=	Total N_2O emissions in tonnes	C
m	=	Mass of organic waste treated by biological treatment type i, kg	U
EF_ CH4	=	CH_4 emissions factor based upon treatment type, i	U fr e
EF_ N2O	=	N_2O emissions factor based upon treatment type, i	U in Bi
i	=	Treatment type: composting or anaerobic digestion	U
R	=	Total tonnes of CH_4 recovered in the inventory year, if gas recovery system is in place	U at

Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 5, Chapter 4: Biolog

EQUATION 4.1
CH_4 EMISSIONS FROM BIOLOGICAL TREATMEN

$$CH_4 \ Emissions = \sum_i (M_i \bullet EF_i) \bullet 10^{-3} - R$$

Where:

CH_4 Emissions = total CH_4 emissions in inventory year, Gg CH_4

M_i = mass of organic waste treated by biological treatment type *i*, G

EF = emission factor for treatment *i*, g CH_4/kg waste treated

i = composting or anaerobic digestion

R = total amount of CH_4 recovered in inventory year, Gg CH_4

Treatment of Solid Waste

solid waste were calculated using GPC equation 8.5. Equation 8.5 estimates direct emissions
tate default values are available for the amount of organic waste that is composted versus
y-specific values on the "Inputs" worksheet if community-specific data is available.

Percent of Organic Waste Sent to Anaerobic Digestion Facility
50%

acility vs. anaerobic digestion facility

Legend:

Linked to data on “inputs” tab

Not applicable cell

(GPC Equation 8.5)

CH4 Emissions Factor (g CH4 / kg waste)	N2O Emissions Factor (g N2O / kg waste)	CH4 Emissions Excluding Methane Capture (MT CH4)	Percent of CH4 Recovered (%)
4	0.3	0.0	0%
1	0	0.0	100%
		Total Biologically Treated Solid Waste:	

e used. "Wet waste" emission factors were used for

robic digestion facilities. This analysis assumes 0%
anaerobic digestion facilities.

MA DEP Source

alue
omputed
omputed
ser input
ser input or default value om table 8.3 Biological treatment mission factor
ser input or default value User put or default value from table 8.3 iological treatment emission factor
ser input
ser input, measured : recovery point

gical Treatment of Solid Waste

T

ig

Table 8.3 Biological treatment emission factors

Treatment type	CH_4 Emissions Fa kg waste)
	Dry waste
Composting	10
Anaerobic digestion at biogas facilities	2

Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventorie

CH4 Emissions Including Methane Capture (MT CH4)	N2O Emissions (MT N2O)
0	0.00
0.0	0.00
0	0

ctors (g CH_4/	N_2O Emissions Factors (g N_2O /kg waste)	
Wet waste	**Dry waste**	**Wet waste**
4	0.6	0.3
1	N/A	N/A

s, Volume 5, Chapter 4: Biological Treatment of Solid Waste

Waste: Community-wide Incineration and Open Bu

Sector:	Waste
Subsector:	Incineration and Open Burning

Summary of Methodology Used

Carbon dioxide, methane, and nitrous oxide emissions associated with incineration of solid waste were ca
estimates non-biogenic carbon dioxide emissions from the incineration of waste, Equation 8.7 estimates r
Equation 8.8 estimates nitrous oxide emissions from the incineration of waste. State default values are av
to landfill. These default values can be replaced with community-specific values on the "Inputs" workshee
of incinerated waste in total and for each fraction of matter type i (paper, textiles, food, etc.) are used to d
NO2 are summed, and then multiplied by the mass to calculate the total emissions from incinerated waste

In Massachusetts, the incinerated waste is used to generate electricity. Emissions generated as a result c
considered Scope 3 emissions. According to the GPC, waste used to generate energy is considered a st
the city's boundary are not included in the inventory. If a waste incineration power plant is located inside t
E. Indus." worksheet.

Table 1: Summary of Emissions From Waste Incineration

CH4 Emissions (MT CH4)	CO2 Emissions (MT CO2)	N2O Emissions (MT N2O)
0.004	463.2	0.9

Table 2: Waste Incineration by Collection Type

Waste Collection Type	Mass of Waste Collected (short tons)	Percent of Collected Waste Incinerated
Municipally Collected	0	90.0%
Private Hauler Collected	33,386	90.0%
All Categories	**33,386**	

Table 3: Non-biogenic CO2 Emissions From Waste Incineration (GPC Equation 8.6)

Description of Variable	Category of Type of Waste Incinerated	Mass of Waste Incinerated (short tons)
GPC Equation 8.6 Variable Corresponding Letter	i	m
Data	**All Incinerated Waste**	**30,041**
	Food Waste	
	Garden Waste and Plant Debris	
	Paper	
	Wood	
	Textiles	
	Industrial Waste	

In accordance with GPC Equation 8.6:
1) Defaults values for Dry Matter Content (dm) and Fraction of Carbon in the Dry Matter (CF) were pulled from 2006 I
2) Default values for Fraction of Fossil Carbon in the Total Carbon Component (FCF) were pulled from 2006 IPCC Gu

3) Default Values for Oxidation Factor (OF) were pulled from GPC Table 8.4.

Equation 8.6 Non-biogenic CO_2 emissions from the incineration of waste

$$CO_2 \text{ Emissions} = m \times \sum_i (WF_i \times dm_i \times CF_i \times FCF_i \times OF_i) \times (44/12)$$

Description			Value
CO_2 emissions	=	Total CO_2 emissions from incineration of solid waste in tonnes	Computed
m	=	Mass of waste incinerated, in tonnes	User input
WF_i	=	Fraction of waste consisting of type i matter	User input[54]
dm_i	=	Dry matter content in the type i matter	
CF_i	=	Fraction of carbon in the dry matter of type i matter	
FCF_i	=	Fraction of fossil carbon in the total carbon component of type i matter	User input (default value
OF_i	=	Oxidation fraction or factor	provided in Table 8.4 bel
i	=	Matter type of the Solid Waste incinerated such as paper/cardboard, textile, food waste, etc.	

Note: $\sum_i WF_i = 1$

Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories

Table 4: CH4 Emissions From Waste Incineration (GPC Equation 8.7)

Description of Variable	Category of Type of Waste Incinerated	Mass of Waste Incinerated (short tons)
GPC Equation 8.7 Variable Corresponding Letter	i	m
Data	All Incinerated Waste	30,041
	Food Waste	
	Garden Waste and Plant Debris	
	Paper	
	Wood	
	Textiles	
	Industrial Waste	

In accordance with GPC equation 8.7 Aggregate CH4 Emission Factor for "Continuous Incineration: Stoker" from GP

Equation 8.7 CH_4 **emissions from the incineration of waste**

$$CH_4 \text{ Emissions} = \sum(IW_i \times EF_i) \times 10^{-6}$$

Description			Value
CH_4 Emissions	=	CH_4 emissions in inventory year, tonnes	Computed
IW_i	=	Amount of solid waste of type i incinerated or open-burned, tonnes	User Input
EF_i	=	Aggregate CH_4 emission factor, g CH_4/ton of waste type i	User Input (default values provide in Table 8.5 below)
10^{-6}	=	Converting factor from gCH_4 to t CH_4	
i	=	Category or type of waste incinerated/open-burned, specified as follows: MSW municipal solid waste, ISW: industrial solid waste, HW: hazardous waste, CW: clinical waste, SS: sewage sludge, others (that must be specified)	User input

Table 5: N2O Emissions From Waste Incineration (GPC Equation 8.8)

Description of Variable	Category of Type of Waste Incinerated	Mass of Waste Incinerated (short tons)
GPC Equation 8.8 Variable Corresponding Letter	i	m
Data	**All Incinerated Waste**	**30,041**
	Food Waste	
	Garden Waste and Plant Debris	
	Paper	
	Wood	
	Textiles	
	Industrial Waste	

In accordance with GPC Equation 8.8 Aggregate N2O Emission Factor (EF) for "continuous and semi-continuous inc

Equation 8.8 N_2O **emissions from the incineration of waste**

$$N_2O \text{ Emissions} = \sum(IW_i \times EF_i) \times 10^{-6}$$

Description			Value
N_2O Emissions	=	N_2O emissions in inventory year, in tonnes	Computed
IW_i	=	Amount of solid waste of type i incinerated or open-burned, in tonnes	User Input
EF_i	=	Aggregate N_2O emission factor, g CH_4/ton of waste type i	User Input (default va provided in Table 8.6
i	=	Category or type of waste incinerated/open-burned, specified as follows: MSW: municipal solid waste, ISW: industrial solid waste, HW: hazardous waste, CW: clinical waste, SS: sewage sludge, others (that must be specified)	User input

Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 5, chapter 5: Incineration and Open Burning of Waste

urning

Legend:

Linked to data on “inputs” t

Not applicable cell

alculated using GPC equations 8.6, 8.7, and 8.8. Equation 8.6 nethane emissions from the incineration of waste, and vailable for the amount of waste that is incinerated versus sent t if community-specific data is available. In general, the mass etermine the emissions. The quantities for CO2, CH4 and e.

of incineration occurring outside of a city's boundary are ationary energy source. Stationary energy sources outside of he city's boundary, it is accounted for the "Stationary Energy -

Mass of Waste Incinerated (short tons)
0
30,041
30,041

Fraction of Waste Consisting of Type i Matter	Dry Matter Content in Type i Matter	Fraction of Carbon in the Dry Matter of Type i Matter	Fraction of Fossil Carbon in the Total Carbon Component of Type i Matter	Oxidation Factor
WFi	dm(i)	CF(i)	FCF(i)	OF(i)
21.6%	40%	38%	0%	100%
8.0%	40%	49%	0%	100%
21.8%	90%	46%	1%	100%
6.4%	85%	50%	0%	100%
5.2%	80%	50%	16%	100%
0.0%	90%	3%	3%	100%
			All CO2 Incinerated Waste Emissions:	

PCC Guidelines, Vol. 5, Ch. 2, Table 2.4. uidelines, Vol. 5, Ch. 2, Table 2.5.	IPCC Guidelines, , Ch. 2
	See GPC Table 8.4

Table 8.4 Default data for CO_2 emission factors for incineration and open burning

Parameters	Management practice	MSW	Industrial Waste (%)	Clinical Waste (%)	Sewage Sludge (%)[Note 4]	Fossil liquid waste (%)[Note 5]
Dry matter content in % of wet weight		(see Note 1)	NA	NA	NA	NA
Total carbon content in % of dry weight		(see Note 1)	50	60	40 – 50	80
Fossil carbon fraction in % of total carbon content		(see Note 2)	90	40	0	100
Oxidation factor in % of carbon input	Incineration	100	100	100	100	100
	Open-burning (see Note 3)	58	NO	NO	NO	NO

Note 1: Use default data from Default data available in *2006 IPCC Guidelines*, Vol. 5, Ch. 2, Table 2.4 in Section 2.3 Waste composition and equat 5.8 (for dry matter), Equation 5.9 (for carbon content) and Equation 5.10 (for fossil carbon fraction) in *2006 IPCC Guidelines*, Vol. 5, Ch. 5
Note 2: Default data by industry type is given in *2006 IPCC Guidelines*, Vol. 5, Ch. 2 Table 2.5 in Section 2.3 Waste composition. For estimation of emissions, use equations mentioned in Note 1.
Note 3: When waste is open-burned, refuse weight is reduced by approximately 49 to 67 percent (US-EPA, 1997, p.79). A default value of 58 perc is suggested.
Note 4: See Section 2.3.2 Sludge in Chapter 2.
Note 5: Fossil liquid waste is here defined as industrial and municipal residues, based on mineral oil, natural gas or other fossil fuels. It includes wa formerly used as solvents and lubricants. It does not include wastewater, unless it is incinerated (e.g., because of a high solvent content) T total carbon content of fossil liquid waste is provided in percent of wet weight and not in percent of dry weight (GIO, 2005).
References: *2006 IPCC Guidelines for National Greenhouse Gas Inventories*, Volume 5, chapter 5: Incineration and Open Burning of Waste

Fraction of Waste Consisting of Type i Matter	Amount of Solid Waste of Type i Incinerated (short tons)	Aggregate CH4 Emission Factor (g CH4/ton of waste type i)	CH4 Emissions (MT)
WFi	IW(i)	EF(i)	
21.6%	6,497	0.2	0.0013
8.0%	2,397	0.2	0.0005
21.8%	6,560	0.2	0.0013
6.4%	1,908	0.2	0.0004
5.2%	1,550	0.2	0.0003
0.0%	0	0.2	0.0000
	All CH4 Incinerated Waste Emissions:		**0.0038**

C Table 8.5 was used.	See GPC Table 8.5

Table 8.5 CH_4 emission factors for incineration of MSW

Type of premises	Temporary	Permanent
Continuous incineration	stoker	0.2
	fluidised bed Note1	~0
Semi-continuous incineration	stoker	6
	fluidised bed	188
Batch type incineration	stoker	60
	fluidised bed	237

Note: In the study cited for this emission factor, the measured CH_4 concentration in the exhaust air was lower than
Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 5, chapter 5: Incineration and

Fraction of Waste Consisting of Type i Matter	Amount of Solid Waste of Type i Incinerated (short tons)	Aggregate N2O Emission Factor (g N2O/ton of waste type i)	N2O Emissions (MT)
WFi	IW(i)	EF(i)	
21.6%	6,497	50	0.3248
8.0%	2,397	50	0.1199
21.8%	6,560	50	0.3280
6.4%	1,908	50	0.0954
5.2%	1,550	50	0.0775
0.0%	0	50	0.0000
		All N2O Incinerated Waste Emissions:	**0.9**

inerators" from GPC Table 8.6 was used.

See GPC Table 8.6

alues
below)

Table 8.6 Default N_2O emission factors for different types of waste and managemer

Type of waste	Technology / Management practice	Emi (g N
MSW	continuous and semi-continuous incinerators	50
MSW	batch-type incinerators	60
MSW	open burning	150
Industrial waste	all types of incineration	100
Sludge (except sewage sludge)	all types of incineration	450
Sewage sludge	incineration	990
		900

Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 5, chapter 5: Incinerati

ab

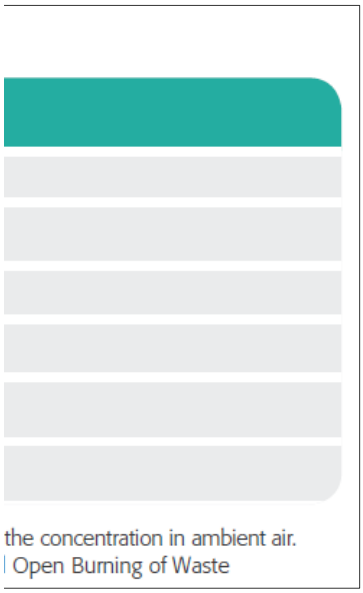
Wfi x dmi x Cfi x FCFi x Ofi
0.00%
0.00%
0.09%
0.00%
0.33%
0.00%
463.2

ion

f

cent

ste
he



the concentration in ambient air.

Open Burning of Waste

ıt practices

ssion factor $_2O$ / t waste)	weight basis
	wet weight
	wet weight
	dry weight
	wet weight
	wet weight
	dry weight
	wet weight

ion and Open Burning of Waste

Waste: Community-wide Wastewater Treate

Sector:	Waste
Subsector:	Wastewater Treatment and Di

Summary of Methodology Used

The analysis of wastewater emissions follows the approach used by the Massachusetts Department of E wastewater treatment emissions for communities in Massachusetts in Appendix C of the Greehouse Ga methodology from the "Wastewater" tab of the Appendix C workbook was used to calculate the total me wastewater treatment plants (WWTP) and septic systems. This methodology in compliance with method

For communities served by the Clinton, Deer Island, Greater Lawrence, Pittsfield, and Rockland wastew emissions from wastewater effluent is calculated. These wastewater treatment plants do not release me anaerobic digestion (AD) process and diverted to co-generation systems where it is used to heat buildin generators. These wastewater treatment plants are referred to as wastewater treatment plants with anae generated as a result of methane capture and co-generation occurring outside of a city's boundary are c GPC, wastewater used to generate energy is considered a stationary energy source. Stationary energy included in the inventory. If a wastewater treatment power plant is located inside the city's boundary, it is Indus." worksheet.

For communities served by a wastewater treatment plant without anaerobic digestion (WWTPs w/o AD), effluent and methane generation emissions from wastewater treatment are calculated using the methode Greenhouse Gas Baseline & Inventory report. Communities that are served by WWTPs w/o AD do have wastewater treatment because methane capture and co-generation systems are not in place.

Some communities are only partially served by WWTPs, and the remainder of the population is on septi population on septic systems, the methane emissions and indirect nitrous oxide emissions from wastewa outlined in the Massachusetts DEP Greenhouse Gas Baseline & Inventory report.

Table 1: Summary of Emissions From Wastewater Treatment and Discharge

CH4 Emissions (MT CH4)	N2O Emissions (MT N2O)
0.0	**1.5**

Table 2: Population Served by WWTPs with and without Anaerobic Digestion and Population on Septic Systems

Description	Data
Total Community Population:	30,000
Percent of Community Population Served by WWTP w/ AD:	100%
Percent of Community Population on Septic Systems:	0%
Percent of Community Population Served by WWTP w/o AD:	0%
Community Population Served by WWTP w/ AD:	30,000
Community Population on Septic Systems:	0
Community Population Served by WWTP w/o AD:	0

Table 3: CH4 Emissions from Septic

Description	Data
Septic Biochemical Oxygen Demand (BOD) (kg/cap/day)	0.085
Septic Maximum CH4 Producing Potential (Bo) (kg CH4/kg BOD)	0.6

Septic Methane Correction Factor (MCF)	0.5
Septic Emission Factor for wastewater treatment (EF) (kg CH4/kg BOD)	0.3
Fraction of population managing their septic tank in compliance with the sludge removal instruction of their septic system (F)	0.75
CH4 Emissions (MT CH4):	**0**

Table 4: CH4 Generation from Wastewater Treatment Plants w/o Anaerobic Digestion	
Description	**Data**
WWTP Biochemical Oxygen Demand (BOD) (kg/cap/day)	0.09
WWTP Maximum CH4 Producing Potential (Bo) (kg CH4/kg BOD)	0.6
WWTP Methane Correction Factor (MCF)	0.03
WWTP Emission Factor for wastewater treatment (EF) (kg CH4/kg BOD)	0.018
CH4 Emissions (MT CH4):	**0**

Table 5: Direct N2O Emissions from all WWTPs	
Description	**Data**
WWTP N2O Process Emissions (g N2O / cap / year)	4
N2O Emissions (MT N2O):	**0.12**

Table 6: Indirect N2O Emissions from Wastewater Effluent	
Description	**Data**
Effluent Fraction of nitrogen in protein (F_NPR) (kg N/kg protein)	0.16
Effluent Factor for nitrogen in non-consumed protein disposed in sewer system (F_NonCon) (kg N/kg N)	1.75
Effluent Emision factor for biosolids EF_biosolids (kg N2O-N/kg sewage-N produced)	0.005
Annual Per Capita Protein Consumption (kg/person/year)	34.4
Effluent Fraction for nitrogen in fertilizer (F_Fertilizer)	0.4
N2O Emissions (MT N2O):	**1.36**

ed & Emissions

ischarge

Environmental Protection (DEP) to estimate
s Baseline & Inventory report. The data and
thane and nitrous oxide emissions from
lologies recommended by the GPC.

vater treatement plants, only indirect nitrous oxide
thane because the methane is captured during an
gs and generate electricity via steam turbine
erobic digestion (WWTPs w/ AD). Emissions
onsidered Scope 3 emissions. According to the
sources outside of the city's boundary are not
s accounted for in the "Stationary Energy - E.

, indirect nitrous oxide emissions from wastewater
ology outlined in the Massachusetts DEP
some methane emissions associated with

c systems. For the portion of the community's
ater effluent are calculated using the methodology

Legend:

Linked to data on “i

Not applicable cell

nputs” tab