Partial Local Government Operations GHG Inventory and Recordkeeping Recommendations for the City of Lompoc 2019 Baseline Year

A Senior Project
presented to
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Introduction

In response to human activities and their impact on climate change, the State of California and local governments have taken action to track and reduce greenhouse gas (GHG) emissions. This includes emissions both at the community scale and from local government operations alone.[1]

This report intends to quantify, to the extent feasible and for which data is available, the greenhouse gas emissions produced by the local government operations of the City of Lompoc for the baseline year 2019. In addition, the purpose of this report is to identify ways in which the City can improve record keeping and data collection techniques in order to more accurately and efficiently track emissions in the future.

In anticipation of continued concern for GHG emissions at the State and local level, as well as public interest, an inventory of baseline emissions and identification of ways in which emissions can be tracked in the future can supply multiple benefits to the City. ICLEI (Local Governments for Sustainability) identifies five major benefits of developing a GHG inventory at the scope of local government operations. These benefits are listed below[2]:

- Risk Management: early actions to reduce emissions can help the City manage climate risk, and future legislation or State-level programs may accept such information
- Addressing Inefficiencies: developing an inventory can help identify areas where inputs are inefficient or there is unnecessary waste both from carbon emissions and operations as a whole. The City can then implement programs or improve operations in a way that saves money and resources.
- Readiness for a Carbon Constrained Future: Identifying emissions sources early can prepare the City for the impact of future regulations.

[1] Local Governments for Sustainability (ICLEI). (2010). *Local Government Operations Protocol: For the quantification and reporting of greenhouse gas emissions inventories.*
[2] *Id.*

- Recognition as an Environmental Leader: Reporting emissions allows the City to promote its own environmental stewardship and signal to the community that it is committed to addressing climate change issues.
- Stakeholder Education. An inventory can help inform other employees, the public, and other government constituents about the City's carbon profile.

Tracking and reporting government emissions produces secondary benefits and furthers other City goals as well. The City of Lompoc currently does not have a Climate Action Plan (CAP). If the City were to create a CAP in the future, baseline City emissions can be included in the plan and compared to either a new baseline inventory or other community sources of emissions. For City capital projects, an inventory can help streamline the environmental review process under the California Environmental Quality Act (CEQA). A Plan for Reduction of Greenhouse Gases can be prepared along with a future CAP which would allow significant effects of GHGs to be identified and mitigated at a programmatic level. Further, a local government operations inventory would help implement and maintain consistency with the goals of the General Plan. Lastly, an inventory would further State GHG goals as identified in various pieces of legislation and provide an extra piece of information to provide to Regional, State and Federal agencies when applying for funding related to reducing emissions.[3]

Disclaimer: Due to the pandemic enclosure of City of Lompoc offices, this project relies on publicly available data. As a result, there is a gap in information that is necessary for a complete inventory. This project is therefore primarily academic in nature. Nonetheless, this project provides suggestions for future inventories and emissions-related programs.

[3] Local Governments for Sustainability (ICLEI). (2010). *Local Government Operations Protocol: For the quantification and reporting of greenhouse gas emissions inventories.*

Background

The City of Lompoc is a jurisdiction in Santa Barbara County with a population of 42,434 at the 2010 census. According to the American Community Survey 2019 5-year estimate, the population was 43,232. The city has a total area of about 11.7 square miles. The city lies within the Santa Ynez River Valley.[4]

Fig 1. 2007 aerial photo of the city of Lompoc

Certain city facilities and operations produce greenhouse gases. The City of Lompoc operates a publicly owned water and electric utility (POU). Lompoc is within the CAMX eGRID sub-region. eGRID is the Emissions and Generation Resource Integrated Database, a source of aggregated emissions data by region. This data is used in calculations for emissions estimates. The City is not part of the State Water Project, and uses nine wells to obtain water from the Santa Ynez Valley Groundwater Basin. The City does not import any water from other jurisdictions. The City of Lompoc has operational control over one landfill which has a comprehensive landfill gas

[4] City of Lompoc. Community Development Department. (2011). *Final Environmental Impact Report Addendum.*

(LFG) collection system. The city operates one regional wastewater treatment system which uses aerobic treatment.[5]

Left – Fig 2. Lompoc City Hall is a source of emissions from electricity usage and stationary combustion
Right. Fig 3. COLT, the Lompoc transit system, is a source of mobile emissions

The most recent inventory completed for the City of Lompoc occurred for the baseline year 2008 as part of the Environmental Impact Report for the 2030 General Plan update. This inventory was at the community scale, meaning emissions were estimated for the entire jurisdiction. City operations are included as part of this community-scale inventory.[6] Most likely, local government operations and therefore emissions have changed in the 11 years between inventories. An updated baseline of government emissions would help the City more accurately assess decisions in light of their impacts on GHG emissions, as well as identify areas of inefficiency and create programs for reducing GHG emissions. Specific recommendations for future programs or record-keeping strategies for the City of Lompoc are included in the Record-Keeping and Conclusion sections of this report.

[5] California Regional Water Quality Control Board. Central Coast Region. (2011). *WASTE DISCHARGE REQUIREMENTS FOR THE CITY OF LOMPOC REGIONAL WASTEWATER RECLAMATION PLANT.* https://www.cityoflompoc.com/home/showpublisheddocument?id=1142

[6] City of Lompoc. Community Development Department. (2011). *Final Environmental Impact Report Addendum.*

Planning Relevance

A baseline emissions inventory for government operations would provide the City with context for future land use decisions related to City buildings, infrastructure, or other capital projects. In addition, if the inventory were to be used in a Climate Action Plan, other implementation programs related to land use could be quantified in relation to the inventory. Most GHG emissions from City operations come from energy used in buildings and for fleet vehicles. The amount of energy used in buildings and the transportation network are both influenced by land use decisions related to planning. Recommendations for improved efficiency and recordkeeping can also help the City make more informed land use decisions and strive to locate and operate new facilities efficiently.

Research and Methodology

Step 1: Background Research

ICLEI (Local Governments for Sustainability) partners with the California Air Resources Board, California Climate Action Registry, and The Climate Registry to publish protocols for the quantification of greenhouse gases. These are extensive and detailed guides to conducting GHG inventories at various scopes, using current technology and scientific methods. The primary reference material for this report was the Local Government Operations Protocol Version 1.1, published in 2010. This protocol provided information on how to identify both direct and indirect emissions, choosing the appropriate methodology for quantifying emissions, default emissions factors, and recommendations for finding the correct activity data. Detailed information regarding the protocol and the methodologies used for each sector of emissions can be found in the "Inventory Report" section of this report and Appendix A and B.

The second major material used for the completion of this inventory is the Local Greenhouse Gas Inventory Tool published by the EPA in 2020[7]. This is a free spreadsheet tool built to quickly and simply inventory GHGs for communities in the United States. The tool is pre-programmed with default emissions factors, assumptions, and calculation-based methodologies identical or similar to those identified in the Local Government Operations Protocol. The tool splits emissions into three scopes and further identifies ten major sources of local government emissions to be calculated. These include: Stationary fuel combustion, mobile fuel combustion, solid waste, wastewater treatment, electricity, employee commute, water consumption, agriculture/land management, sequestration from urban trees, and waste generation from a separate landfill. The tool also provides the ability to enter any additional emissions data from other sources, as well as modify the spreadsheet according to the data available.

Other research materials included climate action plans for the City of Oceanside[8] and City of Lodi[9]. Both contain their own GHG inventories and were used to learn how to properly and attractively report emissions. Those reports also contained helpful background information about the purpose of conducting an inventory and implementation measures to reduce

[7] U.S. Environmental Protection Agency. (2020). *Local Greenhouse Gas Inventory Tool.* https://www.epa.gov/statelocalenergy/local-greenhouse-gas-inventory-tool

[8] City of Oceanside. (2016). *2013 Local Government Operations Greenhouse Gas Emissions Inventory.*

[9] City of Lodi. (2014). *Climate Action Plan.*

emissions from that baseline. The community-wide inventory conducted for the Lompoc General Plan Update EIR was also used as reference material.[10]

Step 2: Outreach and Data Collection

A range of different data sets and information is necessary to conduct a GHG inventory. Each piece of data corresponds to a different source of emissions, and must be input into the EPA spreadsheet in order to be calculated and converted into the standard GHG reporting unit, $MTCO_2e$ (Metric tons of CO_2 equivalent). Some of this data is readily available online. In fact, some sources of emissions from government operations are required to be reported to the State of California. For all required data that was not available online, City of Lompoc staff members from corresponding departments were contacted via email to request data. For example, mobile emissions from government operations come from the city fleet. As such, staff from the Fleet division of the City of Lompoc were contacted to request the necessary data to input into the EPA spreadsheet.

Some data was unable to be obtained due to multiple factors. First, staff and time constraints meant that some staff may have been unresponsive to outreach. In addition, some data was simply not available as records did not exist. Still other pieces of data could not be released to the public and were therefore not made available. Finally, time constraints of the Senior Project class meant that some minor sectors of emissions were omitted from the report. Omissions, information on the exact type of data used for the EPA spreadsheet tool, and detailed information on the sources of that data is included in the "Inventory Report" section of the report. For copies of the raw data collected, refer to Appendix A.

Step 3: Data Entry

The EPA Local Greenhouse Gas Inventory Tool is interactive, meaning raw data can easily be input into the spreadsheet and calculations are made automatically.[11] Some unit conversions must be made in order to change the data into a form that is acceptable to the calculator. For each section of emissions, there is a control tab, an entry tab, and a calculations tab. The calculations tab serves to visualize how the input data was converted into $MTCO_2e$. Figure 4

[10] City of Lompoc. Community Development Department. (2011). *Final Environmental Impact Report Addendum.*

[11] U.S. Environmental Protection Agency. State and Local Energy and Environment Program. (2020). *User's Guide: Local Greenhouse Gas Inventory Tool: Government Operations Module.*

below provides an example of the entry tab for mobile combustion within the EPA Inventory Tool. Figure 5 provides an example of a typical calculations tab from the Tool.

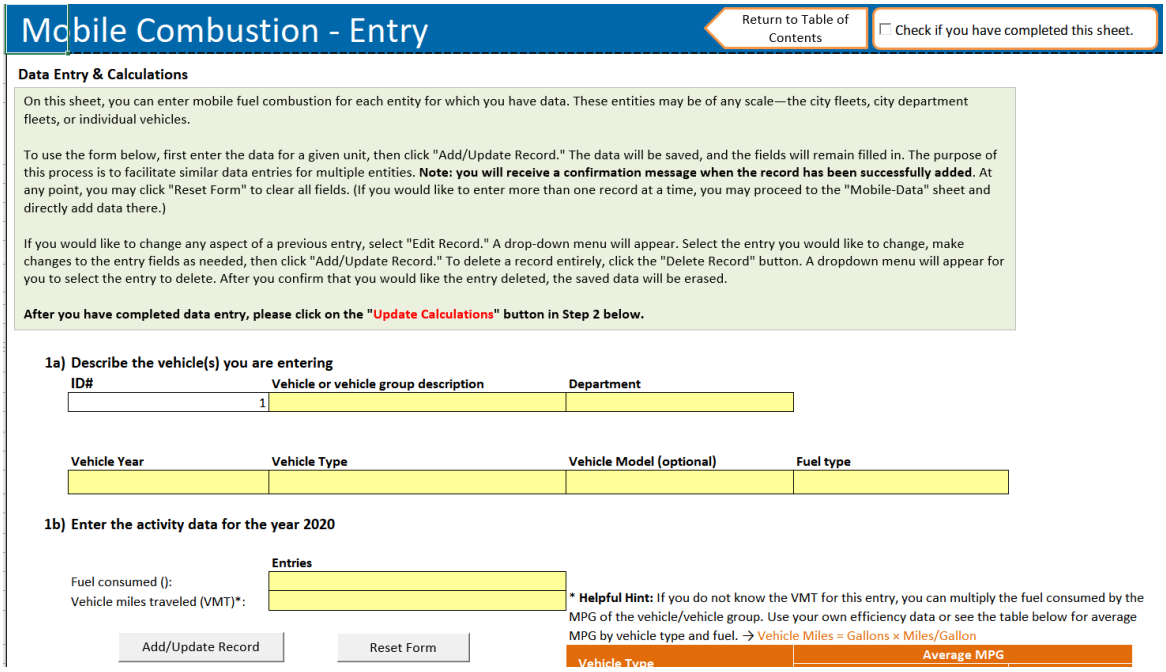

Fig 4. An example of the entry tab for mobile combustion (without any data entered)

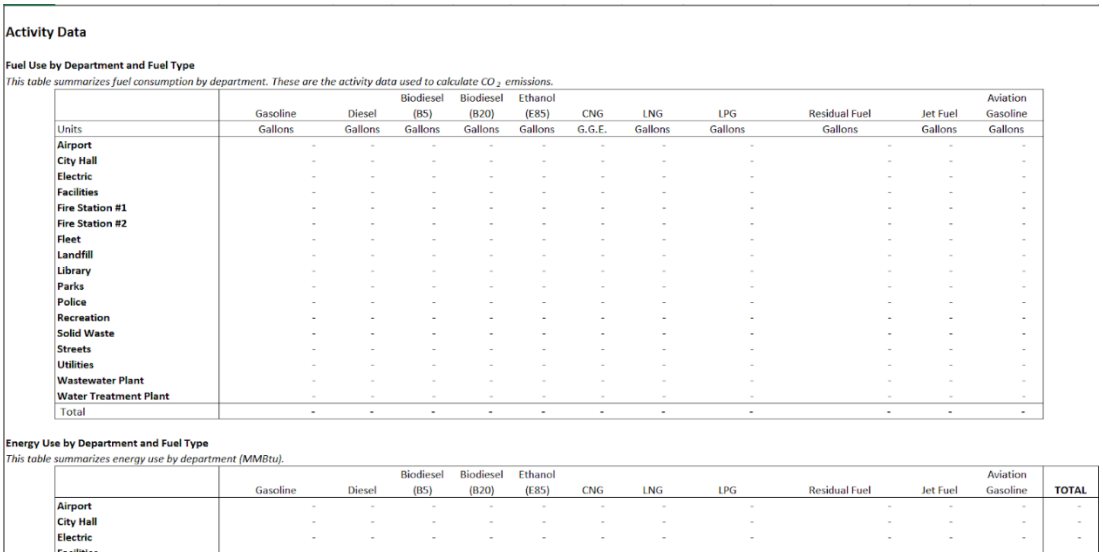

Fig 5. An example of the calculations tab for mobile combustion (without any data entered)

Step 4: Reporting

The outputs of the calculator and actual inventory of emissions are included in the “Inventory Report” section. This section also includes information of the sources of data, data omitted from

the inventory, and assumptions made. The “Inventory Report” section follows the standard template outlined in the ICLEI Local Government Operations Protocol.

Inventory Report

State, Regional and Local Context

The State of California, County of Santa Barbara, and City of Lompoc have all taken action to address climate change. Many of these actions aim to mitigate GHG emissions. The State has passed legislation, adopted regulations, and implemented programs that set aggressive goals for GHG reduction.

State Regulations

California Executive Order S-3-05 mandates reduction of GHG emissions to 2000 levels by 2010, 1990 levels by 2020, and 80% below 1990 levels by 2050. The 2020 target was incorporated into legislation under AB 32[12].

The California Global Warming Solutions Act of 2006 (Assembly Bill 32) requires that California reduce its overall greenhouse gas emissions to 1990 levels by 2020 and 40% below 1990 levels by 2030. The bill directs the California Air Resources Board (CARB) to develop policies to achieve these goals. CARB is currently in the process of updating its scoping plan to meet 2030 reduction goals and achieve carbon neutrality by 2045[13]. The scoping plan was last updated in 2017. The scoping plan also outlines the statewide Cap-and-Trade program, where large emitters buy and sell emissions allowances to meet limitations set by CARB. The scoping plan also contains the Renewable Portfolio Standard requiring utilities to achieve a certain percentage of renewable energy mix, and the Low Carbon Fuel Standard that requires producers to reduce the intensity of greenhouse gas emissions from fuel.

Senate Bill 375, signed in 2008, provides new directions for land use planning and regional transportation plans. In addition, it provides funding opportunities to help meet the requirements of AB 32. First, the bill allows streamlined CEQA review for projects involving infill or transit-oriented development. Second, it requires that regional transportation plans include a

[12] City of Lompoc. Community Development Department. (2011). *Final Environmental Impact Report Addendum.*
[13] *Id.*

Sustainable Communities Strategy that aims to reduce Vehicle Miles Traveled from light-duty vehicles in order to reduce emissions.

Activities in Santa Barbara County

In January 2021, the County adopted interim thresholds of significance for GHG emissions to be used in CEQA review of projects to determine if significant effects will occur. The County normally acts as a responsible agency during CEQA review of projects, providing comments and strategies for reducing emissions[14].

The County also supports a number of programs directly related to GHG emissions reduction. Among these are rebates for zero-emissions vehicles, expansion of zero-emissions fleet vehicles and buses, energy-efficient building retrofits, and expansion of fuel-cell electric vehicle infrastructure[15].

Activities in the City of Lompoc

The City of Lompoc acts as a Lead Agency for projects within its jurisdiction that require preparation of an Environmental Impact Report (EIR) per CEQA. The City is therefore required to address greenhouse gas emissions in their assessment of the environmental impacts of certain projects. This includes developing potential mitigation measures and monitoring programs for significant impacts increasing greenhouse gas emissions.

Quantifying Greenhouse Gases

Emissions from local government operations are a subset of community-wide emissions. This inventory aims to estimate emissions only from activities carried out by the City of Lompoc and its staff. In order to quantify emissions and eventually achieve greenhouse gas reductions, a standard protocol of inventory must be utilized. This inventory uses ICLEIs 2010 Local Government Operations Inventory, which is the nationwide standard for quantifying greenhouse gas emissions. This protocol was created in partnership with the California Air Resources Board (CARB)and the California Climate Action Registry (CCAR). The purpose of the protocol is to provide all the information necessary to accurately develop a local government operations inventory of greenhouse gas emissions.

[14] City of Lompoc. Community Development Department. (2011). *Final Environmental Impact Report Addendum.*
[15] *Id.*

The inventory sets a baseline of emissions for a given calendar year, also known as the baseline year. The Baseline year for this inventory is 2019. Setting a baseline year allows the city to accurately track emissions in reference to the baseline.

Carbon Dioxide Equivalent

The 1997 Kyoto Protocol, an international treaty for the reduction of greenhouse gas emissions, recognizes six different greenhouse gases which all have a different global warming potential based on the intensity with which they act as greenhouse gases. For example, Methane produces a greenhouse effect about 21 times stronger than carbon dioxide. In accordance with the Local Government Operations Protocol (LGO), emissions summaries in this report combine emissions from different sources into one unit, carbon dioxide equivalent (CO_{2e}). This inventory will report emissions as metric tons of carbon dioxide equivalent ($MTCO_{2e}$). The table below shows the greenhouse gases included in the LGO protocol and their respective global warming potential.

Table 1: Greenhouse Gases

Gas	Chemical Formula	Activity	Global Warming Potential (CO_2e)
Carbon Dioxide	CO_2	Combustion	1
Methane	CH_4	Combustion, Anaerobic Decomposition of Organic Waste (Landfills, Wastewater), Fuel Handling	21
Nitrous Oxide	N_2O	Combustion, Wastewater Treatment	310
Hydrofluorocarbons	Various	Leaked Refrigerants, Fire Suppressants	12–11,700
Perfluorocarbons	Various	Aluminum Production, Semiconductor Manufacturing, HVAC Equipment Manufacturing	6,500–9,200
Sulfur Hexafluoride	SF_6	Transmission and Distribution of Power	23,900

Calculation Methods

Methods of calculating greenhouse gas emissions are split into two distinct categories[16].

1. Measurement-based methodologies are the most accurate method of collecting emissions data, but only exist for certain activities. Measurement refers to the use of a

[16] Local Governments for Sustainability (ICLEI). (2010). *Local Government Operations Protocol: For the quantification and reporting of greenhouse gas emissions inventories.*

monitoring system to measure emissions, usually from the flue of a power plant, wastewater treatment plant, or landfill. Measurement-based methodologies simply take the outputs of the monitoring system and convert them into statistics relevant to the report and baseline year.

2. Calculation-based methodologies use activity data and emissions factors to estimate emissions. Emissions reported using these methods are usually less accurate, but the data needed to use these methods is more widely available for a broader range of activities. “Activity data” refers to a measurement of energy use or amount of consumption that produces greenhouse gases, which is then multiplied by a set “emissions factor” that converts the input activity data into carbon dioxide equivalent. It is necessary to ensure that activity data is in the proper form to be multiplied by emissions factors. It is also necessary to ensure that the correct emissions factors are used for corresponding activities.

As an example, emissions from energy consumption can be estimated using a calculation-based method. Activity data providing the kWh of electricity consumed for a given year can be multiplied by an emissions factor that estimates the amount of CO_2 emitted per kWh to produce the total amount of CO_2 emitted for that year.

Scopes of Emissions

Emissions are commonly separated into three scopes based on how direct the emissions are, as exemplified by the City of Oceanside’s LGO GHG Inventory.[17] Emissions within this inventory are also splits into the same three scopes. These scopes are described below.

Scope 1: All direct GHG emissions except for those from biogenic sources located within the jurisdiction of the city. Scope 1 emissions include activities such as stationary and mobile combustion of fuels, process emissions from chemical and physical process, and fugitive emissions from production, processing, and transportation of fuels.

Scope 2: Indirect emissions associated with the consumption of purchased or acquired electricity, steam, heating, or cooling. Scope 2 emissions include emissions that occur within the

[17] City of Oceanside. (2016). *2013 Local Government Operations Greenhouse Gas Emissions Inventory.*

city's boundaries, but that rely on emissions-producing process that occur outside of the jurisdiction of the city

Scope 3: All indirect emissions not covered by the other scopes. These include emissions resulting from the extraction and production of purchased materials and fuels, employee commute emissions, waste disposal, and others. Any emissions that are relevant to the policies of the city that are not covered in the other scopes can be reported as scope 3 emissions.

Organizational Boundaries

It is necessary to determine the organization boundaries of the local government to determine which activities must be reported as activities and emissions of that local government. The LGO protocol identifies two control approaches for setting organizational boundaries: financial control and operational control. A local government has financial control over an activity if that activity is fully consolidated in the local government's financial accounts. If the local government holds joint authority over certain activities, the details of contractual agreements must be examined to determine who ultimately holds the responsibility for reporting emissions. A local government has operational control over an activity if it has full authority to introduce and implement policies that impact the operation.

The LGO protocol encourages local governments to use the organizational control approach to inventory emissions, as this method most accurately captures the activities and emissions that local governments are responsible for. For this reason, the operational control approach was used for this inventory.[18]

Types of Emissions

As exemplified by the scope framework, emissions come in several forms. These include stationary and mobile combustion, purchased electricity, fugitive emissions, and process emissions. Stationary or mobile combustion emissions result from on-site combustion of fuels (natural gas, diesel, gasoline, etc.) to generate heat, electricity, or to power vehicles and mobile equipment. Process emissions result from physical or chemical processing, other than fuel combustion (e.g., from the manufacturing of cement, aluminum, adipic acid, ammonia, etc.).

[18] Local Governments for Sustainability (ICLEI). (2010). *Local Government Operations Protocol: For the quantification and reporting of greenhouse gas emissions inventories.*

Fugitive emissions result from typically unintentional releases of emissions due to operations like transport and processing.

Community-wide GHG emissions inventories typically report emissions by sector, such as residential, commercial, and industrial emissions. For local governments, however, it is more practical to report emissions by activity or department. For example, one category of emissions would include only emissions resulting from activities related to solid waste (landfill gas).

Results of Emissions Calculations for the City of Lompoc

The following section outlines the estimated emissions for the City of Lompoc in 2019. This section includes information on the total amount of emissions reported for Lompoc, as well as detailed information on emissions by sector. Reported emissions also include disclosure information on the source of activity data and the calculation method employed.

Table 2: Local Government Profile

Jurisdiction Name	City of Lompoc
Street Address	100 Civic Center Plaza
City, State, ZIP, Country	Lompoc, CA 93436
Website Address	www.cityoflompoc.com
Size (sq. miles)	11.68
Population (2019)	43,649
Annual Budget	37,324,768
Employees (full-time equivalent)	383.7
Climate Zone	Marine
Annual Heating Degree Days	2,196

Table 3: GHG Inventory Details

Reporting Year	2019

Protocol Used	Local Government Operations Protocol
Control Approach	Operational

GHG Emissions Summary

Table 4: City of Lompoc Total Emissions by Sector, 2019 Baseline Year

Sector	**$MTCO_2e$**
Stationary Combustion & Electricity Use	243
Mobile Combustion	201
Solid Waste	17,825
Wastewater	504
Employee Commute	756
Imported Water	0
Urban Forestry	-609
Waste Production	0
Total	18,920

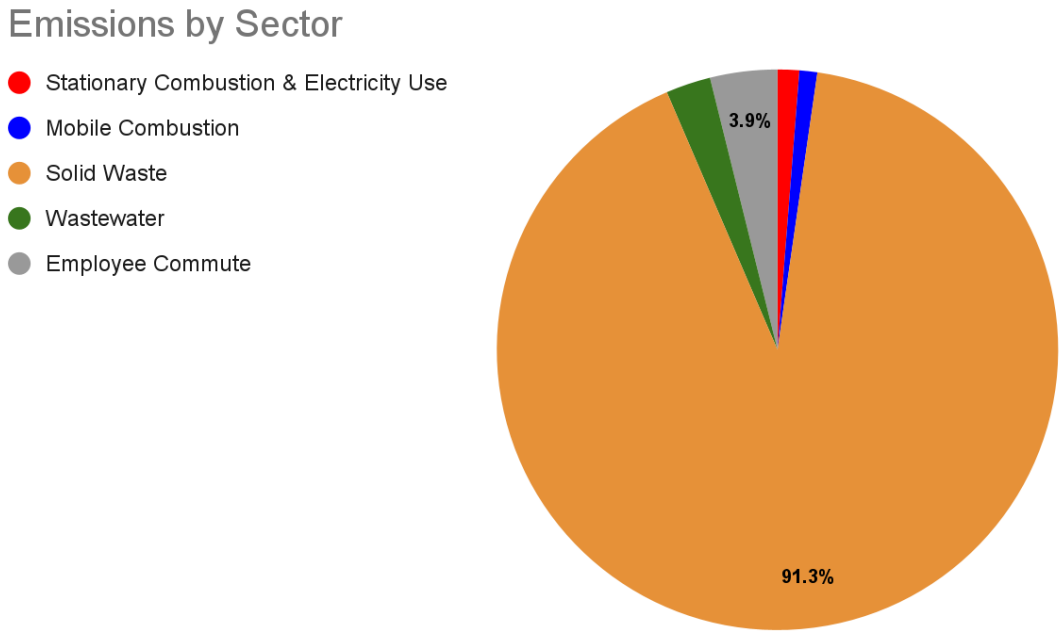

Fig 6. Pie chart, City of Lompoc 2019 Emissions by Sector

Estimations for unavailable data:

Due to limiting factors such as unavailability of data, staff, and time constraints of the project, three sectors of emissions cannot be reported in this inventory. These include **Stationary Combustion, Mobile Combustion**, and **Electricity Use.** Some of this data was unable to be obtained because it contained sensitive information that could not be released publicly. For these types of emissions, the City of Oakley was chosen as a stand-in to provide mock levels of emissions so that estimated total emissions would reflect what might have been produced had all data been available. The overall GHG emissions summary represented by Table 4 includes the reported Oakley emissions.

The City of Oakley reported their own government operations emissions in 2010. The City of Oakley was chosen due to its similarity to the City of Lompoc. Both cities contain between 40,000-45,000 residents, both have the same climate zone, and both have similar operational control over certain activities. In addition, the City of Oakley used the same LGO Protocol to inventory their own emissions. The stand-in for the missing emissions data is shown in the tables below. However, the reported emissions for the City of Oakley are separated into sectors that differ from those in this report. For example, the City of Oakley reports emissions for the Buildings and Facilities sector, which includes both Stationary Combustion and Electricity Use.

Table 5 summarizes those sectors of Oakley's emissions that correspond with the missing data noted above. Calculations methods for the City of Oakley's reported emissions included methodologies incorporated into the LGO Protocol.[19]

Table 5: City of Oakley 2010 Emissions by Sector

Sector	**$MTCO_2e$**
Buildings and Facilities (Stationary Consumption and Electricity Use)	100
Public Lighting (Electricity Use)	143
Vehicle Fleet (Mobile Combustion)	201

Activity Data Information

Stationary Combustion refers to the burning of carbon-based fuels for building operations. This can include equipment such as furnaces, boilers, or heaters. Fuels can include natural gas and coal. In order to estimate emissions, data is collected either quantifying the amount of fuel burned through these activities, or the amount of fuel purchased for these activities. This is then converted into $MTCO_2e$, which appears in the report.

Mobile Combustion refers to emissions from the burning of fuel in transit and other fleet vehicles operated by the local government. Data on the quantity of these emissions are typically obtained by records kept for the amount of fuel consumed or for the amount of fuel purchased. Emissions can also be estimated using total vehicle miles traveled by the fleet.

Electricity Use refers to the amount of electricity used by all city operations within the baseline year. This includes all city facilities and any other equipment under operational control of the city. This data is usually obtained in the form of kWh of electricity usage measured by the metered utility connections corresponding to city operations.

City of Lompoc Results

[19] City of Oakley. (2014). *2010 Community-Wide & Local Government Operations Greenhouse Gas Emissions Inventory Update.* https://www.ci.oakley.ca.us/wp-content/uploads/2018/10/Oakley-LGO-Community-Update-2010.pdf

Solid Waste

Inventory Details

Solid Waste contributes by far the most emissions from City of Lompoc operations at **17,825 $MTCO_2e$**. Emissions from solid waste activities include gas burned at the City of Lompoc Sanitary Landfill. A landfill gas collection system collects gas to control odors and minimize organic compound releases into the atmosphere. The gas that is burned emits methane which contributes to overall GHG emissions. The City of Lompoc has operational control over only the single City of Lompoc Sanitary Landfill.

Activity Data Disclosure

The City of Lompoc already reports GHG emissions from the City of Lompoc Sanitary Landfill to the Environmental Protection Agency (EPA). The reported emissions can be viewed using the EPAs FLIGHT Tool.[20] Activity and total emissions data is available for the year 2019 using this tool. No calculations were necessary in obtaining the total amount of emissions from solid waste in the City of Lompoc. The calculation method used to report to the EPA is explained in the section below. A copy of the emissions summary report is available in Appendix A.

Calculation Method Disclosure

According to the emissions summary report from the EPA Local Greenhouse Gas Inventory Tool, the City of Lompoc has 100 percent operational control over the City of Lompoc Sanitary Landfill. The landfill has a landfill gas collection system and uses scales to determine the amount of waste disposed of. The landfill gas collection system measures the annual volume of collected gas volumetric flow and average methane concentration to determine the total amount of gas collected and burned in the baseline year. This amount is then converted to $MTCO_2e$ to report total emissions.

Wastewater

Inventory Details

Emissions from wastewater for the City of Lompoc occur due to nitrification/denitrification processes of wastewater treatment and effluent discharge which emits greenhouse gases in the form of nitrous oxide (N_2O). Total emissions from wastewater treatment were **504.11 $MTCO_2e$**. Lompoc Regional Wastewater Reclamation Plant does not use anaerobic treatment or septic

[20] U.S. Environmental Protection Agency. (2020). *Facility Level Information on GreenHouse gases Tool (FLIGHT).* https://ghgdata.epa.gov/ghgp/main.do

systems throughout the community. There is little to no industrial nitrogen load in the wastewater treatment system.

Activity Data Disclosure

Activity data for effluent discharge and population served by aerobic treatment and nitrification/denitrification was obtained from the National Pollutant Discharge Elimination System (NPDES) permit issued in 2011 for the Lompoc Regional Wastewater Reclamation Plant.[21] Upgrades to the wastewater treatment system have not occured in the time period between 2011 and 2019. Therefore, emissions estimates based on data obtained from the NPDES permit would be relatively accurate for the 2019 baseline year. However, the total population served by the regional wastewater treatment plant has undoubtedly increased since 2011. Information on the 2019 population served by the treatment plant was unable to be obtained. Emissions were estimates using the 2011 population regardless. The total population served by facilities with nitrification/denitrification and aerobic treatment was 53,050. The average total nitrogen discharged at the facility was 993.67 kg N/day.

Calculation Method Disclosure

Wastewater emissions were calculated using the EPA Local Greenhouse Gas Tool which is based on methodologies from the LGO Protocol. The calculations used to estimate wastewater emissions are shown in Figure 7.

[21] California Regional Water Quality Control Board. Central Coast Region. (2011). *WASTE DISCHARGE REQUIREMENTS FOR THE CITY OF LOMPOC REGIONAL WASTEWATER RECLAMATION PLANT.* https://www.cityoflompoc.com/home/showpublisheddocument?id=1142

Background Calculations

LGOP Equation 10.7 - Process N_2O Emissions from WWTP with Nitrification/Denitrification						
Effective Population Served by Nit/Denit	× Factor for Industrial Discharge into System	× Nit/Denit Emissions Factor (g N_2O/person/yr)	× MT/g =	**MT N_2O**	× GWP =	**MT CO_2e**
53,050	1.25	7	0.000001	0.4641875	298	**138.33**

LGOP Equation 10.10 - Process N_2O Emissions from Effluent Discharge (default N load data)												
Population Served	Factor for Industrial Discharge into System	× [Total N Load (kg N/person/day)	- N uptake* (kg N/kg BOD5)	× BOD5 Load]	× Effluent Emissions Factor (kg N_2O-N/kg sewage)	× N_2O/N_2 Molecular Weight Ratio	× 1 - Fraction of Nitrogen Removed**	× day/yr	× MT/kg =	**MT N_2O**	× GWP =	**MT CO_2e**
Aerobic Treatment with Nitrification/Denitrification												
53,050	1.25	0.026	0.05	0.09	0.005	1.571	0.3	365.25	0.001	1.227	298	**365.79**
*Depends if anaerobic/aerobic; **Depends if with/without Nitrification/Denitrification												

Cell Color Codes

Data entered on previous sheet
Calculated or Entered Data
CH_4 Emissions
N_2O Emissions
Value depends on system type

Fig 7. Background calculations used to estimate wastewater emissions for the City of Lompoc

Employee Commute

Inventory Details

Emissions from mobile combustion related to employee commute is reported as Scope 3 emissions. Commuting contributes indirect emissions and can be considered part of local government operations. Estimated emissions for employee commute are less accurate than those reported for mobile combustion of fleet vehicles due to insufficient records available for personal vehicle fuel consumption. Total emissions from employee commute for the City of Lompoc was **755.94 $MTCO_2e$.**

Activity Data Disclosure

A travel survey of city employees was not conducted due to time constraints of the project. Therefore, default values included in the EPA Local Greenhouse Gas Inventory Tool were used to estimate emissions. These default values are based on data obtained from the American Community Survey published by the U.S. Census. This includes data on the mode of transportation and average commute distance. In addition, the number of full-time equivalent City employees is required to estimate commute emissions. The number of employees in the fiscal year 2019 for the City of Lompoc was obtained from City of Lompoc budget records.[22]

Calculation Method Disclosure

Calculations for employee commute emissions were based on the EPA Local Greenhouse Gas Inventory Tool, which uses methodologies found in the LGO Protocol. The formulas for daily CO_2 emissions by department and mode and annual emissions are shown below. For detailed calculations, refer to Appendix B.

Daily CO_2 Emissions by Department and Mode

CO 2 Emissions/Day = Employees traveling × Trip Distance/day ÷ People/Mode ÷ miles per gallon × Mode Emissions Factor (kg CO 2 /gallon) × MT/kg × GWP CO 2 [people × (1/people) × miles/day × gal/mile × kg CO 2 /gal × MT/kg = MT CO 2 /day]

Annual CO_2 Emissions by Department and Mode

[22] City of Lompoc. City of Lompoc Budget Records. (2020). *Full Time Equivalents City Government Employees by Function/Program Last Ten Years.*

Annual CO 2 Emissions (MT) = MT CO 2 /commute day × commute days/yr

Water

The City of Lompoc does not import any water, and as such does not produce any emissions corresponding to the Water section of the EPA Local Greenhouse Gas Inventory Tool.

Urban Forestry

Inventory Details

Carbon sequestration from urban trees are accounted for in the urban forestry section of the EPA Local Greenhouse Gas Inventory Tool. The City of Lompoc maintains a number of urban trees that are included in the Treekeeper 8 software system.[23] This database is publicly available and includes information on the type of tree and associated eco benefits. This includes estimates for the amount of carbon sequestered. The total amount of carbon sequestered as shown in Treekeeper 8 is 1,342,465.24 pounds of CO_2 sequestered. This equates to about **608 $MTCO_2e$ per year**. Those emissions are subtracted from the total emissions from city operations.

Activity Data Disclosure

The Treekeeper 8 system estimates carbon sequestration based on information about urban trees included in the data set, including species. The system display for yearly benefits of Lompoc's urban trees is updated continuously throughout the year. As such, the estimated amount of carbon sequestration is based on system data from the current year. This means that estimated sequestration within this report may not match that of the baseline year.

Calculation Method Disclosure

No calculations were used in this section. Reported emissions are taken directly from the summary provided by the Treekeeper 8 system software.

Waste Production

[23] TreeKeeper 8 System for Lompoc, CA. (2021). *Tree Benefits.* https://lompocca.treekeepersoftware.com/

The City of Lompoc does not export any waste to a separate landfill outside of the City's jurisdiction, and therefore does not produce any emissions corresponding to the Waste Production section of the EPA Local Greenhouse Gas Inventory Tool.

Record-Keeping

The following section summarizes the sources and methods of collecting various activity data for different types of emissions are outlined by the LGO Protocol.[24] Meticulous records are required to provide an accurate estimate of emissions. Internal sources within a local government are often the best places to search for detailed activity data, as needed records may already be kept. This section serves as a list to describe ways in which the City of Lompoc could decide what type of data to keep should the city decide to pursue an internal greenhouse gas inventory in the future. The sectors of emissions in this section include those for which there was no data available to complete a full inventory for the City of Lompoc. For detailed explanations of alternative methods of record-keeping, refer to the LGO Protocol.[25]

Stationary Combustion

Typical stationary combustion sources in buildings and facilities include furnaces, boilers, burners and internal combustion engines. The types of buildings and facilities that can be under operational control of the local government and which may contain stationary combustion equipment can include owner or leased office space, police and fire stations, recreation centers and facilities, warehouses, transportation facilities, water/wastewater treatment plants, and others. Ideally, equipment involved in stationary combustion would contain meters at input points that determine the amount of fuel to be combusted. If not, activity data can be obtained by keeping fuel receipts or purchase records to calculate total usage. Usually these records would be maintained departmentally or through accounts payable.

Electricity Use

Purchased use of electricity falls within Scope 2 emissions. The LGO Protocol requires that Scope 2 emissions be reported in the following sectors:

- Streetlights and traffic signals
- Water delivery facilities
- Port facilities

[24] Local Governments for Sustainability (ICLEI). (2010). *Local Government Operations Protocol: For the quantification and reporting of greenhouse gas emissions inventories.*
[25] *Id.*

- Airport facilities
- Vehicle fleet
- Transit fleet
- Power generation facilities
- Solid waste facilities
- Wastewater facilities
- All other buildings and facilities not included in the sectors above

The recommended source of activity data for purchased electricity includes metered readings or utility bills from connections at any of the sectors listed above. Monthly bills or readings can be aggregated to find the total kWh used annually for each facility. The City of Lompoc already collects and aggregates this data internally in the Electric Division. Therefore, these records can easily be obtained and stored for future use.

Mobile Combustion

Emissions from mobile combustion include on-road and off-road vehicles like trucks, buses, and other fleet vehicles. CO_2 emissions make up the majority of mobile combustion emissions and can be estimated using total fuel consumption or miles traveled data. This data can be obtained through direct methods such as logs of vehicle fuel gauges, fuel receipts, or bulk fuel purchase receipts. These records are usually kept with accounts payable, or through departmental records. Members of the fleet division would most likely be the ones to collect data for mobile combustion.

Conclusion

Developing a greenhouse gas inventory at both the local government and community-wide scale can benefit city government in several ways. As stated, an emissions baseline can provide a city with concrete numbers from which to strategically plan for the reduction of greenhouse gases. In addition, a detailed inventory can provide supporting information for grant proposals and assist in environmental review. In anticipation of future Statewide legislation likely to aggressively tackle climate change, preparation of a greenhouse gas inventory and in turn a Climate Action Plan can proactively prepare local governments for challenges ahead. It is recommended that the City of Lompoc update its community-wide emissions inventory and consider developing a Climate Action Plan specifically outlining steps towards mitigation and adaptation to climate change.

References

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Appendices

Appendix A: Sources of Emissions Data

Facility Name: CITY OF LOMPOC SANITARY LANDFILL
Facility Identifier:
Facility Reporting Year: 2019
Facility Location:
Address: 700 SOUTH AVALON ROAD
City: LOMPOC
State: CA
Postal Code: 93436

Facility Site Details:
CO2 equivalent emissions from facility subparts C-II, SS, and TT (metric tons): 17,824.5
CO2 equivalent emissions from supplier subparts LL-QQ (metric tons):
Biogenic CO2 emissions from facility subparts C-II, SS, and TT (metric tons): 0
Cogeneration Unit Emissions Indicator: N
GHG Report Start Date: 2019-01-01
GHG Report End Date: 2019-12-31
Description of Changes to Calculation Methodology:
Plant Code Indicator: N
Primary NAICS Code: 562212
Second Primary NAICS Code:

Parent Company Details:
Parent Company Name: CITY OF LOMPOC
Address: 100 Civic Center Plaza, Lompoc, CA 93436
Percent Ownership Interest: 100

Subpart HH: Municipal Solid Waste Landfills

Gas Information Details

Gas Name	Methane
Gas Quantity	712.98 (Metric Tons)
Own Result?	

Landfill Details

Is the landfill open?	Y	
Estimated Year LandFill Closure	2045	
Starting Year for Accepting Waste	1961	
First year of emissions reporting	2010	
Leachate recirculation was used during the reporting year	N	
Typical frequency of use for leachate recirculation system	Not used for the past 10 years	
Scales are present at the landfill in the reporting year	Y	
Does the landfill have a landfill gas collection system?	Y	
Passive vents and/or flares are present	N	
Landfill Capacity	20027013 (Metric Tons)	
Total surface area of the landfill containing waste	157826 (Square Meters)	
Covertype Details	Other soil mixture	( )

Aeration Details

Aeration Blower Capacity	( )
Landfill Fraction Affected by Aeration	( )
Aeration Blower Operations Hours	( )

Other MCF Factors	
Additional Description	

Current Waste Disposal Quantity Determination Details

First Year to Current Year Annual Waste Quantity Method

Reporting Year	**2019**
Total Annual Waste Disposal Quantity	36869 (Metric Tons)
Method Used to Determine Quantity	Used scales to weigh loads before off-loading and either used scales to weigh individual loads after off-loading or used representative tare vehicle/container weights
Annual Waste Disposal Quantity	36869 (Metric Tons)
Reporting Year	**2018**
Total Annual Waste Disposal Quantity	35681 (Metric Tons)
Method Used to Determine Quantity	Used scales to weigh loads before off-loading and either used scales to weigh individual loads after off-loading or used representative tare vehicle/container weights
Annual Waste Disposal Quantity	35681 (Metric Tons)
Reporting Year	**2017**
Total Annual Waste Disposal Quantity	34165 (Metric Tons)
Method Used to Determine Quantity	Used scales to weigh loads before off-loading and either used scales to weigh individual loads after off-loading or used representative tare vehicle/container weights
Annual Waste Disposal Quantity	34165 (Metric Tons)
Reporting Year	**2016**
Total Annual Waste Disposal Quantity	35723 (Metric Tons)
Method Used to Determine Quantity	Used scales to weigh loads before off-loading and either used scales to weigh individual loads after off-loading or used representative tare vehicle/container weights
Annual Waste Disposal Quantity	35723 (Metric Tons)
Reporting Year	**2015**
Total Annual Waste Disposal Quantity	34069 (Metric Tons)
Method Used to Determine Quantity	Used scales to weigh loads before off-loading and either used scales to weigh individual loads after off-loading or used representative tare vehicle/container weights
Annual Waste Disposal Quantity	34069 (Metric Tons)
Reporting Year	**2014**
Total Annual Waste Disposal Quantity	31438 (Metric Tons)

Method Used to Determine Quantity	Used scales to weigh loads before off-loading and either used scales to weigh individual loads after off-loading or used representative tare vehicle/container weights
Annual Waste Disposal Quantity	31438 (Metric Tons)
Reporting Year	**2013**
Total Annual Waste Disposal Quantity	29138 (Metric Tons)
Method Used to Determine Quantity	Used scales to weigh loads before off-loading and either used scales to weigh individual loads after off-loading or used representative tare vehicle/container weights
Annual Waste Disposal Quantity	29138 (Metric Tons)
Reporting Year	**2012**
Total Annual Waste Disposal Quantity	31160 (Metric Tons)
Method Used to Determine Quantity	Used scales to weigh loads before off-loading and either used scales to weigh individual loads after off-loading or used representative tare vehicle/container weights
Annual Waste Disposal Quantity	31160 (Metric Tons)
Reporting Year	**2011**
Total Annual Waste Disposal Quantity	32185 (Metric Tons)
Method Used to Determine Quantity	Used scales to weigh loads before off-loading and either used scales to weigh individual loads after off-loading or used representative tare vehicle/container weights
Annual Waste Disposal Quantity	32185 (Metric Tons)
Reporting Year	**2010**
Total Annual Waste Disposal Quantity	33935 (Metric Tons)
Method Used to Determine Quantity	Used scales to weigh loads before off-loading and either used scales to weigh individual loads after off-loading or used representative tare vehicle/container weights
Annual Waste Disposal Quantity	33935 (Metric Tons)

Waste Type Details

Year Waste Disposed	**2019**
Missing data procedure used?	N
Number of Times Substituted	
Waste Type Details	Option: Bulk Waste; Waste Type: Bulk waste; Percent by Weight: 1; Degradable Organic Carbon Value: 0.2; Fraction Of DOC Dissimilated: 0.5; Decay Rate: 0.02
Year Waste Disposed	**2018**
Missing data	N

procedure used?	
Number of Times Substituted	
Waste Type Details	Option: Bulk Waste; Waste Type: Bulk waste; Percent by Weight: 1; Degradable Organic Carbon Value: 0.2; Fraction Of DOC Dissimilated: 0.5; Decay Rate: 0.02
Year Waste Disposed	**2017**
Missing data procedure used?	N
Number of Times Substituted	
Waste Type Details	Option: Bulk Waste; Waste Type: Bulk waste; Percent by Weight: 1; Degradable Organic Carbon Value: 0.2; Fraction Of DOC Dissimilated: 0.5; Decay Rate: 0.02
Year Waste Disposed	**2016**
Missing data procedure used?	N
Number of Times Substituted	
Waste Type Details	Option: Bulk Waste; Waste Type: Bulk waste; Percent by Weight: 1; Degradable Organic Carbon Value: 0.2; Fraction Of DOC Dissimilated: 0.5; Decay Rate: 0.02
Year Waste Disposed	**2015**
Missing data procedure used?	N
Number of Times Substituted	
Waste Type Details	Option: Bulk Waste; Waste Type: Bulk waste; Percent by Weight: 1; Degradable Organic Carbon Value: 0.2; Fraction Of DOC Dissimilated: 0.5; Decay Rate: 0.02
Year Waste Disposed	**2014**
Missing data procedure used?	N
Number of Times Substituted	
Waste Type Details	Option: Bulk Waste; Waste Type: Bulk waste; Percent by Weight: 1; Degradable Organic Carbon Value: 0.2; Fraction Of DOC Dissimilated: 0.5; Decay Rate: 0.02
Year Waste Disposed	**2013**
Missing data procedure used?	N
Number of Times Substituted	
Waste Type Details	Option; Waste; Percent by; Degradable Organic; Fraction Of DOC; Decay

		Type	Weight	Carbon Value	Dissimilated	Rate
	Bulk Waste	Bulk waste	1	0.2	0.5	0.02
Year Waste Disposed	**2012**					
Missing data procedure used?	N					
Number of Times Substituted						
Waste Type Details	Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
	Bulk Waste	Bulk waste	1	0.2	0.5	0.02
Year Waste Disposed	**2011**					
Missing data procedure used?	N					
Number of Times Substituted						
Waste Type Details	Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
	Bulk Waste	Bulk waste	1	0.2	0.5	0.02
Year Waste Disposed	**2010**					
Missing data procedure used?	N					
Number of Times Substituted						
Waste Type Details	Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
	Bulk Waste	Bulk waste	1	0.2	0.5	0.02

Historical Waste Disposal Quantity Estimation Details

Method used to determine the annual waste quantity for any prior years

Were scales used to determine the annual waste quantity	Y
Start Year	1989
End Year	2010

Prior Year Annual Waste Quantity Method

Reporting Year	**2009**
Total Annual Waste Disposal Quantity	30480 (Metric Tons)
Method Used to Determine Quantity	Used scales to weigh loads before off-loading and either used scales to weigh individual loads after off-loading or used representative tare vehicle/container weights
Annual Waste Disposal Quantity	30480 (Metric Tons)
Reporting Year	**2008**
Total Annual Waste Disposal Quantity	32908 (Metric Tons)

Method Used to Determine Quantity	Used scales to weigh loads before off-loading and either used scales to weigh individual loads after off-loading or used representative tare vehicle/container weights
Annual Waste Disposal Quantity	32908 (Metric Tons)
Reporting Year	**2007**
Total Annual Waste Disposal Quantity	34900 (Metric Tons)
Method Used to Determine Quantity	Used scales to weigh loads before off-loading and either used scales to weigh individual loads after off-loading or used representative tare vehicle/container weights
Annual Waste Disposal Quantity	34900 (Metric Tons)
Reporting Year	**2006**
Total Annual Waste Disposal Quantity	38063 (Metric Tons)
Method Used to Determine Quantity	Used scales to weigh loads before off-loading and either used scales to weigh individual loads after off-loading or used representative tare vehicle/container weights
Annual Waste Disposal Quantity	38063 (Metric Tons)
Reporting Year	**2005**
Total Annual Waste Disposal Quantity	39817 (Metric Tons)
Method Used to Determine Quantity	Used scales to weigh loads before off-loading and either used scales to weigh individual loads after off-loading or used representative tare vehicle/container weights
Annual Waste Disposal Quantity	39817 (Metric Tons)
Reporting Year	**2004**
Total Annual Waste Disposal Quantity	39485 (Metric Tons)
Method Used to Determine Quantity	Used scales to weigh loads before off-loading and either used scales to weigh individual loads after off-loading or used representative tare vehicle/container weights
Annual Waste Disposal Quantity	39485 (Metric Tons)
Reporting Year	**2003**
Total Annual Waste Disposal Quantity	40096 (Metric Tons)
Method Used to Determine Quantity	Used scales to weigh loads before off-loading and either used scales to weigh individual loads after off-loading or used representative tare vehicle/container weights
Annual Waste Disposal Quantity	40096 (Metric Tons)
Reporting Year	**2002**
Total Annual Waste Disposal Quantity	39519 (Metric Tons)
Method Used to Determine	Used scales to weigh loads before off-loading and either used scales to weigh individual loads after off-loading or used representative tare vehicle/container

Quantity	weights
Annual Waste Disposal Quantity	39519 (Metric Tons)
Reporting Year	**2001**
Total Annual Waste Disposal Quantity	39714 (Metric Tons)
Method Used to Determine Quantity	Used scales to weigh loads before off-loading and either used scales to weigh individual loads after off-loading or used representative tare vehicle/container weights
Annual Waste Disposal Quantity	39714 (Metric Tons)
Reporting Year	**2000**
Total Annual Waste Disposal Quantity	39922 (Metric Tons)
Method Used to Determine Quantity	Used scales to weigh loads before off-loading and either used scales to weigh individual loads after off-loading or used representative tare vehicle/container weights
Annual Waste Disposal Quantity	39922 (Metric Tons)
Reporting Year	**1999**
Total Annual Waste Disposal Quantity	36041 (Metric Tons)
Method Used to Determine Quantity	Used scales to weigh loads before off-loading and either used scales to weigh individual loads after off-loading or used representative tare vehicle/container weights
Annual Waste Disposal Quantity	36041 (Metric Tons)
Reporting Year	**1998**
Total Annual Waste Disposal Quantity	33774 (Metric Tons)
Method Used to Determine Quantity	Used scales to weigh loads before off-loading and either used scales to weigh individual loads after off-loading or used representative tare vehicle/container weights
Annual Waste Disposal Quantity	33774 (Metric Tons)
Reporting Year	**1997**
Total Annual Waste Disposal Quantity	30348 (Metric Tons)
Method Used to Determine Quantity	Used scales to weigh loads before off-loading and either used scales to weigh individual loads after off-loading or used representative tare vehicle/container weights
Annual Waste Disposal Quantity	30348 (Metric Tons)
Reporting Year	**1996**
Total Annual Waste Disposal Quantity	32425 (Metric Tons)
Method Used to Determine Quantity	Used scales to weigh loads before off-loading and either used scales to weigh individual loads after off-loading or used representative tare vehicle/container weights
Annual Waste	32425 (Metric Tons)

Disposal Quantity	
Reporting Year	**1995**
Total Annual Waste Disposal Quantity	34300 (Metric Tons)
Method Used to Determine Quantity	Used scales to weigh loads before off-loading and either used scales to weigh individual loads after off-loading or used representative tare vehicle/container weights
Annual Waste Disposal Quantity	34300 (Metric Tons)
Reporting Year	**1994**
Total Annual Waste Disposal Quantity	35717 (Metric Tons)
Method Used to Determine Quantity	Used scales to weigh loads before off-loading and either used scales to weigh individual loads after off-loading or used representative tare vehicle/container weights
Annual Waste Disposal Quantity	35717 (Metric Tons)
Reporting Year	**1993**
Total Annual Waste Disposal Quantity	36065 (Metric Tons)
Method Used to Determine Quantity	Used scales to weigh loads before off-loading and either used scales to weigh individual loads after off-loading or used representative tare vehicle/container weights
Annual Waste Disposal Quantity	36065 (Metric Tons)
Reporting Year	**1992**
Total Annual Waste Disposal Quantity	35592 (Metric Tons)
Method Used to Determine Quantity	Used scales to weigh loads before off-loading and either used scales to weigh individual loads after off-loading or used representative tare vehicle/container weights
Annual Waste Disposal Quantity	35592 (Metric Tons)
Reporting Year	**1991**
Total Annual Waste Disposal Quantity	34733 (Metric Tons)
Method Used to Determine Quantity	Used scales to weigh loads before off-loading and either used scales to weigh individual loads after off-loading or used representative tare vehicle/container weights
Annual Waste Disposal Quantity	34733 (Metric Tons)
Reporting Year	**1990**
Total Annual Waste Disposal Quantity	53848 (Metric Tons)
Method Used to Determine Quantity	Used scales to weigh loads before off-loading and either used scales to weigh individual loads after off-loading or used representative tare vehicle/container weights
Annual Waste Disposal Quantity	53848 (Metric Tons)
Reporting Year	**1989**

Total Annual Waste Disposal Quantity	75264 (Metric Tons)
Method Used to Determine Quantity	Used scales to weigh loads before off-loading and either used scales to weigh individual loads after off-loading or used representative tare vehicle/container weights
Annual Waste Disposal Quantity	75264 (Metric Tons)
Reporting Year	**1988**
Total Annual Waste Disposal Quantity	35666 (Metric Tons)
Method Used to Determine Quantity	other
Annual Waste Disposal Quantity	35666 (Metric Tons)
Reporting Year	**1987**
Total Annual Waste Disposal Quantity	35666 (Metric Tons)
Method Used to Determine Quantity	other
Annual Waste Disposal Quantity	35666 (Metric Tons)
Reporting Year	**1986**
Total Annual Waste Disposal Quantity	35666 (Metric Tons)
Method Used to Determine Quantity	other
Annual Waste Disposal Quantity	35666 (Metric Tons)
Reporting Year	**1985**
Total Annual Waste Disposal Quantity	35666 (Metric Tons)
Method Used to Determine Quantity	other
Annual Waste Disposal Quantity	35666 (Metric Tons)
Reporting Year	**1984**
Total Annual Waste Disposal Quantity	35666 (Metric Tons)
Method Used to Determine Quantity	other
Annual Waste Disposal Quantity	35666 (Metric Tons)
Reporting Year	**1983**
Total Annual Waste Disposal	35666 (Metric Tons)

Quantity	
Method Used to Determine Quantity	other
Annual Waste Disposal Quantity	35666 (Metric Tons)
Reporting Year	**1982**
Total Annual Waste Disposal Quantity	35666 (Metric Tons)
Method Used to Determine Quantity	other
Annual Waste Disposal Quantity	35666 (Metric Tons)
Reporting Year	**1981**
Total Annual Waste Disposal Quantity	35666 (Metric Tons)
Method Used to Determine Quantity	other
Annual Waste Disposal Quantity	35666 (Metric Tons)
Reporting Year	**1980**
Total Annual Waste Disposal Quantity	35666 (Metric Tons)
Method Used to Determine Quantity	other
Annual Waste Disposal Quantity	35666 (Metric Tons)
Reporting Year	**1979**
Total Annual Waste Disposal Quantity	35666 (Metric Tons)
Method Used to Determine Quantity	other
Annual Waste Disposal Quantity	35666 (Metric Tons)
Reporting Year	**1978**
Total Annual Waste Disposal Quantity	35666 (Metric Tons)
Method Used to Determine Quantity	other
Annual Waste Disposal Quantity	35666 (Metric Tons)
Reporting Year	**1977**
Total Annual Waste Disposal Quantity	35666 (Metric Tons)
Method Used to	other

Determine Quantity	
Annual Waste Disposal Quantity	35666 (Metric Tons)
Reporting Year	**1976**
Total Annual Waste Disposal Quantity	35666 (Metric Tons)
Method Used to Determine Quantity	other
Annual Waste Disposal Quantity	35666 (Metric Tons)
Reporting Year	**1975**
Total Annual Waste Disposal Quantity	35666 (Metric Tons)
Method Used to Determine Quantity	other
Annual Waste Disposal Quantity	35666 (Metric Tons)
Reporting Year	**1974**
Total Annual Waste Disposal Quantity	35666 (Metric Tons)
Method Used to Determine Quantity	other
Annual Waste Disposal Quantity	35666 (Metric Tons)
Reporting Year	**1973**
Total Annual Waste Disposal Quantity	35666 (Metric Tons)
Method Used to Determine Quantity	other
Annual Waste Disposal Quantity	35666 (Metric Tons)
Reporting Year	**1972**
Total Annual Waste Disposal Quantity	35666 (Metric Tons)
Method Used to Determine Quantity	other
Annual Waste Disposal Quantity	35666 (Metric Tons)
Reporting Year	**1971**
Total Annual Waste Disposal Quantity	35666 (Metric Tons)
Method Used to Determine Quantity	other

Annual Waste Disposal Quantity	35666 (Metric Tons)
Reporting Year	**1970**
Total Annual Waste Disposal Quantity	35666 (Metric Tons)
Method Used to Determine Quantity	other
Annual Waste Disposal Quantity	35666 (Metric Tons)
Reporting Year	**1969**
Total Annual Waste Disposal Quantity	35666 (Metric Tons)
Method Used to Determine Quantity	other
Annual Waste Disposal Quantity	35666 (Metric Tons)
Reporting Year	**1968**
Total Annual Waste Disposal Quantity	35666 (Metric Tons)
Method Used to Determine Quantity	other
Annual Waste Disposal Quantity	35666 (Metric Tons)
Reporting Year	**1967**
Total Annual Waste Disposal Quantity	35666 (Metric Tons)
Method Used to Determine Quantity	other
Annual Waste Disposal Quantity	35666 (Metric Tons)
Reporting Year	**1966**
Total Annual Waste Disposal Quantity	35666 (Metric Tons)
Method Used to Determine Quantity	other
Annual Waste Disposal Quantity	35666 (Metric Tons)
Reporting Year	**1965**
Total Annual Waste Disposal Quantity	35666 (Metric Tons)
Method Used to Determine Quantity	other
Annual Waste Disposal Quantity	35666 (Metric Tons)

Reporting Year	**1964**
Total Annual Waste Disposal Quantity	35666 (Metric Tons)
Method Used to Determine Quantity	other
Annual Waste Disposal Quantity	35666 (Metric Tons)
Reporting Year	**1963**
Total Annual Waste Disposal Quantity	35666 (Metric Tons)
Method Used to Determine Quantity	other
Annual Waste Disposal Quantity	35666 (Metric Tons)
Reporting Year	**1962**
Total Annual Waste Disposal Quantity	35666 (Metric Tons)
Method Used to Determine Quantity	other
Annual Waste Disposal Quantity	35666 (Metric Tons)

Waste Type Details

Year Waste Disposed	**2009**
Missing data procedure used?	N
Number of Times Substituted	

Waste Type Details

Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
Bulk Waste	Bulk waste	1	0.2	0.5	0.02

Year Waste Disposed	**2008**
Missing data procedure used?	N
Number of Times Substituted	

Waste Type Details

Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
Bulk Waste	Bulk waste	1	0.2	0.5	0.02

Year Waste Disposed	**2007**
Missing data procedure used?	N
Number of Times Substituted	
Waste Type Details	

	Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
	Bulk Waste	Bulk waste	1	0.2	0.5	0.02
Year Waste Disposed	**2006**					
Missing data procedure used?	N					
Number of Times Substituted						
Waste Type Details	Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
	Bulk Waste	Bulk waste	1	0.2	0.5	0.02
Year Waste Disposed	**2005**					
Missing data procedure used?	N					
Number of Times Substituted						
Waste Type Details	Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
	Bulk Waste	Bulk waste	1	0.2	0.5	0.02
Year Waste Disposed	**2004**					
Missing data procedure used?	N					
Number of Times Substituted						
Waste Type Details	Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
	Bulk Waste	Bulk waste	1	0.2	0.5	0.02
Year Waste Disposed	**2003**					
Missing data procedure used?	N					
Number of Times Substituted						
Waste Type Details	Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
	Bulk Waste	Bulk waste	1	0.2	0.5	0.02
Year Waste Disposed	**2002**					
Missing data procedure used?	N					
Number of Times Substituted						
Waste Type Details	Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
	Bulk Waste	Bulk waste	1	0.2	0.5	0.02

Year Waste Disposed	**2001**
Missing data procedure used?	N
Number of Times Substituted	
Waste Type Details	

Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
Bulk Waste	Bulk waste	1	0.2	0.5	0.02

Year Waste Disposed	**2000**
Missing data procedure used?	N
Number of Times Substituted	
Waste Type Details	

Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
Bulk Waste	Bulk waste	1	0.2	0.5	0.02

Year Waste Disposed	**1999**
Missing data procedure used?	N
Number of Times Substituted	
Waste Type Details	

Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
Bulk Waste	Bulk waste	1	0.2	0.5	0.02

Year Waste Disposed	**1998**
Missing data procedure used?	N
Number of Times Substituted	
Waste Type Details	

Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
Bulk Waste	Bulk waste	1	0.2	0.5	0.02

Year Waste Disposed	**1997**
Missing data procedure used?	N
Number of Times Substituted	
Waste Type Details	

Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
Bulk Waste	Bulk waste	1	0.2	0.5	0.02

Year Waste Disposed	**1996**
Missing data procedure used?	N

Number of Times Substituted	
Waste Type Details	Option: Bulk Waste; Waste Type: Bulk waste; Percent by Weight: 1; Degradable Organic Carbon Value: 0.2; Fraction Of DOC Dissimilated: 0.5; Decay Rate: 0.02
Year Waste Disposed	**1995**
Missing data procedure used?	N
Number of Times Substituted	
Waste Type Details	Option: Bulk Waste; Waste Type: Bulk waste; Percent by Weight: 1; Degradable Organic Carbon Value: 0.2; Fraction Of DOC Dissimilated: 0.5; Decay Rate: 0.02
Year Waste Disposed	**1994**
Missing data procedure used?	N
Number of Times Substituted	
Waste Type Details	Option: Bulk Waste; Waste Type: Bulk waste; Percent by Weight: 1; Degradable Organic Carbon Value: 0.2; Fraction Of DOC Dissimilated: 0.5; Decay Rate: 0.02
Year Waste Disposed	**1993**
Missing data procedure used?	N
Number of Times Substituted	
Waste Type Details	Option: Bulk Waste; Waste Type: Bulk waste; Percent by Weight: 1; Degradable Organic Carbon Value: 0.2; Fraction Of DOC Dissimilated: 0.5; Decay Rate: 0.02
Year Waste Disposed	**1992**
Missing data procedure used?	N
Number of Times Substituted	
Waste Type Details	Option: Bulk Waste; Waste Type: Bulk waste; Percent by Weight: 1; Degradable Organic Carbon Value: 0.2; Fraction Of DOC Dissimilated: 0.5; Decay Rate: 0.02
Year Waste Disposed	**1991**
Missing data procedure used?	N
Number of Times Substituted	
Waste Type Details	Option; Waste Type; Percent by Weight; Degradable Organic Carbon Value; Fraction Of DOC Dissimilated; Decay Rate

	Bulk Waste	Bulk waste	1	0.2	0.5	0.02
Year Waste Disposed	**1990**					
Missing data procedure used?	N					
Number of Times Substituted						
Waste Type Details	Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
	Bulk Waste	Bulk waste	1	0.2	0.5	0.02
Year Waste Disposed	**1989**					
Missing data procedure used?	N					
Number of Times Substituted						
Waste Type Details	Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
	Bulk Waste	Bulk waste	1	0.2	0.5	0.02
Year Waste Disposed	**1988**					
Missing data procedure used?	N					
Number of Times Substituted						
Waste Type Details	Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
	Bulk Waste	Bulk waste	1	0.2	0.5	0.02
Year Waste Disposed	**1987**					
Missing data procedure used?	N					
Number of Times Substituted						
Waste Type Details	Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
	Bulk Waste	Bulk waste	1	0.2	0.5	0.02
Year Waste Disposed	**1986**					
Missing data procedure used?	N					
Number of Times Substituted						
Waste Type Details	Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
	Bulk Waste	Bulk waste	1	0.2	0.5	0.02
Year Waste Disposed	**1985**					

Missing data procedure used?	N
Number of Times Substituted	

Waste Type Details

Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
Bulk Waste	Bulk waste	1	0.2	0.5	0.02

Year Waste Disposed	**1984**
Missing data procedure used?	N
Number of Times Substituted	

Waste Type Details

Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
Bulk Waste	Bulk waste	1	0.2	0.5	0.02

Year Waste Disposed	**1983**
Missing data procedure used?	N
Number of Times Substituted	

Waste Type Details

Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
Bulk Waste	Bulk waste	1	0.2	0.5	0.02

Year Waste Disposed	**1982**
Missing data procedure used?	N
Number of Times Substituted	

Waste Type Details

Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
Bulk Waste	Bulk waste	1	0.2	0.5	0.02

Year Waste Disposed	**1981**
Missing data procedure used?	N
Number of Times Substituted	

Waste Type Details

Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
Bulk Waste	Bulk waste	1	0.2	0.5	0.02

Year Waste Disposed	**1980**
Missing data procedure used?	N
Number of Times Substituted	

Waste Type Details

Waste Type Details	Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
	Bulk Waste	Bulk waste	1	0.2	0.5	0.02
Year Waste Disposed	**1979**					
Missing data procedure used?	N					
Number of Times Substituted						
Waste Type Details	Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
	Bulk Waste	Bulk waste	1	0.2	0.5	0.02
Year Waste Disposed	**1978**					
Missing data procedure used?	N					
Number of Times Substituted						
Waste Type Details	Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
	Bulk Waste	Bulk waste	1	0.2	0.5	0.02
Year Waste Disposed	**1977**					
Missing data procedure used?	N					
Number of Times Substituted						
Waste Type Details	Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
	Bulk Waste	Bulk waste	1	0.2	0.5	0.02
Year Waste Disposed	**1976**					
Missing data procedure used?	N					
Number of Times Substituted						
Waste Type Details	Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
	Bulk Waste	Bulk waste	1	0.2	0.5	0.02
Year Waste Disposed	**1975**					
Missing data procedure used?	N					
Number of Times Substituted						
Waste Type Details	Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
	Bulk Waste	Bulk waste	1	0.2	0.5	0.02

Year Waste Disposed	**1974**
Missing data procedure used?	N
Number of Times Substituted	
Waste Type Details	

Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
Bulk Waste	Bulk waste	1	0.2	0.5	0.02

Year Waste Disposed	**1973**
Missing data procedure used?	N
Number of Times Substituted	
Waste Type Details	

Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
Bulk Waste	Bulk waste	1	0.2	0.5	0.02

Year Waste Disposed	**1972**
Missing data procedure used?	N
Number of Times Substituted	
Waste Type Details	

Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
Bulk Waste	Bulk waste	1	0.2	0.5	0.02

Year Waste Disposed	**1971**
Missing data procedure used?	N
Number of Times Substituted	
Waste Type Details	

Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
Bulk Waste	Bulk waste	1	0.2	0.5	0.02

Year Waste Disposed	**1970**
Missing data procedure used?	N
Number of Times Substituted	
Waste Type Details	

Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
Bulk Waste	Bulk waste	1	0.2	0.5	0.02

Year Waste Disposed	**1969**
Missing data procedure used?	N

Number of Times Substituted	
Waste Type Details	Option: Bulk Waste; Waste Type: Bulk waste; Percent by Weight: 1; Degradable Organic Carbon Value: 0.2; Fraction Of DOC Dissimilated: 0.5; Decay Rate: 0.02
Year Waste Disposed	**1968**
Missing data procedure used?	N
Number of Times Substituted	
Waste Type Details	Option: Bulk Waste; Waste Type: Bulk waste; Percent by Weight: 1; Degradable Organic Carbon Value: 0.2; Fraction Of DOC Dissimilated: 0.5; Decay Rate: 0.02
Year Waste Disposed	**1967**
Missing data procedure used?	N
Number of Times Substituted	
Waste Type Details	Option: Bulk Waste; Waste Type: Bulk waste; Percent by Weight: 1; Degradable Organic Carbon Value: 0.2; Fraction Of DOC Dissimilated: 0.5; Decay Rate: 0.02
Year Waste Disposed	**1966**
Missing data procedure used?	N
Number of Times Substituted	
Waste Type Details	Option: Bulk Waste; Waste Type: Bulk waste; Percent by Weight: 1; Degradable Organic Carbon Value: 0.2; Fraction Of DOC Dissimilated: 0.5; Decay Rate: 0.02
Year Waste Disposed	**1965**
Missing data procedure used?	N
Number of Times Substituted	
Waste Type Details	Option: Bulk Waste; Waste Type: Bulk waste; Percent by Weight: 1; Degradable Organic Carbon Value: 0.2; Fraction Of DOC Dissimilated: 0.5; Decay Rate: 0.02
Year Waste Disposed	**1964**
Missing data procedure used?	N
Number of Times Substituted	
Waste Type Details	Option; Waste Type; Percent by Weight; Degradable Organic Carbon Value; Fraction Of DOC Dissimilated; Decay Rate

	Bulk Waste	Bulk waste	1	0.2	0.5	0.02
Year Waste Disposed	**1963**					
Missing data procedure used?	N					
Number of Times Substituted						
Waste Type Details	Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
	Bulk Waste	Bulk waste	1	0.2	0.5	0.02
Year Waste Disposed	**1962**					
Missing data procedure used?	N					
Number of Times Substituted						
Waste Type Details	Option	Waste Type	Percent by Weight	Degradable Organic Carbon Value	Fraction Of DOC Dissimilated	Decay Rate
	Bulk Waste	Bulk waste	1	0.2	0.5	0.02

Working Capacity Details

Were working capacities used to determine waste disposal quantities	N

Tipping Receipt Details

Were tipping receipts or company records used to determine waste disposal quantities	N

Method used for estimating all annual waste quantities that are not determined with the methods above

Method	Method #3: Use the landfill capacity or, for operating landfills, the amount of waste-in-place to estimate a constant average waste disposal quantity (Equation HH-3).

Method Start Year	1962
Method End Year	1988

Historical Estimation Population Details

Historical landfill Capacity	962981Metric Tons
Reason	Best available estimation method

Methane Generation and Emissions for Landfills with LFG Collection Systems

Gas Collection System Information

System Manufacturer	LFG Technologies
System Capacity	400 (acfm)
Number of Wells	42

Methane Oxidation Fractions

Methane Oxidation Fraction HH-5	0.10
Methane Oxidation Fraction HH-6	0.10
Methane Oxidation Fraction HH-7	0.10
Methane Oxidation Fraction HH-8	0.10

Measurement Locations

Name	**Flare Facility**
Description	Flare/Blower System
Annual Operating Hours	8674 (Hours)
Quantity of Recovered Methane	1141.0 (Metric Tons)
Destruction Devices	Name: Flare; Annual Operating Hours: 8674 (Hours); Destruction Efficiency: 0.99 (fraction (number between 0 and 1))

Methane Generation and Emissions values

Estimated Gas Collection Efficiency HH3	0.6 (decimal fraction)
Is Override Indicator?	N
Methane Generation Equation HH5	1474.89 (Metric Tons)
Is Override Indicator?	N
Methane Emissions Equation HH6	459.40 (Metric Tons)
Is Override Indicator?	N
Methane Generation Equation HH7	1728.47 (Metric Tons)
Is Override Indicator?	N
Basis for Input Methane Generation Value	Equation HH-1
Methane Emission from Equation HH8	712.98 (Metric Tons)
Is Override Indicator?	N

Gas Collection Systems details

Annual Volume FGCollected Gas Volumetric Flow	Measured Value	140280649 (scf)
	Is Substituted Indicator?	N
	Number of Times Substituted	
Annual Average Methane Concentration	Measured Value	43.3 (Number (between 0 and 100))
	Is Substituted Indicator?	N
	Number of Days Substituted	
	Number of Weeks Substituted	
	Number of Months Substituted	
	Number of Times Substituted	
Temperature Incorporated Indicator	Y	
Pressure Incorporated Indicator	Y	
LFG Flow Wet Basis Indicator	N	
Methane Concentration Wet Basis Indicator	N	
Site Destruction Location	On-site	
Annual Quantity Of Recovered MethaneHH4	1141 (Metric Tons)	

Waste Depth Details

Area Type	Waste Depth	Surface Area
A1	0 (Meters)	0 (Square Meters)
A2	0 (Meters)	0 (Square Meters)
A3	28 (Meters)	157827 (Square Meters)

A4	0 (Meters)	0 (Square Meters)
A5	0 (Meters)	0 (Square Meters)

Equation HH-1 Details:

The fraction of CH4 in landfill gas (F), is it based on a measured value or default value	default
Fraction by volume of CH4 in landfill gas	0.5
An MCF value other than the default of 1 was used	N
Annual MCF Value	1.0

Annual Modeled Methane Generation	1638.77 (Metric Tons)
Annual Modeled Methane Generation User Overrided value?	N

City of Lompoc
Full Time Equivalents City Government Employees by Function/Program
Last Ten Years

	Fiscal Year									
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
City Council	0.5	0.5	0.5	0.55	0.55	0.3	0.3	0.3	0.3	0.3
Mayor and City Council Members*	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
City Administration	2.4	2.2	2.2	2.3	2.3	3.8	3.8	3.8	3.8	4.9
City Clerk	3.0	3.0	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
City Attorney	3.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Human Resources	7.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Management Services	28.2	28.2	28.2	29.2	29.2	29.2	29.2	29.1	29.1	28.1
IS and Communications	10.3	10.4	10.4	11.9	11.9	13.2	13.2	13.0	13.0	14.3
Police	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0
Fire	25.4	26.0	26.0	27.0	27.0	29.3	29.3	29.3	29.3	30.0
Police and Fire Grants*	6.0	5.0	5.0	15.0	15.0	8.0	8.0	2.0	2.0	2.0
Community Development	13.3	13.9	13.9	12.5	12.5	14.1	14.1	14.1	14.1	7.8
Community Services	33.1	33.0	33.0	32.7	32.7	37.2	37.2	37.0	37.0	36.2
Library Grant*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Public Utilities	118.4	118.5	118.5	115.9	115.9	111.4	111.4	114.9	114.9	115.9
Public Works	64.5	60.8	60.8	59.3	59.3	64.2	64.2	65.2	65.2	66.7
Total	377.03	371.42	371.42	368.38	368.38	379.75	379.75	383.70	383.70	381.25

* Information only not included in totals

Source: City of Lompoc Budget Records

Appendix B: Emissions Calculations

1. Enter Employee Data

Please enter the number of employees in each department. This will be used to calculate the commute emissions per department.

Department	Number of employees
Airport	
City Hall	383.7
Electric	
Facilities	
Fire Station #1	
Fire Station #2	
Fleet	
Landfill	
Library	
Parks	
Police	
Recreation	
Solid Waste	
Streets	
Utilities	
Wastewater Plant	
Water Treatment Plant	

2. Enter mode of transit proportions, commute length, and work days

Please enter what percentage of employees use each form of transportation to work. These values will be used to determine how many city employees travel by each mode every day.
Default values are from the American Communities Survey, and represent the average distribution of transit modes in the United States. For more accurate emissions estimates, use proportions gathered from a travel survey of city employees.

Mode	Employees who use mode (%)	Default Values
Single Occupancy Vehicle	76%	76%
Carpool	10%	10%
Motorcycle	0%	0%
Transit	5%	5%
Bike	1%	1%
Walk	3%	3%
Work at home	4%	4%
Other	1%	1%
Total	**100%**	

Please enter the average one-way commute length for city employees. Default commute distance is 12.6 miles (from FHWA's 2010 Status of the Nation's Highways Bridges and Transit, http://www.fhwa.dot.gov/policy/2010cpr/execsum.htm).
This commute distance may be longer or shorter than the average commute for your city's employees. For the most accurate emissions estimates, use data from a travel survey of city employees.

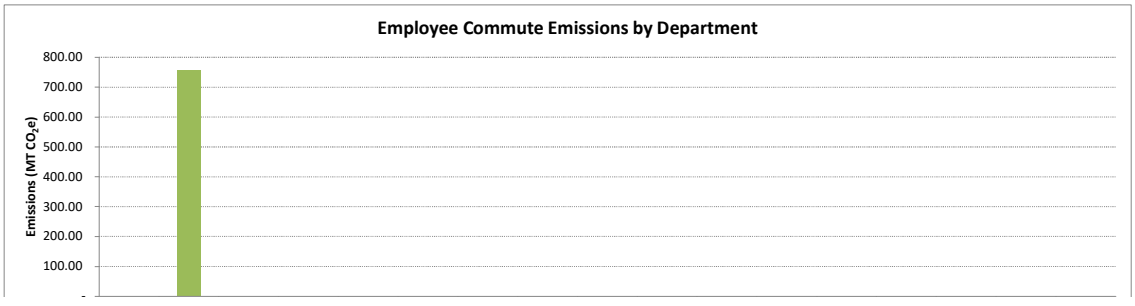
Average One-Way Commute Length (miles)	12.6	12.6

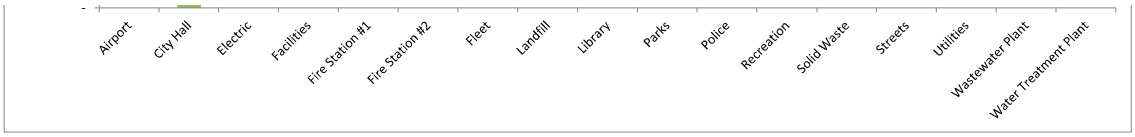
Please enter the number of days each city employee works per year. This number will be multiplied by the emissions from daily commutes. Default work-year days is provided (240 days), assuming a 5-day work week, two weeks (10 days) of vacation, and 10 federal holidays.

Workdays per year	240	240

Employee Commute Emissions Summary

Emissions by Department (MT CO_2e)	
	CO_2
Airport	-
City Hall	755.94
Electric	-
Facilities	-
Fire Station #1	-
Fire Station #2	-
Fleet	-
Landfill	-
Library	-
Parks	-
Police	-
Recreation	-
Solid Waste	-
Streets	-
Utilities	-
Wastewater Plant	-
Water Treatment Plant	-
Total	755.94





Background Calculations

Employees by Department and Mode

Number of Employees who use mode = # of employees × percentage of employees who use each mode

	Single Occupancy Vehicle	Carpool	Motorcycle	Transit	Bike	Walk	Work at Home	Other
Airport	0	0	0.0	0	0	0	0	0
City Hall	292	38	0.0	19	4	12	15	4
Electric	0	0	0.0	0	0	0	0	0
Facilities	0	0	0.0	0	0	0	0	0
Fire Station #1	0	0	0.0	0	0	0	0	0
Fire Station #2	0	0	0.0	0	0	0	0	0
Fleet	0	0	0.0	0	0	0	0	0
Landfill	0	0	0.0	0	0	0	0	0
Library	0	0	0.0	0	0	0	0	0
Parks	0	0	0.0	0	0	0	0	0
Police	0	0	0.0	0	0	0	0	0
Recreation	0	0	0.0	0	0	0	0	0
Solid Waste	0	0	0.0	0	0	0	0	0
Streets	0	0	0.0	0	0	0	0	0
Utilities	0	0	0.0	0	0	0	0	0
Wastewater Plant	0	0	0.0	0	0	0	0	0
Water Treatment Plant	0	0	0.0	0	0	0	0	0
Total	292	38	0	19	4	12	15	4

Daily CO_2 Emissions by Department and Mode

CO_2 Emissions/Day = Employees traveling × Trip Distance/day ÷ People/Mode ÷ miles per gallon × Mode Emissions Factor (kg CO_2/gallon) × MT/kg × GWP CO_2 [people × (1/people) × miles/day × gal/mile × kg CO_2/gal × MT/kg = MT CO_2/day]

	Single Occupancy Vehicle	Carpool	Motorcycle	Transit	Bike	Walk	Work at Home	Other	**TOTAL**
CO_2 Emission Factor (kg/gal)	8.78	8.78	8.78	0	0	0	0	0	
mpg	21.6	21.6	43.4	-	-	-	-	-	
People/Mode	1	2	1	0	0	0	0	0	
Airport	-	-	-	0	0	0	0	0	0.00
City Hall	2.99	0.16	-	0	0	0	0	0	3.15
Electric	-	-	-	0	0	0	0	0	0.00
Facilities	-	-	-	0	0	0	0	0	0.00
Fire Station #1	-	-	-	0	0	0	0	0	0.00
Fire Station #2	-	-	-	0	0	0	0	0	0.00
Fleet	-	-	-	0	0	0	0	0	0.00
Landfill	-	-	-	0	0	0	0	0	0.00
Library	-	-	-	0	0	0	0	0	0.00
Parks	-	-	-	0	0	0	0	0	0.00
Police	-	-	-	0	0	0	0	0	0.00
Recreation	-	-	-	0	0	0	0	0	0.00
Solid Waste	-	-	-	0	0	0	0	0	0.00
Streets	-	-	-	0	0	0	0	0	0.00
Utilities	-	-	-	0	0	0	0	0	0.00
Wastewater Plant	-	-	-	0	0	0	0	0	0.00
Water Treatment Plant	-	-	-	0	0	0	0	0	0.00
Total	2.99	0.16	0.00	0.00	0.00	0.00	0.00	0.00	**3.15**

Annual CO_2 Emissions by Department and Mode

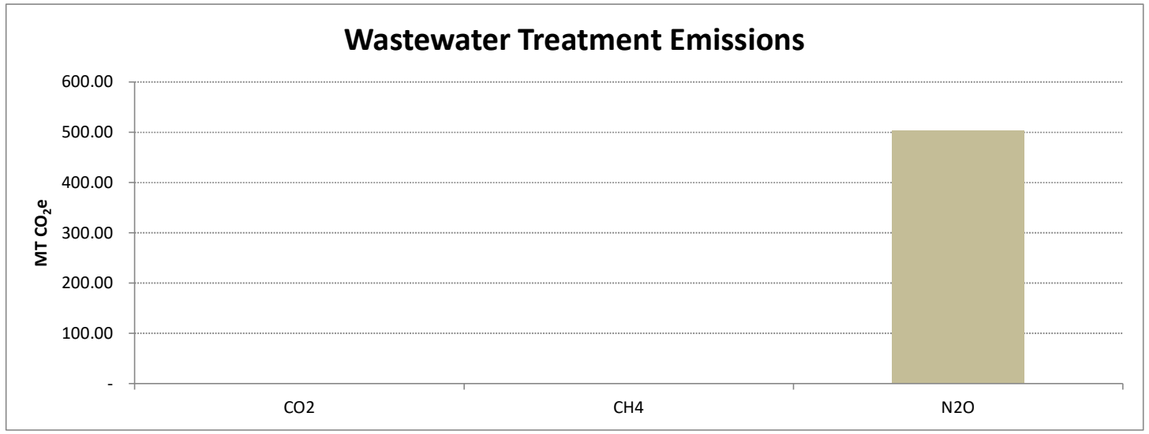
Annual CO_2 Emissions (MT) = MT CO_2/commute day × commute days/yr

	Single Occupancy Vehicle	Carpool	Motorcycle	Transit	Bike	Walk	Work at Home	Other	**TOTAL**
Airport	-	-	-	-	-	-	-	-	0.00
City Hall	716.90	39.04	-	-	-	-	-	-	755.94
Electric	-	-	-	-	-	-	-	-	0.00
Facilities	-	-	-	-	-	-	-	-	0.00
Fire Station #1	-	-	-	-	-	-	-	-	0.00
Fire Station #2	-	-	-	-	-	-	-	-	0.00
Fleet	-	-	-	-	-	-	-	-	0.00
Landfill	-	-	-	-	-	-	-	-	0.00
Library	-	-	-	-	-	-	-	-	0.00
Parks	-	-	-	-	-	-	-	-	0.00
Police	-	-	-	-	-	-	-	-	0.00
Recreation	-	-	-	-	-	-	-	-	0.00
Solid Waste	-	-	-	-	-	-	-	-	0.00
Streets	-	-	-	-	-	-	-	-	0.00
Utilities	-	-	-	-	-	-	-	-	0.00
Wastewater Plant	-	-	-	-	-	-	-	-	0.00
Water Treatment Plant	-	-	-	-	-	-	-	-	0.00
Total	716.90	39.04	0.00	0.00	0.00	0.00	0.00	0.00	**755.94**

This sheet shows the formulas used to determine your city's emissions from wastewater treatment, using methodology from the Local Government Operations Protocol (2010). The yellow cells link to the values you entered on the previous sheet, "Wastewater-Entry."

Your total emissions are summarized in the table below. You may scroll down to view the detailed calculations, but **no action is required on this sheet.** If you would like to change any of the entered values, you may do so on the previous sheet.

GHG Emissions Summary	
	MT CO_2e
CO_2	-
CH_4	-
N_2O	504.11
Total Emissions from Wastewater Treatment	**504.11**



Background Calculations

LGOP Equation 10.7 - Process N_2O Emissions from WWTP with Nitrification/Denitrification						
Effective Population Served by Nit/Denit	× Factor for Industrial Discharge into System	× Nit/Denit Emissions Factor (g N_2O/person/yr)	× MT/g =	**MT N_2O**	× GWP =	**MT CO_2e**
53,050	1.25	7	0.000001	0.4641875	298	**138.33**

LGOP Equation 10.10 - Process N_2O Emissions from Effluent Discharge (default N load data)												
Population Served	Factor for Industrial Discharge into System	× [Total N Load (kg N/person/day)	- N uptake* (kg N/kg BOD5)	× BOD5 Load]	× Effluent Emissions Factor (kg N_2O-N/kg sewage)	× N_2O/N_2 Molecular Weight Ratio	× 1 - Fraction of Nitrogen Removed**	× day/yr	× MT/kg =	**MT N_2O**	× GWP =	**MT CO_2e**
Aerobic Treatment with Nitrification/Denitrification												
53,050	1.25	0.026	0.05	0.09	0.005	1.571	0.3	365.25	0.001	1.227	298	**365.79**
*Depends if anaerobic/aerobic; **Depends if with/without Nitrification/Denitrification												

Cell Color Codes

Data entered on previous sheet
Calculated or Entered Data
CH_4 Emissions
N_2O Emissions
Value depends on system type

Wastewater - Control

Return to Table Contents

Please answer the following questions about your wastewater treatment system.

1) To which city department does your municipal wastewater treatment system belong?

Wastewater Plant

2) Do you have one or more facilities where wastewater is treated in ***anaerobic*** conditions?

Anaerobic

- ○ Yes, we have one or more facilities with anaerobic treatment.
- ◉ No, all facilities use aerobic treatment.

3) Do you have one or more facilities where wastewater is treated in ***aerobic*** conditions?

Aerobic

- ◉ Yes, we have one or more facilities with aerobic treatment.
- ○ No, all facilities use anaerobic treatment.

4) Is data available for your municipal system on both the amount of digester gas produced per day and the fraction of CH_4 in the bioga

Digester Gas Data

- ○ Yes, we have data on both the amount of digester gas produced and its methane content.
- ◉ No, both data items are not available. We would like to use default values.

5) Is data available for your municipal system on both the BOD_5 influent to your WWT process and the amount of BOD_5 removed durin

BOD Data

- ○ Yes, we have data on both the amount of BOD5 and its removal rate.
- ◉ No, both data items are not available. We would like to use default values.

6) Is any portion of your population served by septic systems?

Septic Systems

- ○ Yes.
- ◉ No, no portion of the population uses septic systems.

7) Is there any industrial nitrogen load into your wastewater treatment system?

Industrial Load

- ○ Yes.
- ◉ No, there is no industrial load to our system, or it is negligible.

8) Do one or more centralized wastewater treatment plants in your municipality conduct nitrification/denitrification?

Nitrification/Denitrification

- ◉ Yes.
- ○ No, no nitrification or denitrification occurs.

9) Do one or more centralized wastewater treatment plants in your municipality ***not conduct*** nitrification/denitrification?

Without Nitrification/Denitrification

- ○ Yes.
- ◉ No, all plants conduct nitrification/denitrification.

10) Do you collect measurements of Nitrogen load in your system's effluent discharged to water bodies?

Effluent N Load

- ○ Yes, we have data on the N load discharged.
- ◉ No, we have no data on the N load discharged. We will use default data.

Appendix C: Emissions Factors

Unit Conversion Factors

	Multiply by
kWh to MWh	0.001
lbs to metric tons	0.000453592
kg to metric tons	0.001
g to kg	0.001
lbs to MMT	4.53592E-10
scf to mcf	0.001
mcf_scf	1000
ft3 to m3	0.028316847
Per Day to Per Year	365.25
grams to MT	0.000001
lbs to kg	0.45359237
per Gallon to per MG	0.000001
ft^3 CH_4 to MT CH_4	0.00002
mt/short ton	0.90718474
CO_2 to CO_2e	1
CH_4 to CO_2e	25
N_2O to CO_2e	298

Legend:
Hard-wired factor
Calculated factor

* Following revised reporting requirements under the UNFCCC, this tool presents CO_2 equivalent values based on the IPCC Fourth Assessment Report (AR4) GWP values.

Stationary Fuel Factors

Fuel Emission Factors

Fuel	kg CO_2 / CO_2	kg CH_4 / CH_4	kg N_2O / N_2O	Heat Content (MMBtu/unit)	Unit
Natural Gas	54.505	0.0051	0.0001	1.028	mcf
Digester Gas	43.791	0.0027	0.0005	0.841	mcf
Diesel	10.21	0.0015	0.0001	0.138	gal
LPG	5.79	0.0010	0.0001	0.092	gal
Gasoline	8.78	0.0014	0.0001	0.125	gal
Residual Fuel Oil No. 5	10.21	0.0015	0.0001	0.14	gal
Residual Fuel Oil No. 6	11.27	0.0017	0.0001	0.15	gal
Propane	5.59	0.0010	0.0001	0.091	gal
Butane	6.58	0.0011	0.0001	0.101	gal
Jet Fuel	9.75	0.0015	0.0001	0.135	gal
Bituminous Coal	2328.462	0.2742	0.0399	24.93	short tons

Emission Factors Per MMBtu *(multiplied by heat content to determine emissions/unit)*

Fuel	kg/MMBtu CO_2	CH_4	N_2O	MMBtu/Unit	
Natural Gas	53.02	0.005	0.0001	0.001028	MMBtu/scf
Digester Gas	52.07	0.0032	0.00063	0.000841	MMBtu/scf
Jet Fuel	72.22	0.011	0.0006	0.135	MMBtu/gal
Bituminous Coal	93.4	0.011	0.0016	24.93	MMBtu/short ton

Source: LGOP (Local Government Operations Protocol). 2010. Local Government Operations Protocol, Version 1.1. California Air Resources Board, California Climate Action Registry, ICLEI, and The Climate Registry.

Electricity Factors

eGRID Electricity Emission Factors by eGRID Subregion - *Most recent available factor is applied to all future years.*

lbs CO_2/MWh

eGRID Subregion	Subregion Name	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
AKGD eGRID subregion	ASCC Alaska Grid	1,257.190	1,257.190	1,257.190	1,257.190	1,257.190	1,232.360	1,258.540	1,284.720	1,282.789	1,280.858	1,256.866	1,262.799	1,268.731	1,097.634	926.537	999.409	1,072.280	1,055.958	1,039.635	1,039.635	1,039.635
AKMS eGRID subregion	ASCC Miscellaneous	480.100	480.100	480.100	480.100	480.100	498.860	517.295	535.730	528.496	521.262	448.570	464.869	481.169	580.833	680.498	591.812	503.125	514.104	525.083	525.083	525.083
AZNM eGRID subregion	WECC Southwest	1,254.020	1,254.020	1,254.020	1,254.020	1,254.020	1,311.050	1,281.830	1,252.610	1,221.980	1,191.350	1,177.614	1,165.251	1,152.888	1,014.239	875.591	959.618	1,043.645	1,033.000	1,022.355	1,022.355	1,022.355
CAMX eGRID subregion	WECC California	878.710	878.710	878.710	878.710	878.710	724.120	702.565	681.010	669.847	658.685	610.818	630.565	650.312	609.478	568.644	548.253	527.862	512.199	496.536	496.536	496.536
ERCT eGRID subregion	ERCOT All	1,420.560	1,420.560	1,420.560	1,420.560	1,420.560	1,324.350	1,288.460	1,252.570	1,217.149	1,181.727	1,218.167	1,180.602	1,143.037	1,142.894	1,142.750	1,075.953	1,009.156	970.414	931.672	931.672	931.672
FRCC eGRID subregion	FRCC All	1,327.660	1,327.660	1,327.660	1,327.660	1,327.660	1,318.570	1,269.340	1,220.110	1,198.358	1,176.607	1,196.715	1,161.032	1,125.349	1,100.269	1,075.189	1,043.436	1,011.683	971.763	931.842	931.842	931.842
HIMS eGRID subregion	HICC Miscellaneous	1,456.170	1,456.170	1,456.170	1,456.170	1,456.170	1,514.920	1,429.370	1,343.820	1,347.741	1,351.663	1,330.164	1,265.132	1,200.099	1,070.453	940.807	1,046.412	1,152.016	1,131.353	1,110.689	1,110.689	1,110.689
HIOA eGRID subregion	HICC Oahu	1,728.120	1,728.120	1,728.120	1,728.120	1,728.120	1,811.980	1,716.370	1,620.760	1,607.054	1,593.348	1,621.864	1,599.120	1,576.376	1,527.906	1,479.436	1,571.162	1,662.888	1,666.416	1,669.943	1,669.943	1,669.943
MROE eGRID subregion	MRO East	1,858.720	1,858.720	1,858.720	1,858.720	1,858.720	1,834.720	1,763.520	1,692.320	1,641.986	1,591.652	1,610.803	1,566.687	1,522.570	1,593.176	1,663.781	1,665.997	1,668.212	1,673.114	1,678.016	1,678.016	1,678.016
MROW eGRID subregion	MRO West	1,813.810	1,813.810	1,813.810	1,813.810	1,813.810	1,821.840	1,772.255	1,722.670	1,675.637	1,628.603	1,536.361	1,480.755	1,425.150	1,395.130	1,365.109	1,301.963	1,238.817	1,239.333	1,239.848	1,239.848	1,239.848
NEWE eGRID subregion	NPCC New England	908.900	908.900	908.900	908.900	908.900	927.680	877.815	827.950	778.179	728.409	722.074	679.987	637.900	604.376	570.852	564.504	558.156	540.234	522.312	522.312	522.312
NWPP eGRID subregion	WECC Northwest	921.100	921.100	921.100	921.100	921.100	902.240	880.515	858.790	838.999	819.208	842.579	754.167	665.754	786.357	906.959	779.079	651.199	645.118	639.037	639.037	639.037
NYCW eGRID subregion	NPCC NYC/Westchester	922.220	922.220	922.220	922.220	922.220	815.450	760.125	704.800	657.734	610.669	622.416	659.557	696.697	681.102	665.506	650.658	635.810	616.112	596.414	596.414	596.414
NYLI eGRID subregion	NPCC Long Island	1,412.200	1,412.200	1,412.200	1,412.200	1,412.200	1,536.800	1,477.770	1,418.740	1,383.364	1,347.988	1,336.110	1,268.653	1,201.196	1,198.705	1,196.213	1,187.268	1,178.322	1,181.282	1,184.241	1,184.241	1,184.241
NYUP eGRID subregion	NPCC Upstate NY	819.680	819.680	819.680	819.680	819.680	720.800	702.035	683.270	590.594	497.919	545.787	477.293	408.799	387.256	365.713	330.187	294.661	273.887	253.112	253.112	253.112
RFCE eGRID subregion	RFC East	1,095.530	1,095.530	1,095.530	1,095.530	1,095.530	1,139.070	1,099.195	1,059.320	1,003.372	947.424	1,001.716	930.138	858.560	844.002	829.444	793.811	758.178	737.072	715.966	715.966	715.966
RFCM eGRID subregion	RFC Michigan	1,641.410	1,641.410	1,641.410	1,641.410	1,641.410	1,563.280	1,607.195	1,651.110	1,655.283	1,659.457	1,629.382	1,599.306	1,569.230	1,550.347	1,531.464	1,401.755	1,272.045	1,292.303	1,312.560	1,312.560	1,312.560
RFCW eGRID subregion	RFC West	1,556.390	1,556.390	1,556.390	1,556.390	1,556.390	1,537.820	1,544.670	1,551.520	1,536.057	1,520.593	1,503.471	1,441.474	1,379.477	1,380.180	1,380.884	1,312.162	1,243.439	1,204.768	1,166.096	1,166.096	1,166.096
RMPA eGRID subregion	WECC Rockies	2,035.810	2,035.810	2,035.810	2,035.810	2,035.810	1,883.080	1,894.570	1,906.060	1,865.286	1,824.513	1,896.740	1,859.695	1,822.650	1,780.170	1,737.690	1,552.729	1,367.768	1,320.692	1,273.615	1,273.615	1,273.615
SPNO eGRID subregion	SPP North	1,971.420	1,971.420	1,971.420	1,971.420	1,971.420	1,960.940	1,879.825	1,798.710	1,807.234	1,815.757	1,799.448	1,760.550	1,721.653	1,648.322	1,574.992	1,493.671	1,412.350	1,287.769	1,163.187	1,163.187	1,163.187
SPSO eGRID subregion	SPP South	1,761.140	1,761.140	1,761.140	1,761.140	1,761.140	1,658.140	1,641.085	1,624.030	1,611.523	1,599.017	1,580.603	1,559.615	1,538.627	1,507.240	1,475.853	1,362.091	1,248.329	1,207.456	1,166.582	1,166.582	1,166.582
SRMV eGRID subregion	SERC Mississippi Valley	1,135.460	1,135.460	1,135.460	1,135.460	1,135.460	1,019.740	1,011.920	1,004.100	1,003.256	1,002.412	1,029.816	1,041.367	1,052.918	1,037.448	1,021.978	930.434	838.889	846.767	854.645	854.645	854.645
SRMW eGRID subregion	SERC Midwest	1,844.340	1,844.340	1,844.340	1,844.340	1,844.340	1,830.510	1,804.890	1,779.270	1,764.512	1,749.753	1,810.827	1,760.787	1,710.747	1,741.376	1,772.005	1,692.298	1,612.590	1,638.370	1,664.150	1,664.150	1,664.150
SRSO eGRID subregion	SERC South	1,490.370	1,490.370	1,490.370	1,490.370	1,490.370	1,489.540	1,492.505	1,495.470	1,410.577	1,325.684	1,354.095	1,251.571	1,149.048	1,146.434	1,143.821	1,116.598	1,089.374	1,058.651	1,027.928	1,027.928	1,027.928
SRTV eGRID subregion	SERC Tennessee Valley	1,494.890	1,494.890	1,494.890	1,494.890	1,494.890	1,510.440	1,525.645	1,540.850	1,449.280	1,357.711	1,389.200	1,363.175	1,337.151	1,336.715	1,336.280	1,260.857	1,185.433	1,108.485	1,031.537	1,031.537	1,031.537
SRVC eGRID subregion	SERC Virginia/Carolina	1,146.390	1,146.390	1,146.390	1,146.390	1,146.390	1,134.880	1,126.645	1,118.410	1,077.139	1,035.869	1,073.648	1,003.261	932.875	894.729	856.583	830.934	805.285	774.307	743.328	743.328	743.328

lbs CH_4/MWh

eGRID Subregion	Subregion Name	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
AKGD eGRID subregion	ASCC Alaska Grid	0.0266	0.0266	0.0266	0.0266	0.0266	0.0256	0.026355	0.02711	0.027424	0.027737	0.026076	0.026205	0.0263352	0.036482	0.046629	0.061815	0.077	0.0795	0.082	0.082	0.082

lbs CH_4/GWh

2005	2007	2009	2010	2012	2014
25.60	27.11	27.74	26.08	26.34	46.63

AKMS eGRID subregion	ASCC Miscellaneous	0.0239	0.0239	0.0239	0.0239	0.0239	0.02075	0.0217	0.02265	0.022216	0.021782	0.018745	0.018699	0.01865272	0.027361	0.03607	0.029535	0.023	0.0235	0.024	0.024	0.024	20.75	22.65	21.78	18.74	18.65	36.07
AZNM eGRID subregion	WECC Southwest	0.018	0.018	0.018	0.018	0.018	0.01745	0.018125	0.0188	0.018966	0.019132	0.019207	0.01893	0.01865292	0.042515	0.066378	0.072689	0.079	0.078	0.077	0.077	0.077	17.45	18.80	19.13	19.21	18.65	66.38
CAMX eGRID subregion	WECC California	0.03024	0.03024	0.03024	0.03024	0.03024	0.03024	0.029265	0.02829	0.028615	0.02894	0.02849	0.029803	0.03111618	0.032111	0.033105	0.033053	0.033	0.0335	0.034	0.034	0.034	30.24	28.29	28.94	28.49	31.12	33.11
ERCT eGRID subregion	ERCOT All	0.021	0.021	0.021	0.021	0.021	0.01865	0.018205	0.01776	0.017232	0.016703	0.016851	0.016776	0.0167007	0.049268	0.081835	0.078918	0.076	0.071	0.066	0.066	0.066	18.65	17.76	16.70	16.85	16.70	81.84
FRCC eGRID subregion	FRCC All	0.054	0.054	0.054	0.054	0.054	0.04592	0.043555	0.04119	0.040214	0.039238	0.03891	0.039478	0.04004528	0.063911	0.087777	0.081389	0.075	0.0705	0.066	0.066	0.066	45.92	41.19	39.24	38.91	40.05	87.78
HIMS eGRID subregion	HICC Miscellaneous	0.101	0.101	0.101	0.101	0.101	0.31468	0.224915	0.13515	0.103774	0.072399	0.073985	0.07103	0.06807502	0.081708	0.09534	0.09517	0.095	0.1065	0.118	0.118	0.118	314.68	135.15	72.40	73.98	68.08	95.34
HIOA eGRID subregion	HICC Oahu	0.0911	0.0911	0.0911	0.0911	0.0911	0.10947	0.10026	0.09105	0.096397	0.101745	0.099299	0.094852	0.09040612	0.124908	0.15941	0.170205	0.181	0.1805	0.180	0.18	0.18	109.47	91.05	101.74	99.30	90.41	159.41
MROE eGRID subregion	MRO East	0.041	0.041	0.041	0.041	0.041	0.02759	0.02819	0.02879	0.026385	0.023981	0.024288	0.024295	0.02430337	0.107732	0.19116	0.17358	0.156	0.1625	0.169	0.169	0.169	27.59	28.79	23.98	24.29	24.30	191.16
MROW eGRID subregion	MRO West	0.028	0.028	0.028	0.028	0.028	0.028	0.028485	0.02897	0.028884	0.028798	0.028528	0.028062	0.027596	0.094482	0.161369	0.138185	0.115	0.1265	0.138	0.138	0.138	28.00	28.97	28.80	28.53	27.60	161.37
NEWE eGRID subregion	NPCC New England	0.08	0.08	0.08	0.08	0.08	0.08649	0.081735	0.07698	0.076332	0.075684	0.071757	0.072298	0.07283823	0.084421	0.096003	0.093002	0.090	0.086	0.082	0.082	0.082	86.49	76.98	75.68	71.76	72.84	96.00
NWPP eGRID subregion	WECC Northwest	0.022	0.022	0.022	0.022	0.022	0.01913	0.017735	0.01634	0.015817	0.015293	0.01605	0.014324	0.01259737	0.055202	0.097807	0.079404	0.061	0.0625	0.064	0.064	0.064	19.13	16.34	15.29	16.05	12.60	97.81
NYCW eGRID subregion	NPCC NYC/Westchester	0.038	0.038	0.038	0.038	0.038	0.03602	0.03112	0.02622	0.024985	0.023751	0.023808	0.024659	0.02550877	0.024937	0.024365	0.023183	0.022	0.022	0.022	0.022	0.022	36.02	26.22	23.75	23.81	25.51	24.37
NYLI eGRID subregion	NPCC Long Island	0.102	0.102	0.102	0.102	0.102	0.11541	0.102955	0.0905	0.093682	0.096865	0.081486	0.079844	0.07820158	0.105306	0.132411	0.129206	0.126	0.1325	0.139	0.139	0.139	115.41	90.50	96.86	81.49	78.20	132.41
NYUP eGRID subregion	NPCC Upstate NY	0.024	0.024	0.024	0.024	0.024	0.02482	0.021115	0.01741	0.016674	0.015939	0.016297	0.015946	0.01559402	0.02314	0.030686	0.025843	0.021	0.0195	0.018	0.018	0.018	24.82	17.41	15.94	16.30	15.59	30.69
RFCE eGRID subregion	RFC East	0.028	0.028	0.028	0.028	0.028	0.03027	0.028835	0.0274	0.027119	0.026838	0.027071	0.026758	0.02644407	0.050189	0.073933	0.061967	0.050	0.0555	0.061	0.061	0.061	30.27	27.40	26.84	27.07	26.44	73.93
RFCM eGRID subregion	RFC Michigan	0.035	0.035	0.035	0.035	0.035	0.03393	0.03324	0.03255	0.03198	0.031409	0.030464	0.030412	0.03036061	0.100223	0.170085	0.118543	0.067	0.098	0.129	0.129	0.129	33.93	32.55	31.41	30.46	30.36	170.09
RFCW eGRID subregion	RFC West	0.02	0.02	0.02	0.02	0.02	0.01823	0.0183	0.01837	0.018245	0.018119	0.018204	0.017657	0.01710884	0.083654	0.150199	0.1291	0.108	0.1125	0.117	0.117	0.117	18.23	18.37	18.12	18.20	17.11	150.20
RMPA eGRID subregion	WECC Rockies	0.024	0.024	0.024	0.024	0.024	0.02288	0.023255	0.02363	0.02294	0.022249	0.02266	0.022159	0.02165768	0.099908	0.178158	0.157579	0.137	0.13	0.123	0.123	0.123	22.88	23.63	22.25	22.66	21.66	178.16
SPNO eGRID subregion	SPP North	0.024	0.024	0.024	0.024	0.0240	0.02382	0.02252	0.02122	0.021114	0.021009	0.020807	0.020511	0.02021564	0.097002	0.173789	0.161395	0.149	0.1365	0.124	0.124	0.124	23.82	21.22	21.01	20.81	20.22	173.79
SPSO eGRID subregion	SPP South	0.03	0.03	0.03	0.03	0.0300	0.02498	0.02475	0.02452	0.023884	0.023248	0.0232	0.023475	0.0237507	0.079596	0.135441	0.115221	0.095	0.093	0.091	0.091	0.091	24.98	24.52	23.25	23.20	23.75	135.44
SRMV eGRID subregion	SERC Mississippi Valley	0.042	0.042	0.042	0.042	0.0420	0.02431	0.023055	0.0218	0.020624	0.019448	0.020663	0.020808	0.02095275	0.049789	0.078625	0.064313	0.050	0.0525	0.055	0.055	0.055	24.31	21.80	19.45	20.66	20.95	78.63
SRMW eGRID subregion	SERC Midwest	0.021	0.021	0.021	0.021	0.021	0.02115	0.02086	0.02057	0.02007	0.019571	0.020484	0.020033	0.01958237	0.114212	0.208841	0.145421	0.082	0.1335	0.185	0.185	0.185	21.15	20.57	19.57	20.48	19.58	208.84
SRSO eGRID subregion	SERC South	0.04	0.04	0.04	0.04	0.0400	0.02627	0.024955	0.02364	0.022956	0.022272	0.022822	0.022741	0.02266135	0.063187	0.103712	0.095356	0.087	0.084	0.081	0.081	0.081	26.27	23.64	22.27	22.82	22.66	103.71
SRTV eGRID subregion	SERC Tennessee Valley	0.023	0.023	0.023	0.023	0.0230	0.02005	0.01996	0.01987	0.018574	0.017277	0.017696	0.017541	0.01738564	0.078012	0.138639	0.11582	0.093	0.095	0.097	0.097	0.097	20.05	19.87	17.28	17.70	17.39	138.64
SRVC eGRID subregion	SERC Virginia/Carolina	0.029	0.029	0.029	0.029	0.0290	0.02377	0.023015	0.02226	0.021886	0.021512	0.021692	0.02282	0.02394782	0.059835	0.095723	0.081362	0.067	0.067	0.067	0.067	0.067	23.77	22.26	21.51	21.69	23.95	95.72

		lbs N_2O/MWh																				lbs N_2O/GWh					
eGRID Subregion	**Subregion Name**	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2005	2007	2009	2010	2012	2014
AKGD eGRID subregion	ASCC Alaska Grid	0.0064	0.0064	0.0064	0.0064	0.0064	0.00651	0.006975	0.00744	0.007564	0.007688	0.007179	0.007387	0.00759476	0.007378	0.007161	0.009081	0.011	0.011	0.011	0.011	0.011	6.51	7.44	7.69	7.18	7.59	7.16
AKMS eGRID subregion	ASCC Miscellaneous	0.0044	0.0044	0.0044	0.0044	0.0044	0.00408	0.00428	0.00448	0.004381	0.004281	0.003681	0.003614	0.00354823	0.004773	0.005998	0.004999	0.004	0.004	0.004	0.004	0.004	4.08	4.48	4.28	3.68	3.55	6.00
AZNM eGRID subregion	WECC Southwest	0.015	0.015	0.015	0.015	0.015	0.01794	0.017255	0.01657	0.016076	0.015582	0.015723	0.015415	0.01510615	0.01221	0.009313	0.010657	0.012	0.0115	0.011	0.011	0.011	17.94	16.57	15.58	15.72	15.11	9.31
CAMX eGRID subregion	WECC California	0.00808	0.00808	0.00808	0.00808	0.00808	0.00808	0.007155	0.00623	0.006198	0.006165	0.006027	0.005851	0.005674	0.004855	0.004036	0.004018	0.004	0.004	0.004	0.004	0.004	8.08	6.23	6.17	6.03	5.67	4.04
ERCT eGRID subregion	ERCOT All	0.015	0.015	0.015	0.015	0.015	0.01511	0.01455	0.01399	0.013547	0.013104	0.014071	0.013203	0.01233473	0.011955	0.011575	0.011288	0.011	0.01	0.009	0.009	0.009	15.11	13.99	13.10	14.07	12.33	11.58
FRCC eGRID subregion	FRCC All	0.016	0.016	0.016	0.016	0.016	0.01694	0.016095	0.01525	0.014391	0.013533	0.013746	0.0128	0.01185274	0.011952	0.012051	0.011026	0.010	0.0095	0.009	0.009	0.009	16.94	15.25	13.53	13.75	11.85	12.05
HIMS eGRID subregion	HICC Miscellaneous	0.018	0.018	0.018	0.018	0.018	0.04688	0.034295	0.02171	0.017757	0.013804	0.013882	0.013283	0.01268332	0.013952	0.01522	0.01511	0.015	0.0165	0.018	0.018	0.018	46.88	21.71	13.80	13.88	12.68	15.22
HIOA eGRID subregion	HICC Oahu	0.0212	0.0212	0.0212	0.0212	0.0212	0.02362	0.022255	0.02089	0.021435	0.021981	0.022411	0.021981	0.02155025	0.023005	0.02446	0.02623	0.028	0.0275	0.027	0.027	0.027	23.62	20.89	21.98	22.41	21.55	24.46
MROE eGRID subregion	MRO East	0.03	0.03	0.03	0.03	0.03	0.03036	0.029705	0.02905	0.028046	0.027041	0.027522	0.026538	0.0255547	0.026866	0.028178	0.027089	0.026	0.0255	0.025	0.025	0.025	30.36	29.05	27.04	27.52	25.55	28.18
MROW eGRID subregion	MRO West	0.029	0.029	0.029	0.029	0.029	0.03071	0.02995	0.02919	0.02849	0.02779	0.026291	0.025276	0.02426106	0.023804	0.023347	0.021674	0.020	0.02	0.020	0.02	0.02	30.71	29.19	27.79	26.29	24.26	23.35
NEWE eGRID subregion	NPCC New England	0.015	0.015	0.015	0.015	0.015	0.01701	0.016105	0.0152	0.014528	0.013855	0.012976	0.011842	0.01070769	0.011775	0.012843	0.012422	0.012	0.0115	0.011	0.011	0.011	17.01	15.20	13.86	12.98	10.71	12.84
NWPP eGRID subregion	WECC Northwest	0.014	0.014	0.014	0.014	0.014	0.0149	0.01427	0.01364	0.01307	0.0125	0.013072	0.011724	0.01037502	0.0123	0.014224	0.011612	0.009	0.009	0.009	0.009	0.009	14.90	13.64	12.50	13.07	10.38	14.22
NYCW eGRID subregion	NPCC NYC/Westchester	0.006	0.006	0.006	0.006	0.006	0.00546	0.004405	0.00335	0.003078	0.002807	0.0028	0.002866	0.00293229	0.002952	0.002971	0.002986	0.003	0.003	0.003	0.003	0.003	5.46	3.35	2.81	2.80	2.93	2.97
NYLI eGRID subregion	NPCC Long Island	0.016	0.016	0.016	0.016	0.016	0.01809	0.015595	0.0131	0.012737	0.012373	0.010285	0.010076	0.0098682	0.013531	0.017194	0.016597	0.016	0.017	0.018	0.018	0.018	18.09	13.10	12.37	10.28	9.87	17.19
NYUP eGRID subregion	NPCC Upstate NY	0.011	0.011	0.011	0.011	0.011	0.01119	0.010545	0.0099	0.008333	0.006766	0.007242	0.005534	0.0038269	0.003982	0.004138	0.003569	0.003	0.0025	0.002	0.002	0.002	11.19	9.90	6.77	7.24	3.83	4.14
RFCE eGRID subregion	RFC East	0.017	0.017	0.017	0.017	0.017	0.01871	0.01787	0.01703	0.015996	0.014962	0.01533	0.013409	0.0114873	0.011357	0.011226	0.010113	0.009	0.0085	0.008	0.008	0.008	18.71	17.03	14.96	15.33	11.49	11.23
RFCM eGRID subregion	RFC Michigan	0.025	0.025	0.025	0.025	0.025	0.02717	0.02748	0.02779	0.027839	0.027888	0.026841	0.025478	0.02411554	0.024288	0.024461	0.021231	0.018	0.018	0.018	0.018	0.018	27.17	27.79	27.89	26.84	24.12	24.46
RFCW eGRID subregion	RFC West	0.024	0.024	0.024	0.024	0.024	0.02571	0.02582	0.02593	0.025532	0.025133	0.024747	0.023207	0.02166649	0.02185	0.022034	0.020517	0.019	0.018	0.017	0.017	0.017	25.71	25.93	25.13	24.75	21.67	22.03
RMPA eGRID subregion	WECC Rockies	0.03	0.03	0.03	0.03	0.03	0.02875	0.02882	0.02889	0.02804	0.02719	0.029207	0.028668	0.0281295	0.02695	0.025771	0.022886	0.020	0.019	0.018	0.018	0.018	28.75	28.89	27.19	29.21	28.13	25.77
SPNO eGRID subregion	SPP North	0.03	0.03	0.03	0.03	0.03	0.03209	0.030645	0.0292	0.029046	0.028891	0.028624	0.027884	0.02714401	0.026181	0.025217	0.023609	0.022	0.02	0.018	0.018	0.018	32.09	29.20	28.89	28.62	27.14	25.22
SPSO eGRID subregion	SPP South	0.023	0.023	0.023	0.023	0.023	0.02261	0.022515	0.02242	0.022104	0.021788	0.020851	0.020413	0.01997501	0.019833	0.01969	0.017345	0.015	0.014	0.013	0.013	0.013	22.61	22.42	21.79	20.85	19.98	19.69
SRMV eGRID subregion	SERC Mississippi Valley	0.013	0.013	0.013	0.013	0.013	0.01171	0.01143	0.01115	0.010902	0.010654	0.010756	0.010681	0.01060709	0.010927	0.011247	0.009124	0.007	0.0075	0.008	0.008	0.008	11.71	11.15	10.65	10.76	10.61	11.25
SRMW eGRID subregion	SERC Midwest	0.029	0.029	0.029	0.029	0.029	0.0305	0.03005	0.0296	0.029291	0.028983	0.029574	0.028537	0.02749911	0.028935	0.030371	0.028186	0.026	0.0265	0.027	0.027	0.027	30.50	29.60	28.98	29.57	27.50	30.37
SRSO eGRID subregion	SERC South	0.025	0.025	0.025	0.025	0.025	0.02547	0.02502	0.02457	0.022673	0.020776	0.020888	0.018188	0.01548781	0.015406	0.015325	0.014163	0.013	0.0125	0.012	0.012	0.012	25.47	24.57	20.78	20.89	15.49	15.33
SRTV eGRID subregion	SERC Tennessee Valley	0.024	0.024	0.024	0.024	0.024	0.02564	0.02556	0.02548	0.023783	0.022086	0.022412	0.021598	0.02078407	0.020489	0.020194	0.018597	0.017	0.0155	0.014	0.014	0.014	25.64	25.48	22.09	22.41	20.78	20.19
SRVC eGRID subregion	SERC Virginia/Carolina	0.019	0.019	0.019	0.019	0.019	0.01979	0.019435	0.01908	0.018263	0.017447	0.01764	0.01612	0.01459944	0.014188	0.013777	0.012389	0.011	0.01	0.009	0.009	0.009	19.79	19.08	17.45	17.64	14.60	13.78

Sources:

Emissions & Generation Resource Integrated Database (eGRID). https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid.

LGOP (Local Government Operations Protocol). 2010. Local Government Operations Protocol, Version 1.1. California Air Resources Board, California Climate Action Registry, ICLEI, and The Climate Registry.

Mobile Factors

Fuel CO_2 Emission Factors

	kg CO_2/gallon (GGE for CNG)			
Other Fuels	**Total**	**Biogenic Portion**	**Fossil portion**	**MMBTU/unit**
Gasoline	8.78		8.78	0.13
Diesel	10.21		10.21	0.14
Biodiesel (B5)	10.17	0.47	9.70	0.14
Biodiesel (B20)	10.06	1.89	8.17	0.14
B100	9.45	9.45		0.13
Ethanol (E85)	6.20	4.89	1.32	0.09
E100	5.75	5.75		0.08
CNG	6.84		6.84	0.13
LNG	4.46		4.46	0.08
LPG	5.79		5.79	0.09
Methanol	4.10		4.10	
Residual Fuel	11.80		11.80	0.15
Jet Fuel	9.57		9.57	0.14
Aviation Gasoline	8.31		8.31	0.12

Default CH_4 and N_2O Emission Factors for Highway Vehicles by Model Year

Vehicle Type and Year	CH_4 (g/mi)					
	Gasoline	Gasoline	Gasoline	Diesel	Diesel	Diesel
	Passenger Car	Light Truck (Vans, Pickup Trucks, SUVs)	Heavy-Duty Vehicle	Passenger Car	Light Truck (Vans, Pickup Trucks, SUVs)	Heavy-Duty Vehicle
1980	0.0704	0.0813	0.409	0.0006	0.0011	0.0051
1981	0.0704	0.0813	0.409	0.0006	0.0011	0.0051
1982	0.0704	0.0813	0.409	0.0006	0.0011	0.0051
1983	0.0704	0.0813	0.409	0.0005	0.0009	0.0051
1984	0.0704	0.0813	0.409	0.0005	0.0009	0.0051
1985	0.0704	0.0813	0.409	0.0005	0.0009	0.0051
1986	0.0704	0.0813	0.409	0.0005	0.0009	0.0051
1987	0.0704	0.0813	0.3675	0.0005	0.0009	0.0051
1988	0.0704	0.0813	0.3492	0.0005	0.0009	0.0051
1989	0.0704	0.0813	0.3492	0.0005	0.0009	0.0051
1990	0.0704	0.0813	0.3246	0.0005	0.0009	0.0051
1991	0.0704	0.0813	0.3246	0.0005	0.0009	0.0051
1992	0.0704	0.0813	0.3246	0.0005	0.0009	0.0051
1993	0.0704	0.0813	0.3246	0.0005	0.0009	0.0051
1994	0.0531	0.0646	0.3246	0.0005	0.0009	0.0051
1995	0.0358	0.0517	0.3246	0.0005	0.0009	0.0051
1996	0.0272	0.0452	0.1278	0.0005	0.001	0.0051
1997	0.0268	0.0452	0.0924	0.0005	0.001	0.0051
1998	0.0249	0.0391	0.0641	0.0005	0.001	0.0051
1999	0.0216	0.0321	0.0578	0.0005	0.001	0.0051
2000	0.0178	0.0346	0.0493	0.0005	0.001	0.0051
2001	0.011	0.0151	0.0528	0.0005	0.001	0.0051
2002	0.0107	0.0178	0.0546	0.0005	0.001	0.0051
2003	0.0114	0.0155	0.0533	0.0005	0.001	0.0051
2004	0.0145	0.0152	0.0341	0.0005	0.001	0.0051
2005	0.0147	0.0157	0.0326	0.0005	0.001	0.0051
2006	0.0161	0.0159	0.0326	0.0005	0.001	0.0051
2007	0.017	0.0161	0.0327	0.0005	0.001	0.0051
2008	0.0172	0.0163	0.0327	0.0005	0.001	0.0051
2009	0.0172	0.0163	0.0327	0.0005	0.001	0.0051
2010	0.0172	0.0163	0.0327	0.0005	0.001	0.0051
2011	0.0172	0.0163	0.0327	0.0005	0.001	0.0051
2012	0.0172	0.0163	0.0327	0.0005	0.001	0.0051
2013	0.0172	0.0163	0.0327	0.0005	0.001	0.0051
2014	0.0172	0.0163	0.0327	0.0005	0.001	0.0051
2015	0.0172	0.0163	0.0327	0.0005	0.001	0.0051
2016	0.0172	0.0163	0.0327	0.0005	0.001	0.0051
2017	0.0172	0.0163	0.0327	0.0005	0.001	0.0051
2018	0.0172	0.0163	0.0327	0.0005	0.001	0.0051
2019	0.0172	0.0163	0.0327	0.0005	0.001	0.0051
2020	0.0172	0.0163	0.0327	0.0005	0.001	0.0051

Vehicle Type and Year	N_2O (g/mi)					
	Gasoline	Gasoline	Gasoline	Diesel	Diesel	Diesel
	Passenger Car	Light Truck (Vans, Pickup Trucks, SUVs)	Heavy-Duty Vehicle	Passenger Car	Light Truck (Vans, Pickup Trucks, SUVs)	Heavy-Duty Vehicle
1980	0.0647	0.1035	0.0515	0.0012	0.0017	0.0048
1981	0.0647	0.1035	0.0515	0.0012	0.0017	0.0048
1982	0.0647	0.1035	0.0515	0.0012	0.0017	0.0048
1983	0.0647	0.1035	0.0515	0.001	0.0014	0.0048
1984	0.0647	0.1035	0.0515	0.001	0.0014	0.0048
1985	0.0647	0.1035	0.0515	0.001	0.0014	0.0048
1986	0.0647	0.1035	0.0515	0.001	0.0014	0.0048
1987	0.0647	0.1035	0.0849	0.001	0.0014	0.0048
1988	0.0647	0.1035	0.0933	0.001	0.0014	0.0048
1989	0.0647	0.1035	0.0933	0.001	0.0014	0.0048
1990	0.0647	0.1035	0.1142	0.001	0.0014	0.0048
1991	0.0647	0.1035	0.1142	0.001	0.0014	0.0048
1992	0.0647	0.1035	0.1142	0.001	0.0014	0.0048
1993	0.0647	0.1035	0.1142	0.001	0.0014	0.0048
1994	0.056	0.0982	0.1142	0.001	0.0014	0.0048
1995	0.0473	0.0908	0.1142	0.001	0.0014	0.0048
1996	0.0426	0.0871	0.168	0.001	0.0015	0.0048
1997	0.0422	0.0871	0.1726	0.001	0.0015	0.0048
1998	0.0393	0.0728	0.1693	0.001	0.0015	0.0048
1999	0.0337	0.0564	0.1435	0.001	0.0015	0.0048
2000	0.0273	0.0621	0.1092	0.001	0.0015	0.0048
2001	0.0158	0.0164	0.1235	0.001	0.0015	0.0048
2002	0.0153	0.0228	0.1307	0.001	0.0015	0.0048
2003	0.0135	0.0114	0.124	0.001	0.0015	0.0048
2004	0.0083	0.0132	0.0285	0.001	0.0015	0.0048
2005	0.0079	0.0101	0.0177	0.001	0.0015	0.0048
2006	0.0057	0.0089	0.0175	0.001	0.0015	0.0048
2007	0.0041	0.0079	0.0173	0.001	0.0015	0.0048
2008	0.0038	0.0066	0.0171	0.001	0.0015	0.0048
2009	0.0038	0.0066	0.0171	0.001	0.0015	0.0048
2010	0.0038	0.0066	0.0171	0.001	0.0015	0.0048
2011	0.0038	0.0066	0.0171	0.001	0.0015	0.0048
2012	0.0038	0.0066	0.0171	0.001	0.0015	0.0048
2013	0.0038	0.0066	0.0171	0.001	0.0015	0.0048
2014	0.0038	0.0066	0.0171	0.001	0.0015	0.0048
2015	0.0038	0.0066	0.0171	0.001	0.0015	0.0048
2016	0.0038	0.0066	0.0171	0.001	0.0015	0.0048
2017	0.0038	0.0066	0.0171	0.001	0.0015	0.0048
2018	0.0038	0.0066	0.0171	0.001	0.0015	0.0048
2019	0.0038	0.0066	0.0171	0.001	0.0015	0.0048
2020	0.0038	0.0066	0.0171	0.001	0.0015	0.0048

Source: Based on U.S. EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2008 (2010).

Source: LGOP (Local Government Operations Protocol). 2020. Local Government Operations Protocol, Version 1.1. California Air Resources Board, California Climate Action Registry, ICLEI, and The Climate Registry.

Default CH_4 and N_2O Emission Factors for Alternative Fuel Vehicles

CH_4 (g/mi)	Passenger Car	Light Truck (Vans, Pickup Trucks, SUVs)	Heavy-Duty Vehicle
Methanol	0.018	0.018	0.066
CNG	0.737	0.737	1.966
LNG	NA	NA	1.966
LPG	0.037	0.037	0.066
Ethanol (E85)	0.055	0.055	0.197
Biodiesel (B5)	0.001	0.001	0.005
Biodiesel (B20)	0.001	0.001	0.005

N_2O (g/mi)	Passenger Car	Light-Duty Vehicle	Heavy-Duty Vehicle
Methanol	0.067	0.067	0.175
CNG	0.05	0.05	0.175
LNG	NA	NA	0.175
LPG	0.067	0.067	0.175
Ethanol (E85)	0.067	0.067	0.175
Biodiesel (B5)	0.001	0.001	0.005
Biodiesel (B20)	0.001	0.001	0.005

Source (all except motorcycles): LGOP (Local Government Operations Protocol). 2010. Local Government Operations Protocol, Version 1.1. California Air Resources Board, California Climate Action Registry, ICLEI, and The Climate Registry.

Non-CO_2 Emission Factors for Other Vehicles

	CH_4 (g/gallon fuel)					N_2O (g/gallon fuel)						
Vehicle Types	Gasoline	Diesel	Residual Fuel	Jet Fuel	Aviation Gasoline	Gasoline	Diesel	Residual Fuel	Jet Fuel	Aviation Gasoline		
Motorcycles (1996 +)	0.0672					0.0069					VMT	9.6
Motorcycles (- 1995)	0.0899					0.0087					VMT	
Agricultural Equipment	1.26	1.44				0.22	0.26				gal	
Construction Equipment	0.5	0.58				0.22	0.26				gal	
Utility and Recreational Equipment	0.5	0.58				0.22	0.26				gal	
Aircraft				0.27	7.04				0.31	0.11	gal	
Ships and Boats	0.64	0.74	0.86			0.22	0.26	0.3			gal	
Locomotives		0.8					0.26				gal	

Source: U.S. EPA Climate Leaders, Mobile Combustion Guidance (2008) based on U.S. EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2005 (2007), Annex 3.2, Table A-101.

Source (motorcycles): U.S. EPA. 2020. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2018. Office of Atmospheric Programs, U.S. Environmental Protection Agency. EPA 430-R-20-002.

Wastewater

Default Factors Used to Calculate Emissions from Wastewater Treatment

Variable Description	Shorthand	Value
Density of Methane	p(CH4)	662
CH_4 Destruction Efficiency	DE	0.99
Default biogas production	Digester Gas	1
Fraction of CH_4 in Biogas (default	F CH4 default	0.65
Maximum CH_4 Production Capaci	Bo	0.6
Anaerobic CH_4 Correction Factor	MCF anaerobic	0.8
Industrial Discharge Factor	F ind	1.25
Default fraction BOD_5 removed in	F p	0.325
Septic CH_4 Correction Factor	MCF septic	0.5
Default BOD_5 Load	BOD_5 load	0.09
Emissions Factor, Nitrification/De	EF nit/denit	7
Emissions Factor, no Nitrification,	EF no nit/denit	3.2
Emissions Factor, Effluent	EF effluent	0.005
Molecular Weight Ratio of N2O to	N2O/N2	1.571428571
Total N Load	N Load	0.026
Nitrogen uptake in aerobic syster	N uptake aerobic	0.05
Nitrogen uptake in anaerobic syst	N uptake anaerobic	0.005
Fraction of nitrogen removed wit	Nit/denit default	0.7
Fraction of nitrogen removed wit	No Nit/denit default	0

Used in Equation…									
10.1	10.2								
10.1	10.2								
	10.2								
		10.3	10.4	10.5	10.6				
		10.3	10.4						
			10.4			10.7	10.8		10.10
			10.4						
				10.5	10.6				
					10.6				10.10
						10.7			
							10.8		
								10.9	10.10
								10.9	10.10
									10.10
									10.10
									10.10
									10.10
									10.10

Source: LGOP (Local Government Operations Protocol). 2010. Local Government Operations Protocol, Version 1.1. California Air Resources Board, California Climate Action Registry, ICLEI – Local Governments for Sustainability, and The Climate Registry.

Employee Commute

Employee Commute Factors - For simplicity, assumes all modes use gasoline, and all alternative transportation options have effective emissions of zero.

Mode	Average mpg	people/mode	kg CO_2/gal
Single Occupancy Vehicle	21.6	1	8.78
Carpool	21.6	2.42	8.78
Motorcycle	43.4	1	8.78
Transit			0
Bike			0
Walk			0
Work at home			0
Other			0

Old Table Rows

Mode	Average m	people/m	kg CO_2/gal
Single Occupancy Vehicle	20.5	1	8.78
Carpool	20.5	2.498	8.78
Motorcycle	56.5	1	8.78

carpool calculation		Weighted Average
In 2-person carpool	10,382,478	2.416031
In 3-person carpool	1,759,044	
In 4-person carpool	641,090	
In 5- or 6-person carpool	330,934	
In 7-or-more-person carpool	274,032	
Total	13,387,578	

Sources:
Average Fuel Efficiency of each Mode: FHWA (Federal Highway Administration). 2012. Highway Statistics 2010. Federal Highway Administration, U.S. Department of Transportation.
Average Number of Carpoolers: U.S. Census Bureau. 2008. American Community Survey
CO_2 per Gallon of Gasoline: CARB (California Air Resources Board). 2010. Local Government Operations Protocol, Version 1.1. California Air Resources Board, California Climate Action Registry, ICLEI, and The Climate Registry.

Water

Electricity Use in Southern California Water Systems- Average used to develop calculations in the Water worksheet
Table C-4: Potential Adjustments to WER Table 1-3, Electricity Use in Typical Urban Water Systems (CEC 2006)

Southern California (kWh/MG)		kWh/MG
	Adjusted	w/ Losses
SWP west branch	7900	9232
SWP east branch	9900	11569
MWD west branch	906	1013
MWD east branch	540	604

Source: CEC (California Energy Commission). 2006. Refining Estimates of Water-Related Energy Use in California. California Energy Commission. CEC-500-2006-118.

eGRID Electricity Emission Factors

CAMX eGRID subregion	(lb/MWh)																				
Gas	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
CO_2	878.71	878.71	878.71	878.71	878.71	724.12	702.57	681.01	669.85	658.68	610.82	630.56	650.31	609.48	568.64	548.25	527.86	512.20	496.54	496.54	496.54
CH_4	0.0302	0.0302	0.0302	0.0302	0.0302	0.0302	0.0293	0.0283	0.0286	0.0289	0.0285	0.0298	0.0311	0.0321	0.0331	0.0331	0.0330	0.0335	0.0340	0.0340	0.0340
N_2O	0.008	0.008	0.008	0.008	0.008	0.008	0.007	0.006	0.006	0.006	0.006	0.006	0.006	0.005	0.004	0.004	0.004	0.004	0.004	0.004	0.004

Source: Emissions & Generation Resource Integrated Database (eGRID). https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid.

Land Use Factors

Emission Factors For N_2O

Fertilizer Type	Percent N Content	Percent N lost to Volatilization	Percent N Leach and Runoff	Percent from Applied N	Percent from Volatized N	Percent from Leached and Runoff N

Synthetic	1	0.1	0.3	0.0125	0.01	0.025
Organic	0.037	0.2	0.3	0.0125	0.01	0.025
Manure	0.005	0.2	0.3	0.0125	0.01	0.025

Sources: Unless otherwise noted, all fertilizer emission factors are IPCC default values from the Revised 1996 Guidelines for National GHG Inventories.

Fertilizer Emissions = ((Fertilizer Consumption in the Park)*(Percent N Content)*(1-Percent N lost to Volatilization)*(Percent from Applied N)+(Fertilizer Consumption in the Park)*(Percent N Content)*(Percent N lost to Volatilization)*(Percent from Volatized N)+(Fertilizer Consumption in the Park)*(Percent N content)*(1-Percent N lost to Volatilization)*(Percent N Leach and Runoff)*(Percent from Leached and Runoff))

N2O/N2O-N	1.571428571

Carbon Sequestration Factor 2.23 (metric ton C/hectare/year)

Source: EPA State Inventory Tools, Land-Use Land Use Change and Forestry module.