Appendix A

Greenhouse Gas Emissions Inventory and Forecasts

Memo

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Date: February 16, 2021

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From: Honey Walters, Hannah Kornfeld, and Sam Ruderman (Ascent Environmental)

Subject: City of Milpitas Climate Action Plan Update, Greenhouse Gas Emissions Inventory Update – Technical Memorandum

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INTRODUCTION

In 2013, the City of Milpitas (City) adopted its first Climate Action Plan (CAP), which served as a roadmap to meet the State's 2020 greenhouse gas (GHG) emissions reduction target (i.e., 15 percent below 2005 baseline emissions). The 2005 inventory included GHG emissions generated by community activities but did not include the emissions associated with the City's municipal operations. The City is now updating the 2005 GHG emissions inventory for baseline year 2019 in preparation of its Climate Action Plan Update (CAP Update). The CAP Update will include both GHG emissions generated from activities occurring in the community as well as GHG emissions from municipal operations. To gauge progress since 2005, the original 2005 inventory has been revised to account for new data and methods in alignment with the 2019 inventory update. In addition to updating the City's community baseline inventory to 2019, a 2015 inventory has been developed as a representative interim year for the City.

The CAP Update is intended to reduce GHG emissions for target years of 2030, 2040, and 2045. The long-term target year of 2045 was chosen to better align with newer State GHG targets such as the statewide carbon neutrality goal, rather than the previously issued 2050 goal of 80 percent reduction from 1990 levels. This first phase in preparation of the CAP Update includes: (1) revising the 2005 GHG emissions inventory baseline to be consistent with current methodologies and (2) developing GHG emissions inventories for 2015 and 2019 for both the community and municipal operations. This technical memorandum provides the results of the revised 2005 GHG emissions inventory, the 2015 and 2019 inventories, as well as associated methods, assumptions, emissions factors, and data sources.

The updated GHG emissions inventories will provide a foundation for the forthcoming phases of the CAP Update process, including forecasting future emissions, developing GHG emissions reduction targets, defining GHG emissions reduction measures, and an action plan that will help the City achieve identified targets.

ORGANIZATION OF THIS MEMORANDUM

This memorandum consists of two main parts:

- **Section 1: Summary of Inventory Results** presents an overview of the revised 2005 community GHG emissions inventory and the 2015 and 2019 community and municipal operations inventories for each sector, including new sources and methods not previously included in the 2005 inventory. Key components include:
  - a review of the original and revised 2005 inventories,
  - a summary of 2015 and 2019 community emissions by sector,
  - a general comparison of community emissions to the baseline 2005 inventory, and
  - a summary of 2015 and 2019 municipal emissions by sector.
- **Section 2: Data, Methods, and Assumptions** summarizes data, methods, and assumptions used in the 2015 and 2019 inventories and provides activity data and GHG emissions estimates by sector.

1 SUMMARY OF INVENTORY RESULTS

1.1 REVISED 2005 COMMUNITY INVENTORY

Since the original 2005 GHG inventory was prepared, new protocols have been developed for calculating community GHG emissions in various sectors. These changes reflect refinements in the planning process that have resulted from research in the field and shared knowledge from local governments engaged in climate action planning. For this CAP Update, 2005 GHG emissions estimates were revised using current methodologies and guidance provided by ICLEI – Local Governments for Sustainability (ICLEI) (discussed further in Section 2.2.1). The revisions to the 2005 inventory allow for consistency and enable direct comparison with the 2015 and 2019 inventories.

Based on the modeling conducted for the revised inventory, community activities in the city generated approximately 547,972 metric tons of carbon dioxide equivalent ($MTCO_2e$) in 2005. Major emissions sectors included on-road transportation, residential and nonresidential building energy use, and solid waste. Table 1 presents the original 2005 inventory compared to the revised 2005 inventory, and Figure 1 displays the revised 2005 community emissions inventory.

Table 1 Original and Revised 2005 Milpitas Community Greenhouse Gas Emissions Inventories

Sectors	Original 2005 Inventory		Revised 2005 Inventory	
	$MTCO_2e$/year	Percent of Total	$MTCO_2e$/year	Percent of Total
On-Road Transportation	320,990	50	252,864	46
Nonresidential Building Energy	183,800	29	183,424	33
Residential Building Energy	64,230	10	64,108	12
Solid Waste	54,410	8	26,998	5
Off-Road Vehicles and Equipment	15,140	2	15,034	3
Water Supply	1,960	<1	4,466	1
Wastewater Treatment	1,070	<1	1,078	<1
Light Rail	1,070	<1	NA[1]	NA[1]
Total	**642,670**	**100**	**547,972**	**100**

Notes: Totals may not sum exactly due to independent rounding. $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year; NA = not applicable.

[1] Light rail was excluded from the revised 2005 inventory. Further details are included below.

Source: Original 2005 inventory prepared by the City of Milpitas in 2013; revised 2005 inventory prepared by Ascent Environmental in 2021.

The revised 2005 inventory estimates an approximately 15 percent decrease in emissions below the original 2005 inventory. In general, differences in GHG emissions estimates between the inventories can be explained by:

- the use of different global warming potential (GWP) values between inventories (see Section 2.1 below for explanation of GWP values),
- differences in data sources between inventories, and
- adjustments in calculation methodologies (e.g., equations and emissions factors).

Differences in data sources and calculation methodologies associated with the on-road transportation, solid waste, and water supply sectors were responsible for nearly all of the changes between the original and revised 2005 inventories. Emissions from the on-road transportation sector in the revised 2005 inventory were calculated using

emissions factors obtained from an updated transportation model (discussed further in Sections 2.2.1 and 2.2.3). Calculations for the solid waste sector were adjusted to align with current data sources and methods that were not used in the original 2005 inventory. Water supply emissions in the revised 2005 inventory were estimated using adjusted energy intensity factors (described in detail in Section 2.2.5). All changes were made in accordance with industry-leading GHG emissions inventorying guidance provided by ICLEI.

In addition, while light rail emissions were included in the original 2005 inventory, this sector was excluded from the revised 2005 inventory because the local transit operator, Valley Transit Authority (VTA), has prepared GHG emissions inventories of its own operations, which account for these emissions. VTA is using its inventories to develop strategies to reduce GHG emissions from its operations.

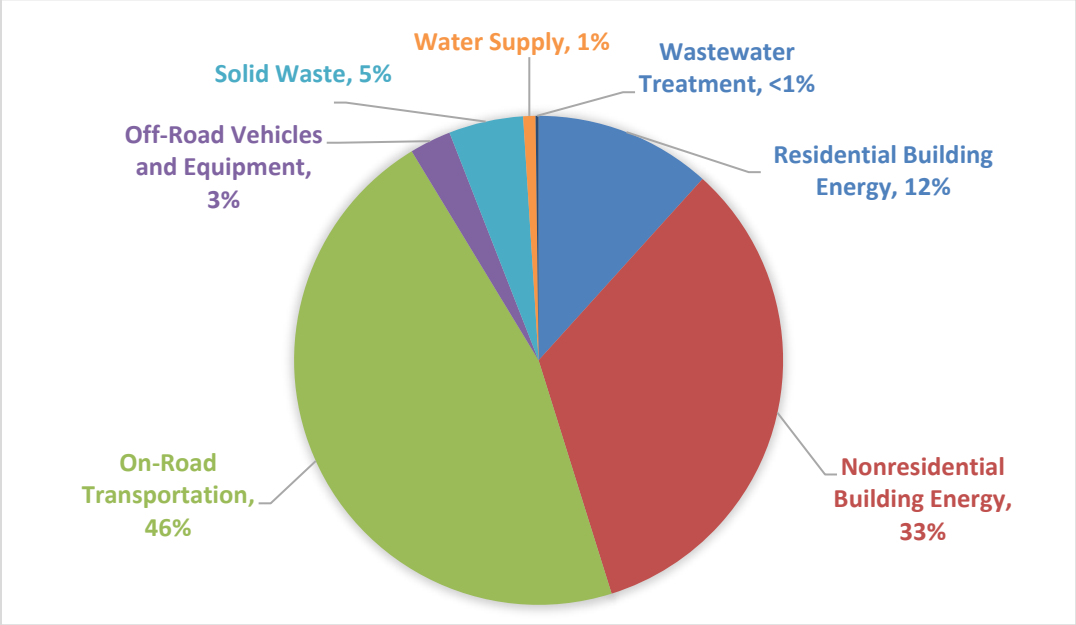

Figure 1 Revised 2005 Milpitas Community Greenhouse Gas Emissions Inventory

1.2 2015 AND 2019 COMMUNITY INVENTORIES

Based on the modeling conducted, community activities generated approximately 588,414 $MTCO_2e$ in 2015 and 441,557 $MTCO_2e$ in 2019. Table 2 presents the city's 2015 and 2019 GHG emissions inventories by sector, and Figure 2 illustrates the 2019 community inventory. The 2019 inventory will act as the city's updated GHG emissions baseline, which will be used to set future emissions reductions targets. For this reason, figures show 2019 emissions, rather than 2015 emissions. A description of each emissions sector, including key sources of emissions, is provided in further detail in Section 2, "Data, Methods, and Assumptions."

Table 2 2015 and 2019 Milpitas Community Greenhouse Gas Emissions Inventories

Sectors	2015 Inventory		2019 Inventory	
	$MTCO_2e$/year	Percent of Total	$MTCO_2e$/year	Percent of Total
Residential Building Energy	57,581	10	42,218	10
Nonresidential Building Energy	202,368	34	98,319	22
On-Road Transportation	278,061	46	259,627	59
Off-Road Vehicles and Equipment	16,511	3	15,554	4
Solid Waste	28,984	5	23,566	5
Water Supply	2,974	1	694	<1
Wastewater Treatment	1,935	<1	1,578	<1
Total	**588,414**	**100**	**441,557**	**100**

Notes: Totals may not sum exactly due to independent rounding. $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year.

Source: 2015 and 2019 inventories prepared by Ascent Environmental in 2021.

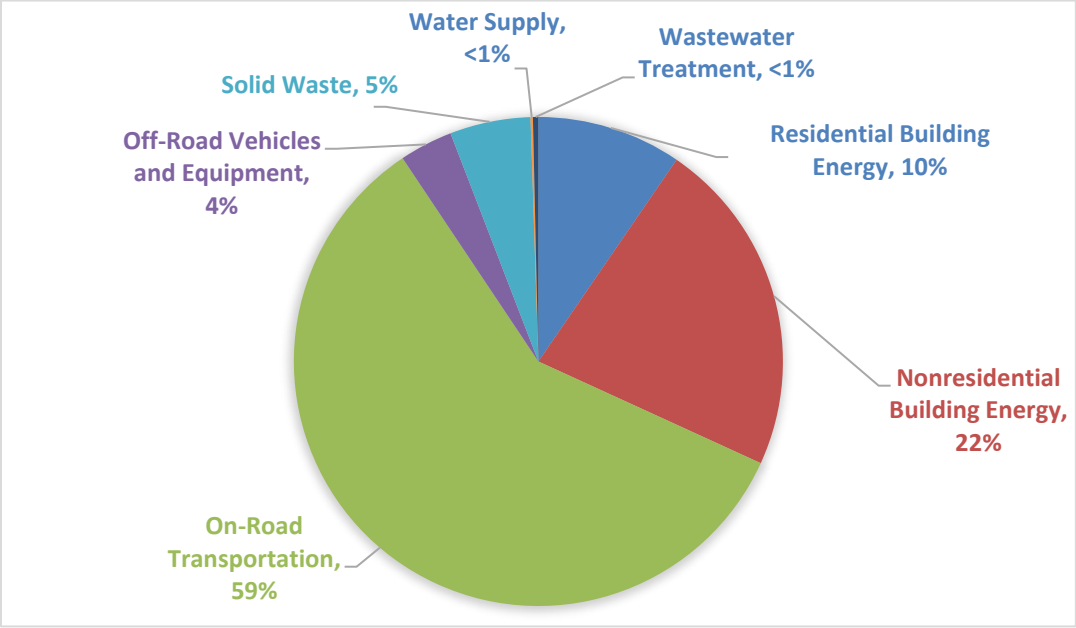

Figure 2 2019 Milpitas Community Greenhouse Gas Emissions Inventory

The organization of the revised 2005 inventory is generally consistent with the updated 2015 and 2019 inventories. One difference is that while the building energy sectors of the 2015 and 2019 inventories include energy consumption from nonresidential backup generators, these data were not available for 2005. Therefore, the building energy sector of the revised 2005 inventory does not estimate GHG emissions from nonresidential backup generators. Similarly, emissions from composting are included in the 2015 and 2019 inventories, but composting data were unavailable for 2005 and thus, composting emissions are not included in the revised 2005 inventory. Table 3 and Figure 3 show the 2005 community inventory alongside the updated 2015 and 2019 community results.

Table 3 Comparison of Milpitas Community Greenhouse Gas Emissions Inventories

Sector	Revised 2005 Inventory ($MTCO_2e$/year)	2015 Inventory ($MTCO_2e$/year)	2019 Inventory ($MTCO_2e$/year)	Percent Change 2005 – 2019
Residential Building Energy	252,864	57,581	42,218	-34
Nonresidential Building Energy	183,424	202,368	98,319	-46
On-Road Transportation	64,108	278,061	259,627	3
Off-Road Vehicles and Equipment	26,998	16,511	15,554	3
Solid Waste	15,034	28,984	23,566	-13
Water Supply	4,466	2,974	694	-84
Wastewater Treatment	1,078	1,935	1,578	46
Total	**547,972**	**588,414**	**441,557**	**-19**

Notes: Totals may not sum exactly due to independent rounding. $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year.

Source: Revised 2005 inventory and 2015 and 2019 inventories prepared by Ascent Environmental in 2021.

Based on the modeling conducted, community GHG emissions increased by approximately 7 percent above the revised 2005 baseline in 2015 as a result of population and employment growth in the city. In 2019, community GHG emissions decreased by approximately 19 percent below the revised 2005 baseline. Although population and employment continued to rise in 2019, the reduction in emissions between the revised 2005 inventory and the 2019 inventory can be explained by:

- improvements in vehicle and equipment fuel efficiency due to State and federal regulations,
- reductions in the carbon intensity of grid electricity due to State regulations, and
- the supply of near-zero-emissions grid electricity from Silicon Valley Clean Energy (SVCE) to the city starting in 2018.

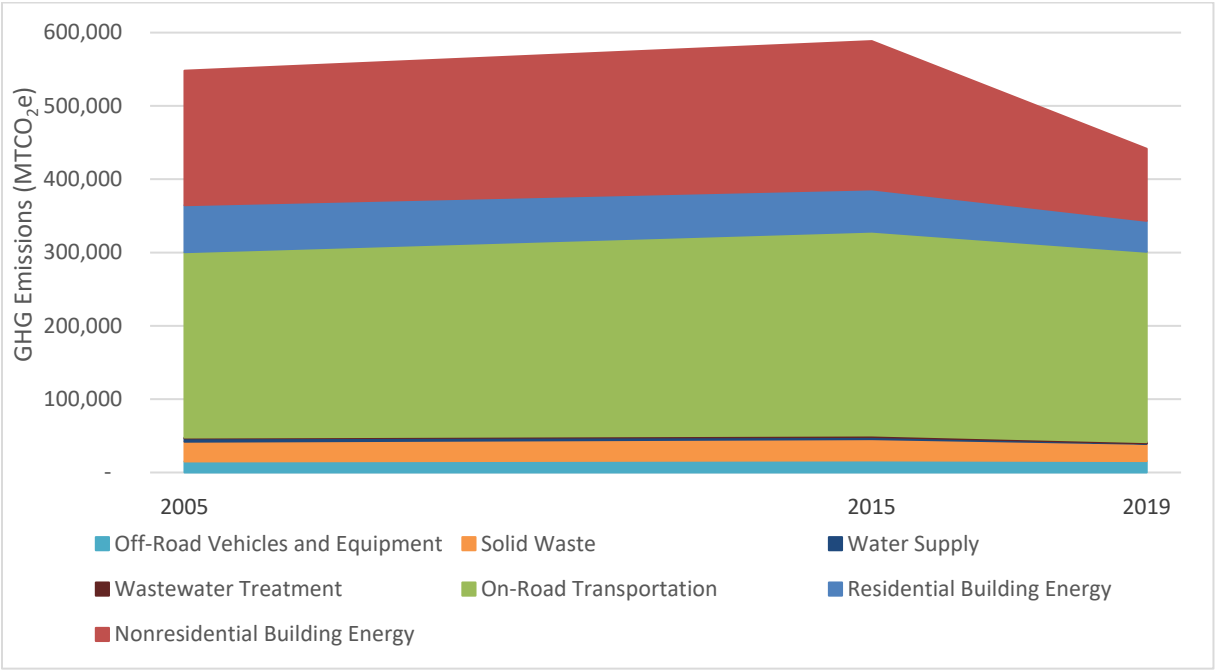

Figure 3 Comparison of Milpitas Community Greenhouse Gas Emissions Inventories

1.3 2015 AND 2019 MUNICIPAL OPERATIONS INVENTORY RESULTS

Based on the modeling conducted, the City's municipal operations generated approximately 5,019 $MTCO_2e$ in 2015 and 3,252 $MTCO_2e$ in 2019. Major emissions sectors included buildings and facilities, streetlights and traffic signals, employee commute, and vehicle fleet. Table 4 presents the City's 2015 and 2019 municipal operations GHG emissions inventories by sector, and Figure 4 illustrates the 2019 municipal operations inventory.

Table 4 2015 and 2019 Milpitas Municipal Operations Greenhouse Gas Emissions Inventories

Sector	2015 Inventory		2019 Inventory	
	$MTCO_2e$/year	Percent of Total	$MTCO_2e$/year	Percent of Total
Buildings and Facilities	2,001	40	870	27
Streetlights and Traffic Signals	564	11	3	<1
Employee Commute	1,304	26	1,195	37
Vehicle Fleet	1,017	20	1,081	33
Solid Waste	52	1	53	2
Water Supply	70	1	41	1
Wastewater Treatment	11	<1	9	<1
Total	**5,019**	**100%**	**3,252**	**100%**

Notes: Totals may not sum exactly due to independent rounding. $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year.

Source: 2015 and 2019 inventories prepared by Ascent Environmental in 2021.

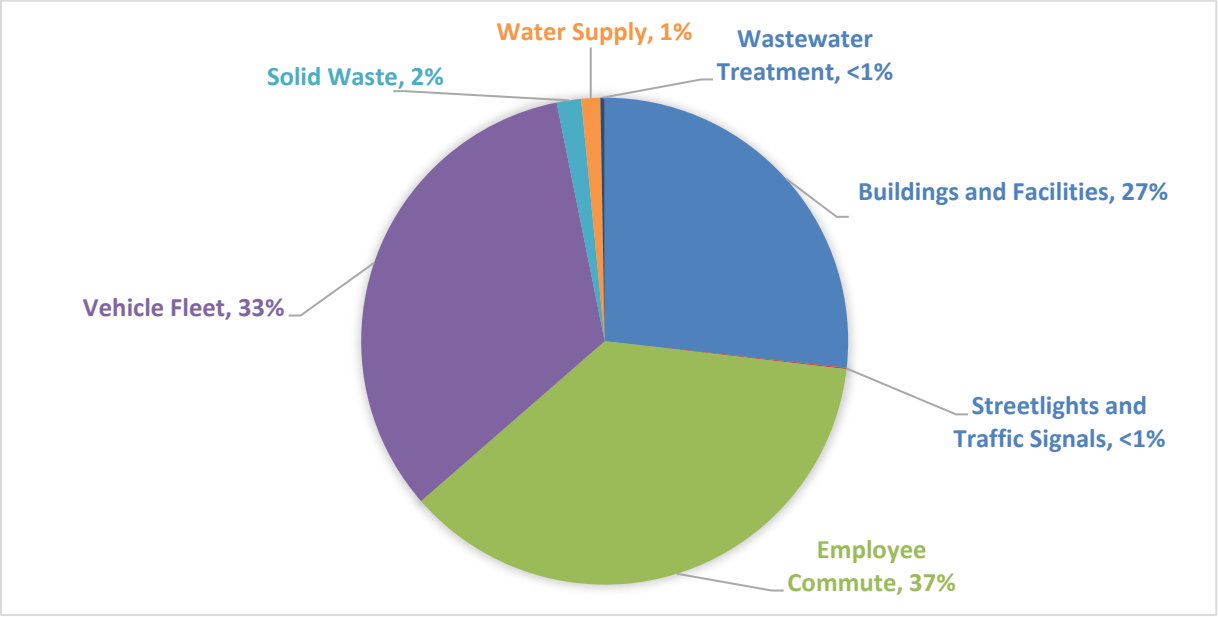

Figure 4 2019 Milpitas Municipal Operations Greenhouse Gas Emissions Inventory

GHG emissions from municipal operations decreased approximately 35 percent between 2015 and 2019. These reductions can be explained primarily by the supply of near-zero-emissions grid electricity from SVCE for municipal operations beginning in 2018.

2 DATA, METHODS, AND ASSUMPTIONS

2.1 OVERALL ASSUMPTIONS AND DATA

2.1.1 Utility Emissions Factors

Emissions of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) per megawatt-hour (MWh) of electricity or therm of natural gas can vary by location and from year to year depending on numerous factors. Utility-specific factors for GHG emissions were obtained and used throughout the 2015 and 2019 inventories to estimate GHG emissions from electricity and natural gas consumption. Sources for electricity and natural gas emissions factors are shown below.

- **Electricity:** Utility electricity emissions factors for CO_2, CH_4, and N_2O were obtained from Pacific Gas and Electric (PG&E), SVCE, and the U.S. Environmental Protection Agency's (EPA's) Emissions & Generation Resource Integrated Database (eGRID). For 2015, PG&E provided the CO_2 emissions factor, and CH_4 and N_2O emissions factors were obtained from eGRID's 2016 Annual Output Emissions Rates (EPA 2020). For 2019, PG&E's CO_2 emissions factor was interpolated using the 2018 emissions factor provided by PG&E and the requirements of the Renewables Portfolio Standard included in Senate Bill (SB) 100. The same approach was taken for CH_4 and N_2O emissions factors from eGRID's 2018 Annual Output Emissions Rates (EPA 2020). SVCE's emissions factor for CO_2 in 2019 was provided by SVCE.
- **Natural Gas:** Utility natural gas emissions factors for CO_2, CH_4, and N_2O were obtained from The Climate Registry's (TCR's) 2020 Default Emission Factors (TCR 2020).

Specific utility emissions factors used in the inventory calculations are shown below in Table 5.

Table 5 2015 and 2019 Milpitas Utility Emissions Factors

Source and Unit	Emissions Factor	
	2015	2019
SVCE – Electricity		
lb CO_2/MWh	NA	2.34
lb CH_4/MWh	NA	0
lb N_2O/MWh	NA	0
PG&E – Electricity		
lb CO_2/MWh	404.51	197.81
lb CH_4/MWh	0.0330	0.0327
lb N_2O/MWh	0.0040	0.00385
PG&E – Natural Gas		
lb CO_2/therm	11.7	11.7
lb CH_4/therm	0.000227	0.000227
lb N_2O/therm	0.00000454	0.00000454

Notes: CH_4 = methane; CO_2 = carbon dioxide; lb = pounds; MWh = megawatt-hours; N_2O = nitrous oxide; NA = not applicable; PG&E = Pacific Gas & Electric; SVCE = Silicon Valley Clean Energy.

Source: Utility emissions factors provided by PG&E, SVCE, EPA, and TCR. Table compiled by Ascent Environmental in 2021.

2.1.2 Global Warming Potentials

GHG emissions other than CO_2 generally have a stronger insulating effect and thus, a greater ability to warm the earth's atmosphere through the greenhouse effect. This effect is measured in terms of a pollutant's GWP. CO_2 has a GWP factor of one while all other GHGs have GWP factors measured in multiples of one. This conversion of non-CO_2 gases to one unit enables the reporting of all emissions in terms of carbon dioxide equivalent (CO_2e), which allows consideration of all gases in comparable terms and makes it easier to communicate how various sources and types of GHG emissions contribute to climate change. $MTCO_2e$ is the standard unit for reporting emissions.

Consistent with the best available science, these inventories use GWP factors published in the Fifth Assessment Report from the Intergovernmental Panel on Climate Change, where CH_4 and N_2O have GWP factors of 28 and 265, respectively (IPCC 2014). This means that CH_4 is 28 times stronger than CO_2 and N_2O is 265 times stronger than CO_2 in their potential to insulate solar radiation within the atmosphere.

2.1.3 Population and Employment

Population and employment data were used to scale activity levels for certain emissions sources and sectors. Population and employment data were obtained from Metropolitan Transportation Commission's (MTC's) Plan Bay Area 2040 for 2015 and 2019. Data for 2005 was estimated by extrapolating backwards (i.e., "back-casting") using the average annual growth rate reported by MTC from 2010 to 2040.

2.2 COMMUNITY INVENTORIES DATA AND ASSUMPTIONS

2.2.1 Sector-Specific Assumptions and Methods for Community Inventories

Several inventory protocols have been developed to provide guidance for communities and local governments to account for emissions accurately and consistently. In coordination with other partners, ICLEI has developed guidance for local-scale accounting of emissions that many local governments use to develop their GHG inventories. The most recent guidance for community-scale emissions inventories is ICLEI's July 2019 publication *U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions* (U.S. Community Protocol), Version 1.2 (ICLEI 2019).

The following summarizes data sources and methods used in estimating community GHG emissions in 2015 and 2019:

- Building Energy: Annual electricity and natural gas usage data for the city and utility emissions factors were provided by PG&E and SVCE (see Table 5 above). Additional emissions factors were obtained from eGRID and TCR. Annual nonresidential backup generator usage was provided by Bay Area Air Quality Management District (BAAQMD). Emissions factors for backup generator fuels was obtained from TCR.
- Transportation: For the on-road transportation sector, daily vehicle miles traveled (VMT) were obtained from MTC for the city, using the SB 375 Regional Technical Advisory Committee's (RTAC's) origin-destination method. Vehicle emissions factors were derived from California Air Resources Board's (CARB's) 2021 EMissions FACtor (EMFAC2021) model. Off-road vehicle emissions were estimated from CARB's OFFROAD2007 and OFFROAD2017 models and scaled by population, employment, or share of road miles.
- Solid Waste: Emissions associated with waste generated by residents and businesses in the city were estimated using disposal data available from the California Department of Resources Recycling and Recovery (CalRecycle) for landfills receiving waste from the city. Landfill gas (LFG) collection information was available from EPA.

- **Water Supply:** Water supply emissions were estimated using region-specific energy intensity factors obtained from the California Public Utilities Commissions (CPUC) in combination with water consumption volumes provided by the city's water purveyors, San Francisco Public Utilities Commission (SFPUC), Santa Clara Valley Water District (Valley Water), and South Bay Water Recycling (SBWR). PG&E utility emissions factors were used to estimate GHG emissions[1].
- **Wastewater:** Wastewater sector emissions depend on the types of treatment processes and equipment that each wastewater treatment plant uses. Data regarding treatment processes, population served, digester gas production and combustion, biological oxygen demand (BOD) load, and average nitrogen load were obtained from the San Jose–Santa Clara Regional Wastewater Facility (RWF).

2.2.2 Building Energy

Residential and nonresidential building energy use in 2015 resulted in approximately 259,949 $MTCO_2e$ and in 2019 resulted in approximately 140,537 $MTCO_2e$. This sector generated approximately 32 percent of the city's emissions in 2019 and represents the second largest emissions sector in the inventory. Most of these emissions were a result of electricity and natural gas use in homes and business, primarily for lighting and heating, ventilation, air condition, and cooling (HVAC), as well as to power appliances. A small proportion of nonresidential building energy emissions are associated with diesel and natural gas consumption in backup generators. In 2019, electricity from both residential and nonresidential buildings accounted for approximately 22 percent of emissions from the building energy sector. Natural gas use accounted for approximately 78 percent, and backup generators accounted for less than 1 percent, of emissions from the building sector in 2019. Annual electricity, natural gas, and backup generator usage and GHG emissions are shown in Table 6.

Table 6 2015 and 2019 Milpitas Community Building Energy Use Greenhouse Gas Emissions

Source	2015		2019	
	Quantity	GHG Emissions	Quantity	GHG Emissions
Electricity	**MWh/year**	**$MTCO_2e$/year**	**MWh/year**	**$MTCO_2e$/year**
Residential	117,026	21,578	121,801	581
Nonresidential	784,254	144,603	708,759	29,880
Electricity Total	*901,280*	*166,180*	*830,560*	*30,461*
Natural Gas	**therms/year**	**$MTCO_2e$/year**	**therms/year**	**$MTCO_2e$/year**
Residential	6,779,674	36,003	7,840,602	41,637
Nonresidential	10,875,823	57,756	12,772,616	67,828
Natural Gas Total	*17,655,497*	*93,759*	*20,613,218*	*109,466*
Backup Generators		**$MTCO_2e$/year**		**$MTCO_2e$/year**
Nonresidential	NA	10	NA	611
Energy Combined		**$MTCO_2e$/year**		**$MTCO_2e$/year**
Residential	NA	57,581	NA	42,218
Nonresidential	NA	202,368	NA	98,319
Total	**NA**	**259,949**	**NA**	**140,537**

Notes: Totals in columns may not sum exactly due to independent rounding. GHG = greenhouse gas; MMBTU = million British thermal units; $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year; MWh = megawatt-hours; NA = not applicable.

[1] Based on communications with the City, it was assumed that SFPUC was supplied by carbon-free electricity in 2019.

Source: 2015 and 2019 inventories prepared by Ascent Environmental in 2021.

RESIDENTIAL ENERGY

Residential energy emissions result indirectly from electricity consumption and directly from onsite combustion of natural gas. SVCE and PG&E are the providers of residential energy in the city. In 2015, PG&E provided electricity to residents in the city, and in 2019, both PG&E and SVCE provided electricity to the city's residents. SVCE is a public, not-for profit community choice energy provider that was formed to serve the communities of Silicon Valley, including Milpitas. It began providing clean, near-zero-emissions electricity to the city in 2018 and currently serves approximately 97 percent of residential and nonresidential accounts, while the remaining electricity accounts are served by PG&E. As SVCE provides near-zero-emissions electricity, residential electricity emissions in 2019 were generated almost entirely by PG&E customers. Residential natural gas was provided by PG&E in both 2015 and 2019.

Annual residential electricity usage data for 2015 and 2019 in the city was obtained from PG&E and SVCE, expressed as MWh per year (MWh/year). To calculate the $MTCO_2e$ of residential electricity consumption, emissions factors (shown in Table 5) for CO_2, CH_4, and N_2O were applied to electricity consumption data.

Annual residential natural gas consumption for 2015 and 2019 in the city was obtained from PG&E and SVCE, expressed as therms per year (therms/year). CO_2, CH_4, and N_2O emissions factors for natural gas were applied to consumption data to estimate $MTCO_2e$ from residential natural gas usage.

NONRESIDENTIAL ENERGY

Nonresidential energy emissions, which are generated by commercial and industrial uses, result indirectly from electricity consumption and directly from onsite combustion of natural gas. PG&E and SVCE provide nonresidential electricity in the city. PG&E provided all nonresidential electricity in 2015, and both PG&E and SVCE provided nonresidential electricity in 2019. Nearly all emissions generated from nonresidential electricity consumption are associated with customers that opted out of SVCE-supplied electricity and thus are due to PG&E electricity use. Nonresidential natural gas was in the city was provided by PG&E in 2015 and 2019.

Annual nonresidential electricity usage data for 2015 and 2019 were obtained from PG&E and SVCE, expressed as MWh/year, and annual nonresidential natural gas consumption in the city was obtained from PG&E and SVCE, expressed as therms/year. Emissions associated with nonresidential energy consumption were quantified using the same methods as described above for residential energy calculations.

Data for annual nonresidential backup generators were obtained from BAAQMD, expressed as gallons per year (gallons/year) for diesel fuel, and standard cubic feet per year (scf/year) for natural gas. Emissions factors obtained from TCR were applied to fuel consumption data to estimate GHG emissions associated with nonresidential backup generator usage.

2.2.3 Transportation

ON-ROAD TRANSPORTATION

The on-road transportation sector represents the largest emissions-generator sector in the city. Based on modeling conducted, on-road transportation in the city resulted in approximately 278,061 $MTCO_2e$ in 2015 and 259,627 $MTCO_2e$ in 2019, or 59 percent of the city's 2019 inventory. Passenger vehicles represented 66 percent of emissions in 2015 and 67 percent of emissions from this sector in 2019, and commercial vehicles represented 34 percent of

emissions in 2015 and 33 percent of emissions in 2019. Annual VMT and GHG emissions from on-road transportation are shown in Table 7.

Table 7 2015 and 2019 Milpitas Community On-Road Transportation Greenhouse Gas Emissions

Vehicle Type	2015		2019	
	VMT/year	GHG Emissions ($MTCO_2e$/year)	VMT/year	GHG Emissions ($MTCO_2e$/year)
Passenger Vehicles	492,014,849	182,927	509,968,096	173,746
Commercial Vehicles	67,476,778	95,134	62,921,403	85,881
Total	**559,491,627**	**278,061**	**572,889,499**	**259,627**

Notes: Totals may not sum exactly due to independent rounding. GHG = greenhouse gas; $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year; VMT/year = vehicle miles traveled per year.

Source: 2015 and 2019 inventories prepared by Ascent Environmental in 2021.

On-road transportation emissions are primarily the result of the combustion of gasoline and diesel fuels in passenger vehicles (i.e., cars, light-duty trucks, and motorcycles), medium- and heavy-duty trucks, and other types of vehicles permitted to operate "on-road." To a smaller degree, emissions from on-road vehicles also result from upstream electricity generation for electric vehicles; these emissions are represented in annual electricity emissions in the city. Due to lack of available data, emissions from the combustion of natural gas and other non-electric alternative fuels in on-road vehicles were not included in the community inventory and are assumed to have minimal contribution to total emissions.

MTC is the regional metropolitan planning organization responsible for regional transportation planning in the San Francisco Bay Area. MTC conducted a VMT study that provides daily VMT by city for the years 2015 and 2020. These VMT estimates are associated with trips that begin or end in the city. VMT estimates included 100 percent of vehicle trips that both originate from and end in the city (i.e., fully internal trips), 50 percent of trips that either end in or depart from the city (i.e., internal-external or external-internal trips), and zero percent of vehicle trips that are simply passing through the city boundaries (i.e., external-external, or "pass-through," trips). This vehicle trip accounting method is consistent with the RTAC origin-destination method established through SB 375 and CARB recommendations. Daily VMT was annualized by applying region-specific annualization factors, or the average amount of days driven by residents and visitors of the city. The annualization factors were 352.3 and 355.3 in 2015 and 2019, respectively (Caltrans 2021).

An overall emissions rate for citywide VMT was derived from the statewide mobile source emissions inventory model EMFAC2021, developed by CARB. EMFAC2021 was used to generate emission rates for the city for calendar years 2015 and 2019 with all vehicle classes, model years, speeds, and fuel types. The citywide $MTCO_2e$/mile emissions factor was calculated based on the distribution of VMT for each vehicle class and its emissions factor.

The reduction in on-road transportation emissions between 2015 and 2019 can be explained by two factors. First, VMT from commercial vehicles decreased. While passenger vehicle VMT increased, emissions factors for commercial vehicles (i.e., medium- and heavy-duty vehicles) are much higher than passenger vehicle emissions factors, so changes in commercial vehicle VMT generate proportionally larger impacts on total emissions compared to changes in passenger vehicle VMT. Second, emissions factors for both passenger and commercial vehicles were reduced between 2015 and 2019. This improvement is due to the turnover of older vehicles in the vehicle fleet and increased fuel efficiencies of newer vehicles introduced into the fleet.

OFF-ROAD VEHICLES AND EQUIPMENT

Based on modeling conducted, off-road vehicles and equipment operating in the city emitted approximately 16,511 $MTCO_2e$ in 2015 and 15,554 $MTCO_2e$ in 2019, or 4 percent of the 2019 inventory. The largest emissions-generating off-road transportation categories include industrial equipment, construction and mining equipment, lawn and garden equipment, and light commercial equipment. The estimated annual emissions and scaling factors used are presented in Table 8 below by equipment type.

Table 8 2015 and 2019 Milpitas Community Off-Road Vehicles and Equipment Greenhouse Gas Emissions

Off-Road Vehicles and Equipment Type	GHG Emissions ($MTCO_2e$/year)		Scaling Method
	2015	2019	
Construction and Mining Equipment	4,661	3,478	population + employment
Entertainment Equipment	45	44	population
Industrial Equipment	8,469	8,590	employment
Lawn and Garden Equipment	1,561	1,602	population
Light Commercial Equipment	1,291	1,290	employment
Railyard Operations	1	1	employment
Recreational Equipment	376	430	population
Transportation Refrigeration Units	107	118	share of road miles
Total	**16,511**	**15,554**	NA

Notes: Totals may not sum exactly due to independent rounding. GHG = greenhouse gas; $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year; NA = not applicable.

Source: Data provided by Ascent Environmental in 2021, based on modeling from OFFROAD2007 and OFFROAD2017.

Emissions from the off-road vehicles and equipment sector result from fuel combustion in off-road vehicles and equipment. Data associated with this sector were available from CARB's OFFROAD2007 and OFFROAD2017 models. These models provide emissions details at the State, air basin, or county level. Santa Clara County emissions data from OFFROAD2007 and OFFROAD2017 were apportioned to the city using custom scaling factors depending on the off-road fleet type. For example, due to the likely correlation between commercial activity and employment, the city's portion of emissions from light commercial equipment in the county is assumed to be proportional to the number of jobs in the city as compared to the county as a whole.

OFFROAD2007 provides emissions details for all off-road vehicle and equipment types, but OFFROAD2017 only provides details for certain types of off-road vehicles and equipment that are relevant to the city (i.e., construction and mining equipment, industrial equipment, and transport refrigeration units). CARB recommends using OFFROAD2007 where desired information is unavailable from the OFFROAD2017 model, so data from both models was used (CARB 2020). Additionally, while OFFROAD2017 provides estimates of CO_2 emissions, it does not provide estimates for CH_4 and N_2O emissions. To estimate CH_4 and N_2O emissions from the vehicle and equipment types included in OFFROAD2017, ratios of CH_4 to CO_2 and N_2O to CO_2 were obtained from OFFROAD2007 and applied to CO_2 data from OFFROAD2017 to calculate CH_4 and N_2O emissions.

2.2.4 Solid Waste

Based on modeling conducted, the solid waste sector was responsible for approximately 28,984 $MTCO_2e$ in 2015 and 23,566 $MTCO_2e$ in 2019, or 5 percent of the 2019 community GHG inventory. Solid waste emissions are associated

primarily with the decomposition of solid waste generated by the city in landfills. Smaller proportions of solid waste emissions are produced by the decomposition of alternative daily cover (ADC) generated by the city, as well as from composting organic waste. Landfill disposed waste accounted for approximately 93 percent of emissions in 2015 and 94 percent of emissions in 2019. ADC represented 5 percent of emissions in 2015 and 4 percent of emissions in 2019, and composting accounted for approximately 1 percent of solid waste emissions in 2015 and 2 percent in 2019. Table 9 summarizes emissions from the solid waste sector. Additional details regarding calculation methods and assumptions are discussed below.

Table 9 2015 and 2019 Milpitas Community Solid Waste Greenhouse Gas Emissions

Source	2015		2019	
	Quantity (tons/year)	GHG Emissions ($MTCO_2e$/year)	Quantity (tons/year)	GHG Emissions ($MTCO_2e$/year)
Landfill Disposed Waste	69,762	27,031	57,763	22,040
Alternative Daily Cover	2,905	1,561	734	973
Composting	4,605	391	6,509	553
Total	**77,272**	**28,984**	**65,006**	**23,566**

Notes: Totals may not sum exactly due to independent rounding. GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent.

Source: 2015 and 2019 inventories prepared by Ascent Environmental in 2021.

SOLID WASTE GENERATION

CH_4 emissions generated by landfill disposed waste occur from the decay of waste generated annually by residences and businesses in the city. A total of 69,762 tons of landfilled waste was reported for the city in 2015 and 57,763 tons was reported in 2019. In addition to landfilled waste, communities send ADC to landfills. ADC is non-earthen material used to cover an active surface of a landfill at the end of each operating day to control for vectors, fires, odors, blowing litter, and scavenging. This material can include compost, construction and demolition waste, sludge, green material, shredded tires, spray-on cement, and fabric. Given that ADC can also include organic material, CH_4 emissions from landfills result from organic decomposition in both waste disposal and ADC. ADC from the city was reported to be 2,905 tons in 2015 and 734 tons in 2019. Data for landfilled waste and ADC was obtained from CalRecycle.

Total solid waste generation and ADC by amount and receiving landfill was available from CalRecycle. However, the city is aware that there is an error in CalRecycle's reporting of 2019 waste figures for the city; currently, CalRecycle's report significantly overestimates the city's total disposed waste. The city provided an estimate for total disposed waste for 2019, but it was unable to provide the quantities of waste sent to each receiving landfill. Therefore, the quantity of waste sent to each landfill in 2019 was estimated by applying the proportion of total waste from the city received by landfills in 2018 to the total quantity of landfilled waste provided by the city for 2019.

The amount of CH_4 released from community-generated waste depends on the LFG management systems of the landfills at which the waste is disposed. Information regarding the use of an LFG capture system was available from EPA's Landfill Methane Outreach Program. All facilities that included an LFG capture system applied the default LFG collection efficiency of 0.75, as recommended by the U.S. Community Protocol. Facilities that did not include an LFG capture rate received no efficiency adjustments. Default waste characterization emissions factors obtained from EPA were used in calculations.

COMPOSTING

In addition to solid waste pickup and disposal, the City offers green waste (i.e., yard trimmings) composting services to reduce GHG emissions associated with the decomposition of organic waste that would be sent to landfills. Yard trimmings include flowers and leaves, ivy and weeds, grass clippings, small branches, small tree stumps, and untreated dimensional lumber. All composting is conducted off-site at private facilities.

Composting data were available from the City. Emissions from composting operations were calculated using CARB's *Method for Estimating Greenhouse Gas Emission Reductions from Diversion of Organic Waste from Landfills to Compost Facilities* (CARB 2016). The equations used for calculation included transportation emissions from transferring organic waste, process emissions from composting, and fugitive emissions from composting. Composting results in emissions from the decomposition of waste, but it also results in a reduction of emissions by avoiding landfill disposal. Composting resulted in avoidance of 2,349 $MTCO_2e$ in 2015 and 3,320 in 2019. As shown in Table 9, emissions associated with composting were 391 $MTCO_2e$ in 2015 and 553 $MTCO_2e$ in 2019.

2.2.5 Water Supply

Based on modeling conducted, water supply emissions accounted for approximately 2,974 $MTCO_2e$ in 2015 and 694 $MTCO_2e$ in 2019, or less than 1 percent of the city's 2019 GHG inventory. GHG emissions associated with water consumption occur from the indirect use of energy associated with water extraction, conveyance, treatment, and distribution to the point of use (e.g., residences, businesses). Water supply emissions were estimated by applying energy intensity factors (i.e., the total amount of energy required to produce a unit of water for a particular use) to water consumption values provided by each water supplier for the city in 2015 and 2019. The methods used are explained in more detail below. Table 10 presents water supply and associated GHG emissions for the city.

Table 10 2015 and 2019 Milpitas Community Water Supply Greenhouse Gas Emissions

	2015		2019	
	Quantity	GHG Emissions ($MTCO_2e$/year)	Quantity	GHG Emissions ($MTCO_2e$/year)
Water consumption (MGY)	3,010	2,974	3,428	694
Energy consumption (MWh/year)	16,131		17,322	

Notes: GHG = greenhouse gas; MGY = million gallons per year; $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year; MWh/year = megawatt-hours per year.

Source: 2015 and 2019 inventories prepared by Ascent Environmental in 2021.

ENERGY INTENSITY FACTOR

An energy intensity factor, regarding water supply emissions, is defined by the amount of energy (e.g., electricity, natural gas) required to produce a unit of water for a particular use. Electricity is the primary source of energy used for water extraction, conveyance, treatment, and distribution in the San Francisco Bay hydrologic region. Other energy sources may include fossil fuel-powered pumps and backup generators at treatment plants, but these sources that may be used were considered negligible. Thus, for purposes of this analysis, energy intensity is based on electricity use only, and is expressed as kilowatt-hours per million gallons (kWh/MG).

In 2015, the CPUC commissioned a study of hydrologic zones in California and their relative energy intensities for water extraction, conveyance, treatment, and distribution. The city is within the San Francisco Bay hydrologic zone, which has specific energy intensities by supply type (e.g., local surface water, imported deliveries). The City's General Plan Draft Environmental Impact Report describes the city's water supply. Approximately two-thirds of the water

supplied to the city comes from SFPUC, 85 percent of which is derived from the Tuolumne River, with 15 percent supplied by local surface water sources. Approximately one-third of the city's water is supplied by Valley Water. The water that Valley Water provides to the city comes from the State Water Project, which is supplied by storage reservoirs owned by the California Department of Water Resources, and federal storage reservoirs operated by the Central Valley Project (City of Milpitas 2020). The city also receives some recycled water from SBWR, which originates from water treated at the RWF.

Using the energy intensities for the San Francisco Bay hydrologic zone, a weighted factor for water extraction, conveyance, treatment, and distribution was derived for each water purveyor. This resulted in specific energy intensity factors of 4,475 kWh/MG for SFPUC, 7,200 kWh/MG for Valley Water, and 2,998 kWh/MG for SBWR.

ENERGY CONSUMPTION

The three water purveyors in the city all provided 2015 and 2019 water consumption volumes. To estimate water supply emissions, the energy intensity factors discussed above were applied to total water consumption volumes reported by each water supplier. GHG emissions were estimated using electricity emissions factors in 2015, as described in the building energy sector. In 2019, GHG emissions associated with water supplied by Valley Water and SBWR were also estimated based on these electricity emissions factors, but emissions associated with water supplied by SFPUC were assumed to be zero because the utility was supplied by carbon-free electricity in 2019 (Marshall, pers. comm., 2020).

2.2.6 Wastewater Treatment

Based on modeling conducted, wastewater treatment resulted in GHG emissions of approximately 1,935 $MTCO_2e$ in 2015 and 1,578 $MTCO_2e$ in 2019, which represents less than 1 percent of the city's total 2019 emissions. Wastewater emissions are estimated in three components: (1) energy-related emissions from the energy required to convey wastewater from the source to the treatment facility, and then to treat wastewater, (2) wastewater treatment process emissions, and (3) stationary emissions from the combustion of digester gas. Each is discussed separately below. GHG emissions associated with the treatment of wastewater from the city is shown in Table 11.

Table 11 2015 and 2019 Milpitas Wastewater Treatment Greenhouse Gas Emissions

Wastewater Emission Type	GHG Emissions ($MTCO_2e$/year)	
	2015	2019
Energy-Related Emissions	1,796	1,435
Process Emissions	134	138
Stationary Emissions	5	6
Total	**1,935**	**1,578**

Notes: Totals may not sum exactly due to independent rounding. GHG = greenhouse gas; $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year.

Source: 2015 and 2019 inventories prepared by Ascent Environmental in 2021.

ENERGY-RELATED EMISSIONS

The RWF is the primary agency responsible for sewer conveyance and wastewater treatment for the city. Wastewater is collected from customers' homes and businesses via sewer collection pipes operated by the City's Public Works Department. Wastewater is then conveyed and pumped through a network of lower lateral and main pipes owned

and operated by the City. These pipes are connected to larger interceptor pipelines, which ultimately convey the wastewater to the RWF.

Energy-related emissions result from the energy required for wastewater treatment operations. This includes the energy used in wastewater conveyance as well as energy used throughout wastewater treatment processes and to provide power to the RWF. The RWF provided data for electricity and natural gas consumption for 2015 and 2019. Energy-related emissions were calculated using the same methods described in the building energy sector.

PROCESS EMISSIONS

Treatment process emissions at the RWF include process CH_4 from treatment lagoons, process N_2O from nitrification/denitrification, and fugitive N_2O from wastewater effluent. The RWF provided data for BOD load in kilograms per day (kg/day) and average nitrogen load in kg/day, and wastewater treatment process emissions for the RWF were calculated in accordance with the U.S. Community Protocol, Version 1.2. Specifically, the following equations/methods from the U.S. Community Protocol were used to capture all emissions types that occur at the RWF.

- Equation WW.6 for process CH_4 emissions from treatment lagoons.
- Equation WW.7 for process N_2O emissions from nitrification/denitrification.
- Equation WW.12 for fugitive N_2O emissions from effluent discharge.

STATIONARY EMISSIONS

Anaerobic digesters used in the wastewater treatment processes produce biogas, or digester gas. The RWF employs anaerobic digesters and thus produces digester gas, which is collected and combusted onsite. Annual production of digester gas, in scf/day, and the fraction of CH_4 in the digester gas, was provided by the RWF. The quantity of digester gas was scaled to the service population of Milpitas, and default assumptions and emissions factors from Equations WW.1 and WW.2 from the U.S. Community Protocol, Version 1.2, were used to estimate emissions from the combustion of digester gas.

2.3 MUNICIPAL OPERATIONS INVENTORIES DATA AND ASSUMPTIONS

2.3.1 Sector-Specific Assumptions and Methods

Like community GHG emissions inventories, ICLEI has developed guidance to assist local governments in conducting municipal operations inventories. The most recent standardized guidance for municipal operations-scale emissions inventories is ICLEI's May 2010 publication *Local Government Operations Protocol for the Quantification and Reporting of Greenhouse Gas Emissions Inventories* (ICLEI 2010).

The following summarizes data sources and methods used in estimating the City's municipal operations GHG emissions in 2015 and 2019:

- **Buildings and Facilities:** Annual municipal electricity and natural gas usage data for the City and utility emissions factors were provided by PG&E and SVCE. Additional emissions factors were obtained from eGRID and TCR. Annual municipal backup generator usage was provided by the City, and emissions factors for backup generators were available from TCR.

- **Streetlights and Traffic Signals:** Annual municipal electricity use for all streetlights and traffic signals was provided by the City. The same PG&E and SVCE utility electricity emissions factors used in the buildings and facilities sector were used for streetlights and traffic signals.
- **Employee Commute:** Emissions associated with municipal employee commutes were calculated using employment data provided by the City, including the number of temporary and permanent employees, and employees' home and work zip codes. Vehicle emissions factors were derived using EMFAC2021.
- **Vehicle Fleet:** Municipal vehicle fleet fuel consumption data was provided by the City. The municipal vehicle fleet includes both on-road vehicles as well as off-road vehicles and equipment. Emissions factors were obtained from TCR.
- **Solid Waste:** Because annual municipal-generated solid waste was unavailable, solid waste generation estimates were conducted using the number of municipal employees provided by the City, and average solid waste disposal per public administration employee data from CalRecycle. Emissions factors were obtained from EPA.
- **Water Supply:** Water supply data was provided by the City's water purveyors, SFPUC, Valley Water, and SBWR. Emissions were estimated by applying the region-specific energy intensity factors to the municipal water consumption volumes provided by each water purveyor. PG&E utility emissions factors were used to estimate GHG emissions[2].
- **Wastewater Treatment:** Data regarding treatment processes, population served, digester gas production and combustion, BOD load, and nitrogen load were obtained from the RWF.

2.3.2 Buildings and Facilities

Municipal buildings and facilities accounted for approximately 2,001 $MTCO_2e$ in 2015 and 870 $MTCO_2e$ in 2019, or 27 percent of total municipal operations emissions in 2019. This sector includes emissions from energy (i.e., electricity, natural gas, diesel) used for all City buildings and facilities, primarily for lighting, HVAC, pumps, generators, and other equipment. Natural gas accounted for approximately 95 percent of emissions from this sector in 2019, while diesel backup generators and electricity accounted for 4 percent and 1 percent, respectively. Buildings and facilities include City-owned and leased buildings, as well as other infrastructure such as park buildings, park lighting and irrigation controllers, and other facilities. Building energy use and emissions by source are presented in Table 12 below.

Table 12 2015 and 2019 Milpitas Municipal Operations Buildings and Facilities Greenhouse Gas Emissions

Source	2015		2019	
	Quantity	GHG Emissions ($MTCO_2e$/year)	Quantity	GHG Emissions ($MTCO_2e$/year)
Electricity (MWh/year)	6,357	1,192	7,568	8
Natural Gas (therms/year)	150,551	799	155,596	826
Backup Generators (gallons/year)	903	9	3,456	35
Total	**NA**	**2,001**	**NA**	**870**

Notes: Totals may not sum exactly due to independent rounding. GHG = greenhouse gas; $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year; MWh/year = megawatt-hours per year; NA = not applicable.

Source: 2015 and 2019 inventories prepared by Ascent Environmental in 2021.

[2] Based on communications with the City, it was assumed that SFPUC was supplied by carbon-free electricity in 2019.

Buildings and facilities utility energy use data for 2015 and 2019 was provided by PG&E and SVCE, and generator fuel usage was provided by the City. In 2015, all municipal electricity was provided by PG&E, so buildings and facilities GHG emissions were estimated using 2015 utility electricity emissions factors provided by PG&E and eGRID. Municipal electricity was provided by SVCE in 2019, so emissions factors from SVCE were used to estimate 2019 emissions. Emissions factors for diesel fuel in backup generators were obtained from TCR. GHG emissions were estimated using the same methods as described in the building energy sector.

2.3.3 Streetlights and Traffic Signals

City streetlights and traffic signals accounted for approximately 564 $MTCO_2e$ in 2015 and 3 $MTCO_2e$ in 2019, or less than 1 percent of total municipal operations emissions in 2019. This sector includes emissions associated with electricity consumption to power City-owned streetlights and traffic signals, including road and highway lights. Streetlights and traffic signals electricity usage and GHG emissions are shown in Table 13.

Table 13 2015 and 2019 Milpitas Municipal Operations Streetlights and Traffic Signals Greenhouse Gas Emissions

Source	2015		2019	
	Quantity	GHG Emissions ($MTCO_2e$/year)	Quantity	GHG Emissions ($MTCO_2e$/year)
Electricity (MWh/year)	3,007	564	2,951	3

Notes: Totals may not sum exactly due to independent rounding. GHG = greenhouse gas; $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year; MWh/year = megawatt-hours per year.

Source: 2015 and 2019 inventories prepared by Ascent Environmental in 2021.

Electricity consumption from streetlights and traffic signals was provided by the City. GHG emissions were estimated using the methods and emissions factors as described in the buildings energy sector.

2.3.4 Employee Commute

Employee commute accounted for approximately 1,304 $MTCO_2e$ in 2015 and 1,195 $MTCO_2e$ in 2019, approximately 37 percent of total municipal operations emissions in 2019. This sector estimates GHG emissions associated with fuel use and VMT for City of Milpitas employees commuting to and from work. Table 14 shows employee commute VMT and GHG emissions.

Table 14 2015 and 2019 Milpitas Municipal Operations Employee Commute Greenhouse Gas Emissions

Source	2015		2019	
	VMT/year	GHG Emissions ($MTCO_2e$/year)	VMT/year	GHG Emissions ($MTCO_2e$/year)
Employee Commute	3,508,561	1,304	3,508,561	1,195

Notes: Totals may not sum exactly due to independent rounding. GHG = greenhouse gas; $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year; VMT/year = vehicle miles traveled per year.

Source: 2015 and 2019 inventories prepared by Ascent Environmental in 2021.

Anonymized employee home and work zip code information was available for all City employees 2019. This data was used to calculate an average employee daily VMT estimate[3]. This figure was applied to the number of temporary and

[3] Employee commute one-way driving distances estimated to be greater than 100 miles were excluded from VMT calculations.

permanent employees in 2015 and 2019, separate data that was provided by the City. It was assumed that temporary employees commute to work 2.5 days per week on average, while permanent employees commute 5 days per week on average. To account for holidays and vacations, an annualization factor of 48 weeks was applied to weekly employee commute VMT estimates. Emissions were estimated using emissions factors derived from EMFAC2021, as discussed in the on-road transportation sector.

2.3.5 Vehicle Fleet

City-owned vehicle fleet emissions accounted for 1,017 $MTCO_2e$ in 2015 and 1,081 $MTCO_2e$ in 2019, approximately 33 percent of total municipal operations emissions in 2019. This sector includes emissions estimated from on-road and off-road vehicles and equipment owned and operated by the City. Table 15 displays vehicle fleet usage and GHG emissions.

Table 15 2015 and 2019 Milpitas Municipal Operations Vehicle Fleet Greenhouse Gas Emissions

Source	2015		2019	
	Fuel Use (gallons/year)	GHG Emissions ($MTCO_2e$/year)	Fuel Use (gallons/year)	GHG Emissions ($MTCO_2e$/year)
Gasoline	88,875	790	92,606	823
Diesel	22,030	228	24,975	258
Total	**110,905**	**1,017**	**117,581**	**1,081**

Notes: Totals may not sum exactly due to independent rounding. GHG = greenhouse gas; $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year.

Source: 2015 and 2019 inventories prepared by Ascent Environmental in 2021.

Vehicle fleet fuel consumption data (i.e., gallons of gasoline and diesel fuel) for 2015 and 2019 were provided by the City for all City-owned vehicles and equipment. Because additional vehicle fleet data was unavailable, total emissions for gasoline and diesel fuel were estimated using emissions factors obtained from TCR. Fuel-specific CO_2 emissions factors were available for both gasoline and diesel, while the CH_4 and N_2O emissions factors were aggregated factors for both gasoline and diesel fuel in passenger cars and light-duty trucks.

2.3.6 Solid Waste

Municipal solid waste disposal accounted for approximately 52 $MTCO_2e$ in 2015 and 53 $MTCO_2e$ in 2019, or 2 percent of total municipal operations emissions in 2019. Solid waste emissions are generated from the decomposition of organic material in landfills. Table 16 presents estimated tons of solid waste disposal and associated GHG emissions from municipal operations.

Table 16 2015 and 2019 Milpitas Municipal Operations Solid Waste Greenhouse Gas Emissions

Source	2015		2019	
	Quantity (tons/year)	GHG Emissions ($MTCO_2e$/year)	Quantity (tons/year)	GHG Emissions ($MTCO_2e$/year)
Landfill Disposed Waste	154	52	157	53

Notes: Totals may not sum exactly due to independent rounding. GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent.

Source: 2015 and 2019 inventories prepared by Ascent Environmental in 2021.

Annual municipal disposed solid waste data was unavailable, so municipal-generated solid waste tonnages were estimated using an average solid waste disposal per public administration employee (tons/employee/year) figure obtained from CalRecycle (CalRecycle 2020). This figure was applied to the number of the City's municipal employees to calculate municipal tons of disposed solid waste. Methods use to estimate GHG emissions associated with solid waste disposal from municipal operations are consistent with those described in the community solid waste sector.

2.3.7 Water Supply

Water supplied for the City's municipal operations resulted in approximately 70 $MTCO_2e$ in 2015 and 41 $MTCO_2e$ in 2019, or 1 percent of total municipal operations GHG emissions in 2019. GHG emissions associated with this sector result from the electricity used in the extraction, conveyance, treatment, and distribution of water for the City's municipal operations. This includes potable water as well as recycled water and water used for irrigation. Water usage and associated electricity consumption is provided in Table 17.

Table 17 2015 and 2019 Milpitas Municipal Operations Water Supply Greenhouse Gas Emissions

Source	2015		2019	
	Quantity	GHG Emissions ($MTCO_2e$)	Quantity	GHG Emissions ($MTCO_2e$)
Water consumption (MGY)	77	70	155	41
Energy consumption (MWh/year)	380		729	

Notes: GHG = greenhouse gas; MGY = million gallons per year; MWh/year = megawatt-hours per year.

Source: 2015 and 2019 inventories prepared by Ascent Environmental in 2021.

Municipal water consumption volumes from were provided by the City. Recycled water consumption volume was assumed to be supplied by SBWR. Total potable water supplied for municipal operations was provided, but it was not broken down by water purveyor. It was assumed that 60 percent of this water was supplied by SFPUC, and 40 percent was supplied by Valley Water (Marshall, pers. comm., 2021). This assumption was based on the location of municipal buildings and facilities in relation to the supply zones of each water purveyor. To obtain municipal water supply energy use and calculate associated GHG emissions, the region-specific energy intensity factors, methods, and emissions factors described in the community water supply sector were applied.

2.3.8 Wastewater Treatment

Wastewater emissions associated with municipal operations accounted for approximately 11 $MTCO_2e$ in 2015 and 9 $MTCO_2e$ in 2019, or less than 1 percent of total municipal operations emissions in 2019. Municipal wastewater GHG emissions associated with this sector included emissions generated by the energy used to treat municipal wastewater as well as emissions that are produced as a result as wastewater treatment processes. GHG emissions from municipal wastewater are shown in Table 18.

Table 18 2015 and 2019 Milpitas Municipal Operations Wastewater Greenhouse Gas Emissions

Source	GHG Emissions ($MTCO_2e$/year)	
	2015	2019
Wastewater Treatment	11	9

Notes: Totals may not sum exactly due to independent rounding. GHG = greenhouse gas; $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year.

Source: 2015 and 2019 inventories prepared by Ascent Environmental in 2021.

The RWF facility provided wastewater-related data for the City's municipal operations, including annual wastewater treated, BOD load, and nitrogen load. Methods for estimating emissions from these sources are identical to what was described in the community wastewater sector. The RWF also provided total annual digester gas combustion and total annual energy consumption from its operations. To estimate emissions associated with the digester gas combustion and energy consumption, data was scaled to the total number of employees of the City of Milpitas. GHG emissions were estimated using PG&E utility emissions factors.

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Attachment A

GHG Inventory

Data and Calculations

2005, 2015, and 2019 Milpitas Community Greenhouse Gas Emissions Inventories												
Emissions Sector	2005 GHG Emissions				2015 GHG Emissions				2019 GHG Emissions			
	Activity	Units	$MTCO_2e$	$MTCO_2e$ % of Annual Total	Activity	Units	$MTCO_2e$	$MTCO_2e$ % of Annual Total	Activity	Units	$MTCO_2e$	$MTCO_2e$ % of Annual Total
Building Energy			**247,533**	**45.17%**			**259,949**	**44.18%**			**140,537**	**31.83%**
Electricity	114,391	MWh	25,528	10.3%	117,026	MWh	21,578	8.3%	121,801	MWh	581	0.4%
Natural Gas	7,265,000	Therms	38,580	15.6%	6,779,674	Therms	36,003	13.9%	7,840,602	Therms	41,637	29.6%
Residential Subtotal			**64,108**	**25.9%**			**57,581**	**22.2%**			**42,218**	**30.0%**
Electricity	545,800	MWh	121,802	49.2%	784,254	MWh	144,603	55.6%	708,759	MWh	29,880	21.3%
Natural Gas	11,604,000	Therms	61,623	24.9%	10,875,823	Therms	57,756	22.2%	12,772,616	Therms	67,828	48.3%
Backup Generators (Diesel)					964	Gallons	10	0.0%	58,522	Gallons	599	0.4%
Backup Generators (Natural Gas)					0	Scf	0	0.0%	221,027	Scf	12	0.0%
Non-Residential Subtotal			**183,424**	**74.1%**			**202,368**	**77.8%**			**98,319**	**70.0%**
On-Road Transportation	**483,632,677**	**VMT**	**252,864**	**46.15%**	**559,491,627**	**VMT**	**278,061**	**47.26%**	**572,889,499**	**VMT**	**259,627**	**58.80%**
Passenger Vehicles	434,135,841	VMT	181,172	71.6%	492,014,849	VMT	182,927	65.8%	509,968,096	VMT	173,746	66.9%
Commercial Vehicles	49,496,836	VMT	71,692	28.4%	67,476,778	VMT	95,134	34.2%	62,921,403	VMT	85,881	33.1%
Off-Road Vehicles			**15,034**	**2.74%**			**16,511**	**2.81%**			**15,554**	**3.52%**
Construction and Mining Equipment			3,813	25.4%			4,661	28.2%			3,478	22.4%
Entertainment Equipment			36	0.2%			45	0.3%			44	0.3%
Industrial Equipment			8,490	56.5%			8,469	51.3%			8,590	55.2%
Lawn and Garden Equipment			1,192	7.9%			1,561	9.5%			1,602	10.3%
Light Commercial Equipment			1,193	7.9%			1,291	7.8%			1,290	8.3%
Railyard Operations			1	0.0%			1	0.0%			1	0.0%
Recreational Equipment			212	1.4%			376	2.3%			430	2.8%
Transport Refrigeration Units			98	0.7%			107	0.6%			118	0.8%
Solid Waste	**68,512**	**Tons**	**26,998**	**4.93%**	**72,667**	**Tons**	**28,984**	**4.93%**	**58,497**	**Tons**	**23,566**	**5.34%**
Solid Waste Generation	68,512	Tons	26,998	100.0%	72,667	Tons	28,592	98.6%	58,497	Tons	23,013	97.7%
Composting					4,605	Tons	391	1.4%	6,509	Tons	553	2.3%
Water Supply	**3,575**	**MGY**	**4,466**	**0.81%**	**3,010**	**MGY**	**2,974**	**0.51%**	**3,428**	**MGY**	**694**	**0.16%**
Wastewater Treatment			**1,078**	**0.20%**			**1,935**	**0.33%**			**1,578**	**0.36%**
Energy-Related			981	91.0%			1,796	92.8%			1,435	90.9%
Process			94	8.7%			134	6.9%			138	8.7%
Stationary			4	0.3%			5	0.3%			6	0.4%
Total $MTCO_2e$/yr			**547,972**	**100%**			**588,414**	**100%**			**441,557**	**100%**

Building Energy Consumption
Milpitas Greenhouse Gas Inventory

Electricity

Source	2005 MWh/year	2005 Emission Factor (lb CO2/MWh)	2005 Emission Factor (lb CH4/MWh)	2005 Emission Factor (lb N2O/MWh)	2005 Total MT CO2e/year	2015 MWh/year	2015 Emission Factor (lb CO2/MWh)	2015 Emission Factor (lb CH4/MWh)	2015 Emission Factor (lb N2O/MWh)	2015 Total MT CO2e/year	2019 MWh/year	2019 Emission Factor (lb CO2/MWh)	2019 Emission Factor (lb CH4/MWh)	2019 Emission Factor (lb N2O/MWh)	2019 Total MT CO2e/year
Residential Electricty (PG&E)	114,391	489	0.03024	0.00808	25,528	117,026	404.51	0.033	0.004	21,578	48,292	197.81	0.0327	0.0039	568.89
Non-Residential Electricity (PG&E)	545,800	489	0.03024	0.00808	121,802	784,254	404.51	0.033	0.004	144,603	281,013	197.81	0.0327	0.0039	29,267.79
Residential Electricty (SVCE)	--	--	--	--	--	--	--	--	--	--	73,509	2.34	0.0000	0.0000	11.90
Non-Residential Electricity (SVCE)	--	--	--	--	--	--	--	--	--	--	427,746	2.34	0.0000	0.0000	611.98
Total					**147,330**					**166,180**					**30,461**

Source: 2005 Milpitas GHG Inventory, provided by the City

Source: Milpitas Electricity and Natural Gas 2015-2019, provided by SVCE

Source: Electricity Emissions Factors, provided by SVCE

Source: Emissions Inventory Tool, provided by SVCE

Natural Gas

Source	2005 therms/year	2005 Emission Factors (lb/therm) CO_2	2005 Emission Factors (lb/therm) CH_4	2005 Emission Factors (lb/therm) N_2O	2005 Total MT CO2e/year	2015 therms/year	2015 Emission Factors (lb/therm) CO_2	2015 Emission Factors (lb/therm) CH_4	2015 Emission Factors (lb/therm) N_2O	2015 Total MT CO2e/year	2019 therms/year	2019 Emission Factors (lb/therm) CO_2	2019 Emission Factors (lb/therm) CH_4	2019 Emission Factors (lb/therm) N_2O	2019 Total MT CO2e/year
Residential Nautral Gas (PG&E)	7,265,000	11.7	0.000226742	0.000005	38,580	6,779,674	11.7	0.000226742	0.000005	36,003	7,840,602	11.7	0.000226742	0.000005	41,637
Non-Residential Natural Gas (PG&E)	11,604,000	11.7	0.000226742	0.000005	61,623	10,875,823	11.7	0.000226742	0.000005	57,756	12,772,616	11.7	0.000226742	0.000005	67,828
Total				**11.708**	**100,203**					**93,759**					**109,466**

Source: 2005 Milpitas GHG Inventory, provided by the City

Source: Milpitas Electricity and Natural Gas 2015-2019, provided by SVCE

Backup Generators

Source	2005 gallons/year	2005 Emissions Factor (kg CO2/gal)	2005 Emissions Factor (g CH4/MMBTU)	2005 Emissions Factor (g N2O/MMBTU)	2005 Total MT CO2e/year	2015 gallons/year	2015 Emissions Factor (kg CO2/gal)	2015 Emissions Factor (g CH4/MMBTU)	2015 Emissions Factor (g N2O/MMBTU)	2015 Total MT CO2e/year	2019 gallons/year	2019 Emissions Factor (kg CO2/gal)	2019 Emissions Factor (g CH4/MMBTU)	2019 Emissions Factor (g N2O/MMBTU)	2019 Total MT CO2e/year
Diesel						964	10.21	0.9	0.4	9.86	58,522	10.21	0.9	0.4	598.57
Source	**scf/year**	**Emissions Factor (kg CO2/gal)**	**Emissions Factor (g CH4/MMBTU)**	**Emissions Factor (g N2O/MMBTU)**	**Total MT CO2e/year**	**scf/year**	**Emissions Factor (kg CO2/scf)**	**Emissions Factor (g CH4/MMBTU)**	**Emissions Factor (g N2O/MMBTU)**	**Total MT CO2e/year**	**scf/year**	**Emissions Factor (kg CO2/scf)**	**Emissions Factor (g CH4/MMBTU)**	**Emissions Factor (g N2O/MMBTU)**	**Total MT CO2e/year**
Natural Gas						0	0.05444	0.9	0.9	-	221,027	0.05444	0.9	0.9	12
Total					-					**10**					**611**

Source: Generator Permits, provided by BAAQMD

Building Energy Efficiency Assumptions

Sector	Code	% Reduction	Notes	Source
Residential	Energy efficiency improvement of 2013 code above 2008 code	25%		http://www.energy.ca.gov/releases/2014_releases/2014-07-
	Energy efficiency improvement of 2016 code above 2013 code	28%	Lighting, heating, cooling, ventilation, and water heating	*http://www.energy.ca.gov/title24/2016standards/rulemaking/documents/2016_Buildin*
	Energy efficiency improvement of 2019 code above 2016 code	53%	Includes onsite solar requirement	
Commercial	Energy efficiency improvement of 2013 code above 2008 code	30%		http://www.energy.ca.gov/commission/accomplishments/2014_cec
	Energy efficiency improvement of 2016 code above 2013 code	5%		http://www.energy.ca.gov/title24/2016standards/rulemaking/documents/2015-06-
	Energy efficiency improvement of 2019 code above 2016 code	30%		

Total Residential Reduction	74.62%
Total Commercial Reduction	53.45%

On-Road Transportation

	2005		2015		2019	
Source	**VMT/year**	**MTCO2e/year**	**VMT/year**	**MTCO2e/year**	**VMT/year**	**MTCO2e/year**
Passenger	434,135,841	181,172	492,014,849	182,927	509,968,096	173,746
Commercial	49,496,836	71,692	67,476,778	95,134	62,921,403	85,881
Total	**483,632,677**	**252,864**	**559,491,627**	**278,061**	**572,889,499**	**259,627**

Source: 2005 Milpitas GHG Inventory, provided by the City

Source: Milpitas Transportation 2015-2019 Data, provided by SVCE

Source: Transportation Calculations

Sources: CalTrans, BAAQMD, MTC

VMT

Growth	2005	2015	2019
Percent Change from 2019			0.00%

VMT Compound Annual Growth Rate	0.903%

	2005	2015	2019
VMT Per Capita	7,885	6,389	6,363

Off-Road Vehicles and Equipment

		2005					2015					2019				
	Scaling Factor	CO2 (tons/day)	CH4 (tons/day)	N2O (tons/day)	CO2e (tons/day)	CO2e (MT/yr)	CO2 (tons/day)	CH4 (tons/day)	N2O (tons/day)	CO2e (tons/day)	CO2e (MT/yr)	CO2 (tons/day)	CH4 (tons/day)	N2O (tons/day)	CO2e (tons/day)	CO2e (MT/yr)
Construction and Mining Equipment	Service Population	11.43381	0.00219	0.00008	11.5	3,813	14.02545	0.00114	0.00007	14.1	4,661	10.46594	0.00080	0.00006	10.5	3,478
Entertainment Equipment	Population	0.10787	0.00001	0.00000	0.1	36	0.13422	0.00001	0.00000	0.1	45	0.13369	0.00001	0.00000	0.1	44
Industrial Equipment	Employment	24.45336	0.02192	0.00216	25.6	8,490	24.98387	0.00796	0.00140	25.6	8,469	25.36609	0.00738	0.00140	25.9	8,590
Lawn and Garden Equipment	Population	2.85385	0.00564	0.00222	3.6	1,192	3.87925	0.00587	0.00254	4.7	1,561	3.99420	0.00588	0.00257	4.8	1,602
Light Commercial Equipment	Employment	3.39614	0.00186	0.00058	3.6	1,193	3.70840	0.00105	0.00061	3.9	1,291	3.71626	0.00089	0.00058	3.9	1,290
Railyard Operations	Employment	0.00183	0.00000	0.00000	0.0	1	0.00175	0.00000	0.00000	0.0	1	0.00167	0.00000	0.00000	0.0	1
Recreational Equipment	Population	0.39255	0.00346	0.00057	0.6	212	0.70072	0.00591	0.00102	1.1	376	0.80246	0.00665	0.00117	1.3	430
Transport Refrigeration Units	Share of Road Miles	0.29162	0.00013	0.00000	0.3	98	0.32192	0.00003	0.00000	0.3	107	0.35620	0.00003	0.00000	0.4	118
Total						**15,034**					**16,511**					**15,554**

Source: CARB's OFFROAD2007 and OFFROAD2017, CA DOT

OFFROAD2007 to OFFROAD2017 Conversion for CH4 and N2O Emissions

Equipment Sector	2005		2015		2019	
	CH4:CO2	N2O:CO2	CH4:CO2	N2O:CO2	CH4:CO2	N2O:CO2
Construction and Mining Equipment	0.000191468	0.000006773	0.00009932	0.00000627	0.00007602	0.00000609
Industrial Equipment	0.000896235	0.000088317	0.00031876	0.00005585	0.00029105	0.00005503
Light Commercial Equipment	0.000547932	0.000172167	0.00028264	0.00016345	0.00023875	0.00015691
Transport Refrigeration Units	0.000447062	0.000013985	0.00008775	0.00000751	0.00007389	0.00000633

Share of Road Miles

	2005	2015	2019
Milpitas Road Miles	127.91	126.29	127.34
Total Santa Clara County Road Miles	4873.58	4832.31	4,648.99
Milpitas Share of Road Miles	0.026245594	0.026134499	0.027390896

Source: CA DOT

Solid Waste

Milpitas Greenhouse Gas Inventory

	2015				2019			
	Tons	% of Tons	Emissions	% of Emissions	Tons	% of Tons	Emissions	% of Emissions
Total Solid Waste	69,762	90.28%	27,031	93.26%	57,763	88.86%	22,040	93.52%
Total ADC	2,905	3.76%	1,561	5.39%	734	1.13%	973	4.13%
Composted Yard Trimmings	4,605.06	5.96%	391.43	1.35%	6,509.46	10.01%	553.30	2.35%

Solid Waste Emissions Totals

	2005	2015	2019
Waste Generation	26,998	28,592	23,013
Composting		391	553
Total (MTCO2e/year)	26,998	28,984	23,566

SW.4 Community-Generated Waste Sent to Landfills

	2005					2015					2019				
Receiving Landfill	**Tonnage Disposed by City**	**Total ADC**	**LFG collection?**	**Methane Emissions with LFG Capture (MT CH4)**	**MT CO2e**	**Tonnage Disposed by City**	**Total ADC**	**LFG collection?**	**Generated Methane Emissions with LFG Capture (MT CH4)**	**MT CO2e**	**Tonnage Disposed by City**	**Total ADC**	**LFG collection?**	**Methane Emissions with LFG Capture (MT**	**MT CO2e**
Altamont Landfill & Resource Recovery	40.14	88.39	Yes	2	49	92.5	12.9	Yes	1	40	35.49	18.16	Yes	1	20
Azusa Land Reclamation Landfill	82.51	0.82	Yes	1	31	12.8	-	Yes	0	5	5.02	-	Yes	0	2
Bakersfield Metropolitan Sanitary Landfill	1.81	0.00	Yes	0	1										
Corinda Los Trancos Landfill				-	-	40.7	1,185.5	Yes	17	463	112.04	-	Yes	2	42
Covanta Stanislaus Resource Recovery Facility				-	-	-	21.8	Yes	0	8					
Fink Road Landfill				-	-	11.0	71.4	Yes	1	31					
Foothill Sanitary Landfill	0.5	0	Yes	0	0	1.6	-	Yes	0	1	5.71	-	Yes	0	2
Forward Landfill	62	0	Yes	1	23										
Guadalupe Sanitary Landfill	458.8	41.1	Yes	7	189	41.0	269.0	Yes	4	117	362.72	-	Yes	5	137
John Smith Road Landfill	74.79	0	Yes	1	28										
Keller Canyon Landfill	11.29	1444.24	Yes	20	550	1.4	14.8	Yes	0	6	-	15.96	Yes	0	6
Kirby Canyon Recycling & Disposal Facility	39.73	730.27	Yes	10	291	113.8	9.7	Yes	2	47	38,978.22	-	Yes	526	14,734
Monterey Peninsula Landfill				-	-	5,147.3	-	Yes	69	1,946	12,223.96	-	Yes	165	4,621
Newby Island Sanitary Landfill	62,501.4	79.4	Yes	845	23,656	62,147.0	847.2	Yes	850	23,812	5,567.10	-	Yes	75	2,104
North County Landfill & Recycling Center				-	-	1,098.8	-	Yes	15	415					
Potrero Hills Landfill	1562	0	Yes	21	590	35.2	64.7	Yes	1	38	77.32	-	Yes	1	29
Recology Hay Road	78.37	0	Yes	1	30	408.3	-	Yes	6	154	163.28	-	Yes	2	62
Recology Pacheco Pass	0.84	0	Yes	0	0						0.01	-	Yes	0	0
Tri-Cities Recycling & Disposal Facility	0	19.02	Yes	0	7										
Vasco Road Sanitary Landfill	224	0	Yes	3	85	27.9	-	Yes	0	11	50.31	86.34	Yes	2	52
Zanker Material Processing Facility	571.81	0	No	31	865	512.0	408.3	No	50	1,392	181.33	613.54	No	43	1,202
Zanker Road Resource Recovery Operation	398.5	0	No	22	603	70.6	0.2	No	4	107					
Total	66,109	2,403		964	26,998	69,762	2,905		1,021	28,592	57,763	734		822	23,013
								Total Solid Waste	965	27,031			Total Solid Waste	787	22,040
								Total ADC	56	1,561			Total ADC	35	973

Source: 2005 Milpitas GHG Inventory, provided by the City

Source: Jurisdiction Disposal by Facility, provided by CalRecycle

Source: Solid Waste Email from the City

Composting

Waste	2005 Total Annual (tons)	2015 Total Annual (tons)	2019 Total Annual (tons)
Composted Yard Trimmings	NA	4,605.06	6,509.46
Compost Emission Reduction Factor for Yard Trimmings (MTCO2e/ton)		0.44	0.44
Transportation Emissions Factor (MTCO2e/ton)		0.008	0.008
Process Emissions Factor (MTCO2e/ton)		0.007	0.007
Fugitive CH4 Emissions Factor (MTCO2e/ton)		0.049	0.049
Fugitive N2O Emissions Factor (MTCO2e/ton)		0.021	0.021
Overall Emissions from Composting (MTCO2e)		391.43	553.30
Composting Benefits Emissions Factor (MTCO2e/ton)		0.51	0.51
Composting Benefits (MTCO2e)		2,348.58	3,319.82

Source: CARB Compost Emissions Reduction Factors 2016

Table SW.5 CH_4 Yield for Solid Waste Components

Waste Component	Emissions Factor, EF_i (mt CH_4/wet short ton waste)	Source
Mixed MSW*	0.06	U.S. EPA AP-42

* – Mixed MSW factor may be used for entire MSW waste stream if waste composition data is unavailable.

U.S. EPA AP-42 – U.S. EPA Emission Factor Database, Chapter 2.4 Municipal Solid Waste Landfills (1998) WARM—Documentation for Greenhouse Gas Emissions and Energy Factors

Waste Diversion Target			
Milpitas per resident disposal target	6.3	75%	diversion
Milpitas per resident disposal rate	4.2	83%	diversion

Source: Milpitas Diversion/Disposal Rate, provided by CalRecycle

The overall emissions from composting are represented by the following equation:

$$E_{total} = T_e + P_e + F_e \quad (1)$$

where,

E_{total} = Total emissions from composting ($MTCO_2E$/ton of feedstock)

T_e = Net additional transportation emissions from composting as compared to landfilling ($MTCO_2E$/ton of feedstock)

P_e = Net additional process emissions from composting as compared to landfilling ($MTCO_2E$/ton of feedstock)

F_e = Fugitive emissions from composting ($MTCO_2E$/ton of feedstock)

$$CERF = (ALF_b + ((E_b + F_b + H_b) * C_{use})) - E_{total}$$

where,

ERF = Compost emission reduction factor ($MTCO_2E$/ton of feedstoc

LF_b = Emission reductions associated with the avoidance of metha emissions at landfills ($MTCO_2E$/ton of feedstock)

$_b$ = Emission reduction associated with decreased soil erosion ($MTCO_2E$/ton of compost)

$_,$ = Factor to account for the reduced fertilizer use ($MTCO_2E$/ton compost)

$_b$ = Factor to account for the reduced herbicide use ($MTCO_2E$/ton of compost)

$_{use}$ = Conversion factor used to convert from tons of compost to to feedstock

E_{total} = Emissions due to the composting process ($MTCO_2E$/ton of feedstock)

$$B_{total} = ALF_b + ((E_b + F_b + H_b) * C_{use}) \quad (2)$$

where,

B_{total} = Total emission reduction benefit due to compost use ($MTCO_2E$/ton of feedstock)

ALF_b = Emission reductions associated with the avoidance of methane emissions at MSW landfills ($MTCO_2E$/ton of feedstock)

E_b = Emission reduction associated with decreased soil erosion ($MTCO_2E$/ton of compost)

F_b = Factor to account for the reduced fertilizer use ($MTCO_2E$/ton of compost)

H_b = Factor to account for the reduced herbicide use ($MTCO_2E$/ton of compost)

C_{use} = Conversion factor used to convert from tons of compost to tons of feedstock.

Water Supply
Milpitas Greenhouse Gas Inventory

Water

	2005						2015						2019					
Water Provider	**MGY**	**Total MWh**	**Emission Factor (lb CO2/MWh)**	**Emission Factor (lb CH4/MWh)**	**Emission Factor (lb N2O/MWh)**	**Total CO2e (MT/year)**	**MGY**	**Total MWh**	**Emission Factor (lb CO2/MWh)**	**Emission Factor (lb CH4/MWh)**	**Emission Factor (lb N2O/MWh)**	**Total CO2e (MT/year)**	**MGY**	**Total MWh**	**Emission Factor (lb CO2/MWh)**	**Emission Factor (lb CH4/MWh)**	**Emission Factor (lb N2O/MWh)**	**Total CO2e (MT/year)**
SFPUC	1,674	7,489	489.00	0.0302	0.0081	**1,671**	1,652	7,391	404.51	0.0330	0.0040	**1,363**	2,160	9,663	0.00	0.0000	0.0000	**-**
SCVWD	1,623	11,687	489.00	0.0302	0.0081	**2,608**	1,111	8,001	404.51	0.0330	0.0040	**1,475**	918	6,607	197.81	0.0327	0.0039	**599**
SBWR	278	834	489.00	0.0302	0.0081	**186**	246	739	404.51	0.0330	0.0040	**136**	351	1,053	197.81	0.0327	0.0039	**95**
Total	3,575	20,010				**4,466**	3,009.55	16,131				**2,974**	3,428.32	17,322				**694**

Source: 2005 Milpitas GHG Inventory, provided by the City
Source: Water and Wastewater 2015-2019 data, provided by the City

Electric Energy Intensity - San Francisco Bay Hydrologic Region

Water Provider		**Extraction/ Conveyance**	**Distribution**	**Treatment**	**Percent of Total**	**Total (kWh/AF)**	**Total (kWh/MG)**	**Source**	**Notes**
SFPUC	Local deliveries (kWh/AF)	10	977	443	15%	1,458.05	4,474.59	General Plan DEIR p. 3.15-4: Two thirds of the water supplied to the City comes from SFPUC, of which 85 percent is derived from the Tuolumne River, through the Hetch Hetchy reservoir in the Sierra Nevada Mountains, with 15 percent originating from local surface water sources.	
	Local imported deliveries (kWh/AF)	43	977	443	85%				
SCVWD	SWP (kWh/AF)	926	977	443	100%	2,346.00	7,199.60	General Plan DEIR p. 3-15-4: About one third of the City's water is supplied by the SCVWD. More than half of SCVWD's total supply, and all of its supply to the City, comes from the State Water Project (supplied by the California Department of Water Resources from State-owned storage reservoirs) and the Central Valley Project (supplied by Federal water storage under the supervision of the US Bureau of Reclamation).	To be conservative, assuming 100% of the SWP/CVP water supply is coming from SWP because breakdown is not available.
	CVP and other federal deliveries (kWh/AF)	273	977	521	NA	1,771.00	5,434.99		
SBWR	Recycled (kWh/AF)	0	977	521	100%	977.00	2,998.30		The City noted that SBWR is part of the Regional Wastewater Facility and the recycled water supply comes from their treated wastewater. So, Treatment Energy Intensity is removed from SBWR's total Energy Intensity.

Source: Navigant CPUC Water/Energy Cost-Effectiveness Analysis 2015
Source: Milpitas General Plan Draft Environmental Impact Report

Wastewater Treatment
Milpitas Greenhouse Gas Inventory

Wastewater Treatment Characteristics

WWTP/Septic System	Description
San Jose - Santa Clara Regional Wastewater Facility	Solids are lagooned for approximately three years. Secondary treatment process is a step-feed Biological Nutrient Removal (BNR) process that achieves full nitrification (all ammonia is converted to nitrate) and partial de-nitrification (about 65% nitrogen removed as an annual average, about 70% removed in the dry season). The BNR process also removes approximately 90% of the incoming phosphorus. Anaerobic digestion used onsite.

Wastewater Emissions Totals	2005	2015	2019
Energy-Related Emissions	980.6	1796.5	1434.8
Process Emissions	93.8	133.9	137.7
Stationary Emissions	3.6	4.9	5.6
Total (MT CO2e/year)	**1,078**	**1,935**	**1,578**

WW.1a Stationary Methane Emissions from Combustion of Digester Gas	2005	2015	2019
Volume of Digester Gas Produced per Day (scf/day)		1,320,780	1,589,958
Fraction of CH4 in Digester Gas		0.61	0.61
BTU of CH4	1028	1028	1028
BTU to MMBTU conversion	0.000001	0.000001	0.000001
CH4 emissions factor (kg CH4/MMBTU)	0.0032	0.0032	0.0032
MT CH4/year	0	0.06	0.07
Total MT CO2e/year	0.00	1.70	1.96

Source: Water and Wastewater 2015-2019 data, provided by the City

WW.1(alt) Stationary Methane Emissions from Combustion of Digester Gas	2005	2015	2019
Population of Milpitas Served	61,334		
Fraction of CH4 in Digester Gas	0.61		
BTU of CH4	1028	1028	1028
BTU to MMBTU conversion	0.000001	0.000001	0.000001
CH4 emissions factor (kg CH4/MMBTU)	0.0032	0.0032	0.0032
MT CH4/year	0.0450	0	0
Total MT CO2e/year	1.26	0.00	0.00

Source: Water and Wastewater 2015-2019 data, provided by the City

WW.2a Stationary Nitrous Oxide Emissions from Combustion of Digester Gas	2005	2015	2019
Volume of Digester Gas Produced per Day (scf/day)		1,320,780	1,589,958
Fraction of CH4 in Digester Gas		0.61	0.61
BTU of N2O	1028	1028	1028
BTU to MMBTU conversion	0.000001	0.000001	0.000001
N2O emissions factor (kg CH4/MMBTU)	0.00063	0.00063	0.00063
MT N2O/year	0	0.01	0.01
Total MT CO2e/year	0.00	3.16	3.65

Source: Water and Wastewater 2015-2019 data, provided by the City

WW.2a Stationary Nitrous Oxide Emissions from Combustion of Digester Gas	2005	2015	2019
Population of Milpitas Served	61,334		
Fraction of CH4 in Digester Gas	0.61		
BTU of N2O	1028	1028	1028

BTU to MMBTU conversion	0.000001	0.000001	0.000001
N2O emissions factor (kg CH4/MMBTU)	0.00063	0.00063	0.00063
MT N2O/year	0.0089	0	0
Total MT CO2e/year	2.35	0.00	0.00

Source: Water and Wastewater 2015-2019 data, provided by the City

WW.6 Process Methane Emissions from Wastewater Treatment Lagoons

	2005	2015	2019
BOD load (kg/day)	10.78	15.5463	16.4154
Fraction of BOD removed in primary treatment	0.99	0.99	0.99
Maximum CH4 producing capacity for domestic wastewater (kg CH4/kg BOD removed)	0.6	0.6	0.6
CH4 correction factor for anaerobic systems	0.8	0.8	0.8
MT CH4/year	0.02	0.03	0.03
Total MT CO2e/year	0.53	0.76	0.81

Source: Water and Wastewater 2015-2019 data, provided by the City

WW.7 Process Nitrous Oxide Emissions from Wastewater Treatment Plants with Nitrification or Denitrification

	2005	2015	2019
Population of Milpitas Served	61,334	87,570	90,030
Factor for industrial and commercial discharge	1.25	1.25	1.25
Emission factor for a WWTP with nitrification or denitrification (g N2O/ person / year)	7	7	7
MT N2O/year	1	0.8	0.8
Total MT CO2e/year	92	132.0	135.7

Source: Water and Wastewater 2015-2019 data, provided by the City

WW.12 Fugitive Nitrous Oxide Emissions from Effluent Discharge

	2005	2015	2019
Average total nitrogen per day (kg N/day)	1.04	1.5670	1.5235
Emission factor (kg N2O-N/kg sewage-N discharged)	0.005	0.005	0.005
Molecular weight ratio of N2O to N2	1.57	1.57	1.57
MT N2O/year	0.00	0.00	0.00
Total MT CO2e/year	0.79	1.19	1.16

Source: Water and Wastewater 2015-2019 data, provided by the City

WW.15 Energy-related Emissions Associated with Wastewater Collection and Treatment

	2005	2015	2019
MWh/year	11,576.43	17,231	25,684
Emission Factor (lb CO2/MWh)	489	206	198
Emission Factor (lb CH4/MWh)	0.0302	0.0340	0.0327
Emission Factor (lb N2O/MWh)	0.0081	0.0040	0.0039
Total Electricity (MTCO2e/year)	122	102	140
Natural Gas (therms/year)	3,427,462	5,101,718	4,063,308
Emission Factor (lb CO2/therm)	11.7	11.7	11.7
Emission Factor (lb CH4/therm)	0.000226742	0.000226742	0.000226742
Emission Factor (lb N2O/therm)	0.000005	0.000005	0.000005
Total Natural Gas (MTCO2e/year)	859	1,695	1,295
Total MT CO2e/year	981	1,796	1,435

Source: Water and Wastewater 2015-2019 data, provided by the City

Source: Milpitas Wastewater Email

	2005	2015	2019
Milpitas Population	61,334	87,570	90,030
WWTP Service Population	1,300,000	1,400,000	1,500,000
MDG	4.576	6.812	6.751

Source: SJSCRWF 2009 Annual Self Monitoring Report

Assumptions and Conversion Factors

Milpitas Greenhouse Gas Inventory

Category	Value	Notes	Source
Conversion Factors			
g/MT	1000000		
g/lb	453.592		
g/kg	1000		
lb/MT	2204.622622		
kg/MT	1000		
MT/ton	0.907185		
g/ton	907185		
lb/kg	2.20462		
kWh/MWh	1000		
MWh/GWh	1000		
gal/cubic foot	7.480519481		
gal/Liter	0.264172052		
Liter/gallon	3.785411784		
gallon/acrefoot	325,851.43		
days/year	365		
million gal/acre-feet	0.325851432		
MMBTU/gallon (diesel)	0.1374		
MMBTU/scf (natural gas)	0.001037		
GWP			
Source (Select)	*IPCC Fifth Assessment Report (Avg)*	<--drop down selection	
CO2	1		
CH4	28		
N2O	265		

Source	CO2 GWP	CH4 GWP	N2O GWP
IPCC Fourth Assessment Report (w/o climate carbon feedback)	1	25	265
IPCC Fourth Assessment Report (with climate carbon feedback)	1	34	298
IPCC Fourth Assessment Report (Avg)	1	25	298
IPCC Fifth Assessment Report (Avg)	1	28	265
IPCC Third Assessment Report	1	23	296
IPCC Second Assessment Report	1	21	310

Electricity Emission Factors	2005	2015	2018	2019	Source
PG&E EF (lb CO2/MWh)	489	404.51	206.29	197.8123	https://www.theclimateregistry.org/our-members/cris-public-reports/
CAMX EF (lb CH4/MWh)	0.03024	0.033	0.034	0.0327	eGRID (https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid)
CAMX EF (lb N2O/MWh)	0.00808	0.004	0.004	0.00385	eGRID (https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid)
CAMX EF (lb CO2/MWh)	724.12	527.9	496.50	478.1111	eGRID (https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid)
RPS Requirements					
PG&E					
Percent Renewable			27%	30%	
Increase in Renewables (from 2018)				3%	
SVCE EF (lb CO2/MWh)				2.34	SVCE Inventory

*2005 PG&E emissions factor provided by previous 2005 inventory and confirmed here: https://www.ca-ilg.org/sites/main/files/file-attachments/ghg_emission_factor_guidance.pdf

*2015 data is proxy data from 2016

Fuel Emission Factors				
Fuel	Emission Factor	Unit	Source	
Diesel (backup generators)	10.21	kg CO2/gal	Climate Registry 2020 Default Emission Factors	22.5091702
	0.9	g CH4/MMBTU		0.014442768
	0.4	g N2O/MMBTU		0.006419008
Natural Gas (backup generators)	0.05444	kg CO2/scf		1.157372351
	0.9	g CH4/MMBTU		0.000198416
	0.9	g N2O/MMBTU		0.000198416

Demographics

Milpitas Greenhouse Gas Inventory

	Population			Employment			Service Population		
Subarea	**2005**	**2015**	**2019**	**2005**	**2015**	**2019**	**2005**	**2015**	**2019**
Milpitas	61,334	87,570	90,030	39,346	48,180	47,084	100,680	135,750	137,114
Rest of County	1,602,943	1,822,105	1,880,973	809,129	1,039,050	1,066,690	2,412,072	2,861,155	2,947,663
Total County	1,664,277	1,909,675	1,971,003	848,475	1,087,230	1,113,774	2,512,752	2,996,905	3,084,777

Source: MTC Plan Bay Area Population 2010-2040

Note: 2005 population and employment data were extrapolated backwards (i.e., backcast) using MTC data for 2010-2040

	Population			Employment			Service Population		
	2005	**2015**	**2019**	**2005**	**2015**	**2019**	**2005**	**2015**	**2019**
Percent Change from 2019			0.00%			0.00%			0.00%
Percent Change from 2040	--	--	--	--	--	--	--	--	--
Percent of Total County	3.69%	4.59%	4.57%	4.64%	4.43%	4.23%	4.01%	4.53%	4.44%

Population Compound Annual Growth Rate	0.69%
Employment Compound Annual Growth Rate	1.00%
Avg Annual Population Percent Change	0.74%
Avg Annual Employment Percent Change	1.11%

Milpitas Municipal Operations Greenhouse Gas Emissions Inventories								
Emissions Sector	2015 GHG Emissions				2019 GHG Emissions			
	Activity	Units	$MTCO_2e$	$MTCO_2e$ % of Annual Total	Activity	Units	$MTCO_2e$	$MTCO_2e$ % of Annual Total
Buildings and Facilities			**2,001**	**39.86%**			**870**	**26.74%**
Electricity	6,357	MWh	1,192	59.6%	7,568	MWh	8	0.9%
Natural Gas	150,551	Therms	799	40.0%	155,596	Therms	826	95.0%
Backup Generators (Diesel)	903	Gallons	9	0.5%	3,456	Gallons	35	4.1%
Streetlights and Traffic Signals	**3,007**	**MWh**	**564**	**11.23%**	**2,951**	**MWh**	**3**	**0.10%**
Electricity	3,007	MWh	564	100.0%	2,951	MWh	3	100.0%
Employee Commute	**3,508,561**	**VMT**	**1,304**	**25.99%**	**3,508,561**	**VMT**	**1,195**	**36.76%**
Employee Commute	3,508,561	VMT	1,304	100.0%	3,508,561	VMT	1,195	100.0%
Vehicle Fleet	**110,905**	**Gallons**	**1,017**	**20.27%**	**117,581**	**Gallons**	**1,081**	**33.24%**
Gasoline	88,875	Gallons	790	77.6%	92,606	Gallons	823	76.1%
Diesel	22,030	Gallons	228	22.4%	24,975	Gallons	258	23.9%
Solid Waste	**154**	**Tons**	**52**	**1.03%**	**157**	**Tons**	**53**	**1.62%**
Water Supply	**77**	**MGY**	**70**	**1.40%**	**155**	**MGY**	**41**	**1.26%**
Wastewater Treatment			**11**	**0.23%**			**9**	**0.28%**
Total $MTCO_2e$/yr			**5,019**	**100%**			**3,252**	**100%**

Energy Consumption
Milpitas Municipal Operations Greenhouse Gas Inventories

Electricity

Source	2015 MWh/year	2015 Emission Factor (lb CO2/MWh)	2015 Emission Factor (lb CH4/MWh)	2015 Emission Factor (lb N2O/MWh)	2015 Total MT CO2e/year	2019 MWh/year	2019 Emission Factor (lb CO2/MWh)	2019 Emission Factor (lb CH4/MWh)	2019 Emission Factor (lb N2O/MWh)	2019 Total MT CO2e/year
Buildings & Facilities Electricity (PG&E)	6,357	404.51	0.033	0.004	1,192	--	--	--	--	--
Streetlights & Traffic Signals (PG&E)	3,007	404.51	0.033	0.004	564	--	--	--	--	--
Buildings & Facilities Electricity (SVCE)	--	--	--	--	--	7,568	2.34	0.0000	0.0000	8
Streetlights & Traffic Signals (SVCE)	--	--	--	--	--	2,951	2.34	0.0000	0.0000	3
Total					**1,756**					**11**

Source: 2005 Milpitas GHG Inventory, provided by the City
Source: Municipal Electricity and Natural Gas 2015, provided by the City
Source: Municipal Electricity and Natural Gas 2019, provided by the City

Natural Gas

Source	2015 therms/year	2015 Emission Factors (lb/therm) CO_2	2015 Emission Factors (lb/therm) CH_4	2015 Emission Factors (lb/therm) N_2O	2015 Total MT CO2e/year	2019 therms/year	2019 Emission Factors (lb/therm) CO_2	2019 Emission Factors (lb/therm) CH_4	2019 Emission Factors (lb/therm) N_2O	2019 Total MT CO2e/year
Buildings & Facilities Natural Gas (PG&E)	150,551	11.7	0.000226742	0.000005	799	155,596	11.7	0.000226742	0.000005	826
Total					**799**					826

Source: 2005 Milpitas GHG Inventory, provided by the City
Source: Municipal Electricity and Natural Gas 2015, provided by the City
Source: Municipal Electricity and Natural Gas 2019, provided by the City

Backup Generators

Source	2015 gallons/year	2015 Emissions Factor (kg CO2/gal)	2015 Emissions Factor (g CH4/MMBTU)	2015 Emissions Factor (g N2O/MMBTU)	2015 Total MT CO2e/year	2019 gallons/year	2019 Emissions Factor (kg CO2/gal)	2019 Emissions Factor (g CH4/MMBTU)	2019 Emissions Factor (g N2O/MMBTU)	2019 Total MT CO2e/year
Diesel	903	10.21	0.9	0.4	9	3,456	10.21	0.9	0.4	35
Total					**9**					35

Source: Municipal Backup Generator Usage, provided by the City

Building Energy Efficiency Assumptions

Sector	Code	% Reduction	Notes	Source
Commercial	Energy efficiency improvement of 2013 code above 2008 code	30%		http://www.energy.ca.gov/commission/accomplishments/2014_cec_accomplishments.p
	Energy efficiency improvement of 2016 code above 2013 code	5%		http://www.energy.ca.gov/title24/2016standards/rulemaking/documents/2015-06-
	Energy efficiency improvement of 2019 code above 2016 code	30%		

Commercial Reduction	53.45%

Employee Commute

Source	2015 VMT/year	2015 MTCO2e/year	2019 VMT/year	2019 MTCO2e/year
Employee Commute	3,508,561	1,304	3,508,561	1,195
Total	**3,508,561**	**1,304**	**3,508,561**	**1,195**

Source: Municipal Employee data, provided by the City

Vehicle Fleet

Milpitas Municipal Operations Greenhouse Gas Inventories

Vehicle Fleet	2015						2019					
Source	**gallons/year**	**Emissions Factor (kg CO2/gal)**	**MT CO2/year**	**Emissions Ratio (MT CH4/MT CO2)**	**Emissions Ratio (MT N2O/MT CO2)**	**Total MT CO2e/year**	**gallons/year**	**Emissions Factor (kg CO2/gal)**	**MT CO2/year**	**Emissions Ratio (MT CH4/MT CO2)**	**Emissions Ratio (MT N2O/MT CO2)**	**Total MT CO2e/year**
Gasoline	88,875	8.78	780.32	0.0000237	0.0000429	789.71	92,606	8.78	813.08	0.0000237	0.0000429	822.86
Diesel	22,030	10.21	224.93	0.0000237	0.0000429	227.63	24,975	10.21	254.99	0.0000237	0.0000429	258.06
Total						**1,017**						**1,081**

Source: Milpitas Municipal Vehicle Fleet Usage

Solid Waste

Milpitas Municipal Operations Greenhouse Gas Inventories

Solid Waste Emissions Totals	2015	2019
Total (MTCO2e/year)	52	53

Municipal-Generated Solid Waste	2015	2019
Municipal Employees	512	524
Average Solid Waste Disposal Per Employee (tons/employee/year)	0.3	0.3
Solid Waste Disposal (tons)	153.6	157.2
LFG Capture Rate	75%	75%
Percent of Landfills Accepting Waste from Milpitas with LFG Capture	89%	89%
Oxidation Rate	0.1	0.1
EPA Emissions Factor (MTCH4/wet short ton)	0.06	0.06
Total Emissions (MTCO2e/year)	51.61	52.82

Waste Diversion Target			
Milpitas per employee disposal target	9.7	75%	diversion
Milpitas per employee disposal rate	6	85%	diversion

Water Supply

Milpitas Municipal Operations Greenhouse Gas Inventories

Water

	2015						2019					
Water Provider	**MGY**	**Total MWh**	**Emission Factor (lb CO2/MWh)**	**Emission Factor (lb CH4/MWh)**	**Emission Factor (lb N2O/MWh)**	**Total CO2e (MT/year)**	**MGY**	**Total MWh**	**Emission Factor (lb CO2/MWh)**	**Emission Factor (lb CH4/MWh)**	**Emission Factor (lb N2O/MWh)**	**Total CO2e (MT/year)**
SFPUC	35	155	404.51	0.0330	0.0040	**29**	62	277	0.00	0.0000	0.0000	**-**
SCVWD	23	166	404.51	0.0330	0.0040	**31**	41	297	197.81	0.0327	0.0039	**27**
SBWR	20	59	404.51	0.0330	0.0040	**11**	52	154	197.81	0.0327	0.0039	**14**
Total	77	380				**70**	154.79	729				**41**

Municipal Water Use		
	2015	**2019**
Potable Water (HCF)	77181	138040
Recycled Water (HCF)	26113	68878

Source: Milpitas Municipal Water 2015, provided by the City

Source: Milpitas Municipal Water 2019, provided by the City

Wastewater Treatment Characteristics

WWTP/Septic System	Description	Wastewater Treatment Process, Fugitive and Stationary Greenhouse Gas Emission Sources	U.S. Community Protocol, Appendix F, Equations
San Jose - Santa Clara Regional Wastewater Facility	Solids are lagooned for approximately three years. Secondary treatment process is a step-feed Biological Nutrient Removal (BNR) process that achieves full nitrification (all ammonia is converted to nitrate) and partial de-nitrification (about 65% nitrogen removed as an annual average, about 70% removed in the dry season). The BNR process also removes approximately 90% of the incoming phosphorus. Anaerobic digestion used onsite.	full nitrification and partial de-nitrification, lagoon, anaerobic digestion	WW.1a and alt, WW.2a and alt, WW.6, WW.7, WW.12 and alt, WW.15

Wastewater Emissions Totals

	2015	2019
Total (MT CO2e/year)	**11**	**9**

WW.1a Stationary Methane Emissions from Combustion of Digester Gas

	2015	2019
Volume of Digester Gas Produced per Day (scf/day)	483	555
Fraction of CH4 in Digester Gas	0.61	0.61
BTU of CH4	1028	1028
BTU to MMBTU conversion	0.000001	0.000001
CH4 emissions factor (kg CH4/MMBTU)	0.0032	0.0032
MT CH4/year	0.00035	0.00041
Total MT CO2e/year	0.0099	0.0114

Source: Municipal Wastewater 2015 and 2019 data, provided by the City

WW.2a Stationary Nitrous Oxide Emissions from Combustion of Digester Gas

	2015	2019
Volume of Digester Gas Produced per Day (scf/day)	483	555
Fraction of CH4 in Digester Gas	0.61	0.61
BTU of N2O	1028	1028
BTU to MMBTU conversion	0.000001	0.000001
N2O emissions factor (kg CH4/MMBTU)	0.00063	0.00063
MT N2O/year	0.00007	0.00008
Total MT CO2e/year	0.0185	0.0212

Source: Municipal Wastewater 2015 and 2019 data, provided by the City

WW.6 Process Methane Emissions from Wastewater Treatment Lagoons

	2015	2019
BOD load (kg/day)	0.0206	0.0362
Fraction of BOD removed in primary treatment	0.99	0.99
Maximum CH4 producing capacity for domestic wastewater (kg CH4/kg BOD removed)	0.6	0.6
CH4 correction factor for anaerobic systems	0.8	0.8
MT CH4/year	0.000036	0.000063
Total MT CO2e/year	0.0010	0.0018

Source: Municipal Wastewater 2015 and 2019 data, provided by the City

WW.7 Process Nitrous Oxide Emissions from Wastewater Treatment Plants with Nitrification or Denitrification

	2015	2019
Population of Milpitas Municipal Employees	512	524
Factor for industrial and commercial discharge	1.25	1.25
Emission factor for a WWTP with nitrification or denitrification (g N2O/ person / year)	7	7
MT N2O/year	0.0029	0.0030
Total MT CO2e/year	0.77	0.79

Source: Municipal Wastewater 2015 and 2019 data, provided by the City

WW.12 Fugitive Nitrous Oxide Emissions from Effluent Discharge

	2015	2019
Average total nitrogen per day (kg N/day)	0.0017	0.0031
Emission factor (kg N2O-N/kg sewage-N discharged)	0.005	0.005
Molecular weight ratio of N2O to N2	1.57	1.57
MT N2O/year	0.0000049	0.0000089
Total MT CO2e/year	0.0013	0.0024

Source: Municipal Wastewater 2015 and 2019 data, provided by the City

WW.15 Energy-related Emissions Associated with Wastewater Collection and Treatment

	2015	2019
MWh/year	6.30	8.97
Emission Factor (lb CO2/MWh)	206	198
Emission Factor (lb CH4/MWh)	0.0340	0.0327
Emission Factor (lb N2O/MWh)	0.0040	0.0039
Total Electricity (MTCO2e/year)	0.595	0.813
Natural Gas (therms/year)	1,866	1,419
Emission Factor (lb CO2/therm)	11.7	11.7
Emission Factor (lb CH4/therm)	0.000226742	0.000226742
Emission Factor (lb N2O/therm)	0.000005	0.000005
Total Natural Gas (MTCO2e/year)	9.908	7.538
Total MT CO2e/year	10.504	8.351

Source: Water and Wastewater 2015-2019 data, provided by the City
Source: Milpitas Wastewater Email

Population	2015	2019
Milpitas Municipal Employees	512	524
WWTP Service Population	1,400,000	1,500,000

Source: Municipal Employee data, provided by the City

Assumptions and Conversion Factors

Milpitas Municipal Operations Greenhouse Gas Inventories

Category	Value	Notes	Source
Conversion Factors			
g/MT	1000000		
g/lb	453.592		
g/kg	1000		
lb/MT	2204.622622		
kg/MT	1000		
MT/ton	0.907185		
g/ton	907185		
lb/kg	2.20462		
kWh/MWh	1000		
MWh/GWh	1000		
gal/cubic foot	7.480519481		
gal/Liter	0.264172052		
Liter/gallon	3.785411784		
gallon/acrefoot	325851.429		
days/year	365		
million gal/acre-feet	0.325851432		
MMBTU/gallon (diesel)	0.1374		
MMBTU/scf (natural gas)	0.001037		
GWP			
Source (Select)	*IPCC Fifth Assessment Report (Avg)*	<--drop down selection	
CO2	1		
CH4	28		
N2O	265		

Source	CO2 GWP	CH4 GWP	N2O GWP
IPCC Fourth Assessment Report (w/o climate carbon feedback)	1	25	265
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Electricity Emission Factors	2005	2015	2018	2019	Source
PG&E EF (lb CO2/MWh)	489	404.51	206.29	197.8123	https://www.theclimateregistry.org/our-members/cris-public-reports/
CAMX EF (lb CH4/MWh)	0.03024	0.033	0.034	0.0327	eGRID (https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid)
CAMX EF (lb N2O/MWh)	0.00808	0.004	0.004	0.00385	eGRID (https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid)
CAMX EF (lb CO2/MWh)	724.12	527.9	496.50	478.1111	eGRID (https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid)
RPS Requirements					
PG&E					
Percent Renewable			27%	30%	
Increase in Renewables (from 2018)				3%	

*2005 PG&E emissions factor provided by previous 2005 inventory and confirmed here: https://www.ca-ilg.org/sites/main/files/file-attachments/ghg_emission_factor_guidance.pdf

*2015 data is proxy data from 2016

SVCE EF (lb CO2/MWh) 2.34 SVCE Inventory

Fuel Emission Factors			
Gasoline	8.78	kg CO2/gal	Climate Registry Default Emission Factors 2020
Boats - Gasoline 4-stroke	5.443	g CH4/gal	Climate Registry Default Emission Factors 2020
Boats - Gasoline 4-stroke	0.061	g N2O/gal	Climate Registry Default Emission Factors 2020

Fuel Emission Factors				
Fuel	Emission Factor	Unit	Source	
Gasoline (transport fuel)	8.78	kg CO2/gal	Climate Registry 2020 Default Emission Factors	
	0.0000237	MT CH4/MT CO2		
	0.0000429	MT N2O/MTO CO2		
Diesel (transport fuel)	10.21	kg CO2/gal		
	0.0000237	MT CH4/MT CO2		
	0.0000429	MT N2O/MTO CO2		
Diesel (backup generators)	10.21	kg CO2/gal		22.5091702
	0.9	g CH4/MMBTU		0.014442768
	0.4	g N2O/MMBTU		0.006419008
Natural Gas (backup generator)	0.05444	kg CO2/scf		1.157372351
	0.9	g CH4/MMBTU		0.000198416
	0.9	g N2O/MMBTU		0.000198416

Demographics

Milpitas Municipal Operations Greenhouse Gas Inventories

Municipal Employees	2015	2019
Milpitas	512	524
Percent Growth from 2019	--	0
Percent Growth from 2040	--	--

Employment Growth Rate 2019 to 2030	0.50%
Employment Growth Rate 2030 to 2045	0.25%

Note from City:

Given the numbers below with a 1% growth factor, I suggest a 0.5% growth factor until 2030 and then reduce it to 0.25%. By 2030, the City will be build out and we may only add staff for enhancng services.

Memo

1111 Broadway, Suite 300
Oakland, CA 94607
916.444.7301

Date: April 1, 2021

To: Elaine Marshall (City of Milpitas)

From: Honey Walters, Hannah Kornfeld, and Sam Ruderman (Ascent Environmental)

Subject: City of Milpitas Climate Action Plan Update, Greenhouse Gas Emissions Forecasts – Technical Memorandum

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INTRODUCTION

In 2013, the City of Milpitas (City) adopted its first Climate Action Plan (CAP), which served as a roadmap to meet the State's 2020 greenhouse gas (GHG) emissions reduction target (i.e., 15 percent below 2005 baseline emissions). The CAP included GHG forecasts for the year 2020. The City is now updating its inventory, forecasts, and targets in preparation of its Climate Action Plan Update (CAP Update). The CAP Update is intended to reduce GHG emissions from community activities and municipal operations. The next step in this update process is to forecast these GHG emissions for target years 2030, 2040, and 2045. This technical memorandum provides the results of these forecasts as well as associated methods, assumptions, emissions factors, and data sources.

The GHG emissions forecasts will provide a foundation for the forthcoming steps of the CAP Update process, including the development of GHG emissions reduction targets and measures.

ORGANIZATION OF THIS MEMORANDUM

This memorandum consists of two main parts:

- Section 1: Summary of Inventory Results presents an overview of the updated GHG emissions inventory (baseline 2019) for both community and municipal operations.
- Section 2: Emissions Forecasts summarizes the forecasted GHG emissions under "business-as-usual" (BAU) and legislative-adjusted BAU scenarios for years 2030, 2040, and 2045. A BAU scenario is one in which no GHG reductions from actions taken by local, regional, State, or federal agencies are accounted. A legislative-adjusted BAU scenario reflects policy or regulatory actions enacted by regional, State, or federal agencies, without considering any local (City) actions to reduce GHG emissions.

1 SUMMARY OF INVENTORY RESULTS

1.1 2019 COMMUNITY INVENTORY RESULTS

Based on the modeling conducted, the community generated approximately 441,557 metric tons of carbon dioxide equivalent ($MTCO_2e$) in 2019. Major emissions sectors included on-road transportation, residential and nonresidential building energy use, solid waste, and off-road vehicles and equipment. Table 1 and Figure 1 present the city's 2019 GHG emissions inventory by sector. A description of each emissions sector, including key sources of emissions, is provided in further detail in Technical Memorandum #1, dated February 16, 2021.

Table 1 2019 Milpitas Community Greenhouse Gas Emissions Inventory

Sector	2019 ($MTCO_2e$/year)	Percent of Total
Residential Building Energy	42,218	10
Nonresidential Building Energy	98,319	22
On-Road Transportation	259,627	59
Off-Road Vehicles and Equipment	15,554	4
Solid Waste	23,566	5
Water Supply	694	<1
Wastewater Treatment	1,578	<1
Total	**441,557**	**100**

Notes: Totals may not sum exactly due to independent rounding. $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year.

Source: 2019 inventory prepared by Ascent Environmental in 2021.

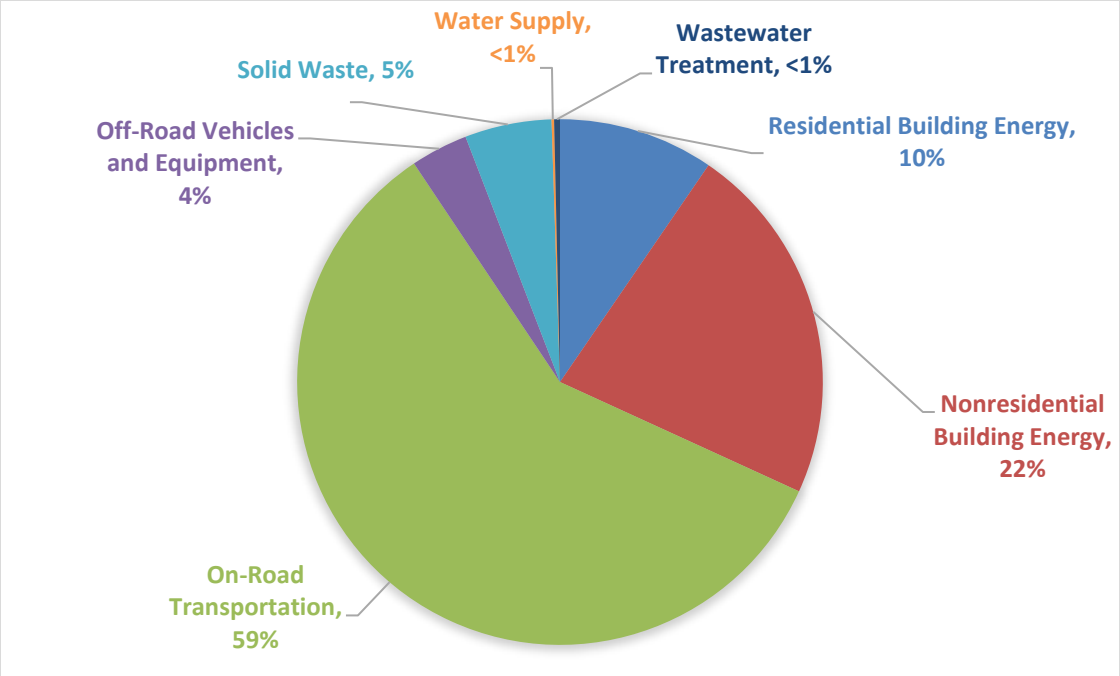

Figure 1 2019 Milpitas Community Greenhouse Gas Emissions Inventory

1.2 2019 MUNICIPAL OPERATIONS INVENTORY RESULTS

Based on the modeling conducted, the City's municipal operations generated approximately 3,252 $MTCO_2e$ in 2019. Major emissions sectors included buildings and facilities, streetlights and traffic signals, employee commute, and vehicle fleet. A description of each emissions sector, including key sources of emissions, is provided in further detail in Technical Memorandum #1, dated February 16, 2021. Table 2 presents the 2019 municipal operations GHG emissions inventories by sector, and Figure 2 illustrates the 2019 municipal operations inventory by sector.

Table 2 2019 Milpitas Municipal Operations Greenhouse Gas Emissions Inventory

Sector	2019 ($MTCO_2e$/year)	Percent of Total
Buildings and Facilities	870	27
Streetlights and Traffic Signals	3	<1
Employee Commute	1,195	37
Vehicle Fleet	1,081	33
Solid Waste	53	2
Water Supply	41	1
Wastewater Treatment	9	<1
Total	**3,252**	**100%**

Notes: Totals may not sum exactly due to independent rounding. $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year.

Source: 2019 inventory prepared by Ascent Environmental in 2021.

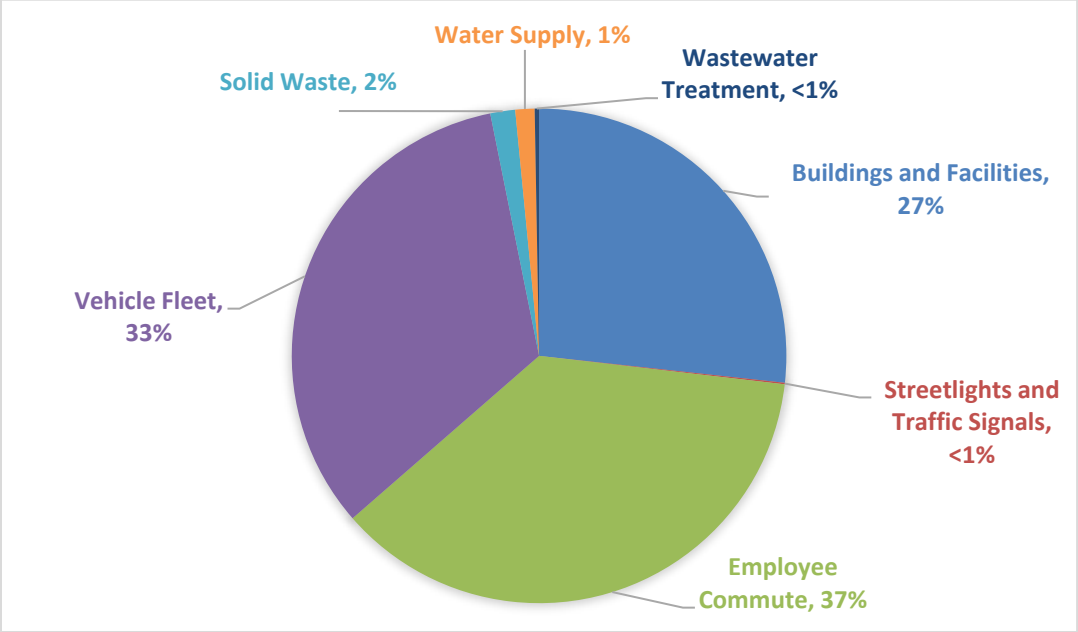

Figure 2 2019 Milpitas Municipal Operations Greenhouse Gas Emissions Inventory

2 GREENHOUSE GAS EMISSIONS FORECASTS TO 2030, 2040, AND 2045

2.1 COMMUNITY FORECAST RESULTS

The BAU GHG emissions forecasts provide an assessment of how emissions generated by community activities will change over time without further local action. In addition to accounting for the city's growth under a BAU scenario, an adjusted BAU forecast was prepared, which includes adopted legislative actions at the State and federal levels that would affect emissions without any local action, such as regulatory requirements to increase vehicle fuel efficiency and increase renewable energy sources in grid electricity portfolios. It is important to note that the legislative-adjusted BAU emissions forecasts only include emissions reductions associated with implementation of adopted federal and State legislation and regulations and do not include goals established by executive orders or targets established by federal or State agencies outside of adopted legislation and regulations. These forecasts provide the City with the information needed to focus efforts on certain emissions sectors and sources that have the greatest opportunities for GHG emissions reductions.

The BAU forecasts described in this section for 2030, 2040, and 2045 are aligned with the State's GHG reduction target years established in key legislation and policies, including Senate Bill (SB) 32 and Executive Order (EO) B-55-18, as well as the City's General Plan Update horizon year. The long-term target year of 2045 was chosen to better align with newer State GHG targets such as the statewide carbon neutrality goal, rather than the previously issued 2050 goal of 80 percent reduction from 1990 levels. The statewide GHG reduction targets are:

- 40 percent below 1990 levels by 2030 (SB 32); and
- to achieve carbon neutrality no later than 2045 (EO B-55-18).

Estimated BAU emissions forecasts were based on predicted growth in existing demographic forecasts, including population and employment changes between 2015 and 2040 for the City, as provided by the Metropolitan Transportation Commission (MTC). Population and employment are expected to increase by 0.69 and 0.75 percent year over year, respectively. These growth factors were used to forecast BAU emissions for 2030 and 2040 for most sectors in the inventory. The same average year over year growth rates were applied to 2045 because no other data is currently available. MTC also provided annual vehicle miles traveled (VMT) growth projections for the years 2015 through 2040. Based on these data, annual VMT is projected to increase by 0.68 percent year over year. VMT projections were used to scale emissions from the on-road transportation sector. The same average annual growth rates were applied to 2045 because there is currently no published information about demographic or VMT projections for the city after 2040. Table 3 shows anticipated growth in the city for the forecast years.

Table 3 Milpitas Community Demographic and Vehicle Miles Traveled Forecasts

Forecast Factor	2019	2030	2040	2045
Population	90,030	95,605	103,970	107,250
Employment	47,084	56,035	58,030	60,000
Annual VMT	572,889,499	633,251,901	662,346,271	687,876,785

Notes: VMT = vehicle miles traveled.

Source: BAAQMD 2015 and MTC 2020; adapted by Ascent Environmental in 2021.

Table 4 shows baseline emissions in 2019 and BAU emissions forecasts for 2030, 2040, and 2045.

Table 4 2019 Milpitas Community Greenhouse Gas Emissions Inventory and BAU Forecasts ($MTCO_2e$/year)

Sector	2019	2030	2040	2045
Residential Building Energy	42,218	44,917	48,815	50,357
Nonresidential Building Energy	98,319	117,517	121,949	126,077
On-Road Transportation	259,627	291,196	310,877	324,507
Off-Road Vehicles and Equipment	15,554	21,139	22,984	23,421
Solid Waste	23,566	25,026	27,215	28,074
Water Supply	694	737	801	827
Wastewater Treatment	1,578	1,676	1,822	1,880
Total	**441,557**	**502,207**	**534,465**	**555,142**

Notes: Total may not sum exactly due to independent rounding. BAU = business-as-usual; $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year.

Source: Forecasts prepared by Ascent Environmental in 2021.

Legislative-adjusted BAU emissions forecasts were prepared using the same demographic and VMT data that were used for the BAU forecasts, while accounting for State and federal legislative actions that would affect local emissions. These forecasts provide the City with a more robust understanding to assist with the prioritization of emissions reduction measures developed to meet the GHG targets. A summary of the legislative reductions applied is provided in Table 5.

Table 5 Legislative Reductions Summary

Source	Legislative Reduction	Description	Sectors Applied
State	SB 100 (Renewables Portfolio Standard)	Requires California energy utilities to procure 60 percent of electricity from renewable sources by 2030 and 100 percent carbon-free electricity by 2045.	Building Energy, Water
State	California's Building Energy Efficiency Standards (Title 24, Part 6)	Requires all new buildings in California to comply with energy efficiency standards established by CEC. Accounts for the energy efficiency gains associated with lighting, heating, cooling, ventilation, and water heating improvements, as well as onsite solar photovoltaic requirements for low-rise residential.	Building Energy
State	Advanced Clean Car Standards	Establishes GHG emission reduction standards for model years 2017 through 2025 that are more stringent than federal CAFE standards.	On-Road Vehicles
State	Truck and Bus Regulation	Requires diesel trucks and buses that operate in California to be upgraded to reduce GHG emissions.	On-Road Vehicles
Federal	Fuel Efficiency Standards for Medium- and Heavy-Duty Vehicles	Establishes fuel efficiency standards for medium- and heavy-duty engines and vehicles.	On-Road Vehicles
Federal	EPA Off-Road Compression-Ignition Engine Standards	Establishes standards for phasing of EPA diesel engine tiers for off-road compression-ignition equipment.	Off-Road Vehicles and Equipment

Notes: CAFE = Corporate Average Fuel Economy; CEC = California Energy Commission; EPA = U.S. Environmental Protection Agency; GHG = greenhouse gas; SB = Senate Bill.

Source: Forecasts prepared by Ascent Environmental in 2021.

The city's legislative-adjusted BAU emissions would decrease by approximately 5 percent between 2019 and 2030, as shown below in Table 6 and Figure 3. Figure 3 also shows the emissions trend that would occur without anticipated

legislative reductions, accounting only for population, employment, and VMT changes. Without the legislative reductions, emissions would be 40 percent higher in 2045 compared to the legislative-adjusted BAU forecast.

Table 6 2019 Milpitas Community Greenhouse Gas Emissions Inventory and Legislative-Adjusted BAU Forecasts ($MTCO_2e$/year)

Sector	2019	2030	2040	2045
Residential Building Energy	42,218	42,660	43,399	43,658
Nonresidential Building Energy	98,319	93,467	82,288	77,177
On-Road Transportation	259,627	236,310	218,898	221,388
Off-Road Vehicles and Equipment	15,554	21,139	22,984	23,421
Solid Waste	23,566	25,026	27,215	28,074
Water Supply	694	421	153	0
Wastewater Treatment	1,578	1,612	1,692	1,713
Total	**441,557**	**420,636**	**396,629**	**395,432**

Notes: Total may not sum exactly due to independent rounding. BAU = business-as-usual; $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year.

Source: Forecasts prepared by Ascent Environmental in 2021.

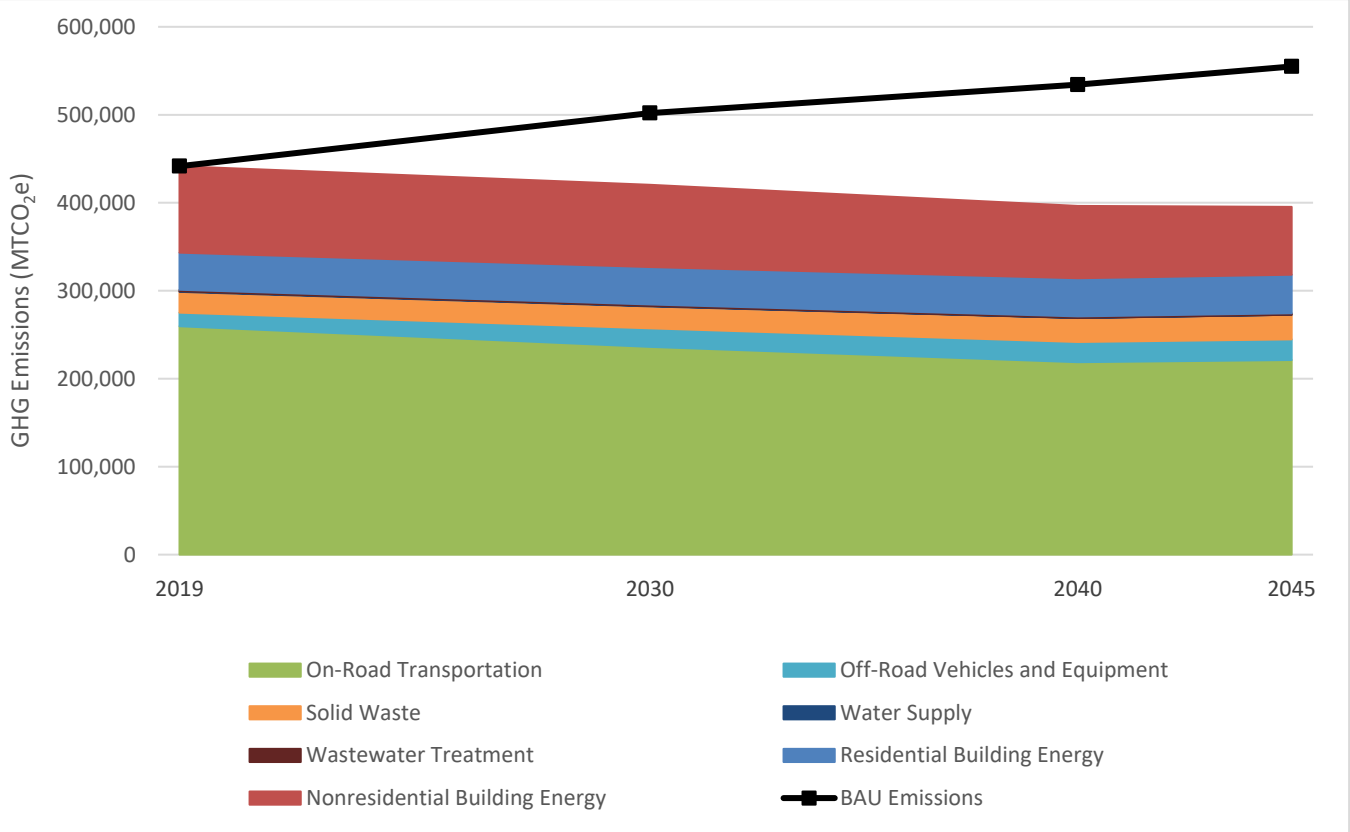

Figure 3 2019 Milpitas Community Greenhouse Gas Emissions Inventory and Legislative-Adjusted BAU Forecasts

Emissions forecasts are detailed for each sector and discussed below.

2.1.1 Building Energy

Emissions from future electricity, natural gas, and backup generator use were estimated by multiplying anticipated energy use with forecasted emissions factors. Future energy use was forecasted in three parts. First, energy use was scaled by population and employment growth factors detailed in Table 3. Second, electricity emissions factors were adjusted to reflect California's Renewables Portfolio Standard (RPS) targets pursuant to SB 100. Electricity emissions factors are anticipated to decline based on current regulations, while natural gas and diesel emissions factors are anticipated to be constant. Third, energy intensity factors were adjusted to reflect increased stringency under California's Building Energy Efficiency Standards (California Code of Regulations Title 24 Part 6, hereafter referred to as "Title 24"). The 2019 Title 24 standards, which became effective in 2020, are expected to achieve decreases in electricity consumption in new construction. The assumptions for energy efficiency and future electricity emissions factors are described below. Table 7 summarizes the scaling factors and legislative reductions used to forecast building use by energy type.

Table 7 Building Energy Emissions Forecast Methods and Legislative Reductions by Source

Energy Type	Forecast Methods	
	Scale Factor	Applied Legislative Reductions
Electricity	Scaled by population growth for residential building energy; scaled by employment growth for nonresidential building energy.	RPS achieved to date and scheduled targets (i.e., 33 percent renewable by 2020, 60 percent renewable by 2030) applied to PG&E's and SVCE's emissions factors. Accounts for 2008 to 2019 Title 24 energy efficiency gains in new construction.
Natural Gas		
Backup Generators	Scaled by employment growth for nonresidential building energy.	Accounts for 2008 to 2019 Title 24 energy efficiency gains in new nonresidential construction.

Notes: PG&E = Pacific Gas & Electric; RPS = Renewables Portfolio Standard; SVCE = Silicon Valley Clean Energy.

Source: Forecasts prepared by Ascent Environmental in 2021.

RESIDENTIAL BUILDING ENERGY

Between 2019 and 2030, electricity and natural gas emissions from residential buildings would increase by approximately 1 percent from 42,218 to 42,660 $MTCO_2e$ per year with legislative adjustments and overall population growth of 6 percent over the same time. While GHG emissions associated with residential electricity usage are anticipated to decline through 2030 and reflect SB 100 requirements, emissions from residential natural gas consumption are expected to rise gradually. This increase is due to population growth in the city and reflects currently adopted legislation. Table 8 shows the 2019 inventory and legislative-adjusted BAU forecasted emissions from the residential building energy sector by energy type for 2030, 2040, and 2045.

Table 8 2019 Residential Building Energy Greenhouse Gas Emissions Inventory and Legislative-Adjusted BAU Emissions Forecasts ($MTCO_2e$/year)

Energy Type	2019	2030	2040	2045
Electricity	581	369	125	0
Natural Gas	41,637	42,292	43,273	43,658
Total	**42,218**	**42,660**	**43,399**	**43,658**

Notes: Totals may not sum exactly due to independent rounding. BAU = business-as-usual; $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year.

Source: Forecasts prepared by Ascent Environmental in 2021.

NONRESIDENTIAL BUILDING ENERGY

Between 2019 and 2030, electricity, natural gas, and back-up generator emissions from nonresidential buildings would decrease by 5 percent from 98,319 to 93,467 $MTCO_2e$ per year with legislative adjustments and overall employment growth of 19 percent over the same time. Table 9 shows the 2019 inventory and legislative-adjusted BAU forecasted emissions for the nonresidential building energy sector by energy type for 2030, 2040, and 2045.

Table 9 2019 Nonresidential Building Energy Greenhouse Gas Emissions Inventory and Legislative-Adjusted BAU Forecasts ($MTCO_2e$/year)

Energy Type	2019	2030	2040	2045
Electricity	29,880	18,973	6,443	0
Natural Gas	67,828	73,831	75,169	76,490
Backup Generators	611	664	676	687
Total	**98,319**	**93,467**	**82,288**	**77,177**

Notes: Totals may not sum exactly due to independent rounding. BAU = business-as-usual; $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year.

Source: Forecasts prepared by Ascent Environmental in 2021.

Electricity Emissions Factors

Emissions from the building energy sector are anticipated to gradually decline through 2045 without additional City action, despite growth, due to State measures already in place that affect the carbon intensity of grid electricity. Pacific Gas and Electric's (PG&E's) carbon dioxide (CO_2) emissions factor for 2019 was interpolated using the 2018 emissions factor provided by PG&E and the requirements of RPS pursuant to SB 100. Silicon Valley Clean Energy's (SVCE's) emissions factor for CO_2 in 2019 was provided by SVCE. Electricity emissions factors for methane (CH_4) and nitrous oxide (N_2O) were obtained from the U.S. Environmental Protection Agency's (EPA's) Emissions & Generation Resource Integrated Database (eGRID) 2018 Annual Output Emissions Rates (EPA 2020).

California utility providers, including PG&E and SVCE, were scheduled to reach a 33 percent renewable electricity generation mix in 2020 and, pursuant to SB 100, are scheduled to achieve 60 percent renewable electricity by 2030 and 100 percent carbon-free electricity by 2045. PG&E's 2030 and 2040 emissions factors are 113.0 and 37.7 pounds of CO_2 per megawatt hour (lb CO_2/MWh), respectively. SVCE's 2030 and 2040 emissions factors are 1.3 and 0.4 lb CO_2/MWh, respectively. The carbon-free electricity requirement results in a 2045 emissions factor of 0 lb CO_2/MWh for both utilities. CH_4 and N_2O electricity emissions factors in future years are assumed to follow the same trends as the CO_2 emissions factors.

Natural Gas Emissions Factors

Natural gas emissions are based on emissions factors obtained from The Climate Registry's (TCR's) 2020 Default Emission Factors, which are estimated to be 11.7 pounds of carbon dioxide equivalent per therm (lb CO_2e/therm) for stationary combustion in buildings and 1.2 lb CO_2e/therm for electricity generation in backup generators (TCR 2020). Emissions factors associated with natural gas combustion are not anticipated to change over time, as there are no legislative actions that would reduce the energy intensity of natural gas.

Diesel Emissions Factors

Emissions from diesel fuel used to power backup generators are based on emissions factors from TCR, which are estimated to be 24.6 pounds of carbon dioxide equivalent per gallon (lb CO_2e/gal). Emissions factors associated with diesel combustion are not anticipated to change over time, as there are no legislative actions that would reduce the energy intensity of diesel.

Energy Efficiency

Title 24 standards apply to both new construction and existing buildings. The 2019 Title 24 standards went into effect January 2020. The California Energy Commission (CEC) estimates that new residential buildings built to the 2019 standards are 53 percent more efficient than residential buildings built to the previous standards (CEC 2018). CEC estimates that new nonresidential buildings built to the 2019 standards are 30 percent more efficient than nonresidential buildings built to the previous standards (CEC 2018).

In addition to the current iteration of Title 24, previous versions of the standards have also achieved energy efficiencies for residential and nonresidential buildings. Since 2008, energy efficiency savings have been quantified and the collective effect of Title 24 was accounted for in the forecasted emissions. It is assumed that collectively, all new residential construction occurring between 2020 and 2045 would be 75 percent more energy efficient than buildings constructed under previous Title 24 standards, and nonresidential construction would be 53 percent more energy efficient compared to buildings constructed under previous Title 24 standards. This includes the energy efficiencies gained through the 2008, 2013, 2016, and 2019 versions of Title 24. Additional efficiencies to be achieved in future code cycles are yet unknown and therefore not factored into the forecast.

2.1.2 Transportation

ON-ROAD TRANSPORTATION

Between 2019 and 2030, GHG emissions from on-road vehicles would decrease by approximately 9 percent from 259,627 to 236,310 $MTCO_2e$ per year, accounting for an increase in VMT of 11 percent and future vehicle emissions factors modeled in California Air Resources Board's (CARB's) EMissions FACtor (EMFAC2021) model. With respect to the legislative adjustments included in this forecast, State and federal policies and associated regulations incorporated in the on-road vehicle sector include the Pavley Clean Car Standards, Advanced Clean Car (ACC) Standards, and fuel efficiency standards for medium- and heavy-duty vehicles. These policies are included in EMFAC2021's emissions factor estimates and forecasts. It should be noted that the Low Carbon Fuel Standard was excluded in EMFAC2021 forecasts because the emissions benefits originate from upstream fuel production and do not directly reduce vehicle tailpipe emissions that affect the city's GHG emissions forecasts.

Table 10 summarizes the scaling factor and legislative reductions used to forecast on-road transportation emissions.

Table 10 On-Road Transportation Forecast Methods and Legislative Reductions

Source	Forecast Methods	
	Scale Factor	Applied Legislative Reductions
On-Road Vehicles	Scaled by VMT estimates provided by MTC.	EMFAC2021 forecasts vehicle fleet distributions by vehicle type and the emissions factors anticipated for each vehicle category based on both vehicle emissions testing and approved legislative reductions. EMFAC2021's forecasts incorporate the effects of the ACC Standards, federal CAFE standards, and fuel efficiency standards for medium- and heavy-duty vehicles, as well as truck and bus regulations.

Notes: ACC = Advanced Clean Cars; CAFE = Corporate Average Fuel Economy; EMFAC2021 = California Air Resources Board's EMisson FACtor 2021 model; MTC = Metropolitan Transportation Commission.

Source: Forecasts prepared by Ascent Environmental in 2021.

Table 11 shows the 2019 inventory and legislative-adjusted BAU forecasted emissions from on-road transportation for 2030, 2040, and 2045.

Table 11 2019 On-Road Transportation Greenhouse Gas Emissions Inventory and Legislative-Adjusted BAU Forecasts ($MTCO_2e$/year)

Source	2019	2030	2040	2045
Passenger Vehicles	173,746	153,600	146,494	149,831
Commercial Vehicles	85,881	82,711	72,405	71,556
Total	**259,627**	**236,310**	**218,898**	**221,388**

Notes: Totals may not sum exactly due to independent rounding. BAU = business-as-usual; $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year.

Source: Forecasts prepared by Ascent Environmental in 2021.

OFF-ROAD VEHICLES AND EQUIPMENT

Between 2019 and 2030, emissions associated with off-road vehicles and equipment used in the city would increase by 36 percent from 15,554 to 21,139 $MTCO_2e$ per year, with legislative adjustments applied and overall growth in various demographics. Emissions were obtained from CARB's OFFROAD2007 and OFFROAD2017 models. With respect to the legislative adjustments in the off-road vehicle sector, CARB's latest off-road emissions model, OFFROAD2017, was used, which incorporates regulatory actions such as reformulated fuels and more stringent emission standards. However, some off-road vehicle and equipment sources that are included in the OFFROAD2007 model are excluded from OFFROAD2017. For these sectors, emissions were obtained from OFFROAD2007. In addition, OFFROAD2017 provides CO_2 emissions but does not provide emissions from CH_4 and N_2O. Ratios of CH_4 and N_2O to CO_2 reported in OFFROAD2007 were calculated and applied to CO_2 data from OFFROAD2017 to calculate CH_4 and N_2O emissions, as recommended by CARB.

Santa Clara County-level emissions from off-road vehicles and equipment were scaled using changes in city-specific demographic factors. Table 12 summarizes the scaling factors and legislative reductions used to forecast off-road vehicle and equipment emissions.

Table 12 Off-Road Vehicles and Equipment Forecast Methods and Legislative Reductions by Source

Source	Forecast Methods	
	Scale Factor	Applied Legislative Reductions
Construction and Mining Equipment	Service population	OFFROAD2007 and OFFROAD2017 emission factor considerations include EPA off-road compression-ignition engine standards implementation schedule.
Entertainment Equipment	Population	
Industrial Equipment	Employment	
Lawn and Garden Equipment	Population	
Light Commercial Equipment	Employment	
Railyard Operations	Employment	
Recreational Equipment	Population	
Transport Refrigeration Units	Share of road miles	

Notes: EPA = U.S. Environmental Protection Agency; OFFROAD2007 = California Air Resources Board's OFFROAD2007 model; OFFROAD2017 = California Air Resources Board's OFFROAD2017 model.

Source: Forecasts prepared by Ascent Environmental in 2021.

Table 13 shows the 2019 inventory and legislative-adjusted BAU forecasted emissions from the off-road vehicles and equipment sector for 2030, 2040, and 2045.

Table 13 2019 Off-Road Vehicles and Equipment Greenhouse Gas Emissions Inventory and Legislative-Adjusted BAU Forecasts ($MTCO_2e$/year)

Source	2019	2030	2040	2045
Construction and Mining Equipment	3,478	5,903	6,244	6,470
Entertainment Equipment	44	42	40	41
Industrial Equipment	8,590	11,151	12,206	12,317
Lawn and Garden Equipment	1,602	1,663	1,724	1,781
Light Commercial Equipment	1,290	1,652	1,814	1,818
Railyard Operations	1	1	1	1
Recreational Equipment	430	588	802	831
Transport Refrigeration Units	118	140	155	163
Total	**15,554**	**21,139**	**22,984**	**23,421**

Notes: Totals may not sum exactly due to independent rounding. BAU = business-as-usual; $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year.

Source: Forecasts prepared by Ascent Environmental in 2021.

2.1.3 Solid Waste

Between 2019 and 2030, solid waste emissions generated from community activities in the city would increase by approximately 6 percent from 23,566 to 25,026 $MTCO_2e$ per year, accounting for overall population growth of 6 percent over the same time. No additional legislative reductions could be applied to this sector because the city is already meeting California's 50 percent waste diversion goal under Assembly Bill (AB) 939, as reported by the California Department of Resources Recycling and Recovery (CalRecycle) (CalRecycle 2020). Therefore, legislative-adjusted BAU emissions are equivalent to BAU emissions, which account for the CH_4 and CO_2 emissions from the decay of waste generated annually and were scaled by population growth within the city between 2019 and 2030.

Table 14 shows the 2019 inventory and legislative-adjusted BAU forecasted emissions from the solid waste sector for 2030, 2040, and 2045.

Table 14 2019 Solid Waste Greenhouse Gas Emissions Inventory and Legislative-Adjusted BAU Forecasts ($MTCO_2e$/year)

Source	2019	2030	2040	2045
Landfill Disposed Waste	22,040	23,405	25,452	26,255
Alternative Daily Cover	973	1,033	1,124	1,159
Composting	553	588	639	659
Total	**23,566**	**25,026**	**27,215**	**28,074**

Notes: Totals may not sum exactly due to independent rounding. BAU = business-as-usual; $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year.

Source: Forecasts prepared by Ascent Environmental in 2021.

2.1.4 Water Supply

Between 2019 and 2030, water supply emissions from community activities in the city would decrease by approximately 39 percent from 694 to 421 $MTCO_2e$ per year, accounting for legislative adjustments and overall

population growth of 6 percent over the same time. This change reflects an increase in water consumption with lower electricity factors related to the 2030 and 2045 RPS targets, pursuant to SB 100 requirements.

Table 15 summarizes the scaling factor and legislative reduction used to forecast water supply emissions.

Table 15 Water Supply Forecast Methods and Legislative Reductions by Source

Source	Forecast Methods	
	Scale Factor	Applied Legislative Reductions
Water Consumption	Scaled by population growth.	Assumes electricity use for extraction, conveyance, distribution, and treatment follow the 2030 RPS schedule and 2045 carbon-free electricity requirements.

Notes: RPS = Renewables Portfolio Standard.

Source: Forecasts prepared by Ascent Environmental in 2021.

Table 16 shows the 2019 inventory and legislative-adjusted BAU forecasted emissions from the water supply sector for 2030, 2040, and 2045.

Table 16 2019 Water Supply Greenhouse Gas Emissions Inventory and Legislative-Adjusted BAU Forecasts ($MTCO_2e$/year)

Source	2019	2030	2040	2045
Water Supply	694	421	153	0

Notes: BAU = business-as-usual; $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year.

Source: Forecasts prepared by Ascent Environmental in 2021.

2.1.5 Wastewater Treatment

Between 2019 and 2030, wastewater treatment emissions from the community would increase by 2 percent from 1,578 to 1,612 $MTCO_2e$ per year, accounting for overall population growth of 6 percent over the same time. This change reflects an increase in wastewater generation with lower electricity factors related to the 2030 and 2045 RPS targets, consistent with SB 100 legislative actions described above. While electricity factors are reduced through 2045, increases in natural gas usage result in an overall increase in energy-related emissions. Table 17 summarizes the scaling factor and legislative reduction used to forecast water supply emissions.

Table 17 Wastewater Treatment Forecast Methods and Legislative Reductions by Source

Source	Forecast Methods	
	Scale Factor	Applied Legislative Reductions
Wastewater Treatment	Scaled by population growth.	Assumes electricity use for collection and treatment of wastewater follow the 2030 RPS schedule and 2045 carbon-free electricity requirements.

Notes: RPS = Renewables Portfolio Standard.

Source: Forecasts prepared by Ascent Environmental in 2021.

Table 18 shows the 2019 inventory and legislative-adjusted BAU forecasted emissions from wastewater treatment sources for 2030, 2040, and 2045.

Table 18 2019 Wastewater Treatment Greenhouse Gas Emissions Inventory and Legislative-Adjusted BAU Forecasts ($MTCO_2e$/year)

Source	2019	2030	2040	2045
Energy-Related Emissions	1,435	1,460	1,526	1,543
Process Emissions	138	146	159	164
Stationary Emissions	6	6	6	7
Total	**1,578**	**1,612**	**1,692**	**1,713**

Notes: BAU = business-as-usual; $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year.

Source: Forecasts prepared by Ascent Environmental in 2021.

2.1.6 Discussion

As discussed above and shown in Table 6 and Figure 3, the community legislative-adjusted BAU emissions would decrease by 5 percent between 2019 and 2030. This is a result of reductions that would be achieved from several legislative actions including:

- a greater renewable mix in California's electricity supply (60 percent by 2030);
- improved building energy efficiency through compliance with Title 24 standards (75 percent energy reduction for residential, 53 percent for nonresidential); and
- reductions in on-road vehicle emission factors forecasted in EMFAC2021.

From 2030 to 2045, new legislative actions that would affect emissions are anticipated to be adopted by State and federal agencies; however, because information regarding these regulatory changes is currently unavailable, emissions reductions from future potential legislative actions could not be quantified. Without future legislative actions and despite growth in the city, emissions would continue to decline gradually though 2045. The main legislative reductions beyond 2030 would come from achievement of SB 100's target of 100 percent carbon-free electricity by 2045. Additional reductions would be in forecasted improvements in vehicle fuel economy and increased VMT share by electric vehicles, as estimated in the EMFAC2021 model. Other previous legislative actions would also continue to apply in the future and ultimately outpace growth in population and employment.

2.2 MUNICIPAL OPERATIONS FORECAST RESULTS

Estimated BAU emissions forecasts were based on predicted growth in City employment between 2019 and 2045 for Milpitas, as provided by the City. Municipal employment is expected to increase by 0.5 percent year over year through 2030, and then by 0.25 percent year over year through 2045. Growth in municipal employment was the sole growth factor used to forecast BAU emissions for 2030, 2040, and 2045 for all sectors in the municipal operations inventory. Table 19 shows 2019 municipal employment and anticipated growth in municipal employment for the forecast years.

Table 19 Milpitas Municipal Operations Demographic Forecasts

Forecast Factor	2019	2030	2040	2045
City Employment	524	554	568	575

Source: City of Milpitas 2021.

Table 20 shows 2019 baseline emissions and BAU emissions forecasts for 2030, 2040, and 2045.

Table 20 2019 Milpitas Municipal Operations Greenhouse Gas Emissions Inventory and BAU Forecasts ($MTCO_2e$/year)

Sector	2019	2030	2040	2045
Buildings and Facilities	870	919	942	954
Streetlights and Traffic Signals	3	3	3	3
Employee Commute	1,195	1,263	1,295	1,311
Vehicle Fleet	1,081	1,142	1,171	1,185
Solid Waste	53	56	57	58
Water Supply	41	43	44	45
Wastewater Treatment	9	10	10	10
Total	**3,252**	**3,435**	**3,522**	**3,567**

Notes: Total may not sum exactly due to independent rounding. BAU = business-as-usual; GHG = greenhouse gas; $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year.

Source: Forecasts prepared by Ascent Environmental in 2021.

Legislative-adjusted BAU emissions forecasts provide an assessment of how the City's municipal operations emissions would change over time without further action from the City. In addition to accounting for the City's municipal growth, the legislative-adjusted BAU forecast accounts for legislative actions at the local, State, and federal levels that would affect emissions, such as regulatory requirements to increase vehicle fuel efficiency and building energy efficiency. These forecasts provide the City with the information needed to focus efforts on certain municipal operations emissions sectors and sources that have the most GHG reduction opportunities. Annual municipal employment growth, described above, was the sole scaling factor applied to all sectors. A summary of legislative reductions applied is provided in Table 5.

Municipal operations legislative-adjusted BAU emissions would decrease by 10 percent between 2019 and 2030, as shown in Table 21 and Figure 4. Figure 4 also shows the emissions trend that would occur without anticipated legislative reductions and accounting only for changes in municipal employment. Without the legislative reductions, emissions would be 29 percent higher in 2045 compared to the legislative-adjusted BAU forecast.

Table 21 2019 Milpitas Municipal Operations Greenhouse Gas Emissions Inventory and Legislative-Adjusted BAU Forecasts ($MTCO_2e$/year)

Sector	2019	2030	2040	2045
Buildings and Facilities	870	889	897	900
Streetlights and Traffic Signals	3	2	1	0
Employee Commute	1,195	1,017	961	961
Vehicle Fleet	1,081	925	840	830
Solid Waste	53	56	57	58
Water Supply	41	25	8	0
Wastewater Treatment	9	9	9	9
Total	**3,252**	**2,923**	**2,773**	**2,759**

Notes: Total may not sum exactly due to independent rounding. BAU = business-as-usual; $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year.

Source: Forecasts prepared by Ascent Environmental in 2021.

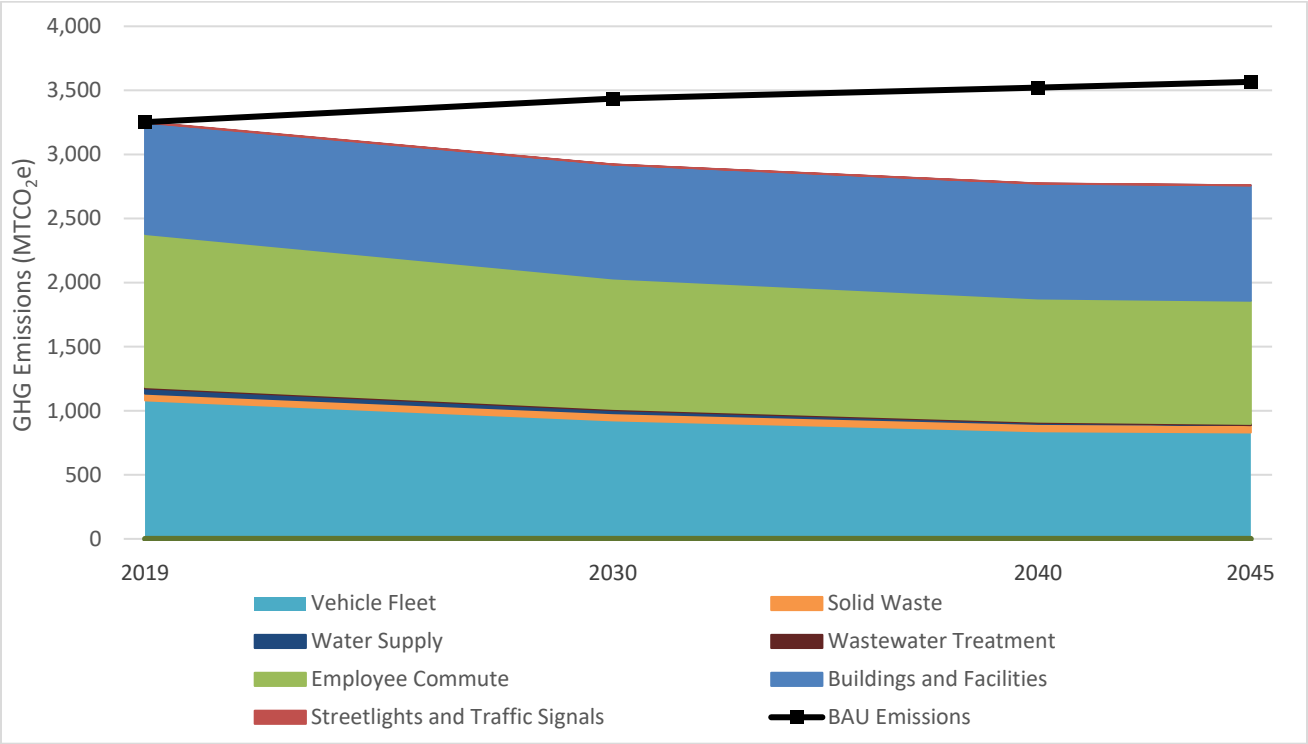

Figure 4 2019 Milpitas Municipal Operations Greenhouse Gas Emissions Inventory and Legislative-Adjusted BAU Forecasts

Emissions forecasts are detailed for each sector and discussed below.

2.2.1 Buildings and Facilities Energy

Emissions from future electricity, natural gas, and backup generator use were estimated by multiplying anticipated energy use with forecasted emissions factors. Future energy use was forecasted in three parts. First, energy use was scaled by growth factors detailed in Table 19. Second, electricity emissions factors were adjusted to reflect California's RPS targets. Electricity emissions factors are anticipated to decline based on current regulations, while natural gas and diesel emissions factors are anticipated to be constant. Third, energy intensity factors were adjusted to reflect increased stringency under Title 24 standards (i.e., 2019 standards which became effective in 2020), which are expected to achieve decreases in electricity consumption in new nonresidential construction. The assumptions to energy efficiency and future electricity emission factors are described below. In addition, it is important to note that all municipal electricity is supplied by SVCE. Table 22 summarizes the legislative reductions used to forecast buildings and facilities emissions by energy type.

Table 22 Buildings and Facilities Energy Emissions Forecast Legislative Reductions by Energy Type

Energy Type	Applied Legislative Reductions
Electricity	RPS achieved to date and scheduled targets (i.e., 33 percent renewable by 2020, 60 percent renewable by 2030) applied to SVCE's emissions factors. Accounts for 2008 to 2019 Title 24 energy efficiency gains in new nonresidential construction.
Natural Gas	
Backup Generators	Accounts for 2008 to 2019 Title 24 energy efficiency gains in new nonresidential construction.

Notes: RPS = Renewables Portfolio Standard; SVCE = Silicon Valley Clean Energy.

Source: Forecasts prepared by Ascent Environmental in 2021.

Between 2019 and 2030, emissions from electricity, natural gas, and backup generator from municipal buildings and facilities would increase by 2 percent from 870 to 889 $MTCO_2e$ per year, accounting for legislative adjustments and municipal growth. This change reflects increases in emissions from natural gas and backup generators combined with decreases in electricity emissions due to lower electricity factors related to the 2030 and 2045 RPS targets, pursuant to SB 100. Table 23 shows the 2019 inventory and legislative-adjusted BAU forecasted emissions for the municipal operations buildings and facilities energy sector by energy type for 2030, 2040, and 2045.

Table 23 2019 Buildings and Facilities Energy Greenhouse Gas Emissions Inventory and Legislative-Adjusted BAU Forecasts ($MTCO_2e$/year)

Energy Type	2019	2030	2040	2045
Electricity	8	5	2	0
Natural Gas	826	848	858	863
Backup Generators	35	36	37	37
Total	**870**	**889**	**897**	**900**

Notes: Totals may not sum exactly due to independent rounding. $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year.

Source: Forecasts prepared by Ascent Environmental in 2021.

ELECTRICITY EMISSIONS FACTORS

Emissions from the buildings and facilities sector are anticipated in increase slightly through 2045 without additional City action. This slight rise in sector emissions would be due to increases in natural gas and backup generator emissions, despite State measures already in place that would result in decreased electricity emissions. SVCE electricity emissions factors and changes through 2045 are described in Section 2.1.1.

NATURAL GAS EMISSIONS FACTORS

Natural gas emissions are based on TCR's 2020 default emissions factors, which are estimated to be 11.7 lb CO_2e/therm for stationary combustion in buildings and facilities. Emissions factors associated with natural gas combustion are not anticipated to change over time, as there are no legislative actions that would reduce the energy intensity of natural gas.

DIESEL EMISSIONS FACTORS

Emissions from diesel fuel used to power backup generators are based on emissions factors from TCR, which are estimated to be 24.6 lb CO_2e/gal. Emissions factors associated with diesel combustion are not anticipated to change over time, as there are no legislative actions that would reduce the energy intensity of diesel.

ENERGY EFFICIENCY

Title 24 standards apply to both new construction and existing buildings. The 2019 Title 24 standards went into effect January 2020. The CEC estimates that new nonresidential built to the 2019 standards are 30 percent more efficient than nonresidential buildings built to the previous standards (CEC 2018). In addition to the current iteration of Title 24, previous versions of have also achieved energy efficiencies for nonresidential buildings. Since 2008, energy

efficiency savings have been quantified and the collective effect of Title 24 was accounted for in the forecasted emissions.

Forecasts of future building energy accounts for Title 24 standards. It is assumed that all new construction occurring between 2020 and 2045 would have energy efficiencies 53 percent better than energy usage rates for nonresidential buildings. This includes the energy efficiencies gained through the 2008, 2013, 2016, and 2019 versions of Title 24.

2.2.2 Streetlights and Traffic Signals

Between 2019 and 2030, emissions from streetlights and traffic signals would decrease from 3 to 2 $MTCO_2e$ per year, accounting for legislative adjustments and municipal growth. This change reflects lower electricity factors related to the 2030 and 2045 RPS targets, consistent with SB 100 legislative actions. Table 24 summarizes the legislative reduction used to forecast streetlight and traffic signal emissions.

Table 24 Streetlights and Facilities Emissions Forecast Legislative Reductions

Source	Applied Legislative Reductions
Electricity	RPS achieved to date and scheduled targets (i.e., 33 percent renewable by 2020, 60 percent renewable by 2030) applied to SVCE's emissions factors.

Notes: RPS = Renewables Portfolio Standard; SVCE = Silicon Valley Clean Energy.

Source: Forecasts prepared by Ascent Environmental in 2021.

Table 25 shows the 2019 inventory and legislative-adjusted BAU forecasted emissions for the streetlights and traffic signals sector for 2030, 2040, and 2045.

Table 25 2019 Streetlights and Traffic Signals Greenhouse Gas Emissions Inventory and Legislative-Adjusted BAU Forecasts ($MTCO_2e$/year)

Source	2019	2030	2040	2045
Streetlights and Traffic Signals	3	2	1	0

Notes: BAU = business-as-usual; $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year.

Source: Forecasts prepared by Ascent Environmental in 2021.

2.2.3 Employee Commute

Between 2019 and 2030, GHG emissions from employee commutes would decrease by approximately 15 percent from 1,195 to 1,017 $MTCO_2e$ per year, accounting for future vehicle emissions factors modeled in CARB's EMFAC2021 model and municipal growth. It was assumed that all employees commute to work using passenger vehicles. With respect to the legislative adjustments included in this forecast, State and federal policies and associated regulations incorporated in the employee commute sector include the Pavley Clean Car Standards and ACC Standards. These policies are already included in EMFAC2021's emissions factor estimates and forecasts. It should be noted that the Low Carbon Fuel Standard was excluded in EMFAC2021 forecasts because most of the emissions benefits originate from upstream fuel production and do not directly reduce emissions in the City's municipal operations GHG emissions forecasts. Table 26 summarizes the legislative reductions used to forecast employee commute emissions.

Table 26 Employee Commute Forecast Legislative Reductions

Source	Applied Legislative Reductions
Employee Commute	EMFAC2021 forecasts vehicle fleet distributions by vehicle type and the emissions factors anticipated for each vehicle category based on both vehicle emissions testing and approved legislative reductions. EMFAC2021's forecasts incorporate the effects of the ACC Standards, as well as federal CAFE standards.

Notes: ACC = Advanced Clean Cars; CAFE = Corporate Average Fuel Economy; EMFAC2021 = California Air Resources Board's EMisson FACtor 2021 model.

Source: Forecasts prepared by Ascent Environmental in 2021.

Table 27 shows the 2019 inventory and legislative-adjusted BAU forecasted emissions from municipal employee commutes for 2030, 2040, and 2045.

Table 27 2019 Employee Commute Greenhouse Gas Emissions Inventory and Legislative-Adjusted BAU Forecasts ($MTCO_2e$/year)

Source	2019	2030	2040	2045
Employee Commute	1,195	1,017	961	961

Notes: Totals may not sum exactly due to independent rounding. BAU = business-as-usual; $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year.

Source: Forecasts prepared by Ascent Environmental in 2021.

2.2.4 Vehicle Fleet

Between 2019 and 2030, emissions associated with the City's municipal vehicle fleet would decrease by 14 percent from 1,081 to 925 $MTCO_2e$ per year, accounting for legislative adjustments and municipal growth. Because VMT data for on-road vehicles were unavailable, and usage hours and mileage data were unavailable for off-road vehicles and equipment, gasoline and diesel fuel consumption data were used to forecast emissions. Gasoline was assumed to be used by passenger vehicles, while diesel was assumed to be used by heavy-duty vehicles. With respect to the legislative adjustments in the vehicle fleet sector, improvements in fuel efficiency reported by CARB's EMFAC2021 model (as described in Section 2.1.2) were applied to BAU emissions forecasts. Table 28 summarizes the legislative reductions used to forecast vehicle fleet emissions.

Table 28 Vehicle Fleet Forecast Legislative Reductions by Source

Source	Applied Legislative Reductions
Gasoline (passenger vehicles)	EMFAC2021 forecasts vehicle fleet distributions by vehicle type and the emissions factors anticipated for each vehicle category based on both vehicle emissions testing and approved legislative reductions. EMFAC2021's forecasts incorporate the effects of the ACC Standards, federal CAFE standards, and fuel efficiency standards for medium- and heavy-duty vehicles, as well as truck and bus regulations.
Diesel (heavy-duty vehicles)	

Notes: ACC = Advanced Clean Cars; CAFE = Corporate Average Fuel Economy; EMFAC2021 = California Air Resources Board's EMisson FACtor 2021 model.

Source: Forecasts prepared by Ascent Environmental in 2021.

Table 29 shows the 2019 inventory and legislative-adjusted BAU forecasted emissions from the vehicle fleet sector by fuel source for 2030, 2040, and 2045.

Table 29 2019 Vehicle Fleet Greenhouse Gas Emissions Inventory and Legislative-Adjusted BAU Forecasts ($MTCO_2e$/year)

Source	2019	2030	2040	2045
Gasoline (passenger vehicles)	823	700	662	662

Diesel (heavy-duty vehicles)	258	224	178	169
Total	**1,081**	**925**	**840**	**830**

Notes: Totals may not sum exactly due to independent rounding. BAU = business-as-usual; $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year.

Source: Forecasts prepared by Ascent Environmental in 2021.

2.2.5 Solid Waste

Between 2019 and 2030, municipal operations solid waste emissions would rise by 6 percent from 53 to 56 $MTCO_2e$ per year, accounting for municipal growth. No additional legislative reductions could be applied to this sector because the City is already meeting California's 50 percent waste diversion goal under AB 939, as reported by the CalRecycle (CalRecycle 2020). Therefore, legislative-adjusted BAU emissions are equivalent to BAU emissions.

Table 30 shows the 2019 inventory and legislative-adjusted BAU forecasted emissions from the municipal operations solid waste sector for 2030, 2040, and 2045.

Table 30 2019 Solid Waste Greenhouse Gas Emissions Inventory and Legislative-Adjusted BAU Forecasts ($MTCO_2e$/year)

Source	2019	2030	2040	2045
Landfill Disposed Waste	53	56	57	58

Notes: Totals may not sum exactly due to independent rounding. BAU = business-as-usual; $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year.

Source: Forecasts prepared by Ascent Environmental in 2021.

2.2.6 Water Supply

Between 2019 and 2030, emissions from water supplied for municipal operations would decrease by 40 percent from 41 to 25 $MTCO_2e$ per year, accounting for legislative adjustments and municipal growth. This change reflects an increase in water consumption with lower electricity factors related to the 2030 and 2045 RPS targets, pursuant to SB 100 requirements. Table 31 summarizes the legislative reductions used to forecast water supply emissions.

Table 31 Water Supply Forecast Legislative Reductions

Source	Applied Legislative Reductions
Water Consumption	Assumes electricity use for extraction, conveyance, distribution, and treatment follow the 2030 RPS schedule and 2045 carbon-free electricity requirements.

Notes: RPS = Renewables Portfolio Standard.

Source: Forecasts prepared by Ascent Environmental in 2021.

Table 32 shows the 2019 inventory and legislative-adjusted BAU forecasted emissions from municipal operations water supply for 2030, 2040, and 2045.

Table 32 2019 Water Supply Greenhouse Gas Emissions Inventory and Legislative-Adjusted BAU Forecasts ($MTCO_2e$/year)

Activity	2019	2030	2040	2045
Water Supply Emissions	41	25	8	0

Notes: BAU = business-as-usual; $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year.

Source: Forecasts prepared by Ascent Environmental in 2021.

2.2.7 Wastewater Treatment

Between 2019 and 2030, wastewater treatment emissions from municipal operations would stay constant at 9 $MTCO_2e$ per year, accounting for legislative reductions and municipal growth. This reflects an increase in wastewater generation with lower electricity intensity factors related to the 2030 and 2045 RPS targets, pursuant to SB 100. Although electricity factors are reduced through 2045, increases in natural gas usage resulting from wastewater collection and treatment offset decreased electricity emissions. Table 33 summarizes the legislative reductions used to forecast emissions from municipal operations wastewater treatment.

Table 33 Wastewater Treatment Forecast Legislative Reductions by Source

Source	Applied Legislative Reductions
Wastewater Treatment	Assumes electricity use for collection and treatment of wastewater follow the 2030 RPS schedule and 2045 carbon-free electricity requirements.

Notes: RPS = Renewables Portfolio Standard.

Source: Forecasts prepared by Ascent Environmental in 2021.

Table 34 shows the 2019 inventory and legislative-adjusted BAU forecasted emissions from wastewater treatment for 2030, 2040, and 2045.

Table 34 2019 Wastewater Treatment Greenhouse Gas Emissions Inventory and Legislative-Adjusted BAU Forecasts ($MTCO_2e$/year)

Activity	2019	2030	2040	2045
Wastewater Treatment	9	9	9	9

Notes: BAU = business-as-usual; $MTCO_2e$/year = metric tons of carbon dioxide equivalent.

Source: Forecasts prepared by Ascent Environmental in 2021.

2.3 DISCUSSION

As discussed above and shown in Table 21 and Figure 4, municipal operations legislative-adjusted BAU emissions would decrease by 10 percent between 2019 and 2030. This is a result of reductions that would be achieved from numerous legislative actions including:

- a greater renewable mix in California's electricity supply (60 percent by 2030);
- improved building energy efficiency through compliance with Title 24 standards (53 percent for nonresidential); and
- reductions in on-road vehicle emission factors forecasted in EMFAC2021.

With respect to emissions beyond 2030, most adopted State and federal legislation and regulations have specific targets and policies that only address activities up to the year 2025 or 2030. While advances in new technologies and State policies may allow for additional significant GHG reductions in the future, specific legislative reductions that may occur between 2030 and 2045 are largely unknown at this time. One notable exception is SB 100, which establishes a 100 percent carbon-free electricity target for retail electricity sales by 2045. Many of the strategies outlined in the *California 2017 Climate Change Scoping Plan* have not yet been implemented and sufficient information is not yet available to estimate the timing and magnitude of their effect on activities and sources within the City's jurisdiction.

Where new State regulations or programs are imminent and reasonably foreseeable, they can be incorporated as complementary actions to locally based GHG reduction measures, as will be discussed in subsequent technical memoranda.

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Attachment A

GHG Forecasts

Data and Calculations

Milpitas Community Greenhouse Gas Emissions Inventories and Forecasts

Emissions Sector	2005 GHG Emissions				2015 GHG Emissions				2019 GHG Emissions				2030 GHG Emissions						2040 GHG Emissions						2045 GHG Emissions					
															BAU		Leg-Adjust BAU				BAU		Leg-Adjust BAU				BAU		Leg-Adjust BAU	
	Activity	Units	$MTCO_2e$	$MTCO_2e$ % of Annual Total	Activity	Units	$MTCO_2e$	$MTCO_2e$ % of Annual Total	Activity	Units	$MTCO_2e$	$MTCO_2e$ % of Annual Total	BAU Activity	Units	$MTCO_2e$	$MTCO_2e$ % of Annual Total	$MTCO_2e$	$MTCO_2e$ % of Annual Total	BAU Activity	Units	$MTCO_2e$	$MTCO_2e$ % of Annual Total	$MTCO_2e$	$MTCO_2e$ % of Annual Total	BAU Activity	Units	$MTCO_2e$	$MTCO_2e$ % of Annual Total	$MTCO_2e$	$MTCO_2e$ % of Annual Total
Building Energy			**247,533**	**45.17%**			**259,949**	**44.18%**			**140,537**	**31.83%**			**162,433**	**32.34%**	**136,128**	**32.36%**			**170,764**	**31.95%**	**125,686**	**31.69%**			**176,433**	**31.78%**	**120,836**	**30.56%**
Electricity	114,391	MWh	25,528	10.3%	117,026	MWh	21,578	8.3%	121,801	MWh	581	0.4%	129,344	MWh	701	0.4%	369	0.3%	140,661	MWh	731	0.4%	125	0.1%	145,098	MWh	755	0.4%	0	0.0%
Natural Gas	7,265,000	Therms	38,580	15.6%	6,779,674	Therms	36,003	13.9%	7,840,602	Therms	41,637	29.6%	8,326,122	Therms	44,215	27.2%	42,292	31.1%	9,054,619	Therms	48,084	28.2%	43,273	34.4%	9,340,270	Therms	49,601	28.1%	43,658	36.1%
Residential Subtotal			**64,108**	**25.9%**			**57,581**	**22.2%**			**42,218**	**30.0%**			**44,917**	**27.7%**	**42,660**	**31.3%**			**48,815**	**28.6%**	**43,399**	**34.5%**			**50,357**	**28.5%**	**43,658**	**36.1%**
Electricity	545,800	MWh	121,802	49.2%	784,254	MWh	144,603	55.6%	708,759	MWh	29,880	21.3%	843,499	MWh	36,068	22.2%	18,973	13.9%	873,530	MWh	37,601	22.0%	6,443	5.1%	903,184	MWh	38,865	22.0%	0	0.0%
Natural Gas	11,604,000	Therms	61,623	24.9%	10,875,823	Therms	57,756	22.2%	12,772,616	Therms	67,828	48.3%	15,200,780	Therms	80,723	49.7%	73,831	54.2%	15,741,970	Therms	83,597	49.0%	75,169	59.8%	16,276,378	Therms	86,435	49.0%	76,490	63.3%
Backup Generators (Diesel)					964	Gallons	10	0.0%	58,522	Gallons	599	0.4%	69,648	Gallons	711	0.4%	650	0.5%	72,127	Gallons	736	0.4%	662	0.5%	74,576	Gallons	761	0.4%	674	0.6%
Backup Generators (Natural Gas)					0	Scf	0	0.0%	221,027	Scf	12	0.0%	263,046	Scf	14	0.0%	13	0.0%	272,411	Scf	15	0.0%	13	0.0%	281,659	Scf	15	0.0%	14	0.0%
Non-Residential Subtotal			**183,424**	**74.1%**			**202,368**	**77.8%**			**98,319**	**70.0%**			**117,517**	**72.3%**	**93,467**	**68.7%**			**121,949**	**71.4%**	**82,288**	**65.5%**			**126,077**	**71.5%**	**77,177**	**63.9%**
On-Road Transportation	**483,632,677**	**VMT**	**252,864**	**46.15%**	**559,491,627**	**VMT**	**278,061**	**47.26%**	**572,889,499**	**VMT**	**259,627**	**58.80%**	**633,251,901**	**VMT**	**291,196**	**57.98%**	**236,310**	**56.18%**	**662,346,271**	**VMT**	**310,877**	**58.17%**	**218,898**	**55.19%**	**687,876,785**	**VMT**	**324,507**	**58.45%**	**221,388**	**55.99%**
Passenger Vehicles	434,135,841	VMT	181,172	71.6%	492,014,849	VMT	182,927	65.8%	509,968,096	VMT	173,746	66.9%	559,587,179	VMT	190,651	65.5%	153,600	65.0%	579,143,509	VMT	197,314	63.5%	146,494	66.9%	599,858,891	VMT	204,372	63.0%	149,831	67.7%
Commercial Vehicles	49,496,836	VMT	71,692	28.4%	67,476,778	VMT	95,134	34.2%	62,921,403	VMT	85,881	33.1%	73,664,721	VMT	100,545	34.5%	82,711	35.0%	83,202,762	VMT	113,563	36.5%	72,405	33.1%	88,017,894	VMT	120,135	37.0%	71,556	32.3%
Off-Road Vehicles			**15,034**	**2.74%**			**16,511**	**2.81%**			**15,554**	**3.52%**			**21,139**	**4.21%**	**21,139**	**5.03%**			**22,984**	**4.30%**	**22,984**	**5.79%**			**23,421**	**4.22%**	**23,421**	**5.92%**
Construction and Mining Equipment			3,813	25.4%			4,661	28.2%			3,478	22.4%			5,903	27.9%	5,903	27.9%			6,244	27.2%	6,244	27.2%			6,470	27.6%	6,470	27.6%
Entertainment Equipment			36	0.2%			45	0.3%			44	0.3%			42	0.2%	42	0.2%			40	0.2%	40	0.2%			41	0.2%	41	0.2%
Industrial Equipment			8,490	56.5%			8,469	51.3%			8,590	55.2%			11,151	52.7%	11,151	52.7%			12,206	53.1%	12,206	53.1%			12,317	52.6%	12,317	52.6%
Lawn and Garden Equipment			1,192	7.9%			1,561	9.5%			1,602	10.3%			1,663	7.9%	1,663	7.9%			1,724	7.5%	1,724	7.5%			1,781	7.6%	1,781	7.6%
Light Commercial Equipment			1,193	7.9%			1,291	7.8%			1,290	8.3%			1,652	7.8%	1,652	7.8%			1,814	7.9%	1,814	7.9%			1,818	7.8%	1,818	7.8%
Railyard Operations			1	0.0%			1	0.0%			1	0.0%			1	0.0%	1	0.0%			1	0.0%	1	0.0%			1	0.0%	1	0.0%
Recreational Equipment			212	1.4%			376	2.3%			430	2.8%			588	2.8%	588	2.8%			802	3.5%	802	3.5%			831	3.5%	831	3.5%
Transport Refrigeration Units			98	0.7%			107	0.6%			118	0.8%			140	0.7%	140	0.7%			155	0.7%	155	0.7%			163	0.7%	163	0.7%
Solid Waste	**68,512**	**Tons**	**26,998**	**4.93%**	**72,667**	**Tons**	**28,984**	**4.93%**	**58,497**	**Tons**	**23,566**	**5.34%**	**69,031**	**Tons**	**25,026**	**4.98%**	**25,026**	**5.95%**	**75,071**	**Tons**	**27,215**	**5.09%**	**27,215**	**6.86%**	**77,440**	**Tons**	**28,074**	**5.06%**	**28,074**	**7.10%**
Solid Waste Generation	68,512	Tons	26,998	100.0%	72,667	Tons	28,592	98.6%	58,497	Tons	23,013	97.7%	62,119	Tons	24,438	97.7%	24,438	97.7%	67,554	Tons	26,576	97.7%	26,576	97.7%	69,685	Tons	27,415	97.7%	27,415	97.7%
Composting					4,605	Tons	391	1.4%	6,509	Tons	553	2.3%	6,913	Tons	588	2.3%	588	2.3%	7,517	Tons	639	2.3%	639	2.3%	7,755	Tons	659	2.3%	659	2.3%
Water Supply	**3,575**	**MGY**	**4,466**	**0.81%**	**3,010**	**MGY**	**2,974**	**0.51%**	**3,428**	**MGY**	**694**	**0.16%**	**3,641**	**MGY**	**737**	**0.15%**	**421**	**0.10%**	**3,959**	**MGY**	**801**	**0.15%**	**153**	**0.04%**	**4,084**	**MGY**	**827**	**0.15%**	**0**	**0.00%**
Wastewater Treatment			**1,078**	**0.20%**			**1,935**	**0.33%**			**1,578**	**0.36%**			**1,676**	**0.33%**	**1,612**	**0.38%**			**1,822**	**0.34%**	**1,692**	**0.43%**			**1,880**	**0.34%**	**1,713**	**0.43%**
Energy-Related			981	91.0%			1,796	92.8%			1,435	90.9%			**1,524**	90.9%	**1,460**	90.6%			**1,657**	90.9%	**1,526**	90.2%			**1,709**	90.9%	**1,543**	90.0%
Process			94	8.7%			134	6.9%			138	8.7%			**146**	8.7%	**146**	9.1%			**159**	8.7%	**159**	9.4%			**164**	8.7%	**164**	9.6%
Stationary			4	0.3%			5	0.3%			6	0.4%			**6**	0.4%	**6**	0.4%			**6**	0.4%	**6**	0.4%			**7**	0.4%	**7**	0.4%
Total $MTCO_2e$/yr			**547,972**	**100%**			**588,414**	**100%**			**441,557**	**100%**			**502,207**	**100%**	**420,636**	**100%**			**534,465**	**100%**	**396,629**	**100%**			**555,142**	**100%**	**395,432**	**100%**

Building Energy Consumption

Milpitas Greenhouse Gas Inventory and Forecasts

Electricity

2005 / 2015

Source	2005 MWh/year	2005 Emission Factor (lb CO2/MWh)	2005 Emission Factor (lb CH4/MWh)	2005 Emission Factor (lb N2O/MWh)	2005 Total MT CO2e/year	2015 MWh/year	2015 Emission Factor (lb CO2/MWh)	2015 Emission Factor (lb CH4/MWh)	2015 Emission Factor (lb N2O/MWh)	2015 Total MT CO2e/year
Residential Electricty (PG&E)	114,391	489	0.03024	0.00808	25,528	117,026	404.51	0.033	0.004	21,578
Non-Residential Electricity (PG&E)	545,800	489	0.03024	0.00808	121,802	784,254	404.51	0.033	0.004	144,603
Residential Electricty (SVCE)	--	--	--	--	--	--	--	--	--	--
Non-Residential Electricity (SVCE)	--	--	--	--	--	--	--	--	--	--
Total					147,330					166,180

2019 / 2030

Source	2019 MWh/year	2019 Emission Factor (lb CO2/MWh)	2019 Emission Factor (lb CH4/MWh)	2019 Emission Factor (lb N2O/MWh)	2019 Total MT CO2e/year	Scale Factor	2030 BAU MWh/year	2030 Leg-Adjust BAU MWh/year	2030 Emission Factor (lb CO2/MWh)	2030 Emission Factor (lb CH4/MWh)	2030 Emission Factor (lb N2O/MWh)	2030 BAU Total CO2e (MT/year)	2030 Leg-Adjust BAU Total CO2e (MT/year)
Residential Electricty (PG&E)	48,292	197.81	0.0327	0.0039	568.89	Population	51,283	49,051	113.04	0.019	0.002	689	363
Non-Residential Electricity (PG&E)	281,013	197.81	0.0327	0.0039	29,267.79	Employment	334,435	305,881	113.04	0.019	0.002	35,457	18,651
Residential Electricty (SVCE)	73,509	2.34	0.0000	0.0000	11.90	Population	78,061	74,664	1.34	0.000	0.000	12	6
Non-Residential Electricity (SVCE)	427,746	2.34	0.0000	0.0000	611.98	Employment	509,064	465,599	1.34	0.000	0.000	611	321
Total					30,461							36,769	19,342

2040 / 2045

Source	2040 BAU MWh/year	2040 Leg-Adjust BAU MWh/year	2040 Emission Factor (lb CO2/MWh)	2040 Emission Factor (lb CH4/MWh)	2040 Emission Factor (lb N2O/MWh)	2040 BAU Total CO2e (MT/year)	2040 Leg-Adjust BAU Total CO2e (MT/year)	2045 BAU MWh/year	2045 Leg-Adjust BAU MWh/year	2045 Emission Factor (lb CO2/MWh)	2045 Emission Factor (lb CH4/MWh)	2045 Emission Factor (lb N2O/MWh)	2045 BAU Total CO2e (MT/year)	2045 Leg-Adjust BAU Total CO2e (MT/year)
Residential Electricty (PG&E)	55,770	50,190	37.68	0.006	0.001	718	123	57,529	50,637	0.00	0.00	0.00	743	-
Non-Residential Electricity (PG&E)	346,342	311,423	37.68	0.006	0.001	36,964	6,334	358,099	316,896	0.00	0.00	0.00	38,206	-
Residential Electricty (SVCE)	84,891	76,398	0.45	0.000	0.000	12	2	87,569	77,077	0.00	0.00	0.00	13	-
Non-Residential Electricity (SVCE)	527,188	474,036	0.45	0.000	0.000	637	109	545,085	482,367	0.00	0.00	0.00	659	-
Total						38,332	6,569					Total	39,620	-

Source: 2005 Milpitas GHG Inventory, provided by the City
Source: Milpitas Electricity and Natural Gas 2015-2019, provided by SVCE
Source: Electricity Emissions Factors, provided by SVCE
Source: Emissions Inventory Tool, provided by SVCE

Natural Gas

2005 / 2015 / 2019

Source	2005 therms/year	2005 Emission Factors (lb/therm) CO_2	2005 CH_4	2005 N_2O	2005 Total MT CO2e/year	2015 therms/year	2015 Emission Factors (lb/therm) CO_2	2015 CH_4	2015 N_2O	2015 Total MT CO2e/year	2019 therms/year	2019 Emission Factors (lb/therm) CO_2	2019 CH_4	2019 N_2O	2019 Total MT CO2e/year
Residential Nautral Gas (PG&E)	7,265,000	11.7	0.000226742	0.000005	38,580	6,779,674	11.7	0.000226742	0.000005	36,003	7,840,602	11.7	0.000226742	0.000005	41,637
Non-Residential Natural Gas (PG&E)	11,604,000	11.7	0.000226742	0.000005	61,623	10,875,823	11.7	0.000226742	0.000005	57,756	12,772,616	11.7	0.000226742	0.000005	67,828
Total				11.708	100,203					93,759					109,466

2030 / 2040 / 2045

Source	Scale Factor	2030 BAU therms/year	2030 Leg-Adjus BAU therms/year	2030 BAU Total CO2e (MT/year)	2030 Leg-Adjust BAU Total CO2e (MT/year)	2040 BAU therms/year	2040 Leg-Adjus BAU therms/year	2040 BAU Total CO2e (MT/year)	2040 Leg-Adjust BAU Total CO2e (MT/year)	2045 BAU therms/year	2045 Leg-Adjus BAU therms/year	2045 BAU Total CO2e (MT/year)	2045 Leg-Adjust BAU Total CO2e (MT/year)
Residential Nautral Gas (PG&E)	Population	8,326,122	7,963,827	44,215	42,292	9,054,619	8,148,719	48,084	43,273	9,340,270	8,221,218	49,601	43,658
Non-Residential Natural Gas (PG&E)	Employment	15,200,780	13,902,926	80,723	73,831	15,741,970	14,154,850	83,597	75,169	16,276,378	14,403,617	86,435	76,490
Total				124,939	116,122			131,681	118,442			136,036	120,148

Source: 2005 Milpitas GHG Inventory, provided by the City
Source: Milpitas Electricity and Natural Gas 2015-2019, provided by SVCE

Backup Generators

2005 / 2015 / 2019

Source	2005 gallons/year	2005 Emissions Factor (kg CO2/gal)	2005 Emissions Factor (g CH4/MMBTU)	2005 Emissions Factor (g N2O/MMBTU)	2005 Total MT CO2e/year	2015 gallons/year	2015 Emissions Factor (kg CO2/gal)	2015 Emissions Factor (g CH4/MMBTU)	2015 Emissions Factor (g N2O/MMBTU)	2015 Total MT CO2e/year	2019 gallons/year	2019 Emissions Factor (kg CO2/gal)	2019 Emissions Factor (g CH4/MMBTU)	2019 Emissions Factor (g N2O/MMBTU)	2019 Total MT CO2e/year
Diesel						964	10.21	0.9	0.4	9.86	58,522	10.21	0.9	0.4	598.57
Source	**scf/year**	**Emissions Factor (kg CO2/gal)**	**Emissions Factor (g CH4/MMBTU)**	**Emissions Factor (g N2O/MMBTU)**	**Total MT CO2e/year**	**scf/year**	**Emissions Factor (kg CO2/scf)**	**Emissions Factor (g CH4/MMBTU)**	**Emissions Factor (g N2O/MMBTU)**	**Total MT CO2e/year**	**scf/year**	**Emissions Factor (kg CO2/scf)**	**Emissions Factor (g CH4/MMBTU)**	**Emissions Factor (g N2O/MMBTU)**	**Total MT CO2e/year**
Natural Gas						0	0.05444	0.9	0.9	-	221,027	0.05444	0.9	0.9	12
Total					-					10					611

2030 / 2040 / 2045

Source	Scale Factor	2030 BAU gallons/year	2030 Leg-Adjust BAU gallons/year	2030 BAU Total CO2e (MT/year)	2030 Leg-Adjust BAU Total CO2e (MT/year)	2040 BAU gallons/year	2040 Leg-Adjust BAU gallons/year	2040 BAU Total CO2e (MT/year)	2040 Leg-Adjust BAU Total CO2e (MT/year)	2045 BAU gallons/year	2045 Leg-Adjust BAU gallons/year	2045 BAU Total CO2e (MT/year)	2045 Leg-Adjust BAU Total CO2e (MT/year)
Diesel	Employment	69,648	63,701	711	650	72,127	64,855	736	662	74,576	65,995	761	674
Source	**Scale Factor**	**BAU scf/year**	**Leg-Adjust BAU sct/year**	**BAU Total CO2e (MT/year)**	**Leg-Adjust BAU Total CO2e (MT/year)**	**BAU scf/year**	**Leg-Adjust BAU sct/year**	**BAU Total CO2e (MT/year)**	**Leg-Adjust BAU Total CO2e (MT/year)**	**BAU scf/year**	**Leg-Adjust BAU sct/year**	**BAU Total CO2e (MT/year)**	**Leg-Adjust BAU Total CO2e (MT/year)**
Natural Gas	Employment	263,046	240,587	14	13	272,411	244,947	15	13	281,659	249,252	15	14
Total				726	664			751	676			777	687

Source: Generator Permits, provided by BAAQMD

Building Energy Efficiency Assumptions

Sector	Code	% Reduction	Notes	Source
Residential	Energy efficiency improvement of 2013 code above 2008 code	25%		http://www.energy.ca.gov/releases/2014_releases/2014-07-01_new_title24_st
	Energy efficiency improvement of 2016 code above 2013 code	28%	Lighting, heating, cooling, ventilation, and water heating	http://www.energy.ca.gov/title24/2016standards/rulemaking/documents/2016_Building_E
	Energy efficiency improvement of 2019 code above 2016 code	53%	Includes onsite solar requirement	
Commercial	Energy efficiency improvement of 2013 code above 2008 code	30%		http://www.energy.ca.gov/commission/accomplishments/2014_cec_acco
	Energy efficiency improvement of 2016 code above 2013 code	5%		http://www.energy.ca.gov/title24/2016standards/rulemaking/documents/2015-06-
	Energy efficiency improvement of 2019 code above 2016 code	30%		

Total Residential Reduction	74.62%
Total Commercial Reduction	53.45%

On-Road Transportation

	2005		2015		2019		2030			2040			2045		
Source	**VMT/year**	**MTCO2e/year**	**VMT/year**	**MTCO2e/year**	**VMT/year**	**MTCO2e/year**	**VMT/year**	**BAU MTCO2e/year**	**Leg-Adjust BAU MTCO2e/year**	**VMT/year**	**BAU MTCO2e/year**	**Leg-Adjust BAU MTCO2e/year**	**VMT/year**	**BAU MTCO2e/year**	**Leg-Adjust BAU MTCO2e/year**
Passenger	434,135,841	181,172	492,014,849	182,927	509,968,096	173,746	559,587,179	190,651	153,600	579,143,509	197,314	146,494	599,858,891	204,372	149,831
Commercial	49,496,836	71,692	67,476,778	95,134	62,921,403	85,881	73,664,721	100,545	82,711	83,202,762	113,563	72,405	88,017,894	120,135	71,556
Total	**483,632,677**	**252,864**	**559,491,627**	**278,061**	**572,889,499**	**259,627**	**633,251,901**	**291,196**	**236,310**	**662,346,271**	**310,877**	**218,898**	**687,876,785**	**324,507**	**221,388**

Source: 2005 Milpitas GHG Inventory, provided by the City
Source: Milpitas Transportation 2015-2019 Data, provided by SVCE
Source: Transportation Calculations
Sources: CalTrans, BAAQMD, MTC

VMT

Growth	2005	2015	2019	2030	2040	2045
Percent Change from 2019			0.00%	10.54%	15.62%	20.07%

VMT Compound Annual Growth Rate	0.903%

	2005	2015	2019	2030	2040	2045
VMT Per Capita	7,885	6,389	6,363	6,624	6,371	6,414

Off-Road Transportation

Milpitas Greenhouse Gas Inventory and Forecasts

Off-Road Vehicles and Equipment

	Scaling Factor	2005 CO2 (tons/day)	2005 CH4 (tons/day)	2005 N2O (tons/day)	2005 CO2e (tons/day)	2005 CO2e (MT/yr)	2015 CO2 (tons/day)	2015 CH4 (tons/day)	2015 N2O (tons/day)	2015 CO2e (tons/day)	2015 CO2e (MT/yr)	2019 CO2 (tons/day)	2019 CH4 (tons/day)	2019 N2O (tons/day)	2019 CO2e (tons/day)	2019 CO2e (MT/yr)
Construction and Mining Equipment	Service Population	11.43381	0.00219	0.00008	11.5	3,813	14.02545	0.00114	0.00007	14.1	4,661	10.46594	0.00080	0.00006	10.5	3,478
Entertainment Equipment	Population	0.10787	0.00001	0.00000	0.1	36	0.13422	0.00001	0.00000	0.1	45	0.13369	0.00001	0.00000	0.1	44
Industrial Equipment	Employment	24.45336	0.02192	0.00216	25.6	8,490	24.98387	0.00796	0.00140	25.6	8,469	25.36609	0.00738	0.00140	25.9	8,590
Lawn and Garden Equipment	Population	2.85385	0.00564	0.00222	3.6	1,192	3.87925	0.00587	0.00254	4.7	1,561	3.99420	0.00588	0.00257	4.8	1,602
Light Commercial Equipment	Employment	3.39614	0.00186	0.00058	3.6	1,193	3.70840	0.00105	0.00061	3.9	1,291	3.71626	0.00089	0.00058	3.9	1,290
Railyard Operations	Employment	0.00183	0.00000	0.00000	0.0	1	0.00175	0.00000	0.00000	0.0	1	0.00167	0.00000	0.00000	0.0	1
Recreational Equipment	Population	0.39255	0.00346	0.00057	0.6	212	0.70072	0.00591	0.00102	1.1	376	0.80246	0.00665	0.00117	1.3	430
Transport Refrigeration Units	Share of Road Miles	0.29162	0.00013	0.00000	0.3	98	0.32192	0.00003	0.00000	0.3	107	0.35620	0.00003	0.00000	0.4	118
Total						**15,034**					**16,511**					**15,554**

	2030 CO2 (tons/day)	2030 CH4 (tons/day)	2030 N2O (tons/day)	2030 CO2e (tons/day)	2030 CO2e (MT/yr)	2040 CO2 (tons/day)	2040 CH4 (tons/day)	2040 N2O (tons/day)	2040 CO2e (tons/day)	2040 CO2e (MT/yr)	2045 CO2 (tons/day)	2045 CH4 (tons/day)	2045 N2O (tons/day)	2045 CO2e (tons/day)	2045 CO2e (MT/yr)	Scaling Factor
Construction and Mining Equipment	17.77665	0.00084	0.00011	17.8	5,903	18.80375	0.00078	0.00011	18.9	6,244	19.48648	0.00081	0.00012	19.5	6,470	Service Population
Entertainment Equipment	0.12617	0.00000	0.000000	0.1	42	0.11989	0.00000	0.00000	0.1	40	0.12367	0.00000	0.00000	0.1	41	Population
Industrial Equipment	32.937	0.00920	0.00181	33.7	11,151	36.053	0.01005	0.00199	36.9	12,206	36.38216	0.01014	0.00201	37.2	12,317	Employment
Lawn and Garden Equipment	4.15243	0.00602	0.002646	5.0	1,663	4.30443	0.00624	0.00274	5.2	1,724	4.44023	0.00649	0.00285	5.4	1,781	Population
Light Commercial Equipment	4.76820	0.00098	0.00073	5.0	1,652	5.23587	0.00107	0.00080	5.5	1,814	5.24871	0.00107	0.00080	5.5	1,818	Employment
Railyard Operations	0.00184	0.00000	0.00000	0.0	1	0.00177	0.00000	0.00000	0.0	1	0.00183	0.00000	0.00000	0.0	1	Employment
Recreational Equipment	1.09008	0.00919	0.001611	1.8	588	1.48360	0.01275	0.00220	2.4	802	1.53041	0.01327	0.00229	2.5	831	Population
Transport Refrigeration Units	0.42195	0.00003	0.00000	0.4	140	0.46609	0.00003	0.00000	0.5	155	0.48987	0.00003	0.00000	0.5	163	Share of Road Miles
Total					**21,139**					**22,984**					**23,421**	

Source: CARB's OFFROAD2007 and OFFROAD2017, CA DOT

Solid Waste Emissions Totals

	2005	2015	2019	2030	2040	2045
Waste Generation	26,998	28,592	23,013	24,438	26,576	27,415
Composting		391	553	587.57	639	659
Total (MTCO2e/year)	26,998	28,984	23,566	25,026	27,215	28,074

SW.4 Community-Generated Waste Sent to Landfills

	2005					2015					2019					2030					2040					2045				
Receiving Landfill	**Tonnage Disposed by City**	**Total ADC**	**LFG collection?**	**Generated Methane Emissions with LFG Capture (MT CH4)**	**MT CO2e**	**Tonnage Disposed by City**	**Total ADC**	**LFG collection?**	**Generated Methane Emissions with LFG Capture (MT CH4)**	**MT CO2e**	**Tonnage Disposed by City**	**Total ADC**	**LFG collection?**	**Methane Emissions with LFG Capture (MT CH4)**	**MT CO2e**	**BAU/Leg-Adjust BAU Tonnage Disposed by County**	**Total ADC**	**LFG collection?**	**Methane Emissions with LFG**	**BAU/Leg-Adjust BAU MT CO2e**	**BAU/Leg-Adjust BAU Tonnage Disposed by County**	**Total ADC**	**LFG collection?**	**Generated Methane Emissions with LFG Capture (MT CH4)**	**BAU/Leg-Adjust BAU MT CO2e**	**BAU/Leg-Adjust BAU Tonnage Disposed by County**	**Total ADC**	**LFG collection?**	**Methane Emissions with LFG Capture (MT**	**BAU/Leg-Adjust BAU MT CO2e**
Altamont Landfill & Resource Recovery	40.14	88.39	Yes	2	49	92.5	12.9	Yes	1	40	35.49	18.16	Yes	1	20	37.69	19.29	Yes	1	22	40.99	20.98	Yes	1	23	42.28	21.64	Yes	1	24
Azusa Land Reclamation Landfill	82.51	0.82	Yes	1	31	12.8	-	Yes	0	5	5.02	-	Yes	0	2	5.34	-	Yes	0	2	5.80	-	Yes	0	2	5.99	-	Yes	0	2
Bakersfield Metropolitan Sanitary Landfill	1.81	0.00	Yes	0	1																									
Corinda Los Trancos Landfill				-	-	40.7	1,185.5	Yes	17	463	112.04	-	Yes	2	42	118.98	-	Yes	2	45	129.39	-	Yes	2	49	133.47	-	Yes	2	50
Covanta Stanislaus Resource Recovery Facility				-	-	-	21.8	Yes	0	8																				
Fink Road Landfill				-	-	11.0	71.4	Yes	1	31																				
Foothill Sanitary Landfill	0.5	0	Yes	0	0	1.6	-	Yes	0	1	5.71	-	Yes	0	2	6.06	-	Yes	0	2	6.59	-	Yes	0	2	6.80	-	Yes	0	3
Forward Landfill	62	0	Yes	1	23																									
Guadalupe Sanitary Landfill	458.8	41.1	Yes	7	189	41.0	269.0	Yes	4	117	362.72	-	Yes	5	137	385.18	-	Yes	5	146	418.88	-	Yes	6	158	432.09	-	Yes	6	163
John Smith Road Landfill	74.79	0	Yes	1	28																									
Keller Canyon Landfill	11.29	1444.24	Yes	20	550	1.4	14.8	Yes	0	6	-	15.96	Yes	0	6	-	16.95	Yes	0	6	-	18.43	Yes	0	7	-	19.01	Yes	0	7
Kirby Canyon Recycling & Disposal Facility	39.73	730.27	Yes	10	291	113.8	9.7	Yes	2	47	38,978.22	-	Yes	526	14,734	41,391.90	-	Yes	559	15,646	45,013.50	-	Yes	608	17,015	46,433.56	-	Yes	627	17,552
Monterey Peninsula Landfill				-	-	5,147.3	-	Yes	69	1,946	12,223.96	-	Yes	165	4,621	12,980.91	-	Yes	175	4,907	14,116.68	-	Yes	191	5,336	14,562.03	-	Yes	197	5,504
Newby Island Sanitary Landfill	62,501.4	79.4	Yes	845	23,656	62,147.0	847.2	Yes	850	23,812	5,567.10	-	Yes	75	2,104	5,911.84	-	Yes	80	2,235	6,429.10	-	Yes	87	2,430	6,631.92	-	Yes	90	2,507
North County Landfill & Recycling Center				-	-	1,098.8	-	Yes	15	415																				
Potrero Hills Landfill	1562	0	Yes	21	590	35.2	64.7	Yes	1	38	77.32	-	Yes	1	29	82.11	-	Yes	1	31	89.30	-	Yes	1	34	92.11	-	Yes	1	35
Recology Hay Road	78.37	0	Yes	1	30	408.3	-	Yes	6	154	163.28	-	Yes	2	62	173.39	-	Yes	2	66	188.56	-	Yes	3	71	194.51	-	Yes	3	74
Recology Pacheco Pass	0.84	0	Yes	0	0						0.01	-	Yes	0	0	0.01	-				0.01	-				0.01	-			
Tri-Cities Recycling & Disposal Facility	0	19.02	Yes	0	7																									
Vasco Road Sanitary Landfill	224	0	Yes	3	85	27.9	-	Yes	0	11	50.31	86.34	Yes	2	52	53.43	91.68	Yes	2	55	58.10	99.70	Yes	2	60	59.93	102.85	Yes	2	62
Zanker Material Processing Facility	571.81	0	No	31	865	512.0	408.3	No	50	1,392	181.33	613.54	No	43	1,202	192.55	651.53	No	46	1,276	209.40	708.54	No	50	1,388	216.01	730.89	No	51	1,432
Zanker Road Resource Recovery Operation	398.5	0	No	22	603	70.6	0.2	No	4	107															-					-
Total	66,109	2,403		964	26,998	69,762	2,905		1,021	28,592	57,763	734		822	23,013	61,339	779		873	24,438	66,706	848		949	26,576	68,811	874		979	27,415
													Total Solid Waste	787	22,040			Total Solid Waste	836	23,405			Total Solid Waste	909	25,452			Total Solid Waste	938	26,255
Source: 2005 Milpitas GHG Inventory, provided by the City								Total Solid Waste	965	27,031			Total ADC	35	973			Total ADC	37	1,033			Total ADC	40	1,124			Total ADC	41	1,159
Source: Jurisdiction Disposal by Facility, provided by CalRecycle								Total ADC	56	1,561																				
Source: Solid Waste Email from the City																														

Composting

Waste	**Total Annual (tons)**	**Total Annual (tons)**	**Total Annual (tons)**	**Total Annual (tons)**	**Total Annual (tons)**	**Total Annual (tons)**
Composted Yard Trimmings	NA	4,605.06	6,509.46	6,912.55	7,517.37	7,754.52
Compost Emission Reduction Factor for Yard Trimmings (MTCO2e/ton)		0.44	0.44	0.44	0.44	0.44
Transportation Emissions Factor (MTCO2e/ton)		0.008	0.008	0.008	0.008	0.008
Process Emissions Factor (MTCO2e/ton)		0.007	0.007	0.007	0.007	0.007
Fugitive CH4 Emissions Factor (MTCO2e/ton)		0.049	0.049	0.049	0.049	0.049
Fugitive N2O Emissions Factor (MTCO2e/ton)		0.021	0.021	0.021	0.021	0.021
Overall Emissions from Composting (MTCO2e)		391.43	553.30	587.57	638.98	659.13
Composting Benefits Emissions Factor (MTCO2e/ton)		0.51	0.51	0.51	0.51	0.51
Composting Benefits (MTCO2e)		2,348.58	3,319.82	3,525.40	3,833.86	3,954.81

Source: CARB Compost Emissions Reduction Factors 2016

Table SW.5 CH_4 Yield for Solid Waste Components

Waste Component	Emissions Factor, EF: (mt CH_4/wet short ton waste)	Source
Mixed MSW*	0.06	U.S. EPA AP-42

* – Mixed MSW factor may be used for entire MSW waste stream if waste composition data is unavailable.
U.S. EPA AP-42 – U.S. EPA Emission Factor Database, Chapter 2.4 Municipal Solid Waste Landfills (1998) WARM—Documentation for Greenhouse Gas Emissions and Energy Factors Used in the

$$B_{total} = ALF_b * ((E_s + F_s + H_b) * C_{case}) \quad (2)$$

where,
B_{total} = Total emission reduction benefit due to compost use (MTCO$_2$E/ton of feedstock)
ALF_b = Emission reductions associated with the avoidance of methane emissions at MSW landfills (MTCO$_2$E/ton of feedstock)
E_s = Emission reduction associated with decreased soil erosion (MTCO$_2$E/ton of compost)
F_s = Factor to account for the reduced fertilizer use (MTCO$_2$E/ton of compost)
H_b = Factor to account for the reduced herbicide use (MTCO$_2$E/ton of compost)
C_{case} = Conversion factor used to convert from tons of compost to tons of feedstock.

The overall emissions from composting are represented by the following equation:

$$E_{total} = T_e + P_e + F_e \quad (1)$$

where,
E_{total} = Total emissions from composting (MTCO$_2$E/ton of feedstock)
T_e = Net additional transportation emissions from composting as compared to landfilling (MTCO$_2$E/ton of feedstock)
P_e = Net additional process emissions from composting as compared to landfilling (MTCO$_2$E/ton of feedstock)
F_e = Fugitive emissions from composting (MTCO$_2$E/ton of feedstock)

$$CERF = (ALF_b + ((E_s + F_s + H_b) * C_{case})) - E_{total}$$

where,
CERF = Compost emission reduction factor (MTCO$_2$E/ton of feedstock)
ALF_b = Emission reductions associated with the avoidance of methane emissions at landfills (MTCO$_2$E/ton of feedstock)
E_s = Emission reduction associated with decreased soil erosion (MTCO$_2$E/ton of compost)
F_s = Factor to account for the reduced fertilizer use (MTCO$_2$E/ton of compost)
H_b = Factor to account for the reduced herbicide use (MTCO$_2$E/ton of compost)
C_{case} = Conversion factor used to convert from tons of compost to tons of feedstock
E_{total} = Emissions due to the composting process (MTCO$_2$E/ton of feedstock)

Water Supply

Milpitas Greenhouse Gas Inventory and Forecasts

Water	2005						2015						2019						2030						2040						2045					
Water Provider	**MGY**	**Total MWh**	**Emission Factor (lb CO2/MWh)**	**Emission Factor (lb CH4/MWh)**	**Emission Factor (lb N2O/MWh)**	**Total CO2e (MT/year)**	**MGY**	**Total MWh**	**Emission Factor (lb CO2/MWh)**	**Emission Factor (lb CH4/MWh)**	**Emission Factor (lb N2O/MWh)**	**Total CO2e (MT/year)**	**MGY**	**Total MWh**	**Emission Factor (lb CO2/MWh)**	**Emission Factor (lb CH4/MWh)**	**Emission Factor (lb N2O/MWh)**	**Total CO2e (MT/year)**	**MGY**	**Total MWh**	**Emission Factor (lb CO2/MWh)**	**Emission Factor (lb CH4/MWh)**	**Emission Factor (lb N2O/MWh)**	**BAU Total CO2e (MT/year)**	**Leg-Adjust BAU Total CO2e**	**MGY**	**Total MWh**	**Emission Factor (lb CO2/MWh)**	**Emission Factor (lb CH4/MW**	**Emission Factor (lb N2O/MW**	**BAU Total CO2e (MT/year**	**Leg-Adjust BAU Total**	**MGY**	**Total MWh**	**Emission Factor (lb CO2/MW**	**Emission Factor (lb CH4/MW**	**Emission Factor (lb N2O/MW**	**BAU Total CO2e (MT/year**	**Leg-Adjust BAU Total**
SFPUC	1,674	7,489	489.00	0.0302	0.0081	**1,671**	1,652	7,391	404.51	0.0330	0.0040	**1,363**	2,160	9,663	0.00	0.0000	0.0000	-	2,293	10,261	0	0.0000	0.0000	-	-	2,494	11,159	0	0.0000	0.0000	-	-	2,573	11,511	0	0.0000	0.0000	-	-
SCVWD	1,623	11,687	489.00	0.0302	0.0081	**2,608**	1,111	8,001	404.51	0.0330	0.0040	**1,475**	918	6,607	197.81	0.0327	0.0039	**599**	974	7,016	113.0356164	0.0189	0.0022	**636**	**363**	1,060	7,630	37.6785388	0.006296	0.000741	**691**	**132**	1,093	7,870	0	0.000000	0.000000	**713**	-
SBWR	278	834	489.00	0.0302	0.0081	**186**	246	739	404.51	0.0330	0.0040	**136**	351	1,053	197.81	0.0327	0.0039	**95**	373	1,118	113.0356164	0.0189	0.0022	**101**	**58**	406	1,216	37.6785388	0.006296	0.000741	**110**	**21**	418	1,254	0	0.000000	0.000000	**114**	-
Total	3,575	20,010				**4,466**	3,009.55	16,131				**2,974**	3,428.32	17,322				**694**						**737**	**421**						**801**	**153**						**827**	-

Source: 2005 Milpitas GHG Inventory, provided by the City

Source: Water and Wastewater 2015-2019 data, provided by the City

Wastewater Treatment Characteristics

WWTP/Septic System	Description	Wastewater Treatment Process, Fugitive and Stationary Greenhouse Gas Emission Sources	U.S. Community Protocol, Appendix F, Equations
San Jose - Santa Clara Regional Wastewater Facility	Solids are lagooned for approximately three years. Secondary treatment process is a step-feed Biological Nutrient Removal (BNR) process that achieves full nitrification (all ammonia is converted to nitrate) and partial de-nitrification (about 65% nitrogen removed as an annual average, about 70% removed in the dry season). The BNR process also removes approximately 90% of the incoming phosphorus. Anaerobic digestion used onsite.	full nitrification and partial de-nitrification, lagoon, anaerobic digestion	WW.1a and alt, WW.2a and alt, WW.6, WW.7, WW.12 and alt, WW.15

Wastewater Emissions Totals	2005	2015	2019	2030 BAU	2030 Leg-Adjust BAU	2040 BAU	2040 Leg-Adjust BAU	2045 BAU	2045 Leg-Adjust BAU
Energy-Related Emissions	980.6	1796.5	1434.8	1524	1,460	1,657	1,526	1,709	1,543
Process Emissions	93.8	133.9	137.7	146	146	159	159	164	164
Stationary Emissions	3.6	4.9	5.6	6	6	6	6	7	7
Total (MT CO2e/year)	**1,078**	**1,935**	**1,578**	**1,676**	**1,612**	**1,822**	**1,692**	**1,880**	**1,713**

WW.1a Stationary Methane Emissions from Combustion of Digester Gas

	2005	2015	2019	2030	2040	2045
Volume of Digester Gas Produced per Day (scf/day)		1,320,780	1,589,958	1,688,414	1,836,143	1,894,069
Fraction of CH4 in Digester Gas		0.61	0.61	0.61	0.61	0.61
BTU of CH4	1028	1028	1028	1028	1028	1028
BTU to MMBTU conversion	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001
CH4 emissions factor (kg CH4/MMBTU)	0.0032	0.0032	0.0032	0.0032	0.0032	0.0032
MT CH4/year	0	0.06	0.07	0.07	0.08	0.08
Total MT CO2e/year	0.00	1.70	1.96	2.08	2.26	2.33

Source: Water and Wastewater 2015-2019 data, provided by the City

WW.1(alt) Stationary Methane Emissions from Combustion of Digester Gas

	2005	2015	2019	2030	2040	2045
Population of Milpitas Served	61,334					
Fraction of CH4 in Digester Gas	0.61					
BTU of CH4	1028	1028	1028	1028	1028	1028
BTU to MMBTU conversion	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001
CH4 emissions factor (kg CH4/MMBTU)	0.0032	0.0032	0.0032	0.0032	0.0032	0.0032
MT CH4/year	0.0450	0	0	0	0	0
Total MT CO2e/year	1.26	0.00	0.00	0.00	0.00	0.00

Source: Water and Wastewater 2015-2019 data, provided by the City

WW.2a Stationary Nitrous Oxide Emissions from Combustion of Digester Gas

	2005	2015	2019	2030	2040	2045
Volume of Digester Gas Produced per Day (scf/day)		1,320,780	1,589,958	1,688,414	1,836,143	1,894,069
Fraction of CH4 in Digester Gas		0.61	0.61	0.61	0.61	0.61
BTU of N2O	1028	1028	1028	1028	1028	1028
BTU to MMBTU conversion	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001
N2O emissions factor (kg CH4/MMBTU)	0.00063	0.00063	0.00063	0.00063	0.00063	0.00063
MT N2O/year	0	0.01	0.01	0.01	0.02	0.02
Total MT CO2e/year	0.00	3.16	3.65	3.88	4.21	4.35

Source: Water and Wastewater 2015-2019 data, provided by the City

WW.2a Stationary Nitrous Oxide Emissions from Combustion of Digester Gas

	2005	2015	2019	2030	2040	2045
Population of Milpitas Served	61,334					
Fraction of CH4 in Digester Gas	0.61					
BTU of N2O	1028	1028	1028	1028	1028	1028
BTU to MMBTU conversion	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001
N2O emissions factor (kg CH4/MMBTU)	0.00063	0.00063	0.00063	0.00063	0.00063	0.00063
MT N2O/year	0.0089	0	0	0	0	0
Total MT CO2e/year	2.35	0.00	0.00	0.00	0.00	0.00

Source: Water and Wastewater 2015-2019 data, provided by the City

WW.6 Process Methane Emissions from Wastewater Treatment Lagoons

	2005	2015	2019	2030	2040	2045
BOD load (kg/day)	10.78	15.5463	16.4154	17.432	18.957	19.555
Fraction of BOD removed in primary treatment	0.99	0.99	0.99	0.99	0.99	0.99

Maximum CH4 producing capacity for domestic wastewater (kg CH4/kg BOD removed)	0.6	0.6	0.6	0.6	0.6	0.6
CH4 correction factor for anaerobic systems	0.8	0.8	0.8	0.8	0.8	0.8
MT CH4/year	0.02	0.03	0.03	0.03	0.03	0.03
Total MT CO2e/year	0.53	0.76	0.81	0.86	0.93	0.96

Source: Water and Wastewater 2015-2019 data, provided by the City

WW.7 Process Nitrous Oxide Emissions from Wastewater Treatment Plants with Nitrification or Denitrification

	2005	2015	2019	2030	2040	2045
Population of Milpitas Served	61,334	87,570	90,030	95,605	103,970	107,250
Factor for industrial and commercial discharge	1.25	1.25	1.25	1.25	1.25	1.25
Emission factor for a WWTP with nitrification or denitrification (g N2O/ person / year)	7	7	7	7	7	7
MT N2O/year	1	0.8	0.8	0.8	0.9	0.9
Total MT CO2e/year	92	132.0	135.7	144.1	156.7	161.6

Source: Water and Wastewater 2015-2019 data, provided by the City

WW.12 Fugitive Nitrous Oxide Emissions from Effluent Discharge

	2005	2015	2019	2030	2040	2045
Average total nitrogen per day (kg N/day)	1.04	1.5670	1.5235	1.6178	1.7594	1.8149
Emission factor (kg N2O-N/kg sewage-N discharged)	0.005	0.005	0.005	0.005	0.005	0.005
Molecular weight ratio of N2O to N2	1.57	1.57	1.57	1.57	1.57	1.57
MT N2O/year	0.00	0.00	0.00	0.00	0.01	0.01
Total MT CO2e/year	0.79	1.19	1.16	1.23	1.34	1.38

Source: Water and Wastewater 2015-2019 data, provided by the City

WW.15 Energy-related Emissions Associated with Wastewater Collection and Treatment

	2005	2015	2019	2030 BAU	2030 Leg-Adjust BAU	2040 BAU	2040 Leg-Adjust BAU	2045 BAU	2045 Leg-Adjust BAU
MWh/year	11,576.43	17,231	25,684	27,275	27,275	29,661	29,661	30,596.83	30,596.83
Emission Factor (lb CO2/MWh)	489	206	198	198	113	198	38	198	0
Emission Factor (lb CH4/MWh)	0.0302	0.0340	0.0327	0.0327	0.01889	0.0327	0.00630	0.0327	0
Emission Factor (lb N2O/MWh)	0.0081	0.0040	0.0039	0.0039	0.00222	0.0039	0.00074	0.0039	0
Total Electricity (MTCO2e/year)	122	102	140	148	85	161	31	166	-
Natural Gas (therms/year)	3,427,462	5,101,718	4,063,308	4,314,923	4,314,923	4,692,460	4,692,460	4,840,495.20	4,840,495.20
Emission Factor (lb CO2/therm)	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
Emission Factor (lb CH4/therm)	0.000226742	0.000226742	0.000226742	0.000226742	0.000226742	0.000226742	0.000226742	0.000226742	0.000226742
Emission Factor (lb N2O/therm)	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005
Total Natural Gas (MTCO2e/year)	859	1,695	1,295	1,375	1,375	1,496	1,496	1,543	1,543
Total MT CO2e/year	981	1,796	1,435	1,524	1,460	1,657	1,526	1,709	1,543

Source: Water and Wastewater 2015-2019 data, provided by the City

Source: Milpitas Wastewater Email

	2005	2015	2019
Milpitas Population	61,334	87,570	90,030
WWTP Service Population	1,300,000	1,400,000	1,500,000
MDG	4.576	6.812	6.751

Source: SJSCRWF 2009 Annual Self Monitoring Report

Assumptions and Conversion Factors

Milpitas Greenhouse Gas Inventory and Forecasts

Category	Value	Notes	Source
Conversion Factors			
g/MT	1000000		
g/lb	453.592		
g/kg	1000		
lb/MT	2204.622622		
kg/MT	1000		
MT/ton	0.907185		
g/ton	907185		
lb/kg	2.20462		
kWh/MWh	1000		
MWh/GWh	1000		
gal/cubic foot	7.480519481		
gal/Liter	0.264172052		
Liter/gallon	3.785411784		
gallon/acrefoot	325,851.43		
days/year	365		
million gal/acre-feet	0.325851432		
MMBTU/gallon (diesel)	0.1374		
MMBTU/scf (natural gas)	0.001037		
GWP			
Source (Select)	*IPCC Fifth Assessment Report (Avg)*	<--drop down selection	
CO2	1		
CH4	28		
N2O	265		

Source	CO2 GWP	CH4 GWP	N2O GWP
IPCC Fourth Assessment Report (w/o climate carbon feedback)	1	25	265
IPCC Fourth Assessment Report (with climate carbon feedback)	1	34	298
IPCC Fourth Assessment Report (Avg)	1	25	298
IPCC Fifth Assessment Report (Avg)	1	28	265
IPCC Third Assessment Report	1	23	296
IPCC Second Assessment Report	1	21	310

Electricity Emission Factors	2005	2015	2018	2019	2020	2030	2040	2045	Source
PG&E EF (lb CO2/MWh)	489	404.51	206.29	197.8123	189.3347	113.0356	37.6785	0	https://www.theclimateregistry.org/our-members/cris-public-reports/
CAMX EF (lb CH4/MWh)	0.03024	0.033	0.034	0.0327	0.0315	0.0189	0.0063	0	eGRID (https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid)
CAMX EF (lb N2O/MWh)	0.00808	0.004	0.004	0.00385	0.0037	0.0022	0.0007	0	eGRID (https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid)
CAMX EF (lb CO2/MWh)	724.12	527.9	496.50	478.1111	459.7222	275.8333	91.9444	0	eGRID (https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid)
RPS Requirements									
PG&E									
Percent Renewable			27%	30%	33%	60%	87%	100%	
Increase in Renewables (from 2018)				3%	6%	33%	60%		
SVCE EF (lb CO2/MWh)				2.34	2.2397	1.3371	0.4457	0.0000	SVCE Inventory

*2005 PG&E emissions factor provided by previous 2005 inventory and confirmed here: https://www.ca-ilg.org/sites/main/files/file-attachments/ghg_emission_factor_guidance.pdf

*2015 data is proxy data from 2016

Fuel Emission Factors							
Fuel	Emission Factor	Unit	Source				
Diesel (backup generators)	10.21	kg CO2/gal	Climate Registry 2020 Default Emission Factors	22.5091702	lb CO2/gal		
	0.9	g CH4/MMBTU		0.014442768	lb CH4/gal	24.6146049	lb CO2e/gal
	0.4	g N2O/MMBTU		0.006419008	lb N2O/gal		
Natural Gas (backup generators)	0.05444	kg CO2/scf		1.157372351	lb CO2/therm		
	0.9	g CH4/MMBTU		0.000198416	lb CH4/therm	1.215508297	lb CO2e/therm
	0.9	g N2O/MMBTU		0.000198416	lb N2O/therm		

Demographics

Milpitas Greenhouse Gas Inventory and Forecasts

	Population							Employment							Service Population						
Subarea	**2005**	**2015**	**2019**	**2020**	**2030**	**2040**	**2045**	**2005**	**2015**	**2019**	**2020**	**2030**	**2040**	**2045**	**2005**	**2015**	**2019**	**2020**	**2030**	**2040**	**2045**
Milpitas	61,334	87,570	90,030	90,645	95,605	103,970	107,250	39,346	48,180	47,084	46,810	56,035	58,030	60,000	100,680	135,750	137,114	137,455	151,640	162,000	167,250
Rest of County	1,602,943	1,822,105	1,880,973	1,895,690	2,122,150	2,434,350	2,556,799	809,129	1,039,050	1,066,690	1,073,600	1,142,330	1,231,830	1,270,386	2,412,072	2,861,155	2,947,663	2,969,290	3,264,480	3,666,180	3,827,185
Total County	1,664,277	1,909,675	1,971,003	1,986,335	2,217,755	2,538,320	2,664,049	848,475	1,087,230	1,113,774	1,120,410	1,198,365	1,289,860	1,330,386	2,512,752	2,996,905	3,084,777	3,106,745	3,416,120	3,828,180	3,994,435

Source: MTC Plan Bay Area Population 2010-2040

Note: 2005 population and employment data were extrapolated backwards (i.e., backcast) using MTC data for 2010-2040

	Population							Employment							Service Population						
	2005	**2015**	**2019**	**2020**	**2030**	**2040**	**2045**	**2005**	**2015**	**2019**	**2020**	**2030**	**2040**	**2045**	**2005**	**2015**	**2019**	**2020**	**2030**	**2040**	**2045**
Percent Change from 2019			0.00%	0.68%	6.1924%	15.48%	19.13%			0.00%	-0.58%	19.01%	23.25%	27.43%			0.00%	0.25%	10.59%	18.15%	21.98%
Percent Change from 2040	--	--	--	--	--	--	3.15%	--	--	--	--	--	--	3.39%	--	--	--	--	--	--	3.24%
Percent of Total County	3.69%	4.59%	4.57%	4.56%	4.31%	4.10%	4.03%	4.64%	4.43%	4.23%	4.18%	4.68%	4.50%	4.51%	4.01%	4.53%	4.44%	4.42%	4.44%	4.23%	4.19%

Population Compound Annual Growth Rate	0.69%
Employment Compound Annual Growth Rate	0.75%
Avg Annual Population Percent Change	0.74%
Avg Annual Employment Percent Change	1.11%

Milpitas Municipal Operations Greenhouse Gas Emissions Inventories and Forecasts

Emissions Sector	2015 GHG Emissions				2019 GHG Emissions				2030 GHG Emissions						2040 GHG Emissions						2045 GHG Emissions					
											BAU		Leg-Adjust BAU				BAU		Leg-Adjust BAU				BAU		Leg-Adjust BAU	
	Activity	Units	$MTCO_2e$	$MTCO_2e$ % of Annual Total	Activity	Units	$MTCO_2e$	$MTCO_2e$ % of Annual Total	BAU Activity	Units	$MTCO_2e$	$MTCO_2e$ % of Annual Total	$MTCO_2e$	$MTCO_2e$ % of Annual Total	BAU Activity	Units	$MTCO_2e$	$MTCO_2e$ % of Annual Total	$MTCO_2e$	$MTCO_2e$ % of Annual Total	BAU Activity	Units	$MTCO_2e$	$MTCO_2e$ % of Annual Total	$MTCO_2e$	$MTCO_2e$ % of Annual Total
Buildings and Facilities			**2,001**	**39.86%**			**870**	**26.74%**			**919**	**26.74%**	**889**	**30.42%**			**942**	**26.74%**	**897**	**32.33%**			**954**	**26.74%**	**900**	**32.64%**
Electricity	6,357	MWh	1,192	59.6%	7,568	MWh	8	0.9%	7,994	MWh	8	0.9%	5	0.5%	8,196	MWh	9	0.9%	2	0.2%	8,299	MWh	9	0.9%	0	0.0%
Natural Gas	150,551	Therms	799	40.0%	155,596	Therms	826	95.0%	164,371	Therms	873	95.0%	848	95.4%	168,527	Therms	895	95.0%	858	95.7%	170,644	Therms	906	95.0%	863	95.9%
Backup Generators (Diesel)	903	Gallons	9	0.5%	3,456	Gallons	35	4.1%	3,651	Gallons	37	4.1%	36	4.1%	3,743	Gallons	38	4.1%	37	4.1%	3,790	Gallons	39	4.1%	37	4.1%
Streetlights and Traffic Signals	**3,007**	**MWh**	**564**	**11.23%**	**2,951**	**MWh**	**3**	**0.10%**	**3,117**	**MWh**	**3**	**0.10%**	**2**	**0.06%**	**3,196**	**MWh**	**3**	**0.10%**	**1**	**0.02%**	**3,236**	**MWh**	**3**	**0.10%**	**0**	**0.00%**
Electricity	3,007	MWh	564	100.0%	2,951	MWh	3	100.0%	3,117	MWh	3	100.0%	2	100.0%	3,196	MWh	3	100.0%	1	100.0%	3,236	MWh	3	100.0%	0	0.0%
Employee Commute	**3,508,561**	**VMT**	**1,304**	**25.99%**	**3,508,561**	**VMT**	**1,195**	**36.76%**	**3,706,429**	**VMT**	**1,263**	**36.76%**	**1,017**	**34.81%**	**3,800,139**	**VMT**	**1,295**	**36.76%**	**961**	**34.66%**	**3,847,879**	**VMT**	**1,311**	**36.76%**	**961**	**34.84%**
Employee Commute	3,508,561	VMT	1,304	100.0%	3,508,561	VMT	1,195	100.0%	3,706,429	VMT	1,263	100.0%	1,017	100.0%	3,800,139	VMT	1,295	100.0%	961	100.0%	3,847,879	VMT	1,311	100.0%	961	100.0%
Vehicle Fleet	**110,905**	**Gallons**	**1,017**	**20.27%**	**117,581**	**Gallons**	**1,081**	**33.24%**	**124,212**	**Gallons**	**1,142**	**33.24%**	**925**	**31.64%**	**127,353**	**Gallons**	**1,171**	**33.24%**	**840**	**30.29%**	**128,952**	**Gallons**	**1,185**	**33.24%**	**830**	**30.09%**
Gasoline	88,875	Gallons	790	77.6%	92,606	Gallons	823	76.1%	97,829	Gallons	869	76.1%	700	75.7%	100,302	Gallons	891	76.1%	662	78.8%	101,562	Gallons	902	76.1%	662	79.7%
Diesel	22,030	Gallons	228	22.4%	24,975	Gallons	258	23.9%	26,383	Gallons	273	23.9%	224	24.3%	27,051	Gallons	280	23.9%	178	21.2%	27,390	Gallons	283	23.9%	169	20.3%
Solid Waste	**154**	**Tons**	**52**	**1.03%**	**157**	**Tons**	**53**	**1.62%**	**166**	**Tons**	**56**	**1.62%**	**56**	**1.91%**	**170**	**Tons**	**57**	**1.62%**	**57**	**2.06%**	**172**	**Tons**	**58**	**1.62%**	**58**	**2.10%**
Water Supply	**77**	**MGY**	**70**	**1.40%**	**155**	**MGY**	**41**	**1.26%**	**164**	**MGY**	**43**	**1.26%**	**25**	**0.85%**	**168**	**MGY**	**44**	**1.26%**	**8**	**0.30%**	**170**	**MGY**	**45**	**1.26%**	**0**	**0.00%**
Wastewater Treatment			**11**	**0.23%**			**9**	**0.28%**			**10**	**0.28%**	**9**	**0.32%**			**10**	**0.28%**	**9**	**0.33%**			**10**	**0.28%**	**9**	**0.33%**
Total $MTCO_2e$/yr			**5,019**	**100%**			**3,252**	**100%**			**3,435**	**100%**	**2,923**	**100%**			**3,522**	**100%**	**2,773**	**100%**			**3,567**	**100%**	**2,759**	**100%**

Energy Consumption

Milpitas Municipal Operations Greenhouse Gas Inventories and Forecasts

Electricity

Source	2015 MWh/year	2015 Emission Factor (lb CO2/MWh)	2015 Emission Factor (lb CH4/MWh)	2015 Emission Factor (lb N2O/MWh)	2015 Total MT CO2e/year	2019 MWh/year	2019 Emission Factor (lb CO2/MWh)	2019 Emission Factor (lb CH4/MWh)	2019 Emission Factor (lb N2O/MWh)	2019 Total MT CO2e/year
Buildings & Facilities Electricity (PG&E)	6,357	404.51	0.033	0.004	1,192	--	--	--	--	--
Streetlights & Traffic Signals (PG&E)	3,007	404.51	0.033	0.004	564	--	--	--	--	--
Buildings & Facilities Electricity (SVCE)	--	--	--	--	--	7,568	2.34	0.0000	0.0000	8
Streetlights & Traffic Signals (SVCE)	--	--	--	--	--	2,951	2.34	0.0000	0.0000	3
Total					**1,756**					**11**

Source	Scale Factor	2030 BAU MWh/year	2030 Leg-Adjust BAU MWh/year	2030 Emission Factor (lb CO2/MWh)	2030 Emission Factor (lb CH4/MWh)	2030 Emission Factor (lb N2O/MWh)	2030 BAU Total CO2e (MT/year)	2030 Leg-Adjust BAU Total CO2e (MT/year)
Buildings & Facilities Electricity (PG&E)								
Streetlights & Traffic Signals (PG&E)								
Buildings & Facilities Electricity (SVCE)	Employment	7,994	7,766	1.34	0.000	0.000	8	5
Streetlights & Traffic Signals (SVCE)	Employment	3,117	3,028	1.34	0.000	0.000	3	2
Total							**12**	**7**

Source	2040 BAU MWh/year	2040 Leg-Adjust BAU MWh/year	2040 Emission Factor (lb CO2/MWh)	2040 Emission Factor (lb CH4/MWh)	2040 Emission Factor (lb N2O/MWh)	2040 BAU Total CO2e (MT/year)	2040 Leg-Adjust BAU Total CO2e (MT/year)
Buildings & Facilities Electricity (PG&E)							
Streetlights & Traffic Signals (PG&E)							
Buildings & Facilities Electricity (SVCE)	8,196	7,860	0.45	0.000	0.000	9	2
Streetlights & Traffic Signals (SVCE)	3,196	3,065	0.45	0.000	0.000	3	1
Total						**12**	**2**

Source	2045 BAU MWh/year	2045 Leg-Adjust BAU MWh/year	2045 Emission Factor (lb CO2/MWh)	2045 Emission Factor (lb CH4/MWh)	2045 Emission Factor (lb N2O/MWh)	2045 BAU Total CO2e (MT/year)	2045 Leg-Adjust BAU Total CO2e (MT/year)
Buildings & Facilities Electricity (PG&E)							
Streetlights & Traffic Signals (PG&E)							
Buildings & Facilities Electricity (SVCE)	8,299	7,908	0.00	0.00	0.00	9	-
Streetlights & Traffic Signals (SVCE)	3,236	3,083	0.00	0.00	0.00	3	-
					Total	**12**	**-**

Source: 2005 Milpitas GHG Inventory, provided by the City
Source: Municipal Electricity and Natural Gas 2015, provided by the City
Source: Municipal Electricity and Natural Gas 2019, provided by the City

Natural Gas

Source	2015 therms/year	2015 Emission Factors (lb/therm) CO_2	2015 CH_4	2015 N_2O	2015 Total MT CO2e/year	2019 therms/year	2019 Emission Factors (lb/therm) CO_2	2019 CH_4	2019 N_2O	2019 Total MT CO2e/year
Buildings & Facilities Natural Gas (PG&E)	150,551	11.7	0.000226742	0.000005	799	155,596	11.7	0.000226742	0.000005	826
Total					**799**					826

Source	Scale Factor	2030 BAU therms/year	2030 Leg-Adjus BAU therms/year	2030 BAU Total CO2e (MT/year)	2030 Leg-Adjust BAU Total CO2e	2040 BAU therms/year	2040 Leg-Adjus BAU therms/year	2040 BAU Total CO2e (MT/year)	2040 Leg-Adjust BAU Total	2045 BAU therms/year	2045 Leg-Adjus BAU therms/year	2045 BAU Total CO2e (MT/year)	2045 Leg-Adjust BAU Total CO2e
Buildings & Facilities Natural Gas (PG&E)	Employment	164,371	159,681	873	848	168,527	161,615	895	858	170,644	162,601	906	863
Total				873	848			895	858			906	863

Source: 2005 Milpitas GHG Inventory, provided by the City
Source: Municipal Electricity and Natural Gas 2015, provided by the City
Source: Municipal Electricity and Natural Gas 2019, provided by the City

Backup Generators

Source	2015 gallons/year	2015 Emissions Factor (kg CO2/gal)	2015 Emissions Factor (g CH4/MMBTU)	2015 Emissions Factor (g N2O/MMBTU)	2015 Total MT CO2e/year	2019 gallons/year	2019 Emissions Factor (kg CO2/gal)	2019 Emissions Factor (g CH4/MMBTU)	2019 Emissions Factor (g N2O/MMBTU)	2019 Total MT CO2e/year
Diesel	903	10.21	0.9	0.4	9	3,456	10.21	0.9	0.4	35
Total					9					35

Source	Scale Factor	2030 BAU gallons/year	2030 Leg-Adjust BAU gallons/year	2030 BAU Total MT CO2e/year	2030 Leg-Adjust BAU Total MT CO2e/year	2040 BAU gallons/year	2040 Leg-Adjust BAU gallons/year	2040 BAU Total MT CO2e/year	2040 Leg-Adjust BAU Total MT CO2e/year	2045 BAU gallons/year	2045 Leg-Adjust BAU gallons/year	2045 BAU Total MT CO2e/year	2045 Leg-Adjust BAU Total MT CO2e/year
Diesel	Employment	3,651	3,547	37.34	36.28	3,743	3,590	38.29	36.72	3,790	3,612	38.77	36.94
Total				37.34	36.28			38.29	36.72			38.77	36.94

Source: Municipal Backup Generator Usage, provided by the City

Building Energy Efficiency Assumptions

Sector	Code	% Reduction	Notes	Source
Residential	Energy efficiency improvement of 2013 code above 2008 code	25%		http://www.energy.ca.gov/releases/2014_releases/2014-07-01_new_title24_standards_nr.html
	Energy efficiency improvement of 2016 code above 2013 code	28%	Lighting, heating, cooling, ventilation, and water heating	http://www.energy.ca.gov/title24/2016standards/rulemaking/documents/2016_Building_Energy_Efficiency_Stan
	Energy efficiency improvement of 2019 code above 2016 code	53%	Includes onsite solar requirement	
Commercial	Energy efficiency improvement of 2013 code above 2008 code	30%		http://www.energy.ca.gov/commission/accomplishments/2014_cec_accomplishments.pdf
	Energy efficiency improvement of 2016 code above 2013 code	5%		http://www.energy.ca.gov/title24/2016standards/rulemaking/documents/2015-06-
	Energy efficiency improvement of 2019 code above 2016 code	30%		

Total Commercial Reduction	53.45%

Employee Commute

Milpitas Municipal Operations Greenhouse Gas Inventories and Forecasts

Employee Commute	2015		2019			2030			2040			2045		
Source	VMT/year	MTCO2e/year	VMT/year	MTCO2e/year	Scaling Factor	VMT/year	BAU MTCO2e/year	Leg-Adjust BAU MTCO2e/year	VMT/year	BAU MTCO2e/year	Leg-Adjust BAU MTCO2e/year	VMT/year	BAU MTCO2e/year	Leg-Adjust BAU MTCO2e/year
Employee Commute	3,508,561	1,304	3,508,561	1,195	Employment	3,706,429	1,263	1,017	3,800,139	1,295	961	3,847,879	1,311	961
Total	**3,508,561**	**1,304**	**3,508,561**	**1,195**		**3,706,429**	**1,263**	**1,017**	**3,800,139**	**1,295**	**961**	**3,847,879**	**1,311**	**961**

Source: Municipal Employee data, provided by the City

Vehicle Fleet	2015						2019						2030				2040			2045	
Source	**gallons/year**	**Emissions Factor (kg CO2/gal)**	**MT CO2/year**	**Emissions Ratio (MT CH4/MT CO2)**	**Emissions Ratio (MT N2O/MT CO2)**	**Total MT CO2e/year**	**gallons/year**	**Emissions Factor (kg CO2/gal)**	**MT CO2/year**	**Emissions Ratio (MT CH4/MT CO2)**	**Emissions Ratio (MT N2O/MT CO2)**	**Total MT CO2e/year**	**Scaling Factor**	**gallons/year**	**BAU Total MT CO2e/year**	**Leg-Adjust BAU Total MT CO2e/year**	**gallons/year**	**BAU Total MT CO2e/year**	**Leg-Adjust BAU Total MT CO2e/year**	**gallons/year**	**BAU Total MT CO2e/year**	**Leg-Adjust BAU Total MT CO2e/year**
Gasoline	88,875	8.78	780.32	0.0000237	0.0000429	789.71	92,606	8.78	813.08	0.0000237	0.0000429	822.86	Employment	97,829	869.27	700.33	100,302	891.25	661.70	101,562	902.44	661.61
Diesel	22,030	10.21	224.93	0.0000237	0.0000429	227.63	24,975	10.21	254.99	0.0000237	0.0000429	258.06	Employment	26,383	272.62	224.26	27,051	279.51	178.21	27,390	283.02	168.58
Total						**1,017**						**1,081**			**1,142**	**925**		**1,171**	**840**		**1,185**	**830**

Source: Milpitas Municipal Vehicle Fleet Usage

Solid Waste

Milpitas Municipal Operations Greenhouse Gas Inventories and Forecasts

Solid Waste Emissions Totals	2015	2019	2030	2040	2045
Total (MTCO2e/year)	52	53	56	57	58

Municipal-Generated Solid Waste	2015	2019	2030	2040	2045
Municipal Employees	512	524	554	568	575
Average Solid Waste Disposal Per Employee (tons/employee/year)	0.3	0.3	0.3	0.3	0.3
Solid Waste Disposal (tons)	153.6	157.2	166.1	170.3	172.4
LFG Capture Rate	75%	75%	75%	75%	75%
Percent of Landfills Accepting Waste from Milpitas with LFG Capture	89%	89%	89%	89%	89%
Oxidation Rate	0.1	0.1	0.1	0.1	0.1
EPA Emissions Factor (MTCH4/wet short ton)	0.06	0.06	0.06	0.06	0.06
Total Emissions (MTCO2e/year)	51.61	52.82	55.80	57.21	57.93

Water Supply

Milpitas Municipal Operations Greenhouse Gas Inventories and Forecasts

Water

2015

Water Provider	MGY	Total MWh	Emission Factor (lb CO2/MWh)	Emission Factor (lb CH4/MWh)	Emission Factor (lb N2O/MWh)	Total CO2e (MT/year)
SFPUC	35	155	404.51	0.0330	0.0040	**29**
SCVWD	23	166	404.51	0.0330	0.0040	**31**
SBWR	20	59	404.51	0.0330	0.0040	**11**
Total	77	380				**70**

2019

Water Provider	MGY	Total MWh	Emission Factor (lb CO2/MWh)	Emission Factor (lb CH4/MWh)	Emission Factor (lb N2O/MWh)	Total CO2e (MT/year)
SFPUC	62	277	0.00	0.0000	0.0000	-
SCVWD	41	297	197.81	0.0327	0.0039	**27**
SBWR	52	154	197.81	0.0327	0.0039	**14**
Total	154.79	729				**41**

2030

Water Provider	MGY	Total MWh	Emission Factor (lb CO2/MWh)	Emission Factor (lb CH4/MWh)	Emission Factor (lb N2O/MWh)	BAU Total CO2e (MT/year)	Leg-Adjust BAU Total CO2e (MT/year)
SFPUC	65	293	0	0.0000	0.0000	-	-
SCVWD	44	314	113.0356164	0.0189	0.0022	**28**	**16**
SBWR	54	163	113.0356164	0.0189	0.0022	**15**	**8**
Total	163.51	770				**43**	**25**

2040

Water Provider	MGY	Total MWh	Emission Factor (lb CO2/MWh)	Emission Factor (lb CH4/MWh)	Emission Factor (lb N2O/MWh)	BAU Total CO2e (MT/year)	Leg-Adjust BAU Total CO2e (MT/year)
SFPUC	67	300	0	0.0000	0.0000	-	-
SCVWD	45	322	37.67853881	0.0063	0.0007	**29**	**6**
SBWR	56	167	37.67853881	0.0063	0.0007	**15**	**3**
Total	167.65	790				**44**	**8**

2045

Water Provider	MGY	Total MWh	Emission Factor (lb CO2/MWh)	Emission Factor (lb CH4/MWh)	Emission Factor (lb N2O/MWh)	BAU Total CO2e (MT/year)	Leg-Adjust BAU Total CO2e (MT/year)
SFPUC	68	304	0	0.0000	0.0000	-	-
SCVWD	45	326	0	0.0000	0.0000	**30**	-
SBWR	57	169	0	0.0000	0.0000	**15**	-
Total	169.75	800				**45**	-

Source: Milpitas Municipal Water 2015, provided by the City

Source: Milpitas Municipal Water 2019, provided by the City

Wastewater Treatment
Milpitas Municipal Operations Greenhouse Gas Inventories and Forecasts

Wastewater Treatment Characteristics

WWTP/Septic System	Description	Wastewater Treatment Process, Fugitive and Stationary Greenhouse Gas Emission Sources	U.S. Community Protocol, Appendix F, Equations
San Jose - Santa Clara Regional Wastewater Facility	Solids are lagooned for approximately three years. Secondary treatment process is a step-feed Biological Nutrient Removal (BNR) process that achieves full nitrification (all ammonia is converted to nitrate) and partial de-nitrification (about 65% nitrogen removed as an annual average, about 70% removed in the dry season). The BNR process also removes approximately 90% of the incoming phosphorus. Anaerobic digestion used onsite.	full nitrification and partial de-nitrification, lagoon, anaerobic digestion	WW.1a and alt, WW.2a and alt, WW.6, WW.7, WW.12 and alt, WW.15

Wastewater Emissions Totals	2015	2019	2030 BAU	2030 Leg-Adjust	2040 BAU	2040 Leg-Adjust B	2045 BAU	2045 Leg-Adjust BAU
Total (MT CO2e/year)	11	9	10	9	10	9	10	9

WW.1a Stationary Methane Emissions from Combustion of Digester Gas

	2015	2019	2030	2040	2045
Volume of Digester Gas Produced per Day (scf/day)	483	555	587	602	609
Fraction of CH4 in Digester Gas	0.61	0.61	0.61	0.61	0.61
BTU of CH4	1028	1028	1028	1028	1028
BTU to MMBTU conversion	0.000001	0.000001	0.000001	0.000001	0.000001
CH4 emissions factor (kg CH4/MMBTU)	0.0032	0.0032	0.0032	0.0032	0.0032
MT CH4/year	0.00035	0.00041	0.00043	0.00044	0.00045
Total MT CO2e/year	0.0099	0.0114	0.0120	0.0123	0.0125

Source: Municipal Wastewater 2015 and 2019 data, provided by the City

WW.2a Stationary Nitrous Oxide Emissions from Combustion of Digester Gas

	2015	2019	2030	2040	2045
Volume of Digester Gas Produced per Day (scf/day)	483	555	587	602	609
Fraction of CH4 in Digester Gas	0.61	0.61	0.61	0.61	0.61
BTU of N2O	1028	1028	1028	1028	1028
BTU to MMBTU conversion	0.000001	0.000001	0.000001	0.000001	0.000001
N2O emissions factor (kg CH4/MMBTU)	0.00063	0.00063	0.00063	0.00063	0.00063
MT N2O/year	0.00007	0.00008	0.00008	0.00009	0.00009
Total MT CO2e/year	0.0185	0.0212	0.0024	0.0024	0.0025

Source: Municipal Wastewater 2015 and 2019 data, provided by the City

WW.6 Process Methane Emissions from Wastewater Treatment Lagoons

	2015	2019	2030	2040	2045
BOD load (kg/day)	0.0206	0.0362	0.0382	0.0392	0.0397
Fraction of BOD removed in primary treatment	0.99	0.99	0.99	0.99	0.99
Maximum CH4 producing capacity for domestic wastewater (kg CH4/kg BOD removed)	0.6	0.6	0.6	0.6	0.6
CH4 correction factor for anaerobic systems	0.8	0.8	0.8	0.8	0.8
MT CH4/year	0.000036	0.000063	0.000067	0.000069	0.000070
Total MT CO2e/year	0.0010	0.0018	0.0019	0.0019	0.0019

Source: Municipal Wastewater 2015 and 2019 data, provided by the City

WW.7 Process Nitrous Oxide Emissions from Wastewater Treatment Plants with Nitrification or Denitrification

	2015	2019	2030	2040	2045
Population of Milpitas Municipal Employees	512	524	554	568	575
Factor for industrial and commercial discharge	1.25	1.25	1.25	1.25	1.25
Emission factor for a WWTP with nitrification or denitrification (g N2O/ person / year)	7	7	7	7	7
MT N2O/year	0.0029	0.0030	0.0031	0.0032	0.0033
Total MT CO2e/year	0.77	0.79	0.83	0.86	0.87

Source: Municipal Wastewater 2015 and 2019 data, provided by the City

WW.12 Fugitive Nitrous Oxide Emissions from Effluent Discharge

	2015	2019	2030	2040	2045
Average total nitrogen per day (kg N/day)	0.0017	0.0031	0.00327	0.00336	0.00340
Emission factor (kg N2O-N/kg sewage-N discharged)	0.005	0.005	0.005	0.005	0.005
Molecular weight ratio of N2O to N2	1.57	1.57	1.57	1.57	1.57
MT N2O/year	0.0000049	0.0000089	0.0000094	0.0000096	0.0000097
Total MT CO2e/year	0.0013	0.0024	0.0025	0.0025	0.0026

Source: Municipal Wastewater 2015 and 2019 data, provided by the City

WW.15 Energy-related Emissions Associated with Wastewater Collection and Treatment

	2015	2019	2030 BAU	2030 Leg-Adjust	2040 BAU	2040 Leg-Adjust B	2045 BAU	2045 Leg-Adjust BAU
MWh/year	6.30	8.97	9.48	9.48	9.72	9.72	9.84	9.84
Emission Factor (lb CO2/MWh)	206	198	198	113	198	38	198	0
Emission Factor (lb CH4/MWh)	0.0340	0.0327	0.0327	0.01889	0.0327	0.00630	0.0327	0
Emission Factor (lb N2O/MWh)	0.0040	0.0039	0.0039	0.00222	0.0039	0.00074	0.0039	0
Total Electricity (MTCO2e/year)	0.595	0.813	0.859	0.491	0.880	0.168	0.892	-
Natural Gas (therms/year)	1,866	1,419	1,499	1,499	1,537	1,537	1,556.73	1,557
Emission Factor (lb CO2/therm)	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
Emission Factor (lb CH4/therm)	0.000226742	0.000226742	0.000226742	0.000226742	0.000226742	0.000226742	0.000226742	0.000226742
Emission Factor (lb N2O/therm)	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005
Total Natural Gas (MTCO2e/year)	9.908	7.538	7.963	7.963	8.164	8.164	8.267	8.267
Total MT CO2e/year	10.504	8.351	8.822	8.454	9.045	8.332	9.158	8.267

Source: Water and Wastewater 2015-2019 data, provided by the City

Source: Milpitas Wastewater Email

Assumptions and Conversion Factors

Milpitas Municipal Operations Greenhouse Gas Inventories and Forecasts

Category	Value	Notes	Source
Conversion Factors			
g/MT	1000000		
g/lb	453.592		
g/kg	1000		
lb/MT	2204.622622		
kg/MT	1000		
MT/ton	0.907185		
g/ton	907185		
lb/kg	2.20462		
kWh/MWh	1000		
MWh/GWh	1000		
gal/cubic foot	7.480519481		
gal/Liter	0.264172052		
Liter/gallon	3.785411784		
gallon/acrefoot	325851.429		
days/year	365		
million gal/acre-feet	0.325851432		
MMBTU/gallon (diesel)	0.1374		
MMBTU/scf (natural gas)	0.001037		
GWP			
Source (Select)	*IPCC Fifth Assessment Report (Avg)*	<--drop down selection	
CO2	1		
CH4	28		
N2O	265		

Source	CO2 GWP	CH4 GWP	N2O GWP
IPCC Fourth Assessment Report (w/o climate carbon feedback)	1	25	265
IPCC Fourth Assessment Report (with climate carbon feedback)	1	34	298
IPCC Fourth Assessment Report (Avg)	1	25	298
IPCC Fifth Assessment Report (Avg)	1	28	265
IPCC Third Assessment Report	1	23	296
IPCC Second Assessment Report	1	21	310

Electricity Emission Factors	2005	2015	2018	2019	2020	2030	2040	2045	Source
PG&E EF (lb CO2/MWh)	489	404.51	206.29	197.8123	189.3347	113.0356	37.6785	0	https://www.theclimateregistry.org/our-members/cris-public-reports/
CAMX EF (lb CH4/MWh)	0.03024	0.033	0.034	0.0327	0.0315	0.0189	0.0063	0	eGRID (https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid)
CAMX EF (lb N2O/MWh)	0.00808	0.004	0.004	0.00385	0.0037	0.0022	0.0007	0	eGRID (https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid)
CAMX EF (lb CO2/MWh)	724.12	527.9	496.50	478.1111	459.7222	275.8333	91.9444	0	eGRID (https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid)
RPS Requirements									
PG&E									
Percent Renewable			27%	30%	33%	60%	87%	100%	
Increase in Renewables (from 2018)				3%	6%	33%	60%		
SVCE EF (lb CO2/MWh)				2.34	2.2397	1.3371	0.4457	0.0000	SVCE Inventory

*2005 PG&E emissions factor provided by previous 2005 inventory and confirmed here: https://www.ca-ilg.org/sites/main/files/file-attachments/ghg_emission_factor_guidance.pdf

*2015 data is proxy data from 2016

Fuel Emission Factors			
Gasoline	8.78	kg CO2/gal	Climate Registry Default Emission Factors 2020
Boats - Gasoline 4-stroke	5.443	g CH4/gal	Climate Registry Default Emission Factors 2020
Boats - Gasoline 4-stroke	0.061	g N2O/gal	Climate Registry Default Emission Factors 2020

Fuel	Emission Factor	Unit	Source
Gasoline (transport fuel)	8.78	kg CO2/gal	Climate Registry 2020 Default Emission Factors
	0.0000237	MT CH4/MT CO2	
	0.0000429	MT N2O/MTO CO2	
Diesel (transport fuel)	10.21	kg CO2/gal	
	0.0000237	MT CH4/MT CO2	
	0.0000429	MT N2O/MTO CO2	
Diesel (backup generators)	10.21	kg CO2/gal	
	0.9	g CH4/MMBTU	
	0.4	g N2O/MMBTU	
Natural Gas (backup generator)	0.05444	kg CO2/scf	
	0.9	g CH4/MMBTU	
	0.9	g N2O/MMBTU	

22.5091702	lb CO2/gal			
0.014442768	lb CH4/gal	24.6146049	lb CO2e/gal	
0.006419008	lb N2O/gal			
1.157372351	lb CO2/therm			
0.000198416	lb CH4/therm	1.215508297	lb CO2e/therm	
0.000198416	lb N2O/therm			

Demographics

Milpitas Municipal Operations Greenhouse Gas Inventories and Forecasts

Municipal Employees	2015	2019	2030	2040	2045
Milpitas	512	524	554	568	575
Percent Growth from 2019	--	0	0.0564	0.0831	0.0967
Percent Growth from 2040	--	--	--	0	0.012563

Employment Growth Rate 2019 to 2030 0.50%

Employment Growth Rate 2030 to 2045 0.25%

Note from City:

Given the numbers below with a 1% growth factor, I suggest a 0.5% growth factor until 2030 and then reduce it to 0.25%. By 2030, the City will be build out and we may only add staff for enhancing services.