CITY OF Fremont

CLIMATE READY FREMONT

Fremont's pathway to a low-carbon, sustainable, and resilient future

Appendices

Appendix A

Greenhouse Gas Inventory and Forecast Memo

Memo

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Date: February 26, 2021

To: Rachel DiFranco and Robbie Barton (City of Fremont)

From: Honey Walters, Hannah Kornfeld, and Angie Xiong (Ascent Environmental)

Subject: City of Fremont Climate Action Plan 2.0 Emissions Forecast Scenarios Technical Memorandum

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INTRODUCTION

The City of Fremont (City) has long been on the forefront of climate action. The City completed its first greenhouse gas (GHG) inventory and appointed a Green Task Force in 2008 to call upon the City to adopt GHG reduction targets and develop a Climate Action Plan (CAP). The City adopted its first CAP in 2012, which includes a GHG emissions reduction target for the year 2020 based on a 2005 baseline year.

The City is currently preparing an updated CAP (CAP 2.0) that will lay out near-, medium-, and long-term pathways to achieve carbon neutrality by 2045 while also advancing the City's commitments to mobility, affordable housing, economic development, innovation, safety, and quality of life. The first phase of developing the CAP 2.0 was conducted by City staff and included an update of the community-wide and municipal operations inventories for 2015, 2017, and 2018. The second phase, as described in this technical memorandum (Tech Memo #1), was estimating GHG emissions forecasts for 2030, 2045, and 2050 in alignment with Senate Bill (SB) 32 of 2016, Executive Order B-55-18 and the City's Carbon Neutrality resolution, and Executive Order B-30-15, respectively. Three different forecast scenarios have been prepared: a legislative-adjusted business-as-usual (BAU) forecast, a zero-carbon energy forecast, and a balance of advanced mitigation measures forecast. Tech Memo #1 provides the results of the 2018 communitywide GHG emissions inventory and emissions forecasts, as well as associated methods, assumptions, emissions factors, and data sources used to develop the updated emissions inventory and forecasts.

ORGANIZATION OF THIS MEMORANDUM

This memorandum consists of three main parts:

- **Section 1: Summary of Inventory Results** presents an overview of the updated communitywide 2018 GHG emissions inventory for the City.
- **Section 2: Emissions Forecasts** summarizes the forecasted GHG emissions under three different scenarios for the years 2030, 2045, and 2050. Each forecast scenario also summarizes the data, methods, and assumptions used in the forecasts.

- **Section 3: Gap Analysis** illustrates the emissions gap between the forecasted GHG emissions and the City's adopted GHG reduction targets. This gap indicates the quantity of emissions reductions that will need to be met through local action.

1 SUMMARY OF INVENTORY RESULTS

1.1 2018 COMMUNITY INVENTORY RESULTS

Based on the modeling conducted, communitywide sources generated 1,242,640 metric tons of carbon dioxide equivalent ($MTCO_2e$) in 2018. Major emissions sectors included residential building energy use, nonresidential building energy use, and on-road transportation. Table 1 and Figure 1 present the City's 2018 GHG emissions inventory by sector.

Table 1 2018 City of Fremont Community Greenhouse Gas Inventory

Sector	2018 Emissions ($MTCO_2e$/year)	Percent of Total
Residential Building Energy	172,974	14%
Nonresidential Building Energy	177,163	14%
On-Road Transportation	783,601	63%
Off-Road Vehicles and Equipment	46,172	4%
BART	997	<1%
Solid Waste	57,018	5%
Water Supply	577	<1%
Wastewater Treatment	4,135	<1%
Total	**1,242,640**	**100%**

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

Source: City of Fremont 2020

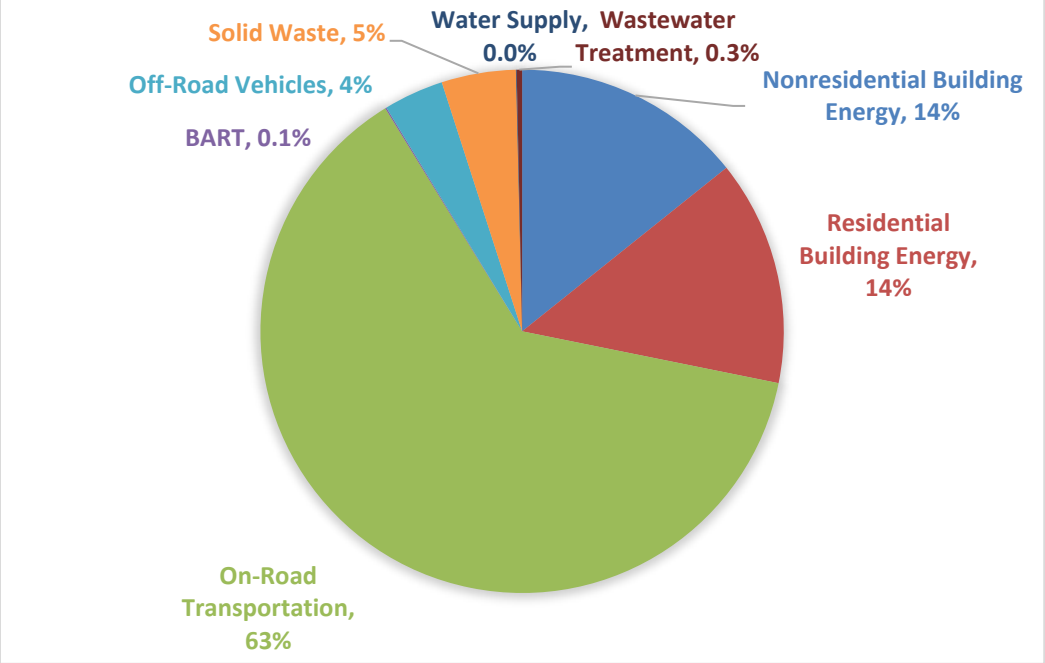

Figure 1 2018 City of Fremont Community Greenhouse Gas Inventory

Table 2 shows a comparison of the City's 2005 inventory alongside the updated 2018 results. In general, the organization of the 2018 inventory is consistent with that of the 2005 inventory. The primary difference is that the 2018 inventory includes the off-road vehicles sector. Additionally, the 2018 inventory includes emissions from nonresidential back-up generators, as well as cleaner electricity offered by East Bay Community Energy (EBCE), which began serving the community in 2018.

Based on the modeling conducted, a 24 percent decrease in emissions from the 2005 inventory was reported. All sectors showed decreases in emissions, except for solid waste, which increased primarily due to a difference in accounting methodology. Specific examples and further comparison between the two inventories are included in Section 2 on a per-sector basis. In general, differences in emissions between the two inventories can be explained by:

- the inclusion of emissions from nonresidential back-up generators, EBCE electricity, and off-road equipment categories;
- adjustments in calculation methodologies (e.g., equations and emission factors);
- differences in data sources between the two inventories; and
- changes in actual activity levels within the city since 2005 (e.g., population increase, number of buildings, building energy use, and vehicle travel).

Table 2 Comparison of City of Fremont Community Greenhouse Gas Inventories (2005 and 2018)

Sector	2005 Inventory ($MTCO_2e$/year)	2018 GHG Inventory ($MTCO_2e$/year)	Difference ($MTCO_2e$/year)	Percent change from 2005
Residential Building Energy	245,222	172,974	-72,248	-29%
Nonresidential Building Energy	440,150	177,163	-262,987	-60%
On-Road Transportation	865,002	783,601	-81,410	-9%

Off-Road Vehicles and Equipment[1]	34,988	46,172	+11,184	+32%
BART	2,111	997	-1,114	-53%
Solid Waste	36,256	57,018	+20,762	+57%
Water Supply	4,210	577	-3,328	-79%
Wastewater Treatment	7,025	4,135	-2,890	-41%
Total	**1,634,965**	**1,242,640**	**-392,325**	**-24%**

Notes: Totals may not sum exactly due to independent rounding; BART = Bay Area Rapid Transit; GHG = greenhouse gas; $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year; NA = Not available.

[1] Off-road vehicles and equipment sector was not included in the original 2005 inventory that was incorporated into the City's 2012 CAP. The CAP 2.0 adds the off-road sector to the 2005 baseline, 2018 inventory update, and all forecast years using the same methodology.

Source: City of Fremont 2020

2 GHG EMISSIONS FORECASTS TO 2030, 2045, AND 2050

The legislative-adjusted BAU emissions forecast, zero-carbon scenario forecast, and balanced scenario forecast provide the City with assessments of how the community's GHG emissions would change over time without further action from the City. The legislative-adjusted BAU emissions forecast only includes emissions reductions associated with implementation of adopted federal and State legislation and regulations and does not include goals established by executive orders or targets established by federal or State agencies outside of adopted legislation and regulations. The legislative-adjusted BAU forecast also does not account for regional or local targets that may affect the City, such as those established by the Bay Area Air Quality Management District, EBCE, StopWaste, or others. Further, this forecast scenario does not incorporate possible emissions reductions due to advancements in clean energy technology deployment such as zero emission vehicle adoption and installation of solar photovoltaics on building rooftops. Therefore, the legislative-adjusted BAU emissions forecast scenario should be interpreted as the absolute minimum emissions reductions that could be achieved over the forecasted timeline. This forecast serves as the starting point from which local GHG emissions reduction measures are formed.

All forecast scenarios include projected emissions for the City's target years of 2030 and 2045, as well as 2050 to align with the State's long-term goals. These forecasts can inform the City's selection of GHG reduction strategies by identifying the relative contribution of different sectors and activities to the City's future emissions totals, and the magnitude of reductions anticipated from State and federal actions (e.g., adopted and proposed rules, regulation, plans, and programs) for the different sectors and activities within the City's jurisdiction.

Various demographic factors were used to estimate future activity levels for each emissions sector and are shown in Table 3. Emissions associated with residential building energy, Bay Area Rapid Transit (BART) ridership, solid waste, water supply, wastewater treatment, and some off-road vehicle categories were scaled using population forecasts provided by the Metropolitan Transportation Commission (MTC) and the California Department of Finance. Nonresidential building energy, and several off-road vehicle categories were scaled using employment projections provided by MTC. Household forecasts were used for projections of lawn and garden equipment (one of the off-road categories). On-road transportation emissions were scaled using MTC's vehicle miles traveled (VMT) estimate for the City, separated by passenger and commercial vehicles. All scaling factors were applied based on the percent change from 2018 activity levels for each target year. Refer to Attachment A for detailed calculations of scaling factors and forecasts.

Table 3 City of Fremont Demographic Forecasts

Forecast Factor	2018	2030	2045	2050
Population	232,685	239,610	283,656	290,591
Households	73,467	79,215	89,560	91,750
Employment	115,403	110,300	140,683	144,122
Annual Vehicle Miles Traveled				
Passenger Vehicles	1,309,215,427	1,384,190,409	1,564,511,455	1,627,908,920
Commercial Vehicles	263,167,145	335,258,854	399,945,546	417,631,081

Source: MTC 2018; MTC 2020; California Department of Finance 2020; calculations conducted by Ascent Environmental in 2020

2.1 LEGISLATIVE-ADJUSTED BAU FORECAST

The legislative-adjusted BAU emissions forecast provides the City with an assessment of how the community's emissions would change over time without further action from the City. In addition to accounting for the city's 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. A summary of legislative reductions applied is provided below in Table 4.

Table 4 Legislative Reductions Summary

Source	Legislative Reduction	Description	Sectors Applied
State	SB 100	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 Building Energy Efficiency Standards (Title 24, Part 6)	Requires all new buildings in California to comply with energy efficiency standards established by CEC.	Building Energy
State	AB 341	Requires California to achieve a 75 percent solid waste diversion target by 2020.	Solid Waste
State	Advanced Clean Car Standards	Establishes GHG emission reduction standards for model years 2017 through 2025 that are more stringent than federal CAFE standards. EPA and NHSTA SAFE Rule revokes California's ACC Standards and amends CAFE Standards for model years 2021–2026.	On-Road Transportation
State	Truck and Bus Regulation	Requires diesel trucks and buses that operate in California to be upgraded to reduce GHG emissions.	On-Road Transportation
Federal	Fuel Efficiency Standards for Medium- and Heavy-Duty Vehicles	Establishes fuel efficiency standards for medium- and heavy-duty engines and vehicles.	On-Road Transportation
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

Notes: AB = Assembly Bill; CAFE = Corporate Average Fuel Economy; CEC = California Energy Commission; EPA = U.S. Environmental Protection Agency; GHG = greenhouse gas; NHTSA = National Highway Traffic Safety Administration; SAFE Rule = Safer Affordable Fuel-Efficient Vehicle Rule; SB = Senate Bill.

Source: Ascent Environmental 2020

Legislative-adjusted BAU forecasts are included below in Table 5. The City's legislative-adjusted BAU emissions would decrease by 13 percent between 2018 and 2045 and decrease by 12 percent between 2018 and 2050, despite an increase in population of 22 percent by 2045 and 25 percent by 2050, from 2018 levels. Emissions forecasts are detailed for each sector and discussed below.

Table 5 City of Fremont 2018 GHG Emissions Inventory and Legislative-Adjusted BAU Forecast ($MTCO_2e$/year)

Sector	2018	2030	2045	2050
Residential Building Energy	172,974	157,096	147,281	148,337
Nonresidential Building Energy	177,163	133,693	134,984	126,861
On-Road Transportation	783,601	670,547	680,791	704,698
Off-Road Vehicles and Equipment	46,172	53,251	68,442	71,018
BART	997	1,027	1,216	1,245
Solid Waste	57,018	33,934	40,172	40,048
Water Supply	577	128	0	0
Wastewater Treatment	4,135	3,741	3,686	3,776
Total	**1,242,640**	**1,053,414**	**1,076,571**	**1,095,984**

Notes: Total may not sum exactly due to independent rounding. BART = Bay Area Rapid Transit; 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 2020

2.2 BUILDING ENERGY

Emissions from future electricity and natural gas use were estimated by multiplying anticipated energy use with forecasted emission factors. Future energy use was forecasted in three parts. First, energy use was scaled by the anticipated population and employment growth detailed in Table 4. Second, electricity emissions factors were aligned with California's Renewables Portfolio Standard (RPS) targets for the years forecasted. Electricity emissions factors are anticipated to decline based on current regulations, while natural gas emission factors stay constant. Third, energy intensity factors were adjusted to reflect increased stringency expected under California's Title 24 building energy efficiency standards (i.e., 2019 standards which became effective in 2020), which are expected to achieve decreases in electricity and natural gas consumption in new construction. The assumptions made regarding energy efficiency and future electricity emission factors are described in the sections below. Additionally, diesel consumption associated with back-up generators was estimated for nonresidential building energy based on anticipated employment growth. Table 6 summarizes the legislative factors used to scale building energy use by energy type.

Table 6 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 commercial/industrial 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 emission factors. EBCE committed to 100 percent clean electricity by 2030. Accounts for 2019 Title 24 energy efficiency gains in new construction.
Natural Gas	Scaled by population growth for residential building energy; scaled by employment growth for commercial/industrial building energy.	Accounts for Title 24 energy efficiency gains in new construction.

Back-Up Generators	Scaled by employment growth for diesel consumption used for emergency power in commercial/industrial buildings.	None.

Notes: EBCE = East Bay Community Energy; PG&E = Pacific Gas & Electric Company; RPS = Renewable Portfolio Standard.

Source: Ascent Environmental 2020

Residential Building Energy

Between 2018 and 2050, electricity and natural gas emissions from residential buildings would decrease by 14 percent from 172,974 to 148,337 $MTCO_2e$ per year with legislative adjustments and considering overall population growth of 25 percent over the same period. Table 7 shows the baseline and legislative-adjusted BAU forecasted emissions from the residential building energy sector by energy type for 2018, 2030, 2045, and 2050.

Table 7 Residential Building Energy Legislative-Adjusted BAU Emissions Forecasts (2018–2050) ($MTCO_2e$/year)

Energy Type	2018	2030	2045	2050
Electricity	32,940	16,518	0	0
Natural Gas	140,034	140,578	147,281	148,337
Total Residential Building Energy Emissions	**172,974**	**157,096**	**147,281**	**148,337**

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 2020

Nonresidential Building Energy

Between 2018 and 2050, electricity and natural gas emissions from commercial and industrial buildings would decrease by 28 percent from 177,163 to 126,861 $MTCO_2e$ per year with legislative adjustments and considering job growth of 25 percent over the same period. Table 8 shows the baseline and legislative-adjusted BAU forecasted emissions for the commercial and industrial building energy sector by energy type for 2018, 2030, 2045, and 2050.

Table 8 Nonresidential Building Energy Legislative-Adjusted BAU Emissions Forecasts (2018–2050) ($MTCO_2e$/year)

Energy Type	2018	2030	2045	2050
Electricity	57,750	19,661	0	0
Natural Gas	119,305	113,925	134,851	126,724
Diesel	109	104	133	137
Total Nonresidential Building Energy Emissions	**177,163**	**133,690**	**134,984**	**126,861**

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 2020

ELECTRICITY EMISSIONS FACTORS

Emissions from the building energy sector would see gradual declines through 2050 without additional City action, despite population and employment growth, due to State measures already in place. Electricity emissions factors for carbon dioxide (CO_2) are based on Pacific Gas & Electric's (PG&E) reported emission factors for 2018, which were provided by PG&E directly (The Climate Registry n.d.). 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 GHG Annual Output Emission Rates (EPA 2020).

California utility providers, including PG&E, are required to reach a 33 percent renewable electricity generation mix by 2020 and 60 percent by 2030, and 100 percent carbon-free electricity by 2045, pursuant to SB 100. PG&E's 2030 emissions factor shall be 113 pounds of CO_2 per megawatt hour (lb CO_2/MWh), and the 2045 and 2050 emissions factors shall be 0 lb CO_2/MWh. CH_4 and N_2O electricity emissions factors in future years are assumed follow the same trends as the CO_2 emissions factors.

In 2018, EBCE began to enroll Fremont residents and businesses into its electricity service. By the end of 2018, approximately 87 percent of Fremont residents, and 51 percent of commercial and industrial consumers were served by PG&E electricity, with the remaining being served by EBCE. EBCE currently offers customers various tiers for electricity, ranging from 62 percent to 100 percent carbon-free. Most residents and businesses in the city that opted into EBCE received the lowest tier of electricity (First Tier) (i.e., 62 percent carbon-free). However, in December 2020, the EBCE Board of Directors approved a policy to achieve 100 percent carbon-free electricity by 2030 (EBCE 2020). Therefore, EBCE's 2030, 2045, and 2050 emissions factors is projected to be 0 lb CO_2/MWh. CH_4 and N_2O electricity emissions factors in future years are assumed to also be 0 lb/MWh.

NATURAL GAS EMISSIONS FACTORS

Natural gas emissions are based on The Climate Registry's 2019 default emission factors, which are estimated to be 11.7 pounds of CO_2e per therm. Emissions rates 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 back-up generators are based on The Climate Registry's 2019 default emission factors, which are estimated to be 0.12 pounds of CO_2e per standard cubic foot of diesel fuel. Emissions rates 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

The State's Title 24 Building Energy Efficiency Standards, updated every three years, apply to both new construction and existing buildings. The 2019 Title 24 standards went into effect January 2020. The California Energy Commission (CEC) estimated that new residential buildings built to the 2019 standards are 53 percent more efficient than residential buildings built to the previous standards, which includes both energy efficiency savings and reduced electricity emissions due to the onsite solar requirements (CEC 2018). 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 Title 24 have also achieved energy efficiencies for residential and nonresidential buildings. Since 2008, energy efficiency savings have been quantified and the collective impact of Title 24 was accounted for in the forecasted emissions.

Forecasts for future building energy use accounts for Title 24 Building Energy Efficiency Standards. It is assumed that all new residential construction taking place between 2020 and 2050 would be 75 percent more energy-efficient than buildings constructed to 2008 Title 24 standards and nonresidential construction taking place between 2020 and 2050 would be 53 percent more energy-efficient compared to buildings constructed to meet 2008 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.

2.3 TRANSPORTATION

On-Road Transportation

Between 2018 and 2050, GHG emissions from on-road transportation would decrease by approximately 10 percent from 783,601 to 704,698 $MTCO_2e$ per year based on future vehicle emission factors modeled in the California Air Resources Board's (CARB's) Emission Factor (EMFAC) 2017 model, despite an increase in VMT of 59 percent. With respect to the legislative adjustments included in this forecast, State and federal policies and associated regulations incorporated in the on-road transportation 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 already included in EMFAC 2017's emission factor estimates and forecasts. It should be noted that the Low Carbon Fuel Standard was excluded in EMFAC 2017 forecasts because most of the emission benefits originate from upstream fuel production and do not directly reduce emissions in the City's GHG inventory or forecasts.

While the legislative-adjusted forecasts use EMFAC 2017 to estimate on-road transportation emissions, an additional adjustment had to be made off model due to changes in federal policy. In April 2020, the EPA and the National Highway Traffic Safety Administration finalized Part Two of the Safer Affordable Fuel-Efficient Vehicle Rule (SAFE Rule). Part Two of the SAFE Rule addresses Corporate Average Fuel Economy (CAFE) Standards for passenger cars and light-duty trucks for model year 2021–2026. CARB has provided adjustment factors to account for the anticipated changes in emissions outputs from CARB's EMFAC 2017 model based on the impacts of SAFE Rule Part Two (CARB 2020). These adjustments were made for all gasoline–powered light-duty vehicles (i.e., passenger and light-duty trucks) for each of the City's target years.

Table 9 summarizes the legislative reductions used to forecast on-road vehicle emissions.

Table 9 On-Road Transportation Forecast Methods and Legislative Reductions by Source

Source	Forecast Methods	
	Scale Factor	Applied Legislative Reductions
Passenger Vehicles	Scaled by VMT estimates provided by MTC	EMFAC 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. EMFAC'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. An off-model adjustment, provided by CARB, was taken to account for the SAFE Rule's impact on GHG emissions for model years 2021–2026.
Commercial Vehicles		

Notes: ACC = Advanced Clean Cars; CARB = California Air Resources Board; MTC = Metropolitan Transportation Commission; EMFAC = California Air Resources Board's EMisson FACtor model; GHG = greenhouse gas; SAFE Rule = Safer Affordable Fuel-Efficient Vehicles Rule; VMT = vehicle miles traveled.

Source: Ascent Environmental 2020

Table 10 shows the baseline and legislative-adjusted BAU forecasted emissions from on-road transportation for 2018, 2030, 2045, and 2050.

Table 10 On-Road Transportation Legislative-Adjusted BAU Emissions Forecasts (2018–2050) ($MTCO_2e$/year)

Source	2018	2030	2045	2050
Passenger Vehicles	430,168	315,987	309,785	320,250
Commercial Vehicles	353,434	354,559	371,006	384,448
Total On-Road Transportation Emissions	**783,601**	**670,547**	**680,791**	**704,698**

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

Source: Forecasts prepared by Ascent Environmental in 2020

Off-Road Transportation

Between 2018 and 2050, emissions associated with off-road vehicles used in the city would increase by 53 percent from 46,318 to 71,018 $MTCO_2e$ per year, with legislative adjustments applied and considering growth in various demographics, as shown in Table 11. With respect to the legislative adjustments in the off-road vehicle sector, emission factors were used from CARB's OFFROAD 2007 and 2017 models, which incorporate regulatory actions such as reformulated fuels and more stringent emission standards. Table 11 summarizes the legislative reductions used to forecast off-road vehicle emissions.

Table 11 Off-Road Transportation Forecast Methods and Legislative Reductions by Source

Off-Road Category	Forecast Methods	
	Scale Factor	Applied Legislative Reductions
Agricultural Equipment	Acres of agricultural land	OFFROAD2007 and OFFROAD2017 emission factor considerations include EPA off-road compression-ignition engine standards implementation schedule.
Construction and Mining Equipment	Change in service population	
Entertainment Equipment	Population	
Industrial Equipment	Acres of industrial land	
Lawn and Garden Equipment	Households	
Light Commercial Equipment	Employment	
Pleasure Craft	Population	
Recreational Equipment	Population	
Transport Refrigeration Units	Share of Road Miles in Alameda County	

Notes: EPA = U.S. Environmental Protection Agency; OFFROAD2007 = CARB's OFFROAD2007 model; OFFROAD2017 = CARB's OFFROAD2017 model.

Source: Ascent Environmental 2020

Table 12 shows the baseline and legislative-adjusted BAU forecasted emissions from the off-road vehicle sector for 2018, 2030, 2045, and 2050.

Table 12 Off-Road Transportation Legislative-Adjusted BAU Emissions Forecasts (2018–2050) ($MTCO_2e$/year)

Source	2018	2030	2045	2050
Off-Road Vehicles	46,318	53,251	68,442	71,018

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

Source: Forecasts prepared by Ascent Environmental in 2020

BART

Between 2018 and 2050, emissions associated with BART ridership by Fremont residents would increase by 25 percent from 997 to 1,245 $MTCO_2e$, considering anticipated population growth. There are no applicable legislative reductions that can be quantified for BART operations. Table 13 shows the baseline and legislative-adjusted BAU forecasted emissions from BART for 2018, 2030, 2045, and 2050.

Table 13 BART Legislative-Adjusted BAU Emissions Forecasts (2018–2050) ($MTCO_2e$/year)

Source	2018	2030	2045	2050
BART	997	1,027	1,216	1,245

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

Source: Forecasts prepared by Ascent Environmental in 2020

2.4 SOLID WASTE

Between 2018 and 2050, solid waste emissions generated from the city would decrease by 30 percent from 57,018 to 40,048 $MTCO_2e$ per year, with legislative adjustments applied and considering population growth of 34 percent over the same time. Table 14 summarizes the legislative reductions used to forecast emissions from the solid waste sector.

Table 14 Solid Waste Forecast Methods and Legislative Reductions by Source

Source	Forecast Methods	
	Scale Factor	Applied Legislative Reductions
Landfill Disposal	Scaled by population growth	Assumes California's 75 percent waste diversion goal would be achieved and maintained by 2030.

Source: Ascent Environmental 2020

The forecasts shown in Table 15 below account for the CH_4 and CO_2 emissions from waste decay generated annually. With respect to solid waste generation, the California Department of Resources Recycling and Recovery (CalRecycle) established a target pursuant to AB 341 (Chapter 476, Statutes of 2011) to achieve a statewide waste diversion of 75 percent by 2020, which is equivalent to a disposal rate of 2.7 pounds of waste per resident per day. The City's waste disposal tonnage, disposal rates, and disposal targets are reported to CalRecycle by year. These data show that the City's disposal rate was 4.7 pounds of waste per resident per day in 2018, or approximately a 56 percent diversion rate. Emission forecasts for this sector assume the City's disposal rate would meet the 2.7 pounds per day per resident diversion target by 2030 (i.e., 75 percent diversion rate) and then remain constant through 2050.

Table 15 shows the baseline and legislative-adjusted BAU forecasted emissions from the solid waste sector for 2018, 2030, 2045, and 2050.

Table 15 Solid Waste Legislative-Adjusted BAU Emissions Forecasts (2018–2050) ($MTCO_2e$/year)

Activity	2018	2030	2045	2050
Total Solid Waste Emissions	57,018	33,934	40,172	40,048

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

Source: Forecasts prepared by Ascent Environmental in 2020

2.5 WATER AND WASTEWATER

Between 2018 and 2050, water- and wastewater-related emissions from the city would decrease by 18 percent from 4,713 to 3,869 $MTCO_2e$ per year, with legislative adjustments and considering population growth of 34 percent over the same time. This change reflects an increase in water consumption and wastewater generation with lower electricity factors because of the 2030 and 2045 RPS targets, consistent with SB 100 legislative actions described above. Table 16 summarizes the legislative reductions used to forecast water and wastewater emissions.

Table 16 Water and Wastewater 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 pumping, conveyance, and treatment follow the 2030 RPS schedule and 2045 carbon-free electricity requirements.
Wastewater Treatment	Scaled by population growth	Assumes electricity use for pumping, conveyance, and treatment follow the 2030 RPS schedule and 2045 carbon-free electricity requirements.

Notes: RPS = Renewable Portfolio Standard.

Source: Ascent Environmental 2020

Table 17 shows the baseline and legislative-adjusted BAU forecasted emissions from water- and wastewater-related sources for 2018, 2030, 2045, and 2050. Population growth rates and electricity emission factors are detailed in Table 3 and Section 2.2.

Table 17 Water and Wastewater Legislative-Adjusted BAU Emissions Forecasts (2018–2050) ($MTCO_2e$/year)

Activity	2018	2030	2045	2050
Water Supply	577	128	0	0
Wastewater Treatment	4,135	3,741	3,686	3,776
Total Water and Wastewater Emissions	**4,713**	**3,869**	**3,686**	**3,776**

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

Source: Forecasts prepared by Ascent Environmental in 2020

2.6 DISCUSSION

As discussed above and shown in Table 5, the City's legislative-adjusted BAU emissions would decrease by 15 percent between 2018 and 2030. This is a result of reductions that would be achieved from numerous legislative reductions, despite anticipated growth, including:

- A greater renewable mix in California's electricity supply (60 percent renewable by 2030);
- Greater building energy efficiency through compliance with 2019 Title 24 standards (53 percent energy reduction for residential, 30 percent for nonresidential);
- Reductions in on-road vehicle emission factors forecasted in EMFAC2017;
- Reductions in off-road vehicle emission factors forecasted in OFFROAD2007; and
- Achieving and maintaining a waste diversion goal of 75 percent, pursuant to AB 341.

From 2030 to 2050, fewer new legislative actions are assumed to be in place due to lack of available information about potential State or federal actions beyond 2030. Section 2.7, "Additional Forecast Scenarios," discusses the potential measures that the State could adopt through legislation to reduce GHG emissions beyond 2030.

2.7 ADDITIONAL FORECAST SCENARIOS

Reducing GHG emissions in California has been the focus of the State government for approximately two decades. *California's 2017 Climate Change Scoping Plan* (2017 Scoping Plan), prepared by CARB, outlines the main strategies California will implement to achieve the legislated GHG emissions target for 2030 and "substantially advance toward our 2050 climate goals" (CARB 2017:1,3,5,25–26). It identifies the reductions needed by each GHG emissions sector

(i.e., transportation, industry, electricity generation, agriculture, commercial and residential, pollutants with high global warming potential [GWP], and recycling and waste).

Since adopting the 2017 Scoping Plan, the State has issued Executive Order B-55-18, which calls for statewide carbon neutrality by 2045. The next iteration of CARB's *Climate Change Scoping Plan* is anticipated to address the reductions needed to meet this new goal. Development of the *2022 Climate Change Scoping Plan* is already underway, and CARB recently released a report outlining potential pathways for the state to meet its carbon neutrality target. This report, titled "Achieving Carbon Neutrality in California," provides three pathways for consideration (E3 2020:3):

- **High Carbon Dioxide Removal (CDR) scenario** achieves an 80 percent reduction in GHG emissions by 2045 and relies most heavily on CO_2 removal strategies (i.e., carbon sequestration or carbon capture and storage).
- **Zero-Carbon Energy scenario** achieves zero fossil fuel emissions by 2045, with some remaining emissions from non-combustion and high GWP gases by 2045. CDR strategies are minimized in this scenario.
- **Balanced scenario** represents a middle point between the High CDR and Zero-Carbon Energy scenarios in terms of energy-related GHG reduction. This scenario includes less CDR than the High CDR scenario, and more CDR than the Zero Carbon Energy scenario.

The City's legislative-adjusted BAU forecasts were used to derive two additional forecast scenarios, following CARB's Zero Carbon Energy and Balanced scenarios. These forecast scenarios provide the City with the information needed to focus efforts on emissions sectors that have the most GHG reduction opportunities, considering what State legislative reductions could achieve in the future. The proposed measures in these scenarios provide an insight into the State's planned trajectory and can help the City align with these efforts. The next two sections provide the City's forecasted GHG emissions under each of these scenarios.

Zero-Carbon Energy Scenario Forecast

The Zero-Carbon Energy scenario evaluates the impact of "earlier, more rapid, and more complete deployment of electrification strategies in buildings, transportation, and some industrial processes, as well as deployment of more speculative technologies such as electric aviation and hydrogen fuel-cell trains" (E3 2020:4). Not all the measures included in the Zero-Carbon Energy scenario are applicable to the City's forecasts and some measures are not quantifiable yet due to lack of data and/or methodologies. Table 18 shows the full list of measures included in the Zero-Carbon Energy scenario and identifies which measures have been quantified and applied to the City's emissions forecast.

Table 18 Zero-Carbon Energy Scenario Measures and Applicability

Sector	Measure	Applicability
Low-Carbon Fuels	▶ 0.4 EJ of advanced biofuels for: ◤ On- and off-road ground transportation ◤ Renewable aviation fuel ◤ Biomethane for electricity generation ▶ 0.3 EJ of hydrogen for: ◤ Pipeline gas demand ◤ Direct hydrogen combustion in industry ◤ HDV fuel cell transportation ▶ 0.04 EJ of synthetic natural gas for: ◤ Industry gas demand	Not applied because upstream emissions related to low carbon fuels (and all transportation fuels) are not included in EMFAC or OFFROAD models. Therefore, an adjustment to fuel carbon content cannot be applied to the models.
Buildings	▶ 100 percent sales of electric appliances by 2030 ▶ All gas end uses retired by 2045	Applied to nonresidential and residential building energy use. All natural gas uses eliminated by 2045 and no new natural gas appliances between 2030 and 2045. Existing

Sector	Measure	Applicability
	▶ SB 350 doubling of AAEE is met by 2030	electricity and natural gas consumption reduced by half from 2018 baseline to 2030.
Transportation	▶ 100 percent new BEV sales for LDV by 2030 ▶ 100 percent new BEV sales for MDV by 2030 ▶ 50 percent new BEV, 50 percent new HFCV sales for HDV by 2035 ▶ 75 percent rail electrification, 25 percent rail powered by hydrogen ▶ 50 percent of in-state aviation electrified	Adjusted EMFAC emissions factors to account for 100 percent zero emission LDVs, MDVs, and HDVs by 2030 for new cars. Rail and aviation electrification are not applied because these sources were not quantified in inventory or legislative-adjusted forecast.
Industry & Agriculture	▶ 53 percent of energy demand met with electricity ▶ 19 percent of energy demand met with hydrogen ▶ 15 MMT CCS for cement and glass ▶ 100 percent reduction in agriculture emissions ▶ 100 percent reduction in energy demand from oil and gas extraction and petroleum refining	Reduced total energy consumption for industrial uses based on anticipated increase in demand met from electricity and hydrogen. No agriculture or other industrial processes were quantified because they are not included in the City's inventory or legislative-adjusted forecast.
Electricity	▶ Remaining dispatchable gas capacity is fueled with biomethane ▶ 100 percent zero carbon generation	No additional reductions applied because SB 100 already requires 100 percent zero carbon electricity by 2045.
High GPW	▶ Emissions reductions relative to 2020: ◤ 23 percent for landfill and wastewater methane ◤ 100 percent for pipeline fugitive methane ◤ 41 percent for agricultural methane ◤ 75 percent for HFCs/refrigerants	Not applied because high GWP gases were not included in inventory or legislative-adjusted forecast.
Carbon Dioxide Removal	▶ 32 MMT per year of carbon dioxide removal by 2045	Not applied because carbon dioxide removal is not an emissions source.

Notes: AAEE = additional achievable energy efficiency; BEV = battery electric vehicle; CCS = carbon capture and storage; EJ = exajoules; GWP = global warming potential; HDV = heavy-duty vehicles; HFCs = hydrofluorocarbons; HFCV = hydrogen fuel cell vehicle; LDV = light-duty vehicles; MDV = medium-duty vehicles; MMT = million metric tons; SB = Senate Bill.

Source: E3 2020; calculations performed by Ascent Environmental in 2020

After applying measures identified in the Zero-Carbon Energy scenario to the City's legislative-adjusted BAU forecast, community-wide emissions would decrease by 82 percent between 2018 and 2050. The impact of the Zero-Carbon Energy scenario on the City's legislative-adjusted BAU forecast is shown in Table 19.

Table 19 City of Fremont GHG Emissions Inventory and Zero-Carbon Energy Scenario Forecast ($MTCO_2e$/year)

Sector	2018	2030	2045	2050
Residential Building Energy	172,974	79,137	0	0
Nonresidential Building Energy	177,163	78,757	36,581	31,923
On-Road Transportation	783,601	632,827	83,352	85,920
Off-Road Vehicles and Equipment	46,318	43,610	55,122	56,312
BART	997	1,027	1,216	1,245
Solid Waste	57,018	33,934	40,172	40,048
Water Supply	577	128	0	0

Wastewater Treatment	4,135	3,741	3,686	3,776
Total	**1,242,786**	**873,161**	**220,129**	**219,225**

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 2020

2.8 BALANCED SCENARIO FORECAST

The balanced scenario "still relies on rapid development of electrification and other carbon mitigation strategies, [but] the deployment of electrification technologies is not as rapid as in the zero-carbon energy scenario…[and] includes less reliance on some of the most expensive carbon mitigation measures, such as synthetic natural gas in the pipeline" (E3 2020:4–5). Not all the measures included in the Balanced scenario are applicable to the City's forecasts and some measures are not yet quantifiable due to lack of data and/or methodologies. Table 20 shows the full list of measures included in the Balanced scenario and identifies which measures have been quantified and applied to the City's emissions forecast.

Table 20 Balanced Scenario Measures and Applicability

Sector	Measure	Applicability
Low-Carbon Fuels	▶ 0.4 EJ of advanced biofuels for: ◤ On- and off-road ground transportation ◤ Renewable aviation fuel ◤ Biomethane for electricity generation ▶ 0.3 EJ of hydrogen for: ◤ Pipeline gas demand ◤ Direct hydrogen combustion in industry ◤ HDV fuel cell transportation	Not applied because low-carbon fuels are considered upstream emissions and are not included in the inventory or legislative-adjusted forecast.
Buildings	▶ 100 percent sales of electric appliances by 2035 ▶ SB 350 doubling of AAEE is met by 2030	Applied to nonresidential and residential building energy use. No new natural gas appliances between 2035 and 2045. Existing electricity and natural gas consumption reduced by half from 2018 baseline to 2030.
Transportation	▶ 100 percent new BEV sales for LDV by 2035 ▶ 100 percent new BEV sales for MDV by 2035 ▶ 45 percent new BEV, 48 percent new HFCV sales for HDV by 2035 ▶ 75 percent rail electrification	Adjusted EMFAC emissions factors to account for 100 percent zero emission LDVs and MDVs, and 93 percent zero emission HDVs by 2035 for new cars. Rail electrification is not applied because this source was not quantified in inventory or legislative-adjusted forecast.
Industry & Agriculture	▶ 44 percent of energy demand met with electricity ▶ 16 percent of energy demand met with hydrogen ▶ 18 MMT CCS for cement and glass ▶ 90 percent reduction in agriculture emissions ▶ 90 percent reduction in energy demand from oil and gas extraction and petroleum refining	Reduced total energy consumption for industrial uses based on anticipated increase in demand met from electricity and hydrogen. No agriculture or other industrial processes were quantified because they are not included in the City's inventory or legislative-adjusted forecast.
Electricity	▶ Remaining dispatchable gas capacity is fueled with biomethane ▶ 100 percent zero carbon generation	No additional reductions applied because SB 100 already requires 100 percent zero carbon electricity by 2045.

Sector	Measure	Applicability
High GPW	▶ Emissions reductions relative to 2020: ◤ 23 percent for landfill and wastewater methane ◤ 72 percent for pipeline fugitive methane ◤ 41 percent for agricultural methane ◤ 75 percent for HFCs/refrigerants	Not applied because high GWP gases were not included in inventory or legislative-adjusted forecast.
Carbon Dioxide Removal	▶ 57 MMT per year of carbon dioxide removal by 2045	Not applied because carbon dioxide removal is not an emissions source.

Notes: AAEE = additional achievable energy efficiency; BEV = battery electric vehicle; CCS = carbon capture and storage; EJ = exajoules; GWP = global warming potential; HDV = heavy-duty vehicles; HFCs = hydrofluorocarbons; HFCV = hydrogen fuel cell vehicle; LDV = light-duty vehicles; MDV = medium-duty vehicles; MMT = million metric tons; SB = Senate Bill.

Source: E3 2020; calculations performed by Ascent Environmental in 2020

After applying measures identified in the Balanced scenario to the City's legislative-adjusted BAU forecast, community-wide emissions would decrease by 61 percent between 2018 and 2050. The impact of the Balanced scenario on the City's legislative-adjusted BAU forecast is shown in Table 21.

Table 21 City of Fremont GHG Emissions Inventory and Balanced Scenario Forecast ($MTCO_2e$/year)

Sector	2018	2030	2045	2050
Residential Building Energy	172,974	79,137	77,519	78,574
Nonresidential Building Energy	177,163	78,757	90,336	82,213
On-Road Transportation	783,601	670,547	219,169	228,554
Off-Road Vehicles and Equipment	46,318	43,610	55,122	56,312
BART	997	1,027	1,216	1,245
Solid Waste	57,018	33,934	40,172	40,048
Water Supply	577	128	0	0
Wastewater Treatment	4,135	3,741	3,686	3,776
Total	**1,242,786**	**910,881**	**487,220**	**490,723**

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 2020

Figure 2 depicts the relative impacts of the three emissions forecast scenarios on the City's GHG emissions over time. It is important to note that Figure 2 only shows emissions sources and does not incorporate carbon sinks such as carbon sequestration or carbon capture and storage technologies, which is an integral part of achieving carbon neutrality.

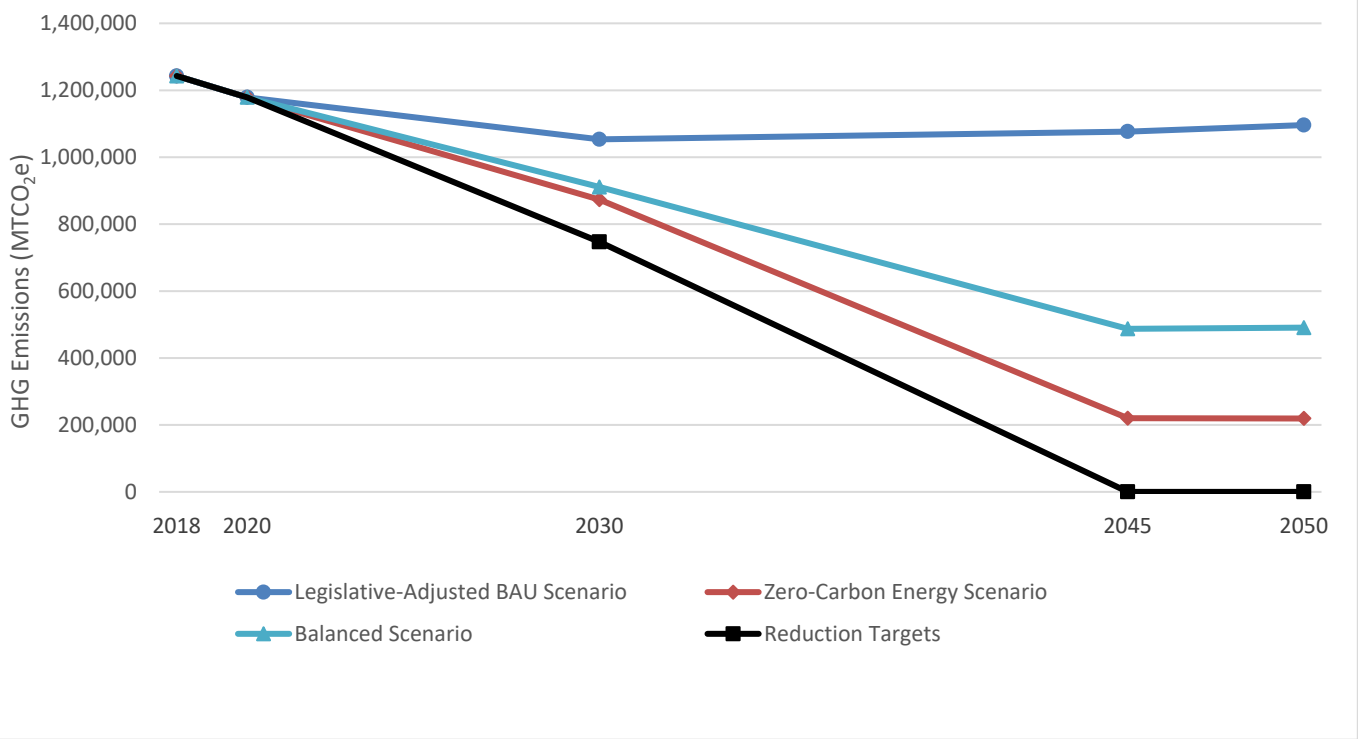

Figure 2 City of Fremont Legislative-Adjusted Business-as-Usual Forecast Scenario, Zero-Carbon Energy Scenario, Balanced Scenario, and Emission Reduction Targets: 2030, 2045, and 2050

3 GAP ANALYSIS

Figure 3 below depicts the 2018 baseline and legislative-adjusted BAU GHG emissions forecasts by sector, as distinguished by the colored wedges. The sum of the wedges represents the anticipated annual GHG emissions each year. Each wedge shows how an emissions sector is expected to contribute to the community-wide GHG inventory over time. The reduction in residential and nonresidential building energy emissions between 2018 and 2050 illustrates the effects of statewide renewable energy policies and building energy efficiency standards on these sectors. On-road transportation emissions are anticipated to decrease considering the legislative reductions applied, despite forecasted growth in VMT. Emissions associated with off-road vehicles and equipment are anticipated to increase due to employment and population growth outpacing legislative reductions.

The black line indicates the City's GHG reduction targets for 2030 and 2045. These targets are relative to the City's 2005 GHG inventory. The City's GHG reduction targets are as follows:

- 2030 target: 55 percent below 2005 levels (735,734 $MTCO_2e$); and
- 2045 target: carbon neutrality.

The space between the trajectory of the black line and the top of the colored wedges represents the "gap" in emissions that will need to be addressed through local actions for the City to meet its future GHG reduction targets.

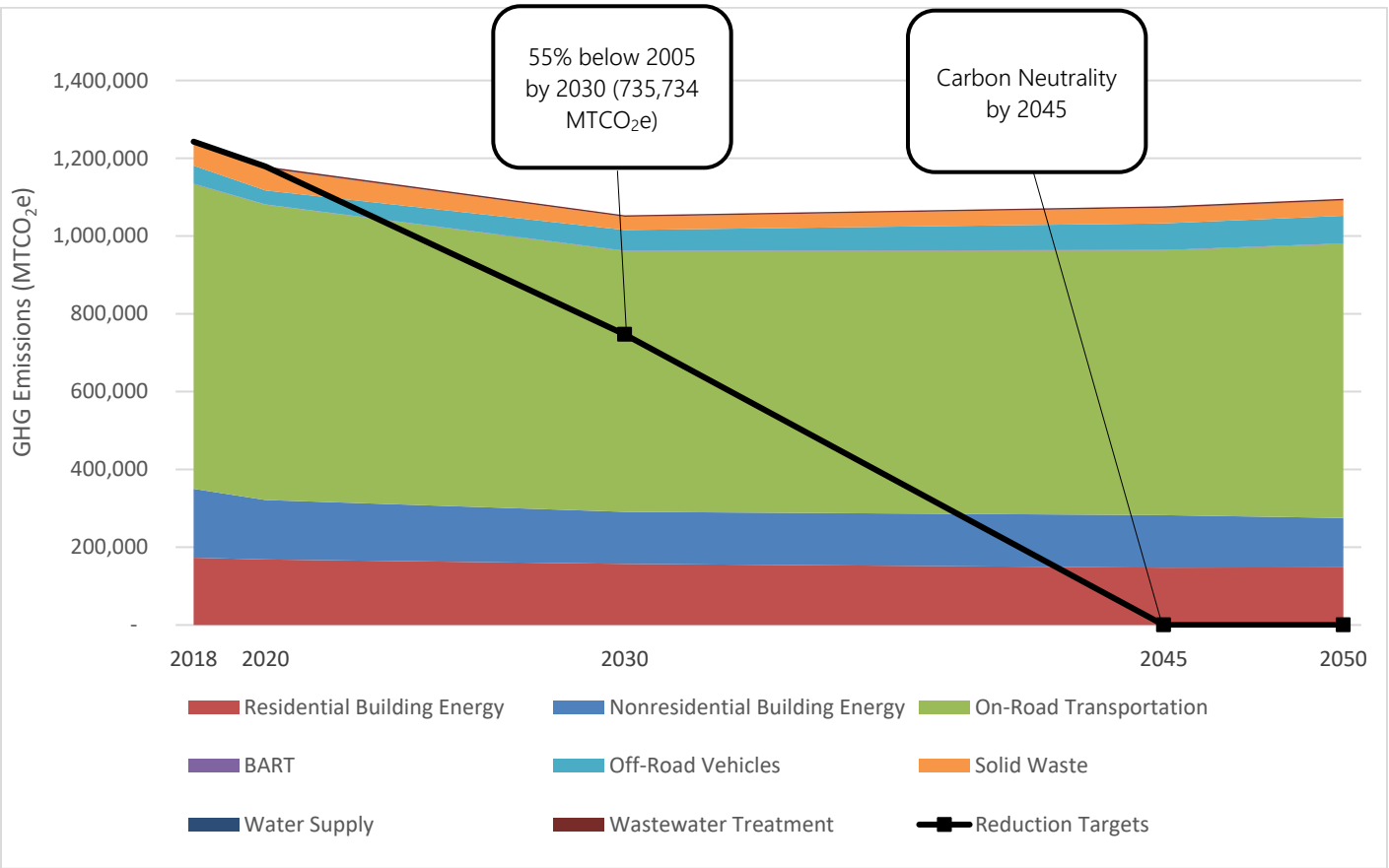

Figure 3 City of Fremont Legislative-Adjusted Business-as-Usual Forecast Emissions by Sector and Emission Reduction Targets: 2030, 2045, and 2050

Based on the City's adopted GHG reduction targets, achievement of these targets will require the City to reduce annual emissions by 317,680 $MTCO_2e$ in 2030; 1,076,571 $MTCO_2e$ in 2045; and 1,095,894 $MTCO_2e$ in 2050, as shown in Table 22. These emissions reductions are in addition to anticipated reductions provided by legislative actions at the State and federal levels. Supporting information and detailed calculation results are included in Attachment A.

Table 22 City of Fremont GHG Emissions Reduction Targets and Legislative-Adjusted BAU Summary

Source	2018	2030	2045	2050
Baseline Emissions and Legislative-Adjusted BAU Forecast ($MTCO_2e$)	1,242,786	1,053,414	1,076,571	1,095,984
Target Percent Reduction Below Baseline (%)	NA	55	Carbon Neutrality	Carbon Neutrality
Target Annual Emissions ($MTCO_2e$)	NA	735,734[1]	0	0
Reduction Needed to Meet Target ($MTCO_2e$)	NA	317,680	1,076,571	1,095,984

Notes: GHG = greenhouse gas; BAU = business-as-usual, $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year; NA = not applicable.

[1] The 2030 target is based on an adjusted 2005 baseline that includes the off-road sector, as presented in this technical memorandum. This differs from the 2005 baseline included in the 2012 CAP.

Source: Calculations conducted by Ascent Environmental in 2020

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 2030. While advances in new technologies and State policy strategies may allow for additional significant reductions in the future, as shown in Tables 19 and 21 from the Zero-Carbon Energy and Balanced scenarios, respectively, specific legislative reductions that may occur between 2030 and 2050 are largely unknown at this time. The reductions afforded by the Zero-Carbon Energy and Balanced scenarios are also depicted in Figures 4 and 5 below.

Thus, estimated growth in future activities incrementally overtakes the reductions resulting from existing legislative actions. Where anticipated State regulations or programs are reasonably foreseeable, such as those included in Tables 18 and 20, they can be incorporated as complementary actions to locally based GHG reduction measures, as will be discussed in a subsequent technical memorandum.

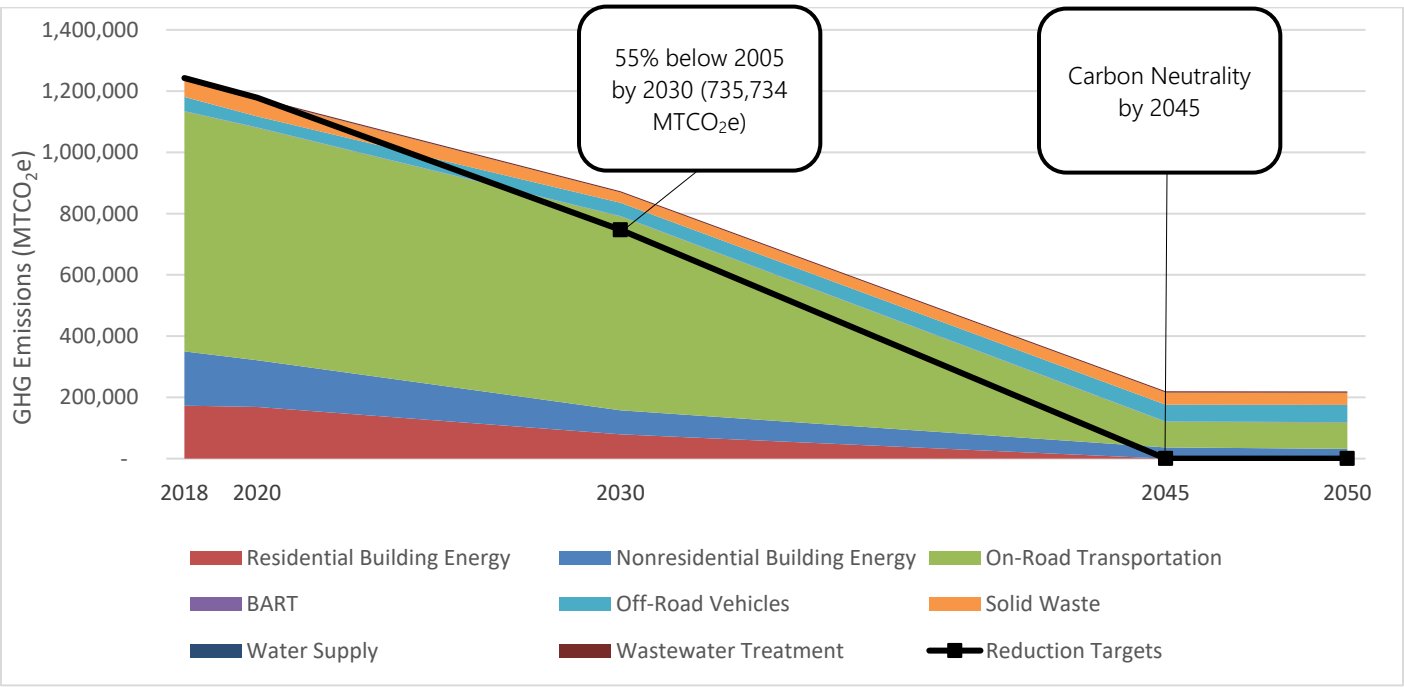

Figure 4 City of Fremont Zero Carbon Energy Scenario Forecast Emissions by Sector and Emission Reduction Targets: 2030, 2045, and 2050

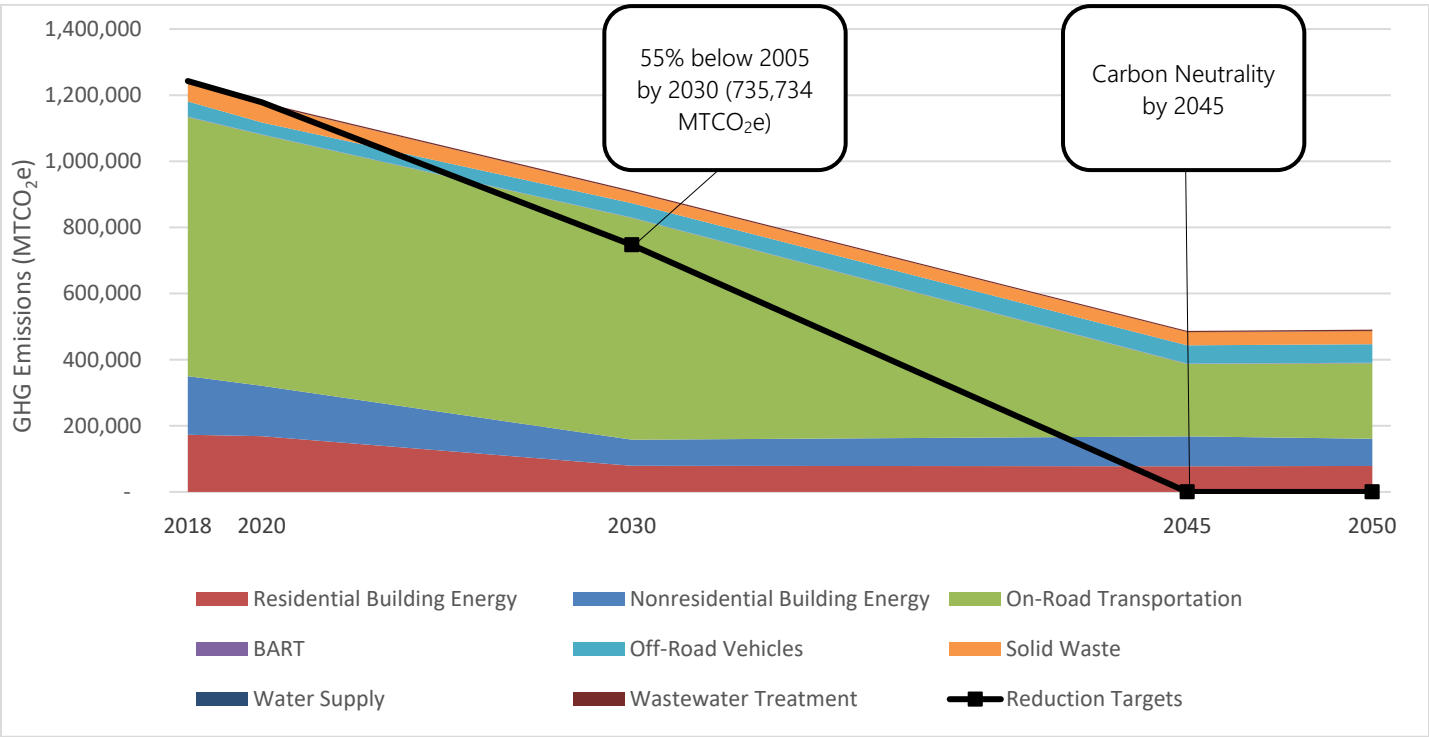

Figure 5 City of Fremont Balanced Scenario Forecast Emissions by Sector and Emission Reduction Targets: 2030, 2045, and 2050

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Appendix A - Attachment I

GHG Forecast Data and Calculations

City of Fremont Greenhouse Gas Emissions Forecast																
Emissions Sector	2018 GHG Emissions				2030 GHG Emissions				2045 GHG Emissions				2050 GHG Emissions			
	Activity	Units	MT CO_2e	CO2e % of Annual Total	Activity	Units	MT CO_2e	CO2e % of Annual Total	Activity	Units	MT CO_2e	CO2e % of Annual Total	Activity	Units	MT CO_2e	CO2e % of Annual Total
Building Energy - Nonresidential			**177,163**	**14.3%**			**133,690**	**12.7%**			**134,984**	**12.5%**			**126,861**	**11.6%**
Electricity																
PG&E	430,095	MWh	40,638	3.3%	379,705	MWh	19,661	1.9%	437,782	MWh	0	0.0%	422,364	MWh	0	0.0%
EBCE - First Tier	374,447	MWh	17,112	1.4%	357,889	MWh	0	0.0%	412,629	MWh	0	0.0%	398,097	MWh	0	0.0%
EBCE - Second Tier	4,678	MWh	0	0.0%	4,472	MWh	0	0.0%	5,155	MWh	0	0.0%	4,974	MWh	0	0.0%
Electricity Subtotal	809,220	MWh	57,750	4.6%	742,066	MWh	19,661	1.9%	855,567	MWh	0	0.0%	825,435	MWh	0	0.0%
Natural Gas																
PG&E	22,445,051	therms	119,193	9.6%	21,452,554	therms	113,923	9.7%	25,392,982	therms	134,848	11.4%	23,862,684	therms	126,722	11.6%
Back-Up Generators	33	mcf	111	0.0%	32	mcf	2		41	mcf	2		42	mcf	2	
Natural Gas Subtotal	22,445,084		119,305	9.6%	21,452,586		113,925	9.7%	25,393,023		134,851	11.4%	23,862,726		126,724	11.6%
Diesel																
Back-Up Generators	9,790	gallons	109	0.0%	9,357	gallons	104		11,935	gallons	133		12,226	gallons	137	
Diesel Subtotal			109	0.0%			104	0.0%			133	0.0%			137	0.0%
Building Energy - Residential			**172,974**	**13.9%**			**157,096**	**14.9%**			**147,281**	**13.7%**			**148,337**	**13.5%**
Electricity																
PG&E	326,827	MWh	30,880	2.5%	319,010	MWh	16,518	1.6%	334,221	MWh	0	0.0%	336,616	MWh	0	0.0%
EBCE - First Tier	45,078	MWh	2,060	0.2%	45,419	MWh	0	0.0%	47,584	MWh	0	0.0%	47,925	MWh	0	0.0%
EBCE - Second Tier	13	MWh	0	0.0%	13	MWh	0	0.0%	13	MWh	0	0.0%	14	MWh	0	0.0%
EBCE - Third Tier	42	MWh	0	0.0%	42	MWh	0	0.0%	44	MWh	0	0.0%	45	MWh	0	0.0%
Electricity Subtotal	371,960	MWh	32,940	2.7%	364,484	MWh	16,518	1.6%	381,863	MWh	0	0.0%	384,599	MWh	0	0.0%
Natural Gas																
PG&E	26,369,188	therms	140,034	11.3%	26,471,932	therms	140,578	13.3%	27,734,186	therms	147,281	13.7%	27,932,915	therms	148,337	13.5%
Natural Gas Subtotal	26,369,188		140,034	11.3%	26,471,932		140,578	13.3%	27,734,186		147,281	13.7%	27,932,915		148,337	13.5%
On-Road Transportation	**1,572,382,573**	**VMT**	**783,601**	**63.1%**	**1,719,449,263**	**VMT**	**670,547**	**63.7%**	**1,964,457,001**	**VMT**	**680,791**	**63.2%**	**2,045,540,001**	**VMT**	**704,698**	**64.3%**
Passenger Vehicles	1,309,215,427	VMT	430,168	34.6%	1,384,190,409	VMT	315,987	26.8%	1,564,511,455	VMT	309,785	28.8%	1,627,908,920	VMT	320,250	29.2%
Heavy-Duty Vehicles	263,167,145	VMT	353,434	28.4%	335,258,854	VMT	354,559	30.1%	399,945,546	VMT	371,006	34.5%	417,631,081	VMT	384,448	35.1%
BART	**75,257,107**	**Passenger Miles**	**997**	**0.1%**	**77,496,854**	**Passenger Miles**	**1,027**	**0.1%**	**91,742,597**	**Passenger Miles**	**1,216**	**0.1%**	**93,985,438**	**Passenger Miles**	**1,245**	**0.1%**
Off-Road Transportation			**46,318**	**3.7%**			**53,251**	**5.1%**			**68,442**	**6.4%**			**71,018**	**6.5%**
Agricultural Equipment	--	--	10	0.0%	--	--	10	0.0%	--	--	10	0.0%	--	--	10	0.0%
Construction and Mining Equipme	--	--	9,934	0.8%	--	--	11,028	1.0%	--	--	13,917	1.3%	--	--	14,533	1.3%
Entertainment Equipment	--	--	122	0.0%	--	--	111	0.0%	--	--	111	0.0%	--	--	116	0.0%
Industrial Equipment	--	--	15,077	1.2%	--	--	18,046	1.7%	--	--	20,686	1.9%	--	--	20,866	1.9%
Lawn and Garden Equipment	--	--	4,063	0.3%	--	--	4,138	0.4%	--	--	5,058	0.5%	--	--	5,182	0.5%
Light Commercial Equipment	--	--	4,051	0.3%	--	--	3,858	0.4%	--	--	5,414	0.5%	--	--	5,414	0.5%
Other Portable Equipment	--	--	8,341	0.7%	--	--	9,641	0.9%	--	--	13,320	1.2%	--	--	14,706	1.3%
Pleasure Craft	--	--	3,276	0.3%	--	--	4,499	0.4%	--	--	7,241	0.7%	--	--	7,418	0.7%
Recreational Equipment	--	--	886	0.1%	--	--	1,224	0.1%	--	--	1,877	0.2%	--	--	1,923	0.2%
Transport Refrigeration Units	--	--	559	0.0%	--	--	696	0.1%	--	--	808	0.1%	--	--	849	0.1%
Solid Waste	**199,805**	**Tons**	**57,018**	**4.6%**	**119,027**	**Tons**	**33,934**	**3.2%**	**140,907**	**Tons**	**40,172**	**3.7%**	**140,474**	**Tons**	**40,048**	**3.7%**
Waste Generation	196,453	Tons			116,215	Tons			137,578	Tons			137,155	Tons		
Alternative Daily Cover	3,351	Tons	57,018	4.6%	2,812	Tons	33,934	3.2%	3,329	Tons	40,172	3.7%	3,319	Tons	40,048	3.7%
Water Supply	**11,447,226**	**HCF**	**577**	**0.0%**	**11,787,910**	**HCF**	**128**	**0.0%**	**13,954,805**	**HCF**	**0**	**0.0%**	**14,295,959**	**HCF**	**0**	**0.0%**
Wastewater Treatment			**4,135**	**0.3%**			**3,741**	**0.4%**			**3,686**	**0.3%**			**3,776**	**0.3%**
Total MTCO2e/yr			**1,242,786**				**1,053,414**				**1,076,571**				**1,095,984**	

City of Fremont Greenhouse Gas Emissions Forecast - Zero-Carbon Energy Scenario												
Emissions Sector	2030 GHG Emissions				2045 GHG Emissions				2050 GHG Emissions			
	Activity	Units	MT CO_2e	CO2e % of Annual Total	Activity	Units	MT CO_2e	CO2e % of Annual Total	Activity	Units	MT CO_2e	CO2e % of Annual Total
Building Energy - Nonresidential			**78,757**	**9.0%**			**36,581**	**16.6%**			**31,923**	**14.6%**
Electricity												
PG&E	181,069	MWh	9,376	1.1%	239,146	MWh	0	0.0%	223,728	MWh	0	0.0%
EBCE - First Tier	170,666	MWh	0	0.0%	225,406	MWh	0	0.0%	210,873	MWh	0	0.0%
EBCE - Second Tier	2,132	MWh	0	0.0%	2,816	MWh	0	0.0%	2,635	MWh	0	0.0%
Electricity Subtotal	353,867	MWh	9,376	0	467,368	MWh	0	0	437,236	MWh	0	0.0%
Natural Gas												
PG&E - Commercial	7,663,939	therms	40,699	4.7%	0	therms	0	0.0%	0	therms	0	0.0%
PG&E - Industrial	5,381,137	therms	28,576	3.3%	6,863,398	therms	36,448	16.6%	5,985,692	therms	31,787	14.5%
Back-Up Generators	32	mcf	2	0.0%	0	mcf	0	0.0%	0	mcf	0	0.0%
Natural Gas Subtotal	13,045,108		69,277	0	6,863,398		36,448	0	5,985,692		31,787	14.5%
Diesel												
Back-Up Generators	9,357	gallons	104	0.0%	11,935	gallons	133	0.1%	12,226	gallons	137	0.1%
Diesel Subtotal	9,357		104	0%	11,935		133	0%	12,226		137	0.1%
Building Energy - Residential			**79,137**	**9.1%**			**0**	**0.0%**			**0**	**0.0%**
Electricity												
PG&E	160,701	MWh	8,321	1.0%	175,912	MWh	0	0.0%	178,307	MWh	0	0.0%
EBCE - First Tier	22,880	MWh	0	0.0%	25,045	MWh	0	0.0%	25,386	MWh	0	0.0%
EBCE - Second Tier	6	MWh	0	0.0%	7	MWh	0	0.0%	7	MWh	0	0.0%
EBCE - Third Tier	21	MWh	0	0.0%	23	MWh	0	0.0%	24	MWh	0	0.0%
Electricity Subtotal	183,608	MWh	8,321	0	200,988	MWh	0	0	203,724	MWh	0	0.0%
Natural Gas												
PG&E	13,335,193	therms	70,816	8.1%	0	therms	0	0.0%	0	therms	0	0.0%
Natural Gas Subtotal	13,335,193		70,816	8%	0		0	0%	0		0	0.0%
On-Road Transportation	**1,719,449,263**	**VMT**	**632,827**	**72.5%**	**1,500,557,239**	**VMT**	**83,352**	**37.9%**	**1,518,242,775**	**VMT**	**85,920**	**39.2%**
Passenger Vehicles	1,384,190,409	VMT	294,966	33.8%	1,100,611,694	VMT	25,288	11.5%	1,100,611,694	VMT	25,288	11.5%
Heavy-Duty Vehicles	335,258,854	VMT	337,861	38.7%	399,945,546	VMT	58,065	26.4%	417,631,081	VMT	60,632	27.7%
BART	**77,496,854**	**Passenger Miles**	**1,027**	**0.1%**	**91,742,597**	**Passenger Miles**	**1,216**	**0.6%**	**93,985,438**	**Passenger Miles**	**1,245**	**0.6%**
Off-Road Transportation			**43,610**	**5.0%**			**55,122**	**25.0%**			**56,312**	**25.7%**
Agricultural Equipment	--	--	10	0.0%	--	--	10	0.0%	--	--	10	0.0%
Construction and Mining Equipme	--	--	11,028	1.3%	--	--	13,917	6.3%	--	--	14,533	6.6%
Entertainment Equipment	--	--	111	0.0%	--	--	111	0.1%	--	--	116	0.1%
Industrial Equipment	--	--	18,046	2.1%	--	--	20,686	9.4%	--	--	20,866	9.5%
Lawn and Garden Equipment	--	--	4,138	0.5%	--	--	5,058	2.3%	--	--	5,182	2.4%
Light Commercial Equipment	--	--	3,858	0.4%	--	--	5,414	2.5%	--	--	5,414	2.5%
Pleasure Craft			4,499	0.5%			7,241	3.3%			7,418	3.4%
Recreational Equipment	--	--	1,224	0.1%	--	--	1,877	0.9%	--	--	1,923	0.9%
Transport Refrigeration Units	--	--	696	0.1%	--	--	808	0.4%	--	--	849	0.4%
Solid Waste	**119,027**	**Tons**	**33,934**	**3.9%**	**140,907**	**Tons**	**40,172**	**18.2%**	**140,474**	**Tons**	**40,048**	**18.3%**
Waste Generation	116,215	Tons			137,578	Tons			137,155	Tons		
Alternative Daily Cover	2,812	Tons	33,934	3.9%	3,329	Tons	40,172	18.2%	3,319	Tons	40,048	18.3%
Water Supply	**11,787,910**	**HCF**	**128**	**0.0%**	**13,954,805**	**HCF**	**0**	**0.0%**	**14,295,959**	**HCF**	**0**	**0.0%**
Wastewater Treatment			**3,741**	**0.4%**			**3,686**	**1.7%**			**3,776**	**1.7%**
Total MTCO2e/yr			**873,161**				**220,129**				**219,225**	

City of Fremont Greenhouse Gas Emissions Forecast - Balanced Scenario												
Emissions Sector	2030 GHG Emissions				2045 GHG Emissions				2050 GHG Emissions			
	Activity	Units	MT CO_2e	CO2e % of Annual Total	Activity	Units	MT CO_2e	CO2e % of Annual Total	Activity	Units	MT CO_2e	CO2e % of Annual Total
Building Energy - Nonresidential			**78,757**	**8.6%**			**90,336**	**18.5%**			**82,213**	**16.9%**
Electricity												
PG&E	181,069	MWh	9,376	1.0%	239,146	MWh	0	0.0%	223,728	MWh	0	0.0%
EBCE - First Tier	170,666	MWh	0	0.0%	225,406	MWh	0	0.0%	210,873	MWh	0	0.0%
EBCE - Second Tier	2,132	MWh	0	0.0%	2,816	MWh	0	0.0%	2,635	MWh	0	0.0%
Electricity Subtotal	353,867	MWh	9,376	1.0%	467,368	MWh	0	0.0%	437,236	MWh	0	0.0%
Natural Gas												
PG&E - Commercial	7,663,939	therms	40,699	4.5%	10,122,106	therms	53,753	11.0%	9,469,514	therms	50,287	10.2%
PG&E - Industrial	5,381,137	therms	28,576	3.1%	6,863,398	therms	36,448	7.5%	5,985,692	therms	31,787	6.5%
Back-Up Generators	32	mcf	2		41	mcf	2		42	mcf	2	
Natural Gas Subtotal	13,045,108		69,277	7.6%	16,985,544		90,203	18.5%	15,455,247		82,076	16.8%
Diesel												
Back-Up Generators	9,357	gallons	104		11,935	gallons	133		12,226	gallons	137	
Diesel Subtotal	9,357		104	0.0%	11,935		133	0.0%	12,226		137	0.0%
Building Energy - Residential			**79,137**	**8.7%**			**77,519**	**15.9%**			**78,574**	**16.1%**
Electricity												
PG&E	160,701	MWh	8,321	0.9%	175,912	MWh	0	0.0%	178,307	MWh	0	0.0%
EBCE - First Tier	22,880	MWh	0	0.0%	25,045	MWh	0	0.0%	25,386	MWh	0	0.0%
EBCE - Second Tier	6	MWh	0	0.0%	7	MWh	0	0.0%	7	MWh	0	0.0%
EBCE - Third Tier	21	MWh	0	0.0%	23	MWh	0	0.0%	24	MWh	0	0.0%
Electricity Subtotal	183,608	MWh	8,321	0.9%	200,988	MWh	0	0.0%	203,724	MWh	0	0.0%
Natural Gas												
PG&E	13,335,193	therms	70,816	7.8%	14,597,447	therms	77,519	15.9%	14,796,176	therms	78,574	16.1%
Natural Gas Subtotal	13,335,193		70,816	7.8%	14,597,447		77,519	15.9%	14,796,176		78,574	16.1%
On-Road Transportation	**1,719,449,263**	**VMT**	**670,547**	**73.6%**	**1,964,457,001**	**VMT**	**219,169**	**45.0%**	**2,045,540,001**	**VMT**	**228,554**	**46.9%**
Passenger Vehicles	1,384,190,409	VMT	315,987	34.7%	1,564,511,455	VMT	83,071	17.0%	1,627,908,920	VMT	86,437	17.7%
Heavy-Duty Vehicles	335,258,854	VMT	354,559	38.9%	399,945,546	VMT	136,098	27.9%	417,631,081	VMT	142,117	29.2%
BART	**77,496,854**	**Passenger Miles**	**1,027**	**0.1%**	**91,742,597**	**Passenger Miles**	**1,216**	**0.2%**	**93,985,438**	**Passenger Miles**	**1,245**	**0.3%**
Off-Road Transportation			**43,610**	**4.8%**			**55,122**	**11.3%**			**56,312**	**11.6%**
Agricultural Equipment	--	--	10	0.0%	--	--	10	0.0%	--	--	10	0.0%
Construction and Mining Equipme	--	--	11,028	1.2%	--	--	13,917	2.9%	--	--	14,533	3.0%
Entertainment Equipment	--	--	111	0.0%	--	--	111	0.0%	--	--	116	0.0%
Industrial Equipment	--	--	18,046	2.0%	--	--	20,686	4.2%	--	--	20,866	4.3%
Lawn and Garden Equipment	--	--	4,138	0.5%	--	--	5,058	1.0%	--	--	5,182	1.1%
Light Commercial Equipment	--	--	3,858	0.4%	--	--	5,414	1.1%	--	--	5,414	1.1%
Pleasure Craft			4,499	0.5%			7,241	1.5%			7,418	1.5%
Recreational Equipment	--	--	1,224	0.1%	--	--	1,877	0.4%	--	--	1,923	0.4%
Transport Refrigeration Units	--	--	696	0.1%	--	--	808	0.2%	--	--	849	0.2%
Solid Waste	**119,027**	**Tons**	**33,934**	**3.7%**	**140,907**	**Tons**	**40,172**	**8.2%**	**140,474**	**Tons**	**40,048**	**8.2%**
Waste Generation	116,215	Tons			137,578	Tons			137,155	Tons		
Alternative Daily Cover	2,812	Tons	33,934	3.7%	3,329	Tons	40,172	8.2%	3,319	Tons	40,048	8.2%
Water Supply	**11,787,910**	**HCF**	**128**	**0.0%**	**13,954,805**	**HCF**	**0**	**0.0%**	**14,295,959**	**HCF**	**0**	**0.0%**
Wastewater Treatment			**3,741**	**0.4%**			**3,686**	**0.8%**			**3,776**	**0.8%**
Total MTCO2e/yr			**910,881**				**487,220**				**490,723**	

Building Energy Consumption

Fremont Greenhouse Gas Forecast

Electricity

Source	2018 MWH/year	2018 Emission Factors (lb/MWh delivered) CO_2	2018 CH_4	2018 N_2O	2018 Total MT CO2e/year	Scale Factor	2020 MWH/year	2020 CO_2	2020 CH_4	2020 N_2O	2020 Total MT CO2e/year	2030 MWH/year	2030 CO_2	2030 CH_4	2030 N_2O	2030 Total MT CO2e/year	2045 MWH/year	2045 CO_2	2045 CH_4	2045 N_2O	2045 Total MT CO2e/year	2050 MWH/year	2050 CO_2	2050 CH_4	2050 N_2O	2050 Total MT CO2e/year
PG&E Residential	316,618	206	0.0340	0.0040	29,915	Population	315,645	189	0.0315	0.0037	27,375	319,010	113	0.0189	0.0022	16,518	334,221	0	0.0000	0.0000	0.0	336,616	0	0.0000	0.0000	0.0
EBCE Residential - First Tier	45,078	0.00010	0.0000	0.0000	2,060	Population	44,940	0.000046	0.0000	0.0000	2,054	45,419	0.000000	0.0000	0.0000	-	47,584	0	0.0000	0.0000	0.0	47,925	0	0.0000	0.0000	0.0
EBCE Residential - Second Tier	13	0	0.0000	0.0000	-	Population	13	0	0.0000	0.0000	-	13	0	0.0000	0.0000	-	13	0	0.0000	0.0000	0.0	14	0	0.0000	0.0000	0.0
EBCE Residential - Third Tier	42	0	0.0000	0.0000	-	Population	42	0	0.0000	0.0000	-	42	0	0.0000	0.0000	-	44	0	0.0000	0.0000	0.0	45	0	0.0000	0.0000	0.0
PG&E Non-Residential	397,272	206	0.0340	0.0040	37,536	Employment	355,023	189	0.0315	0.0037	30,790	379,705	113	0.0189	0.0022	19,661	437,782	0	0.0000	0.0000	0.0	422,364	0	0.0000	0.0000	0.0
EBCE Non-Residential - First Tier	374,447	0.00010	0.0000	0.0000	17,112	Employment	334,625	0.000046	0.0000	0.0000	15,292	357,889	0.000000	0.0000	0.0000	-	412,629	0	0.0000	0.0000	0.0	398,097	0	0.0000	0.0000	0.0
EBCE Non-Residential - Second Tier	4,678	0	0.0000	0.0000	-	Employment	4,181	0	0.0000	0.0000	-	4,472	0	0.0000	0.0000	-	5,155	0	0.0000	0.0000	0.0	4,974	0	0.0000	0.0000	0.0
				Total	**86,623**					Total	**75,510**				Total	**36,179**				Total	**0.0**				Total	**0.0**

Sources: *EBEW GHG Community Inventory 2018, EBCE Pers. Comm. 2020*

Natural Gas

Source	2018 therms/year	2018 Emission Factors (lb/therm) CO_2	2018 CH_4	2018 N_2O	2018 Total MT CO2e/year	Scale Factor	2020 therms/year	2020 CO_2	2020 CH_4	2020 N_2O	2020 Total MT CO2e/year	2030 therms/year	2030 CO_2	2030 CH_4	2030 N_2O	2030 Total MT CO2e/year	2045 therms/year	2045 CO_2	2045 CH_4	2045 N_2O	2045 Total MT CO2e/year	2050 therms/year	2050 CO_2	2050 CH_4	2050 N_2O	2050 Total MT CO2e/year
PG&E Residential	26,273,478	11.7	0.0002267	0.000005	139,524	Population	26,192,744	11.7	0.00022674	0.000005	139,095	26,471,932	11.7	0.000226742	0.000005	140,578	27,734,186	11.7	0.000227	0.000005	147,281	27,932,915	11.7	0.00022674	0.000005	148,337
PG&E Commercial	16,814,957	11.7	0.0002267	0.000005	89,295	Employment	15,026,702	11.7	0.00022674	0.000005	79,799	16,071,417	11.7	0.000226742	0.000005	85,347	18,529,584	11.7	0.000227	0.000005	98,401	17,876,992	11.7	0.00022674	0.000005	94,935
PG&E Industrial	5,630,094	11.7	0.0002267	0.000005	29,898	Employment	5,031,339	11.7	0.00022674	0.000005	26,719	5,381,137	11.7	0.000226742	0.000005	28,576	6,863,398	11.7	0.000227	0.000005	36,448	5,985,692	11.7	0.00022674	0.000005	31,787
				Total	**258,718**					Total	**245,613**				Total	**254,501**				Total	**282,129**				Total	**275,058**

Sources: *EBEW GHG Community Inventory 2018, EBCE Pers. Comm. 2020*

California Building Energy Efficiency Standards

Percent Improvement between 2008 and 2019 standards		
Residential	75%	
Nonresidential	53%	
Building Energy Efficiency Assumptions		
Residential	**%**	
Energy effiency improvement of 2013 code above 2008 code	25%	
Energy effiency improvement of 2016 code above 2013 code	28%	
Energy effiency improvement of 2019 code above 2016 code	53%	
Commercial		
Energy effiency improvement of 2013 code above 2008 code	30%	
Energy effiency improvement of 2016 code above 2013 code	5%	
Energy effiency improvement of 2019 code above 2016 code	30%	

Generator Fuel Consumption

Fremont Greenhouse Gas Forecast

2018			2020			2030			2045			2050		
	Amount	Emissions (MTCO2e)		Amount	Emissions (MTCO2e)		Amount	Emissions (MTCO2e)		Amount	Emissions (MTCO2e)		Amount	Emissions (MTCO2e)
Diesel (gal)	9,790	109.31	Diesel (gal)	8,749	97.68	Diesel (gal	9,357	104.47	Diesel (gal	11,935	133.25	Diesel (gal)	12,226	136.51
Natural Gas (mcf)	33	1.83	Natural Gas (mcf)	30	1.64	Natural Ga	32	1.75	Natural Ga	41	2.23	Natural Gas (scf)	42	2.29
Total		111.14	Total		99.32	Total		106.22	Total		135.48	Total		138.80

FacilityName	Plant City	Hr/day	Day/wk	Wk/yr	Ignition Type	Horse Pow	Emergency	Primary Use	Fuel	Usage Date	Usage/yr	Usage Unit	Max Fuel/hr	Max Fuel Unit	Fuel Usage	Fuel Usage Unit
Alameda County Water Di	Fremont	0.25	1	50	4 Stroke Comp	1592	Emergency	Electrical Gen	Diesel fuel	12/28/2018	9.7	Hours	82.4	gallons/hr	799.28	gallons
Alameda County Water Di	Fremont	0.25	1	50	4 Stroke Comp	1592	Emergency	Electrical Gen	Diesel fuel	12/28/2018	9.2999999	Hours	82.4	gallons/hr	766.32	gallons
XO Communications Inc	Fremont	0.25	1	50	4 Stroke Comp	2198	Emergency	Electrical Gen	Diesel fuel	12/31/2018	16	Hours	113.8	gallons/hr	1,820.80	gallons
XO Communications Inc	Fremont	0.25	1	50	4 Stroke Comp	2198	Emergency	Electrical Gen	Diesel fuel	12/31/2018	4	Hours	113.8	gallons/hr	455.20	gallons
Sysco San Francisco, Inc	Fremont	0.25	1	50	4 Stroke Comp	1850	Emergency	Electrical Gen	Diesel fuel	10/1/2018	5.7411273	Hours	95.8	gallons/hr	550.00	gallons
Sysco San Francisco, Inc	Fremont	0.25	1	50	4 Stroke Comp	1120	Emergency	Electrical Gen	Diesel fuel	10/1/2018	6	Hours	58	gallons/hr	348.00	gallons
Sysco San Francisco, Inc	Fremont	0.25	1	50	4 Stroke Comp	310	Emergency	Electrical Gen	Diesel fuel	10/1/2018	0	Hours	22.54	gallons/hr	-	gallons
Sysco San Francisco, Inc	Fremont	0.25	1	50	4 Stroke Comp	526	Emergency	Fire Pump dri	Diesel fuel	11/1/2018	5.9848485	Hours	26.4	gallons/hr	158.00	gallons
Pacific Gas and Electric	Fremont	0.25	1	50	4 Stroke Comp	225	Emergency	Electrical Gen	Diesel fuel	10/8/2018	8.799735	Hours	16.36	gallons/hr	143.96	gallons
Pacific Gas and Electric	Fremont	0.25	1	50	2 Stroke Comp	150	Emergency	Electrical Gen	Diesel fuel	10/8/2018	11.599741	Hours	10.91	gallons/hr	126.55	gallons
Verizon Business - FRMOC	Fremont	0.25	1	50	4 Stroke Comp	2018	Emergency	Electrical Gen	Diesel fuel	6/30/2018	18	Hours	104.5	gallons/hr	1,881.00	gallons
Sutter Bay Medical Found	Fremont	0.25	1	50	4 Stroke Comp	470	Emergency	Electrical Gen	Diesel fuel	11/15/2018	4.5324675	Hours	23.1	gallons/hr	104.70	gallons
Lucky #714	Fremont	2	1	50	4 Stroke Spark	75	Emergency	Electrical Gen	Natural ga	9/27/2018	16.99429	Thousand Cubic Feet	584	scf/hr	16.99	mcf
LBA Realty	Fremont	0.25	1	50	4 Stroke Comp	535	Emergency	Electrical Gen	Diesel fuel	10/1/2018	0	Hours	25.3	gallons/hr	-	gallons
LBA Realty	Fremont	0.25	1	50	4 Stroke Comp	325	Emergency	Electrical Gen	Diesel fuel	10/1/2018	3.0864198	Hours	16.2	gallons/hr	50.00	gallons
Boehringer Ingelheim Fren	Fremont	0.25	1	50	4 Stroke Comp	755	Emergency	Electrical Gen	Diesel fuel	9/1/2018	2.3999997	Hours	35	gallons/hr	84.00	gallons
Communication & Control	Fremont	0.5	1	52	4 Stroke Spark	48	Emergency	Electrical Gen	LPG	12/1/2018	NULL	Thousand Gallons	5.85	gallons/hr		gallons
Communication & Control	Fremont	1	2	50	4 Stroke Spark	69	Emergency	Electrical Gen	LPG	12/1/2018	0.09126	Thousand Gallons	5.85	gallons/hr	533.87	gallons
Target Store #T2615	Fremont	1	2	50	4 Stroke Spark	164.22	Emergency	Electrical Gen	LPG	7/26/2018	0	Thousand Gallons	14	gallons/hr	-	gallons
Target Store #T2615	Fremont	1	2	50	4 Stroke Spark	164.22	Emergency	Electrical Gen	Natural ga	7/26/2018	3.401905	Thousand Cubic Feet	1260	scf/hr	3.40	mcf
Whole Foods Market	Fremont	1	1	50	4 Stroke Spark	85.64999	Emergency	Electrical Gen	Natural ga	4/18/2018	10.13048	Thousand Cubic Feet	760	scf/hr	10.13	mcf
City of Fremont	Fremont	0.25	1	50	2 Stroke Comp	1232	Emergency	Electrical Gen	Diesel fuel	12/14/2018	14.13046	Hours	65	gallons/hr	918.48	gallons
Safeway Inc #309	Fremont	1	1	50	4 Stroke Spark	56	Emergency	Electrical Gen	Natural ga	12/31/2018	2.965714	Thousand Cubic Feet	245.1	scf/hr	2.97	mcf
SF Bay Area Rapid Transit	Fremont	0.25	1	50	4 Stroke Comp	755	Emergency	Electrical Gen	Diesel fuel	8/15/2018	7.7368421	Hours	38	gallons/hr	294.00	gallons
UL LLC	Fremont	0.25	1	50	4 Stroke Comp	324	Emergency	Electrical Gen	Diesel fuel	11/30/2018	4.0450947	Hours	8.87	gallons/hr	35.88	gallons
Prologis	Fremont	0.25	1	50	4 Stroke Comp	157	Emergency	Fire Pump dri	Diesel fuel	12/31/2018	12.264151	Hours	10.6	gallons/hr	130.00	gallons
Prologis	Fremont	0.25	1	50	4 Stroke Comp	157	Emergency	Fire Pump dri	Diesel fuel	12/31/2018	12.264151	Hours	10.6	gallons/hr	130.00	gallons
TE Electronics	Fremont	0.25	1	50	4 Stroke Comp	1043	Emergency	Electrical Gen	Diesel fuel	11/30/2018	1.153846	Hours	52	gallons/hr	60.00	gallons
Facebook	Fremont	0.25	1	50	4 Stroke Comp	1490	Emergency	Electrical Gen	Diesel fuel	6/1/2018	1.4430013	Hours	69.3	gallons/hr	100.00	gallons
Facebook Inc	Fremont	0.25	1	50	4 Stroke Comp	1490	Emergency	Electrical Gen	Diesel fuel	4/1/2018	0	Thousand Gallons	69.3	gallons/hr	-	gallons
Facebook Inc	Fremont	0.25	1	50	4 Stroke Comp	587.2	Emergency	Electrical Gen	Diesel fuel	2/28/2018	0.00483	Thousand Gallons	29	gallons/hr	140.07	gallons
ALOM Diesel Packaged Pu	FREMONT	1	1	34	4 Stroke Spark	144	Emergency	Fire Pump dri	Diesel fuel	8/16/2018	16	Hours	10	gallons/hr	160.00	gallons

On-Road Transportation

Fremont Greenhouse Gas Forecast

	2018	2020	2030	2040	2045	2050
Passenger						
Daily VMT (not including MCY)	3,751,147	3,799,443	3,966,730	4,301,837	4,483,546	4,665,254
Daily VMT (all vehicles)	3,772,955	3,821,436	3,989,021	4,325,935	4,508,679	4,691,380
Annual VMT (all vehicles)	1,309,215,427	1,326,038,185	1,384,190,409	1,501,099,416	1,564,511,455	1,627,908,920
MTCO2e/year		411,108	315,987	302,296	309,785	320,250
Commercial						
Daily VMT (all vehicles)	758,407	771,132	966,164	1,094,009	1,152,581	1,203,548
Annual VMT (all vehicles)	263,167,145	267,582,733	335,258,854	379,621,163	399,945,546	417,631,081
MTCO2e/year		348,034	354,559	359,074	371,006	384,448

	2018	2020	2030	2040	2045	2050
Motorcycles as a percent of light-duty VMT	0.58%	0.58%	0.56%	0.56%	0.56%	0.56%
Fremont LEHD Share of Alameda County	20.26%	20.26%	20.26%	20.26%	20.26%	20.26%

BART

Fremont Greenhouse Gas Forecast

	2018		2020		2030		2045		2050	
Station	Annual Passenger Miles	MTCO2e	Annual Passenger Miles	MTCO2e	Annual Passenger Miles	MTCO2e	Annual Passenger Miles	MTCO2e	Annual Passenger Miles	MTCO2e
Embarcadero	1,093,405	14.49	1,090,045	14.44	1,125,946	14.92	1,332,921	17.66	1,365,507	18.09
Fremont	40,103,161	531.40	39,979,931	529.77	41,296,682	547.22	48,887,983	647.81	50,083,152	663.65
Hayward	181,245	2.40	180,688	2.39	186,639	2.47	220,948	2.93	226,349	3.00
South Hayward	564,446	7.48	562,712	7.46	581,245	7.70	688,091	9.12	704,913	9.34
Union City	10,055,828	133.25	10,024,928	132.84	10,355,102	137.21	12,258,614	162.44	12,558,301	166.41
Warm Springs/South Fremont	23,259,022	308.20	23,187,551	307.26	23,951,240	317.38	28,354,041	375.72	29,047,215	384.90
Total	75,257,107	997	75,025,856	994	77,496,854	1,027	91,742,597	1,216	93,985,438	1,245

Emissions factor in 2018 and future years (MTCO2e/passenger mile)	0.000013

Off-Road Transportation

Fremont Greenhouse Gas Forecast

Off-Road Equipment	2005				2018				2020				2030				2040				2045				2050				
	CO2 (tons/day)	CH4 (tons/day)	N2O (tons/day)	CO2e (MT/yr)	CO2 (tons/day)	CH4 (tons/day)	N2O (tons/day)	CO2e (MT/yr)	CO2 (tons/day)	CH4 (tons/day)	N2O (tons/day)	CO2e (MT/yr)	CO2 (tons/day)	CH4 (tons/day)	N2O (tons/day)	CO2e (MT/yr)	CO2 (tons/day)	CH4 (tons/day)	N2O (tons/day)	CO2e (MT/yr)	CO2 (tons/day)	CH4 (tons/day)	N2O (tons/day)	CO2e (MT/yr)	CO2 (tons/day)	CH4 (tons/day)	N2O (tons/day)	CO2e (MT/yr)	Allocation Method
Agricultural Equipment	0.03195599	0.000007	0.000000	10.7	0.031330535	0.00000	0.00000	10.4	0.03124	0.00000	0.00000	10.4	0.03091	0.00000	0.00000	10.3	0.03067	0.00000	0.00000	10.2	0.03059	0.00000	0.00000	10.2	0.03051	0.00000	0.00000	10.2	Acres of agricultural land
Airport Ground Support Equipment	0	-	-	0.0	0.00000	0.00000	0.00000	0.0	0.00000	0.00000	0.00000	0.0	0.00000	0.00000	0.00000	0.0	0.00000	0.00000	0.00000	0.0	0.00000	0.00000	0.00000	0.0	0.00000	0.00000	0.00000	0.0	All to Oakland
Construction and Mining Equipment	13.477466	0.002544	0.000088	4494.0	29.88578212	0.00240	0.00018	9933.6	24.40094	0.00173	0.00014	8108.2	33.21163	0.00155	0.00019	11028.4	37.72377	0.00156	0.00022	12525.0	41.91584	0.00173	0.00025	13916.9	43.77251	0.00181	0.00026	14533.3	Change in service population
Entertainment Equipment	0.36904325	0.000042	-	122.6	0.3670858	0.00001	0.00000	121.7	0.35395	0.00001	0.00000	117.3	0.33486	0.00001	0.00000	110.9	0.34377	0.00001	0.00000	113.9	0.33431	0.00001	0.00000	110.8	0.35101	0.00001	0.00000	116.3	Population
Industrial Equipment	40.0922288	0.035932	0.003541	13919.3	44.5164373	0.01311	0.00245	15077.2	45.97336	0.01328	0.00253	15568.0	53.30435	0.01490	0.00294	18046.1	60.56727	0.01688	0.00334	20504.9	61.10079	0.01703	0.00337	20685.5	61.63432	0.01718	0.00340	20866.1	Acres of industrial land
Lawn and Garden Equipment	9.13527893	0.018042	0.007097	3814.9	10.12275101	0.01497	0.00652	4062.8	9.99652	0.01467	0.00641	4008.6	10.33143	0.01499	0.00658	4137.5	11.67663	0.01693	0.00744	4676.0	12.63053	0.01831	0.00805	5058.0	12.93931	0.01876	0.00824	5181.7	Households
Light Commercial Equipment	8.90849045	0.004881	0.001534	3129.6	11.66404044	0.00288	0.00185	4050.9	9.53296	0.00221	0.00149	3307.6	11.13694	0.00229	0.00170	3858.1	12.90794	0.00263	0.00197	4471.3	15.63028	0.00318	0.00239	5414.3	15.63028	0.00318	0.00239	5414.3	Jobs
Oil Drilling	0	-	-	0.0	0.00000	0.00000	0.00000	0.0	0.00000	0.00000	0.00000	0.0	0.00000	0.00000	0.00000	0.0	0.00000	0.00000	0.00000	0.0	0.00000	0.00000	0.00000	0.0	0.00000	0.00000	0.00000	0.0	Number of active wells
Other Portable Equipment	18.5961163	0.002784	-	6183.4	25.14911781	0.00142	0.00000	8340.6	25.22881	0.00120	0.00000	8365.0	29.09471	0.00078	0.00000	9641.2	36.41045	0.00084	0.00000	12064.1	40.20007	0.00093	0.00000	13319.8	44.38413	0.00102	0.00000	14706.1	Population
Pleasure Craft	6.12942833	0.009238	0.001554	2251.6	9.217953725	0.00567	0.00196	3276.4	9.47124	0.00519	0.00195	3355.0	12.81489	0.00547	0.00233	4498.7	20.01601	0.00911	0.00364	7031.7	20.61306	0.00938	0.00375	7241.5	21.11699	0.00961	0.00384	7418.5	Population
Railyard Operations	0	-	-	0.0	0.00000	0.00000	0.00000	0.0	0.00000	0.00000	0.00000	0.0	0.00000	0.00000	0.00000	0.0	0.00000	0.00000	0.00000	0.0	0.00000	0.00000	0.00000	0.0	0.00000	0.00000	0.00000	0.0	Not included (de minimis)
Recreational Equipment	1.02083881	0.009299	0.001527	558.2	1.627588051	0.01397	0.00248	885.8	1.68243	0.01436	0.00256	915.1	2.24709	0.01931	0.00343	1224.4	3.34309	0.02899	0.00510	1822.9	3.44281	0.02985	0.00525	1877.3	3.52697	0.03058	0.00538	1923.2	Population
Transport Refrigeration Units	1.49683732	0.000669	0.000021	503.7	1.682502312	0.00013	0.00001	559.3	1.75473	0.00013	0.00001	583.2	2.09511	0.00015	0.00001	695.9	2.31431	0.00016	0.00001	768.4	2.43236	0.00017	0.00001	807.6	2.55643	0.00018	0.00001	848.7	Share of road miles
				34,988			**Total**	**46,318**			**Total**	**44,338**			**Total**	**53,251**			**Total**	**63,989**			**Total**	**68,442**			**Total**	**71,018**	

OFFROAD2007 to OFFROAD2017 Conversion for CH4 and N2O Emissions

Equipment Sector	2005		2018		2020		2030		2040		2045		2050	
	CH4:CO2	N2O:CO2	CH4:CO2	N2O:CO2	CH4:CO2	N2O:CO2	CH4:CO2	N2O:CO2	CH4:CO2	N2O:CO2	CH4:CO2	N2O:CO2	CH4:CO2	N2O:CO2
Agricultural Equipment	0.00020619	0.00001238	0.00008309	0.00001273	0.00007080	0.00001276	0.00004354	0.00001435	0.00004088	0.00001678	0.00004088	0.00001678	0.00004088	0.00001678
Construction and Mining Equipment	0.00018873	0.00000652	0.00008033	0.00000590	0.00007084	0.00000583	0.00004677	0.00000579	0.00004134	0.00000585	0.00004134	0.00000585	0.00004134	0.00000585
Industrial Equipment	0.00089623	0.00008832	0.00029458	0.00005508	0.00028888	0.00005504	0.00027947	0.00005509	0.00027871	0.00005516	0.00027871	0.00005516	0.00027871	0.00005516
Light Commercial Equipment	0.00054793	0.00017217	0.00024713	0.00015818	0.00023229	0.00015595	0.00020593	0.00015258	0.00020363	0.00015260	0.00020363	0.00015260	0.00020363	0.00015260
Other Portable Equipment	0.00014968	-	0.00005643	-	0.00004762	-	0.00002686	-	0.00002307	-	0.00002307	-	0.00002307	-
Transport Refrigeration Units	0.00044706	0.00001398	0.00007489	0.00000661	0.00007336	0.00000607	0.00007158	0.00000398	0.00007050	0.00000260	0.00007050	0.00000260	0.00007050	0.00000260

*Note: 2040 data used as proxy

*Note: 2040 data used as proxy

Demographics

Fremont Greenhouse Gas Forecast

Community	2005			2018						2020			2030			2040			2045			2050		
	Population	**Households**	**Jobs**	**Population**	**Households**	**Jobs**	**Agricultural acres**	**Industrial acres**	**Active oil wells**	**Population**	**Households**	**Jobs**	**Population**	**Households**	**Jobs**	**Population**	**Households**	**Jobs**	**Population**	**Households**	**Jobs**	**Population**	**Households**	**Jobs**
Fremont	206,712	69,725	89,988	232,685	73,467	115,403	978	5,573	0	231,970	77,065	103,130	239,610	79,215	110,300	275,440	90,160	118,460	283,656	89,560	140,683	290,591	91,750	144,122
Alameda County Total	1,462,736	534,810	660,053	1,655,306	569,598	766,657	144,222	23,678	7	1,711,465	614,970	858,690	1,868,640	668,285	901,085	2,092,365	734,225	952,940	2,154,777	694,372	934,597	2,207,455	711,347	957,445
Fremont (Percent of County)	**14%**	**13%**	**14%**	**14%**	**13%**	**15%**	**1%**	**24%**		**14%**	**13%**	**12%**	**13%**	**12%**	**12%**	**13%**	**12%**	**12%**	**13%**	**13%**	**15%**	**13%**	**13%**	**15%**
Fremont Growth Rate (from 2018)										-0.3%	4.9%	-10.6%	3.0%	7.8%	-4.4%	18.4%	22.7%	2.6%	21.9%	21.9%	21.9%	24.9%	24.9%	24.9%
Alameda County Growth Rate (from 2040)																			3%			6%		

Source: MTC, EBEW GHG Community Inventory 2018

			Local road miles		
Community	**2005**	**2010**	**2015**	**2017**	**2018**
Alameda	120.86	119.92	177.04	135.44	136.18
Alameda County (Unincorporated)	493.61	471.7	623.73	485.16	490.09
Albany	27.15	27.15	31.87	30.26	29.52
Berkeley	222.82	222.82	226.84	224.74	216.32
Dublin	67.42	66.28	119.19	106.89	107.44
Emeryville	19.85	19.85	21.26	21.56	19.74
Fremont	487.69	487.69	550.96	528.55	498.42
Hayward	240.5	270.3	314.94	287.77	287.3
Livermore	279.86	279.89	326.34	333.11	318.44
Newark	100.69	100.69	106.59	106.53	102.55
Oakland	816.32	815.85	872.61	823.25	824.87
Piedmont	43.6	43.6	37.91	37.83	37.06
Pleasanton	198.91	200.24	252.5	214.26	211.92
San Leandro	176.55	176.55	196.21	197.06	187.69
Union City	151.59	151.59	154.71	138.41	135.84
Total	3447.42	3454.12	4012.7	3670.82	3603.38
Fremont (Percent of County)	14%	14%	14%	14%	14%

Data from Caltrans HPMS tables
https://dot.ca.gov/programs/research-innovation-system-information/highway-performance-monitoring-system

Solid Waste

Fremont Greenhouse Gas Forecast

Waste Generation Emissions

	2018				2020				2030				2045				2050			
Receiving Landfill	**Tonnage Disposed by City**	**Total ADC**	**Percent of Total Tonnage Disposed**	**MTCO2e**	**Tonnage Disposed by City**	**Total ADC**	**Percent of Total Tonnage**	**MTCO2e**	**Tonnage Disposed by City**	**Total ADC**	**Percent of Total Tonnage**	**MTCO2e**	**Tonnage Disposed by City**	**Total ADC**	**Percent of Total Tonnage**	**MTCO2e**	**Tonnage Disposed by City**	**Total ADC**	**Percent of Total Tonnage**	**MTCO2e**
Altamont Landfill and Resource Recovery	178,813	533	91%	51,280	178,264	531	91%	51,122	105,779	447	91%	30,368	125,224	529	91%	35,950	124,839	528	91%	35,840
Azusa Land Reclamation Co. Landfill	30	-	0%	8	30	-	0%	8	18	-	0%	5	21	-	0%	6	21	-	0%	6
Clean Harbors Buttonwillow LLC	1	-	0%	0	1	-	0%	0	1	-	0%	0	1	-	0%	0	1	-	0%	0
Corinda Los Trancos Landfill (Ox Mtn)	126	-	0%	36	126	-	0%	36	75	-	0%	21	88	-	0%	25	88	-	0%	25
Fink Road Landfill	62	-	0%	18	61	-	0%	18	36	-	0%	10	43	-	0%	12	43	-	0%	12
Foothill Sanitary Landfill	46	-	0%	13	45	-	0%	13	27	-	0%	8	32	-	0%	9	32	-	0%	9
Forward Landfill, Inc.	29	-	0%	8	29	-	0%	8	17	-	0%	5	20	-	0%	6	20	-	0%	6
Guadalupe Sanitary Landfill	221	46	0%	75	221	46	0%	74	131	38	0%	47	155	46	0%	55	154	45	0%	55
Keller Canyon Landfill	252	29	0%	79	251	29	0%	79	149	25	0%	49	176	29	0%	58	176	29	0%	57
Kettleman Hills - B18 Nonhaz Codisposal	1	-	0%	0	1	-	0%	0	0	-	0%	0	0	-	0%	0	0	-	0%	0
Kirby Canyon Recycl.& Disp. Facility	98	-	0%	28	97	-	0%	28	58	-	0%	17	68	-	0%	20	68	-	0%	19
McKittrick Waste Treatment Site	30	-	0%	9	30	-	0%	8	18	-	0%	5	21	-	0%	6	21	-	0%	6
Monterey Peninsula Landfill	11,480	-	6%	3,284	11,445	-	6%	3,274	6,791	-	6%	1,943	8,040	-	6%	2,300	8,015	-	6%	2,293
Newby Island Sanitary Landfill	943	-	0%	270	940	-	0%	269	558	-	0%	160	660	-	0%	189	658	-	0%	188
Potrero Hills Landfill	2,292	171	1%	698	2,284	171	1%	695	1,356	144	1%	423	1,605	170	1%	501	1,600	170	1%	499
Recology Hay Road	428	-	0%	123	427	-	0%	122	253	-	0%	72	300	-	0%	86	299	-	0%	86
Redwood Landfill	2	1	0%	1	2	1	0%	1	1	1	0%	0	1	1	0%	1	1	1	0%	1
Vasco Road Sanitary Landfill	1,439	2,463	1%	1,017	1,434	2,456	1%	1,014	851	2,067	1%	751	1,007	2,447	1%	889	1,004	2,439	1%	887
Yolo County Central Landfill	10	-	0%	3	10	-	0%	3	6	-	0%	2	7	-	0%	2	7	-	0%	2
Zanker Material Processing Facility	154	108	0%	70	153	108	0%	70	91	91	0%	48	108	107	0%	57	107	107	0%	57
Total	196,453	3,351	1	57,018	195,849	3,341	1	56,843	116,215	2,812	1	33,934	137,578	3,329	1	40,172	137,155	3,319	1	40,048

Source: CalRecycle, US Local Government Operations Protocol Equation 9.1

Note: Excludes compositing faciltiies, transfer stations, inert debris disposal sites, and planned landfills not yet in operation.

Waste characterization constants

LFG collection rate	75%
Oxidation rate of uncaptured gas	10%
Oxidation rate of captured methane to CO2	99%
Carbon to methane generation rate	1.333333333
Decomposing carbon to methane rate	0.5

All values here from the Local Government Operations Protocol (LGOP)

Note: Equation 9.1: Landfills with Comprehensive LFG Collection Systems

California Default

Waste Type	WIPFRAC	TDOC	DANF	%ANDOC	MTCO2e/ton
Newspaper	1.44%	47.09%	15.05%	0.12%	27.90%
Office Paper	0.73%	38.54%	87.03%	0.62%	132.06%
Corrugated Boxes	3.13%	44.84%	44.25%	0.95%	78.12%
Coated Paper	12.10%	33.03%	24.31%	0.72%	31.61%
Food	18.12%	14.83%	86.52%	1.99%	50.52%
Grass	1.84%	13.30%	47.36%	0.12%	24.80%
Leaves	3.52%	29.13%	7.30%	0.07%	8.37%
Branches	3.27%	44.24%	23.14%	0.20%	40.31%
Lumber	11.91%	43.00%	23.26%	1.45%	39.38%
Textiles	5.85%	24.00%	50.00%	0.66%	47.25%
Diapers	4.29%	24.00%	50.00%	0.52%	47.25%
Construction/Demolition	2.31%	4.00%	50.00%	0.11%	7.87%
Medical Waste	0.11%	15.00%	50.00%	0.00%	29.53%
Sludge/Manure	0.57%	5.00%	50.00%	0.00%	9.84%
MSW Total				7.52%	0.28604673

Alternative Daily Cover (ADC)

Waste Type	WIPFRAC	TDOC	DANF	%ANDOC	MTCO2e/ton
Newspaper	0.00%	47.09%	15.05%	0.12%	0.2790298
Office Paper	0.00%	38.54%	87.03%	0.62%	1.3205844
Corrugated Boxes	0.00%	44.84%	44.25%	0.95%	0.7812038

Coated Paper	0.00%	33.03%	24.31%	0.72%	0.3161397
Food	0.00%	14.83%	86.52%	1.99%	0.5051765
Grass	50.00%	13.30%	47.36%	0.12%	0.2479984
Leaves	25.00%	29.13%	7.30%	0.07%	0.0837238
Branches	25.00%	44.24%	23.14%	0.20%	0.4030547
Lumber	0.00%	43.00%	23.26%	1.45%	0.3937890
Textiles	0.00%	24.00%	50.00%	0.66%	0.4724618
Diapers	0.00%	24.00%	50.00%	0.52%	0.4724618
Construction/Demolition	0.00%	4.00%	50.00%	0.11%	0.0787436
Medical Waste	0.00%	15.00%	50.00%	0.00%	0.2952886
Sludge/Manure	0.00%	5.00%	50.00%	0.00%	0.0984295
MSW Total				7.52%	0.245693785

The static values here are from the California Landfill Emissions Tool Version 1.3
At time of writing, this file is currently available at https://www.arb.ca.gov/cc/landfills/landfills.htm

Waste Diversion Target

Statewide per capita diversion target	2.7	75%	diversion
2018 Fremont calculated disposal rate	4.7	56%	diversion

Water Supply

Fremont Greenhouse Gas Forecast

2018						2020						2030						2045						2050					
HCF/year	Total KWh	Emission Factor (lb CO2/MWh)	Emission Factor (lb CH4/MWh)	Emission Factor (lb N2O/MWh)	Total CO2e (MT/year)	HCF/year	Total KWh	Emission Factor (lb CO2/MWh)	Emission Factor (lb CH4/MWh)	Emission Factor (lb N2O/MWh)	Total CO2e (MT/year)	HCF/year	Total KWh	Emission Factor (lb CO2/MWh)	Emission Factor (lb CH4/MWh)	Emission Factor (lb N2O/MWh)	Total CO2e (MT/year)	HCF/year	Total KWh	Emission Factor (lb CO2/MWh)	Emission Factor (lb CH4/MWh)	Emission Factor (lb N2O/MWh)	Total CO2e (MT/year)	HCF/year	Total KWh	Emission Factor (lb CO2/MWh)	Emission Factor (lb CH4/MWh)	Emission Factor (lb N2O/MWh)	Total CO2e (MT/year)
	2,403,918	206.29	0.0340	0.004	**227**		2,396,531	189.3346575	0.0315	0.004	**208**		2,475,462	113.035616	0.0189	0.002	**128.18**		2,930,510	0	0.0000	0.000	-		3,002,152	0	0.0000	0.000	-
11,447,226	7,662,488	0.0001	0.0000	0.000	**350**	11,412,051	7,638,943	0.00005	0.0000	0.000	**349**	11,787,910	7,890,534	0	0.0000	0.000	-	13,954,805	9,340,999	0	0.0000	0.000	-	14,295,959	9,569,359	0	0.0000	0.000	-
				Total	577					**Total**	557					**Total**	128.18					**Total**	-					**Total**	-

Notes: Water district serves Fremont, Union City, and Newark. Water energy use was adjusted to only account for Fremont usage.

	2018
Average Daily Gallons per Capita	100.83
Average Annual HCF per Capita	49.20
Estimated kWh/HCF	0.88

HFC/pop	49	4,919.62	13.48
	3.68	36,801.34	100.83
	0.01		

ACWD	2018
Total electricity consumption (kWh)	15254249
Number of PG&E accounts	16
Number of EBCE accounts	51
Electricity consumption from PG&E (%)	24%
Electricity consumption from EBCE (%)	76%

Wastewater Treatment
Fremont Greenhouse Gas Forecast

Wastewater Treatment Total

	2018	2020	2030	2045	2050
Total MT CO2e/year	4,135	4,032	3,741	3,686	3,776

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

WWTP	Standard cubic feet of digester gas produced per day (ft^3/day)	Fraction of CH4 in gas	BTU content of CH4 (BTU/ft^3)	MT CH4/year	Total MT CO2e/year	Standard cubic feet of digester gas produced per day (ft^3/day)	MT CH4/year	Total MT CO2e/year	Standard cubic feet of digester gas produced per day (ft^3/day)	MT CH4/year	Total MT CO2e/year	Standard cubic feet of digester gas produced per day (ft^3/day)	MT CH4/year	Total MT CO2e/year	Standard cubic feet of digester gas produced per day (ft^3/day)	MT CH4/year	Total MT CO2e/year
Union Sanitation District	408,198	0.6	1,028	0.294	8.24	406,943	0.293	8.21	420,346	0.303	8.48	497,615	0.359	10.04	509,781	0.368	10.29

Source: *Digester gas produced and fraction of CH4 in gas user input, ICLEI 2019 US Community Protocol Equation WW.1.a*

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

WWTP	Standard cubic feet of digester gas produced per day (ft^3/day)	Fraction of CH4 in gas	BTU content of CH4 (BTU/ft^3)	MT N2O/year	Total MT CO2e/year	Standard cubic feet of digester gas produced per day (ft^3/day)	MT N2O/year	Total MT CO2e/year	Standard cubic feet of digester gas produced per day (ft^3/day)	MT N2O/year	Total MT CO2e/year	Standard cubic feet of digester gas produced per day (ft^3/day)	MT N2O/year	Total MT CO2e/year	Standard cubic feet of digester gas produced per day (ft^3/day)	MT N2O/year	Total MT CO2e/year
Union Sanitation District	408,198	0.6	1,028	0.058	15.35	406,943	0.058	15.31	420,346	0.060	15.81	497,615	0.071	18.72	509,781	0.072	19.17

Source: *Digester gas produced and fraction of CH4 in gas user input, ICLEI 2019 US Community Protocol Equation WW.2.a*

WW.8 Process Nitrous Oxide Emissions from Wastewater Treatment Plants without Nitrification or Denitrification

WWTP	Population	Factor for high nitrogen loading of industrial or commercial discharge	Emissions factor for a WWTP without nitrification or denitrification (g N2O/person /year)	MT N2O/year	Total MT CO2e/year	Population	MT N2O/year	Total MT CO2e/year	Population	MT N2O/year	Total MT CO2e/year	Population	MT N2O/year	Total MT CO2e/year	Population	MT N2O/year	Total MT CO2e/year
Union Sanitation District	232,685	1.25	3.2	0.93	246.65	231,970	0.93	245.89	239,610	0.96	253.99	283,656	1.13	300.68	290,591	1.16	308.03

Source: *Population User Input, ICLEI 2019 US Community Protocol Equation WW.8*

WW.12 Fugitive Nitrous Oxide Emissions from Effluent Discharge

WWTP	Average total nitrogen per day (kg N/day)	Emission factor (kg N2O-N/kg sewage-N discharged)	Molecular weight ratio of N2O to N2	MT N2O/year	Total MT CO2e/year	Average total nitrogen per day (kg N/day)	MT N2O/year	Total MT CO2e/year	Average total nitrogen per day (kg N/day)	MT N2O/year	Total MT CO2e/year	Average total nitrogen per day (kg N/day)	MT N2O/year	Total MT CO2e/year	Average total nitrogen per day (kg N/day)	MT N2O/year	Total MT CO2e/year
Union Sanitation District	2,307.70	0.005	1.57	6.61	1752.22	2,300.61	6.59	1746.83	2,376.38	6.81	1804.36	2,813.21	8.06	2136.05	2,881.99	8.26	2188.27

Source: *N-Load User Input, ICLEI 2019 US Community Protocol Equation WW.12*

10.1 Stationary CH4 from Incomplete Combustion of Digester Gas

WWTP	Standard cubic feet of digester gas produced per day (ft^3/day)	Fraction of CH4 in gas	MT CH4/year	Total MT CO2e/year	Standard cubic feet of digester gas produced per day (ft^3/day)	MT CH4/year	Total MT CO2e/year	Standard cubic feet of digester gas produced per day (ft^3/day)	MT CH4/year	Total MT CO2e/year	Standard cubic feet of digester gas produced per day (ft^3/day)	MT CH4/year	Total MT CO2e/year	Standard cubic feet of digester gas produced per day (ft^3/day)	MT CH4/year	Total MT CO2e/year
Union Sanitation District	408,198	0.6	16.76	469.26	406,943	16.71	467.82	420,346	17.26	483.23	497,615	20.43	572.06	509,781	20.93	586.04

Source: *Digester gas produced and fraction of CH4 in gas user input, 2010 Local Government Operations Protocol Equation 10.1*

Energy Consumption from WWTP

Energy Source	Amount	Emission Factors			Total MT CO2e/year	Amount	Total MT CO2e/year	Amount	Total MT CO2e/year	Amount	Total MT CO2e/year	Amount	Total MT CO2e/year
		CO_2	CH_4	N_2O									
Electricity Consumption (MWh/year)	11,765	206	0.0340	0.0040	1,112	11,729	1,017	12,115	627	14,342	-	14,693	-
Natural Gas Consumption (therms/year)	100,196	11.7	0.000226742	0.000005	532	99,888	530	103,178	548	122,144	649	125,130	664

Union Sanitation District	2018	Portion allocated to Fremont
Gas production (scf/day)	618,567	408,198
Electricity consumption (kWh/year)	17,827,876	11,764,764
Natural gas consumption (therms/year)	151,833	100,196
Nitrogen load (kg N/day)	3,497	2,308
Total service population	352,602	
Fremont population	232,685	

Assumptions and Conversion Factors

Fremont Greenhouse Gas Forecast

Category	Value				
Conversion Factors					
g/MT	1000000				
g/lb	453.592				
g/kg	1000				
lb/MT	2204.622622				
kg/MT	1000				
MT/ton	1.10231				
g/ton	907185				
lb/ton	2000				
lb/kg	2.20462				
kWh/MWh	1000				
MWh/GWh	1000				
gal/cubic foot	7.480519481				
gal/Liter	3.785411784				
gallon/acrefoot	325851.429				
gal/MMBTU	0.1374				
scf/MMBTU	972.8				
Liter/gallon	0.264172052				
kilograms/milligrams	1000000				
year/days	365				
million gal/acre-feet	0.325851429				
days/year (VMT)	347				
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					
	2018	**2020**	**2030**	**2045/2050**	**Source**
PG&E EF (lb CO2/MWh)	206	189.3346575	113.0356164	0	https://www.theclimateregistry.org/our-members/cris-public-reports/
CAMX EF (lb CH4/MWh)	0.034	0.031481481	0.018888889	0	eGRID 2018 (https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid)
CAMX EF (lb N2O/MWh)	0.004	0.003703704	0.002222222	0	eGRID 2018 (https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid)
CAMX EF (lb CO2/MWh)	496.5	459.7222222	275.8333333	0	eGRID 2018 (https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid)
EBCE First Tier EF (MTCO2e/kWh)	0.000046	4.56995E-05	0	0	EBEW GHG Inventory 2018
Direct Access (MTCO2e/kwh)	0.000204895	0.0002	0.000119403	0	EBEW GHG Inventory 2018
RPS Requirements					
RPS Target Year	2018	2020	2030	2045	
PG&E					
Percent Renewable	27%	33%	60%	100%	
Increase in Renewables (from 2018)		6%	33%		
EBCE					
Percent Renewable	41%	41%	100%	100%	
Increase in Renewables (from 2018)		0%	59%		
Direct Access					
Percent Renewable	31%	33%	60%	100%	
Increase in Renewables (from 2018)		2%	29%		
Fuel Emission Factors					
Fuel	Emission Factor	Unit	Source		
Diesel	10.21	kg CO2/gal	Climate Registry 2019 Default Emission Factors		
	0.9	g CH4/MMBTU			
	0.4	g N2O/MMBTU			
Natural Gas	0.05444	kg CO2/scf			
	0.9	g CH4/MMBTU			
	0.9	g N2O/MMBTU			

Appendix B

Measure List and Greenhouse Gas Quantification Memo

Memo

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Date: March 25, 2022

To: Rachel DiFranco (City of Fremont)

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

Subject: City of Fremont Climate Action Plan 2.0 Greenhouse Gas Reduction Measures Technical Memorandum

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INTRODUCTION

This technical memorandum summarizes the results of the quantitative "gap analysis" for the City of Fremont's (City's) Climate Action Plan 2.0 (CAP 2.0). The purpose of the gap analysis is to quantify the suite of greenhouse gas (GHG) reduction measures that will set the City on course to meet the reduction targets adopted by the City for the years 2030 and 2045.

GREENHOUSE GAS EMISSIONS FORECASTS

As part of the CAP 2.0 development process, GHG emissions forecasts were calculated to estimate future levels of emissions citywide, absent City-specific reduction measures. Emissions forecasts were prepared for a legislative-adjusted "business-as-usual" (BAU) scenario for 2030, 2045, and 2050. The legislative-adjusted BAU forecast scenario accounts for future growth in emissions associated with changes and growth in the city, along with legislative actions to reduce emissions due to State and federal regulations, programs, or other mandated actions. A summary of legislative reductions applied in the legislative-adjusted BAU forecast scenario is provided in the "Fremont CAP 2.0 Emissions Forecast Scenarios Memo," dated February 26, 2021.

The legislative-adjusted BAU forecasts for the City's GHG emissions are summarized in Table 1. Under the legislative-adjusted BAU forecast, the City's GHG emissions are projected to decrease by 12 percent between 2018 and 2050. Further details with respect to the GHG emissions forecasts are discussed in the Forecasts Memo.

Table 1 City of Fremont 2018 GHG Emissions Inventory and Legislative-Adjusted BAU Forecast ($MTCO_2e$/year)

Sector	2018	2030	2045	2050
Residential Building Energy	172,974	157,096	147,281	148,337
Nonresidential Building Energy	177,163	133,693	134,984	126,861
On-Road Transportation	783,601	670,547	680,791	704,698
Off-Road Vehicles and Equipment	46,318	53,251	68,442	71,018
BART	997	1,027	1,216	1,245
Solid Waste	57,018	33,934	40,172	40,048
Water Supply	577	128	0	0
Wastewater Treatment	4,135	3,741	3,686	3,776
Total	**1,242,786**	**1,053,414**	**1,076,571**	**1,095,984**

Notes: Total may not sum exactly due to independent rounding. BART = Bay Area Rapid Transit; 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 2020

GREENHOUSE GAS EMISSIONS REDUCTION TARGETS

The City's GHG reduction targets are as follows:

- 2030 target: 30 percent below 2018 levels; and
- 2045 target: carbon neutrality.

Based on the City's 2018 GHG inventory, applying the above targets to the 2018 baseline would mean that the City's emissions would need to be reduced by 178,119 metric tons of carbon dioxide equivalent ($MTCO_2e$) by 2030 and 1,076,571 $MTCO_2e$ by 2045. The City's targets, along with the estimated reductions required to achieve the targets, are summarized in Table 2.

Table 2 City of Fremont GHG Emissions Reduction Targets and Legislative-Adjusted BAU Summary

Source	2018	2030	2045	2050
Baseline Emissions and Legislative-Adjusted BAU Forecast ($MTCO_2e$)	1,242,786	1,053,414	1,076,571	1,095,984
Target Percent Reduction Below Baseline (%)	NA	30	Carbon Neutrality	Carbon Neutrality
Target Annual Emissions ($MTCO_2e$)	NA	875,295	0	0
Reduction Needed to Meet Target ($MTCO_2e$)	NA	178,119	1,076,571	1,095,984

Notes: GHG = greenhouse gas; BAU = business-as-usual, $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year; NA = not applicable.

Source: Calculations conducted by Ascent Environmental in 2020

Figure 1 depicts the legislative-adjusted BAU GHG emissions forecasts by sector, as distinguished by colored wedges. The space between the trajectory of the black line and the top of the colored wedges represents the "gap" in emissions that will need to be addressed through local actions for the City to meet its GHG reduction targets.

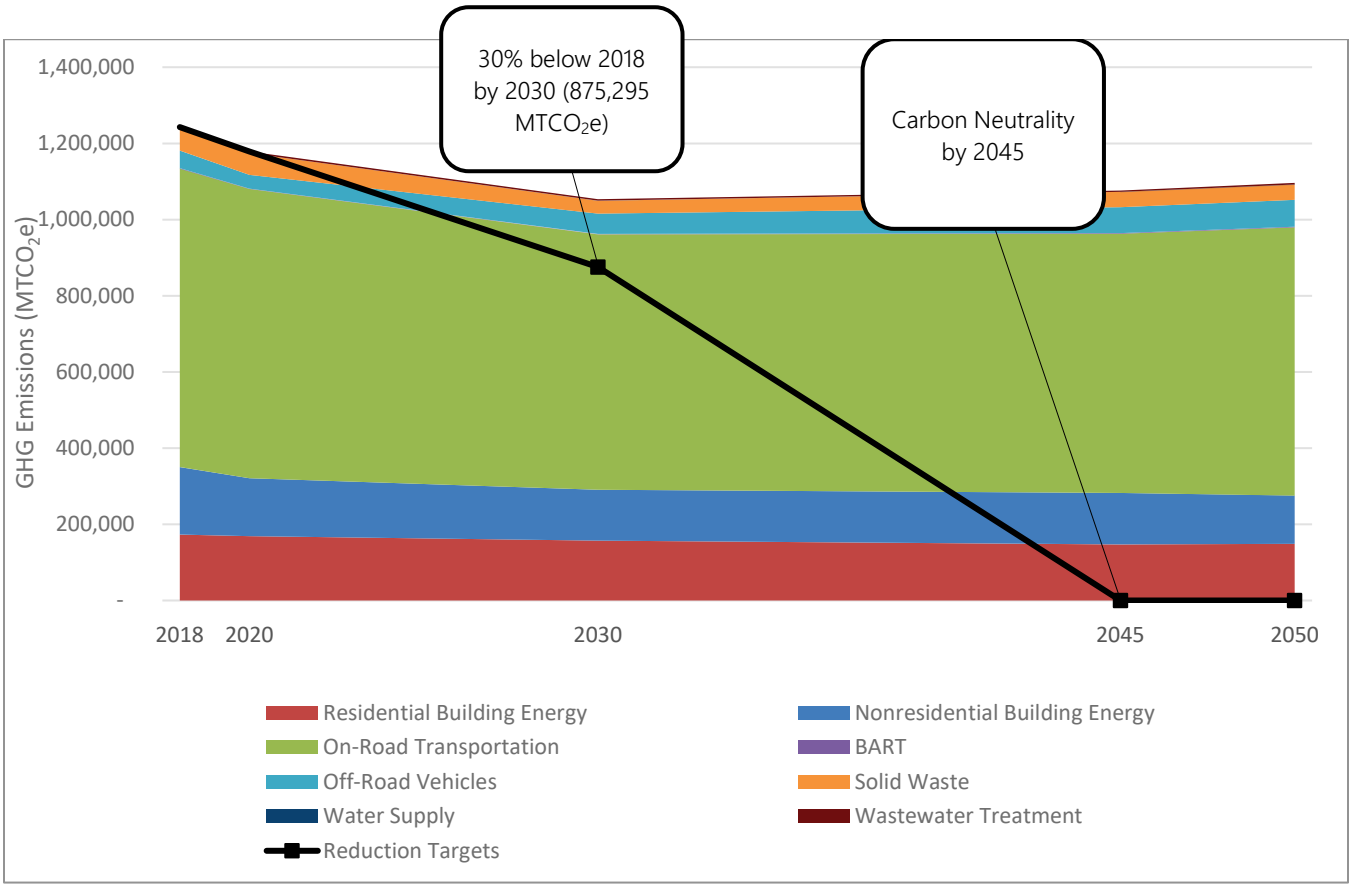

Figure 1 City of Fremont Legislative-Adjusted Business-as-Usual Forecast Emissions by Sector and Emission Reduction Targets: 2030, 2045, and 2050

GREENHOUSE GAS EMISSIONS REDUCTION MEASURES

As discussed above, additional GHG reductions are needed to achieve the reduction targets for 2030, 2045, and 2050. Ascent worked with City staff to develop a draft list of recommended GHG reduction measures based on existing measures from the City's 2012 CAP, as well as new measures informed by community outreach and current best practices.

The measures presented below are organized under seven broad categories that were used in the City's community outreach efforts: buildings, infrastructure, land use and mobility, materials waste, natural and urban landscapes, health and resiliency, and green economy and just transition. These categories do not match up directly with the sectors used for the inventory and forecasts. Each category includes one or more broad strategy, and each strategy includes one or more measures to reduce GHG emissions and adapt to climate change. For measures that are quantifiable, we have included clear performance indicators that can be tracked and monitored to help the City meet its reduction targets. To assist with implementation, measures are broken down into specific actions and supporting actions that the City would take to reduce GHG emissions. The actions and supporting actions are not included in this gap analysis memo but will be included in the implementation chapter of the CAP 2.0 document.

GHG reductions associated with these recommended measures were calculated in a stepwise manner for the future years of 2030, 2045, and 2050. In other words, GHG reductions (in $MTCO_2e$) are assessed during a snapshot in time in

years 2030, 2045, and 2050. Measures are quantified for a single year rather than adding cumulative reductions from prior years, which aligns with the methodology used to derive the City's GHG reduction targets.

GHG emissions reductions were quantified for measures wherever substantial evidence and reasonable assumptions were available to support calculations. City staff and Ascent also identified measures that were not quantifiable due to lack of available data or quantification methods but would still be expected to reduce GHG emissions. These are listed in this memo and will be discussed qualitatively in the CAP 2.0 document.

Preliminary estimates of GHG emissions reductions, along with an estimated emissions "gap" (i.e., the difference between the effective GHG reductions required to meet the targets and the total GHG reductions), are described below, summarized in Table 3, and illustrated in Figure 2. Descriptions of the measures are provided in the following sections. Detailed measure calculations and assumptions supporting the GHG reduction estimates are provided in Attachment A.

Table 3 Greenhouse Gas Emissions Reduction Measures

Measure Number	Strategy	Measure	GHG Reductions ($MTCO_2e$)		
			2030	2045	2050
Buildings and Energy					
BU-1	Clean and Renewable Power Use	Transition to 100 percent clean electricity consumption.	51,370	-	-
BU-2	Building Electrification and Low-Carbon Design	Require new residential construction to be all electric and low carbon.	200	6,921	7,972
BU-3		Require new nonresidential construction to be zero net energy and low carbon.	-	31,807	18,148
BU-4		Retrofit existing residential buildings to be all electric and low carbon.	40,347	119,873	139,387
BU-5		Retrofit existing nonresidential buildings to be all electric and low carbon.	25,634	109,710	144,752
BU-8	Building Energy Efficiency and Demand Management	Reduce energy consumption in buildings and operations.	NA	NA	NA
BU-9		Promote building energy tracking and performance assessment.	NA	NA	NA
BU-10		Reduce overall demand on the electrical grid.	NA	NA	NA
BU-11	Building Energy Resilience	Increase the development of microgrids at emergency facilities.	NA	NA	NA
BU-12		Expand local clean backup power availability.	NA	NA	NA
BU-13	Water Conservation in Buildings	Reduce water consumption in buildings.	39	-	-
BU-14		Increase the capture of rainwater and use of greywater.	6	-	-
BU-15	Waste Reduction in Building Construction and Demolition	Increase sustainable materials use and recovery in construction and demolition (C&D).	NA	NA	NA
		Buildings and Energy Subtotal	**117,596**	**268,311**	**310,258**
Infrastructure and Equipment					
IN-1	Clean and Renewable Power Infrastructure	Upgrade infrastructure to support the transition to 100 percent clean power.	NA	NA	NA
IN-2	Clean Freight and Delivery Infrastructure	Promote clean and efficient movement of goods.	NA	NA	NA
IN-3	Clean Mobility Infrastructure	Install infrastructure to support electric vehicle (EV) charging and other zero-emission vehicle (ZEV) fueling needs.	81,888	393,435	469,766

Table 3 Greenhouse Gas Emissions Reduction Measures

Measure Number	Strategy	Measure	GHG Reductions ($MTCO_2e$)		
			2030	2045	2050
IN-4		Increase the use of smart mobility and modernize transportation infrastructure as identified in the City's Mobility Action Plan.	17,173	13,984	13,225
IN-5		Improve pedestrian and bicycle infrastructure as identified in previous City plans and the new Active Transportation Plan.	13	42	49
IN-6		Replace the City's gasoline and diesel-powered fleet vehicles and other equipment with low-emission and zero-emission vehicles.	NA	NA	NA
IN-7	Critical Infrastructure Protection	Improve energy infrastructure resilience.	NA	NA	NA
IN-8		Improve water and wastewater infrastructure resilience.	NA	NA	NA
IN-9		Protect vulnerable transportation infrastructure, services, and systems from climate impacts.	NA	NA	NA
IN-10		Assess local vulnerabilities to climate change and incorporate climate adaptation and resiliency into City planning, policies, and infrastructure projects.	NA	NA	NA
IN-11	Clean Landscaping and Off-Road Equipment	Reduce emissions and air pollution associated with landscaping equipment.	2,500	5,058	5,182
IN-12		Reduce emissions and air pollution associated with diesel fuel use in off-road equipment and stationary sources.	4,450	11,258	12,481
		Infrastructure and Equipment Subtotal	**106,023**	**423,777**	**500,703**
Land Use and Mobility					
LU-1	Clean and Multimodal Mobility and Connectivity	Promote and enhance active transportation options as identified in the City's Active Transportation Plan and Mobility Action Plan.	NA	NA	NA
LU-2		Reduce vehicle miles traveled (VMT) and single-occupancy vehicle trips, as identified in Fremont's General Plan.	14,004	27,118	30,959
LU-3		Encourage the adoption of zero-emission passenger vehicles.	NA	NA	NA
LU-4		Increase transit ridership and promote transition to zero-emission transit.	31,759	34,172	39,612
LU-5		Increase implementation of transportation demand management (TDM) strategies as identified in Fremont's General Plan.	12,553	18,456	21,776
LU-6		Reduce the amount of parking to encourage transit-oriented development (TOD) as identified in Fremont's General Plan.	10,192	8,840	8,783
LU-7	Sustainable Land Use Planning	Apply smart growth and low-carbon land use development principles.	NA	NA	NA
LU-8		Incorporate climate vulnerabilities into land use planning.	NA	NA	NA
		Land Use and Mobility Subtotal	**68,507**	**88,586**	**101,129**
Materials and Waste					
MW-1	Materials Reuse and Plastic Waste Reduction	Promote responsible consumption of products and materials and reduce disposable packaging use.	NA	NA	NA
MW-2		Encourage repair, reuse, and upcycling of materials.	NA	NA	NA
MW-3	Managing Recycling and Organics	Bolster recovery of organic and recyclable materials and increase landfill diversion rates.	14,653	31,042	35,497

Table 3 Greenhouse Gas Emissions Reduction Measures

Measure Number	Strategy	Measure	GHG Reductions ($MTCO_2e$)		
			2030	2045	2050
MW-4		Support methane recovery and reuse from organic sources.	NA	NA	NA
MW-5		Establish and advance zero waste targets and policies.	NA	NA	NA
		Materials and Waste Subtotal	14,653	31,042	35,497
Natural and Urban Landscapes					
NL-1	Carbon Sequestration	Increase soil carbon content.	NA	NA	NA
NL-2		Increase the carbon sequestration potential of the City's bayfront and bayland areas.	NA	NA	NA
NL-3		Implement the City's Urban Forestry Management Plan.	252	965	1,144
NL-4	Green Infrastructure	Expand and protect green infrastructure and biodiversity.	NA	NA	NA
NL-5	Water Conservation in Landscapes	Reduce water usage for irrigation and landscaping.	35	-	-
NL-6	Habitat Restoration and Biodiversity	Conserve and protect natural habitats, ecosystems, and wildlife corridors impacted by climate change.	NA	NA	NA
NL-7		Restore, rehabilitate, and repurpose degraded, damaged, or destroyed ecosystems through active interventions to enhance the natural adaptive capacity of biological communities.	NA	NA	NA
NL-8		Prioritize nature-based solutions to improve coastal and watershed resilience while promoting biodiversity.	NA	NA	NA
		Natural and Urban Landscapes Subtotal	287	965	1,144
Adaptation and Resiliency					
AR-1	Extreme Heat Mitigation	Adopt urban heat island reduction design guidelines.	NA	NA	NA
AR-2		Protect populations vulnerable to extreme heat and poor air quality.	NA	NA	NA
AR-3	Wildfire Risk Reduction	Reduce the wildland-urban interface (WUI) fire risk.	NA	NA	NA
AR-4	Flood Risk Reduction	Minimize risks to life and property resulting from flooding and flood induced hazards.	NA	NA	NA
AR-5		Reduce flood and drought risk through integrated watershed management.	NA	NA	NA
AR-6	Sea Level Rise Preparedness	Evaluate proposed development in areas of the City subject to flooding impacts caused by rising sea levels.	NA	NA	NA
AR-7		Protect existing development from sea level rise impacts.	NA	NA	NA
AR-8		Minimize risks to life and property resulting from flooding.	NA	NA	NA
AR-9	Emergency Preparedness and Disaster Response	Revise emergency management plans, programs, and activities.	NA	NA	NA
AR-10		Ensure emergency management activities are conducted equitably.	NA	NA	NA
AR-11		Improve notification systems for natural hazards to reach the most vulnerable community members.	NA	NA	NA
AR-12	Community Resilience	Establish resilience hubs.	NA	NA	NA
AR-13		Improve food security.	NA	NA	NA
		Adaptation and Resilience Subtotal	NA	NA	NA

Table 3 Greenhouse Gas Emissions Reduction Measures

Measure Number	Strategy	Measure	GHG Reductions ($MTCO_2e$)		
			2030	2045	2050
Green Economy					
GE-1	Green Businesses and Jobs	Support and encourage circular economy innovation and business leadership in Fremont.	NA	NA	NA
GE-2		Incentivize and promote green business practices.	NA	NA	NA
GE-3		Support green jobs in the city.	NA	NA	NA
GE-4	Climate Equity	Increase resiliency of low-income or otherwise vulnerable housing.	NA	NA	NA
GE-5		Ensure an equitable transition to 100 percent clean power.	NA	NA	NA
GE-6	Climate-Friendly Purchasing, Budgeting, and Financing	Incorporate sustainability best practices into City purchasing decisions and City contracts.	NA	NA	NA
GE-7		Modify the City's capital planning and budgeting processes to incorporate priorities established by *Climate Ready Fremont.*	NA	NA	NA
GE-8		Establish financial mechanisms and pursue outside funding sources to support the implementation of *Climate Ready Fremont.*	NA	NA	NA
		Green Economy Subtotal	**NA**	**NA**	**NA**
Public Participation and Engagement					
PE-1	Access to Nature and Environmental Stewardship	Ensure availability and accessibility to healthy, natural spaces and safe outdoor recreation opportunities for all community members.	NA	NA	NA
PE-2		Encourage residents and community members to act as environmental stewards.	NA	NA	NA
PE-3	Climate Action Engagement	Encourage community participation and ownership of *Climate Ready Fremont.*	NA	NA	NA
PE-4		Increase public awareness and participation in climate planning with a focus on equity and inclusion.	NA	NA	NA
PE-5	Climate Tracking and Reporting	Track climate and sustainability metrics accurately and transparently for the community.	NA	NA	NA
		Public Participation and Engagement Subtotal	**NA**	**NA**	**NA**
Total			307,066	812,681	948,730
Reduction Needed to Meet Target			178,119	1,076,571	1,095,984
Target Met?			Yes	No	No
Remaining Gap to Target			(128,947)[1]	263,91	147,253

Notes: GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent; NA = not applicable.

[1] Negative value indicates the target has been met with a surplus of reductions.

Source: Calculations conducted by Ascent Environmental in 2021.

Buildings

CLEAN AND RENEWABLE POWER USE

Measure BU-1: Transition to 100 percent clean electricity consumption.

Quantification assumptions: This measure assumes that all electricity consumed by residential and nonresidential customers is carbon-free by 2030.

BUILDING ELECTRIFICATION AND LOW-CARBON DESIGN

Measure BU-2: Require new residential construction to be all-electric and low carbon.

Quantification assumptions: This measure assumes that all residential development built after July 1, 2024 is all-electric.

Measure BU-3: Require new nonresidential construction to be zero net energy and low carbon.

Quantification assumptions: This measure assigns different construction electrification targets for industrial and other types of nonresidential buildings such as commercial and retail. As described below in Measure BU-5, industrial sector natural gas usage was estimated using gross building square footage and an average general light and heavy industry natural gas usage factor of 27 kilo-British thermal units (kBtu) per square foot (City of Fremont 2021, CAPCOA 2021). Using this method, the percent of nonresidential natural gas usage that was attributable to industrial uses in 2018 was estimated to be 53 percent. Based on data provided by the City's Economic Development Department, it is anticipated that there will be continued growth in industrial inventory and decline in retail space over time (Lazaro, pers. comm., 2021). Thus, the share of nonresidential natural gas consumption due to industrial uses will likely increase over time. This measure assumes that the share of nonresidential natural gas usage attributable to industrial uses will increase to 56 percent by 2030, 59 percent by 2045, and 60 percent by 2050.

This measure assumes that all nonresidential development, excluding industrial development, built in 2026 or later is zero net energy. This measure assumes that 15 percent of new industrial buildings built after 2018 will be all-electric by 2030, 60 percent by 2045, and 75 percent by 2050.

Measure BU-4: Retrofit existing residential buildings to be all electric and low carbon.

Quantification assumptions: This measure assumes that 36 percent of existing residential buildings are retrofitted by 2030, 86 percent are retrofitted by 2045, and 100 percent are retrofitted by 2050, based on Zero-Carbon Buildings in California: A Feasibility Study (Mozingo 2021).

Measure BU-5: Retrofit existing nonresidential buildings to be all-electric and low carbon.

Quantification assumptions: This measure assigns different retrofit targets for industrial and other types of nonresidential buildings such as commercial and retail. Pacific Gas & Electric Company's (PG&E's) 15/15 rule requires PG&E to combine certain data categories to protect the privacy of individual users if the number of customers is below 15 or if a single customer's load is more than 15 percent of the total. Thus, industrial sector natural gas consumption data was not available for the city's industrial sector. Industrial sector natural gas usage was estimated using gross building square footage and an average general light and heavy industry natural gas usage factor of 27 kBtu per square foot (City of Fremont 2021, CAPCOA 2021). Using this method, the percent of nonresidential natural gas usage that was attributable to industrial uses in 2018 was estimated to be 53 percent.

This measure assumes that 13 percent of existing nonresidential buildings, excluding industrial buildings, are retrofitted by 2030, 49 percent are retrofitted by 2045, and 65 percent are retrofitted by 2050 (Mozingo 2021). This measure assumes that 10 percent of existing industrial buildings are retrofitted by 2030, 40 percent are retrofitted by 2045, and 50 percent are retrofitted by 2050.

BUILDING ENERGY EFFICIENCY AND DEMAND MANAGEMENT

Measure BU-8: Reduce energy consumption in buildings and operations.

Quantification assumptions: Not quantified to avoid double counting with Measure BU-1.

Measure BU-9: Promote building energy tracking and performance assessment.

Quantification assumptions: Not quantified.

Measure BU-10: Reduce overall demand on the electrical grid.

Quantification assumptions: Not quantified.

BUILDING ENERGY RESILIENCE

Measure BU-11: Increase the development of microgrids at emergency facilities.

Quantification assumptions: Not quantified.

Measure BU-12: Expand local clean backup power availability.

Quantification assumptions: Not quantified.

WATER CONSERVATION IN BUILDINGS

Measure BU-13: Reduce water consumption in buildings.

Quantification assumptions: This measure assumes a 50 percent reduction in indoor water consumption by 2030 in new development based on the California Air Pollution Control Officers Association (CAPCOA) Quantifying Greenhouse Gas Mitigation Measures Report, Measure WUW-1 (CAPCOA 2010). This measure assumes a 30 percent reduction in indoor water consumption by 2030, 40 percent by 2045, and 50 percent by 2050 in existing development.

Measure BU-14: Increase the capture of rainwater and use of greywater.

Quantification assumptions: This measure assumes that 20 percent of households would reuse greywater in 2030, 30 percent in 2045, and 40 percent in 2050. Of those households that reuse greywater, there would be a reduction in potable water use of 30 percent by 2030, 40 percent by 2045, and 45 percent by 2050, compared to the average residential water use per capita in Alameda County Water District in 2018.

WASTE REDUCTION IN BUILDING CONSTRUCTION AND DEMOLITION

Measure BU-15: Increase sustainable materials use and recovery in construction and demolition (C&D).

Quantification assumptions: Not quantified.

Infrastructure

CLEAN AND RENEWABLE POWER INFRASTRUCTURE

Measure IN-1: Upgrade infrastructure to support the transition to 100 percent clean power.

Quantification assumptions: Not quantified to avoid double counting with Measure BU-1.

CLEAN FREIGHT AND DELIVERY INFRASTRUCTURE

Measure IN-2: Promote clean and efficient movement of goods.

Quantification assumptions: Not quantified to avoid double counting with Measure IN-3.

CLEAN MOBILITY INFRASTRUCTURE

Measure IN-3: Install infrastructure to support electric vehicle (EV) charging and other zero-emission vehicle (ZEV) fueling needs.

Quantification assumptions: This measure assumes that the percent of light-duty EV miles traveled (eVMT) will be 29 percent of total passenger VMT in 2030, 85 percent in 2045, and 90 percent in 2050, consistent with the statewide EV targets under Executive Order (EO) N-79-20. The California Air Resources Board's (CARB's) EMissions FACtor Model (EMFAC2021) estimates that in Alameda County light-duty eVMT will account for approximately 8 percent of total light-duty VMT in 2030.

This measure assumes that the percent of medium- and heavy-duty eVMT will be 11 percent of total medium- and heavy-duty passenger VMT in 2030, 62 percent in 2045, and 75 percent in 2050, consistent with the statewide EV targets under EO N-79-20. CARB's EMFAC2021 model estimates that in Alameda County medium- and heavy-duty eVMT will account for approximately 7 percent of total light-duty VMT in 2030.

Measure IN-4: Increase the use of smart mobility and modernize transportation infrastructure as identified in the City's Mobility Action Plan.

Quantification assumptions: This measure assumes that traffic signal modernization will achieve a 7 percent reduction in passenger vehicle emissions by 2030, based on CAPCOA measure RPT-2 (CAPCOA 2010).

Measure IN-5: Improve pedestrian and bicycle infrastructure as identified in previous City plans and the new Active Transportation Plan.

Quantification assumptions: This measure assumes 50 miles of new bike lanes will be installed by 2030, 119 miles by 2045, and 130 miles by 2050. The 2018 Bicycle Master Plan proposes 119 miles of new bikeway by 2040 (City of Fremont 2018). This measure assumes 45 miles of new pedestrian paths will be installed by 2030, 55 miles by 2045, and 60 miles by 2050. The 2016 Pedestrian Master Plan proposes 53 miles of new pedestrian paths by 2035 (City of Fremont 2016).

CRITICAL INFRASTRUCTURE PROTECTION

Measure IN-7: Improve energy sector resilience.

Quantification assumptions: Not quantified.

Measure IN-8: Improve water and wastewater sector resilience.

Quantification assumptions: Not quantified.

Measure IN-9: Protect vulnerable transportation infrastructure, services, and systems from climate impacts.

Quantification assumptions: Not quantified.

Measure IN-10: Assess local vulnerabilities to climate change and incorporate climate adaptation and resiliency into City planning, policies, and infrastructure projects.

Quantification assumptions: Not quantified.

CLEAN LANDSCAPING AND OFF-ROAD EQUIPMENT

Measure IN-11: Reduce emissions and air pollution associated with landscaping equipment.

Quantification assumptions: This measure assumes that all new landscaping equipment is electric-powered starting in 2024 and that 60 percent of existing gas-powered landscaping equipment is replaced with electric alternatives by 2030 and 100 percent is replaced by 2045.

Measure IN-12: Reduce emissions and air pollution associated with diesel fuel use in off-road equipment and stationary sources.

Quantification assumptions: This measure assumes that 40 percent of construction equipment is either converted to electric or is powered by renewable diesel by 2030, 80 percent by 2045, and 85 percent by 2050. This measure also assumes that 40 percent of backup generators are replaced with zero-emission alternatives by 2030 and 100 percent are replaced by 2045.

Land Use and Mobility

CLEAN AND MULTIMODAL MOBILITY AND CONNECTIVITY

Measure LU-1: Promote and enhance active transportation options as identified in the City's Active Transportation Plan and Mobility Action Plan.

Quantification assumptions: Not quantified to avoid double counting with Measure IN-5.

Measure LU-2: Reduce vehicle miles traveled (VMT) and single-occupancy vehicle trips, as identified in Fremont's General Plan.

Quantification assumptions: This measure assumes all new development complies with the City's Senate Bill 743 requirements and achieves a 15 percent reduction below in project-generated VMT.

Measure LU-3: Encourage the adoption of zero-emission passenger vehicles.

Quantification assumptions: Not quantified to avoid double counting with Measure IN-3.

Measure LU-4: Increase transit ridership and promote transition to zero-emission transit.

Quantification assumptions: This measure assumes that comprehensive expansion of the transit network would result in a 10.3 percent reduction in citywide passenger VMT in 2030, 12.5 percent in 2045, and 14.8 percent in 2050 (Mozingo 2021). Bay Area Rapid Transit's (BART) Wholesale Electricity Portfolio Policy includes performance measures of achieving a wholesale electric portfolio that is from at least 50 percent Eligible Renewable sources and from at least 90 percent low and zero carbon sources by 2025 and is 100 percent from zero carbon sources by 2035. Accordingly, this measure assumes that BART's electricity supply will be 95 percent carbon-free by 2030 and 100 percent by 2045.

Measure LU-5: Increase implementation of Transportation Demand Management (TDM) strategies as identified in Fremont's General Plan.

Quantification assumptions: This measure assumes implementation of TDM strategies would result in a 15 percent reduction in passenger commute VMT by 2030, 25 percent by 2045, and 30 percent in 2050.

Measure LU-6: Reduce the amount of parking to encourage transit-oriented development (TOD) as identified in Fremont's General Plan.

Quantification assumptions: This measure assumes a 10 percent reduction in passenger commute VMT from implementation of parking reduction and management actions by 2030 (Mozingo 2021).

SUSTAINABLE LAND USE PLANNING

Measure LU-7: Apply smart growth and low carbon land use development principles.

Quantification assumptions: Not quantified.

Measure LU-8: Incorporate climate vulnerabilities into land use planning.

Quantification assumptions: Not quantified.

Materials and Waste

MATERIALS REUSE AND PLASTIC WASTE REDUCTION

Measure MW-1: Promote responsible consumption of products and materials and reduce disposable packaging use.

Quantification assumptions: Not quantified.

Measure MW-2: Encourage repair, reuse, and upcycling of materials.

Quantification assumptions: Not quantified.

MANAGING RECYCLING AND ORGANICS

Measure MW-3: Bolster recovery of organic and recyclable materials and increase landfill diversion rates.

Quantification assumptions: Fremont's estimated waste diversion rate for 2018 was 56 percent. This measure assumes that landfills diversion rates will increase to 75 percent by 2030, 90 percent by 2045, and 95 percent by 2050.

Measure MW-4: Support methane recovery and reuse from organic sources.

Quantification assumptions: Not quantified.

Measure MW-5: Establish and advance zero waste targets and policies.

Quantification assumption: Not quantified to avoid double counting with Measure MW-3.

Natural and Urban Landscapes

CARBON SEQUESTRATION

Measure NL-1: Increase soil carbon content.

Quantification assumptions: Not quantified.

Measure NL-2: Increase the carbon sequestration potential of the City's bayfront and bayland areas.

Quantification assumptions: Not quantified.

Measure NL-3: Implement the City's Urban Forestry Management Plan.

Quantification assumptions: According to the City's 2020 Urban Tree Assessment, the tree canopy covers 14 percent of the City's land area. The Tree Assessment identified an additional 17 percent of the City's land area as possible planting areas, while the remaining 69 percent was deemed unsuitable for plantings (City of Fremont 2020). This measure assumes an increase in total tree canopy coverage to 15 percent of the City's land area by 2030, 16 by 2045, and 17 by 2050.

GREEN INFRASTRUCTURE

Measure NL-4: Expand and protect green infrastructure and biodiversity.

Quantification assumptions: Not quantified.

WATER CONSERVATION IN LANDSCAPES

Measure NL-5: Reduce water usage for irrigation and landscaping.

Quantification assumptions: This measure assumes an 80 percent reduction in outdoor water consumption by 2030, 90 by 2045, and 100 by 2050 in new development. This measure assumes a 50 percent reduction in outdoor water consumption by 2030, 80 percent by 2045, and 90 percent by 2050 in existing development.

Measure NL-6: Conserve and protect natural habitats, ecosystems, and wildlife corridors impacted by climate change.

Quantification assumptions: Not quantified.

Measure NL-7: Restore, rehabilitate, and repurpose degraded, damaged, or destroyed ecosystems through active interventions to enhance the natural adaptive capacity of biological communities.

Quantification assumptions: Not quantified.

Measure NL-8: Prioritize nature-based solutions to improve coastal and watershed resilience while promoting biodiversity.

Quantification assumptions: Not quantified.

Adaptation and Resiliency

EXTREME HEAT MITIGATION

Measure AR-1: Adopt urban heat island reduction design guidelines.
Quantification assumptions: Not quantified.

Measure AR-2: Protect populations vulnerable to extreme heat and poor air quality.
Quantification assumptions: Not quantified.

WILDFIRE RISK REDUCTION

Measure AR-3: Reduce the wildland-urban interface (WUI) fire risk.
Quantification assumptions: Not quantified.

FLOOD RISK REDUCTION

Measure AR-4: Minimize risks to life and property resulting from flooding and flood induced hazards.
Quantification assumptions: Not quantified.

Measure AR-5: Reduce flood and drought risk through integrated watershed management.
Quantification assumptions: Not quantified.

SEA LEVEL RISE PREPAREDNESS

Measure AR-6: Evaluate proposed development in areas of the city subject to flooding impacts caused by rising sea levels.
Quantification assumptions: Not quantified.

Measure AR-7: Protect existing development from sea level rise impacts.
Quantification assumptions: Not quantified.

Measure AR-8: Minimize risks to life and property resulting from flooding caused by sea level rise.
Quantification assumptions: Not quantified.

EMERGENCY PREPAREDNESS AND DISASTER RESPONSE

Measure AR-9: Revise emergency management plans, programs, and activities. Quantification assumptions: Not quantified.

Measure AR-10: Ensure that emergency management activities are being conducted equitably.
Quantification assumptions: Not quantified.

Measure AR-11: Improve notification systems for natural hazards to reach the most vulnerable community members.
Quantification assumptions: Not quantified.

COMMUNITY RESILIENCE

Measure AR-12: Establish resilience hubs.
Quantification assumptions: Not quantified.

Measure AR-13: Improve food security.
Quantification assumptions: Not quantified.

Green Economy

GREEN BUSINESSES AND JOBS

Measure GE-1: Support and encourage circular economy innovation and business leadership in Fremont.
Quantification assumptions: Not quantified.

Measure GE-2: Incentivize and promote green business practices.
Quantification assumptions: Not quantified.

Measure GE-3: Support green jobs in the city.
Quantification assumptions: Not quantified.

CLIMATE EQUITY

Measure GE-4: Increase the resiliency of low-income or otherwise vulnerable housing.
Quantification assumptions: Not quantified.

Measure GE-5: Ensure an equitable transition to 100 percent clean power.
Quantification assumptions: Not quantified to avoid double counting with Measure BU-1.

CLIMATE-FRIENDLY PURCHASING, BUDGETING, AND FINANCING

Measure GE-6: Incorporate sustainability best practices into City purchasing decisions and City contracts.
Quantification assumptions: Not quantified.

Measure GE-7: Modify the City's capital planning and budgeting processes to incorporate priorities established by *Climate Ready Fremont*.
Quantification assumptions: Not quantified.

Measure GE-8: Establish financial mechanisms and pursue outside funding sources to support the implementation of *Climate Ready Fremont*.

Quantification assumptions: Not quantified.

Public Participation and Engagement

ACCESS TO NATURE AND ENVIRONMENTAL STEWARDSHIP

Measure PE-1: Ensure availability and accessibility to healthy, natural spaces and safe outdoor recreation opportunities for all community members.

Quantification assumptions: Not quantified.

Measure PE-2: Encourage residents and community members to act as environmental stewards.

Quantification assumptions: Not quantified.

CLIMATE ACTION AND ENGAGEMENT

Measure PE-3: Encourage community participation and ownership of *Climate Ready Fremont*.

Quantification assumptions: Not quantified.

Measure PE-4: Increase public awareness and participation in climate planning, with a focus on equity and inclusion.

Quantification assumptions: Not quantified.

CLIMATE TRACKING AND REPORTING

Measure PE-5: Track climate and sustainability metrics accurately and transparently for the community.

CONCLUSION

The total estimated GHG emissions reductions from all measures quantified would be 307,066 $MTCO_2e$ in 2030; 812,681 $MTCO_2e$ in 2045; and 948,730 $MTCO_2e$ in 2050. This would result in total citywide GHG emissions of 746,348 $MTCO_2e$ in 2030; 263,891 $MTCO_2e$ in 2045; and 147,253 $MTCO_2e$ in 2050. The total estimated reductions from all proposed GHG reduction measures would not be sufficient to meet the 2030 target of 178,119 $MTCO_2e$.

The scale of reductions required to achieve the carbon neutrality target for 2045 discussed earlier would require significant improvements in the availability and/or cost of near-zero and zero-emissions technologies, as well as potential increased reductions from ongoing State and federal legislative actions that are currently unknown. Progress toward meeting future targets that could be set by the State would be part of the ongoing monitoring and updates to the CAP 2.0 as new legislation or future updates to CARB's Climate Change Scoping Plan are adopted.

Figure 2 shows the GHG reductions achieved by the proposed measures, organized by the same sectors used for the inventory and forecasts. Note, the nonresidential and residential building energy sectors have been combined. The

chart shows the estimated GHG reductions due to carbon sequestered through measure NL-3 to implement the City's Urban Forestry Management Plan as a dashed line that is not associated with any particular emissions sector. Figure 2 shows the City's progress towards the 2030 target with the proposed GHG reduction measures and demonstrates progress toward the 2045 carbon neutrality target.

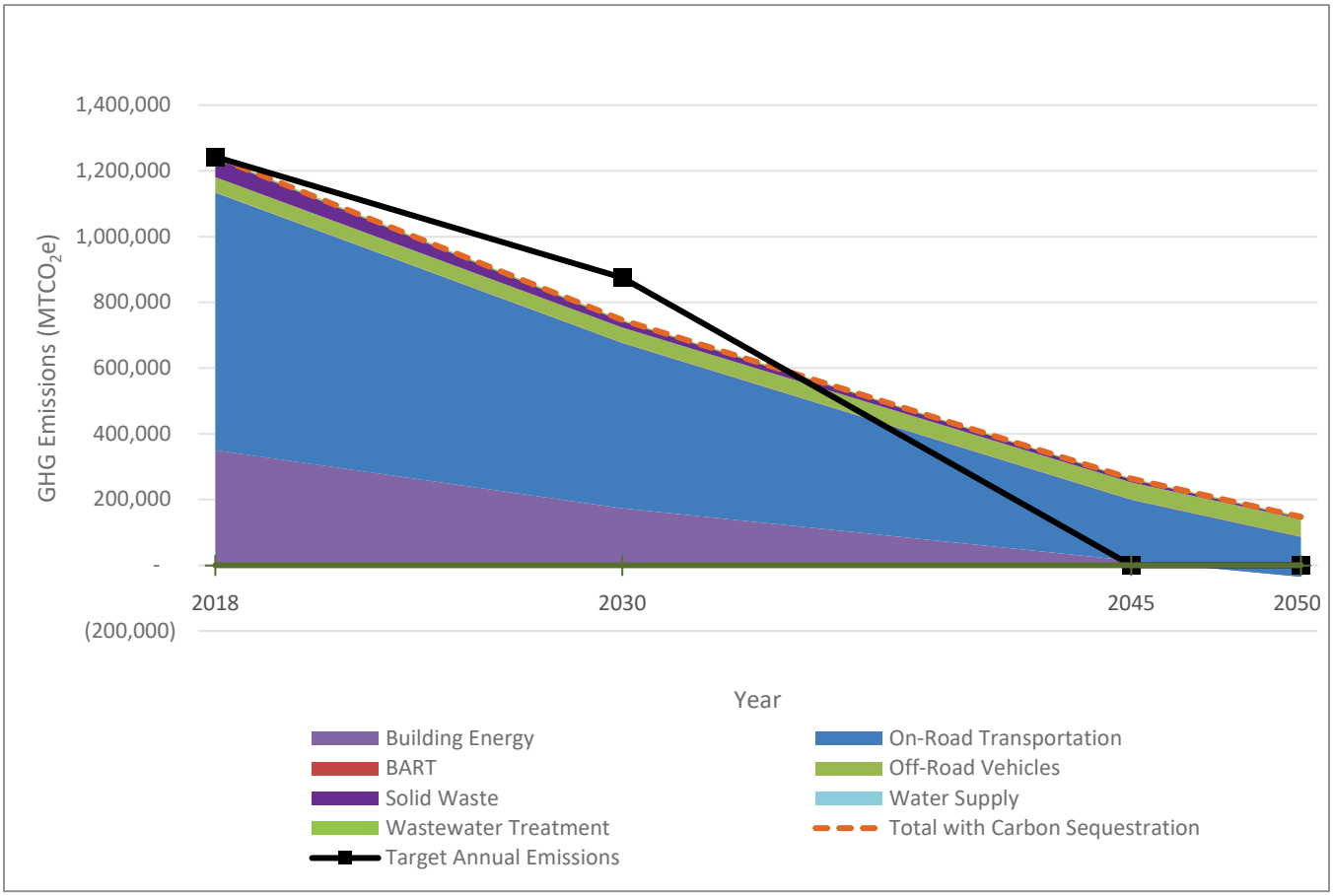

Figure 2 Forecasted GHG Emissions by Sector with Implementation of Proposed GHG Reduction Measures and Reduction Targets: 2030, 2045, and 2050

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Appendix B - Attachment I

GHG Measure Quantification Calculations

Measure Number	Measure Title	2030	2045	2050
BU-1	Transition to 100% clean electricity consumption.	51,370	-	-
BU-2	Require new residential construction to be all electric and low carbon.	200	6,921	7,972
BU-3	Require new nonresidential construction to be zero net energy and low carbon.	-	31,807	18,148
BU-4	Retrofit existing residential buildings to be all electric and low carbon.	40,347	119,873	139,387
BU-5	Retrofit existing nonresidential buildings to be all electric and low carbon.	25,634	109,710	144,752
BU-13	Reduce water consumption in buildings.	39	-	-
BU-14	Increase the capture and use of rainwater and use of greywater.	6	-	-
IN-3	Install infrastructure to support electric vehicle (EV) charging and other zero-emission vehicle (ZEV) refueling needs.	81,888	393,435	469,766
IN-4	Increase the use of smart mobility and modernize transportation infrastructure as identified in the City's Mobility Action Plan.	17,173	13,984	13,225
IN-5	Improve pedestrian and bicycle infrastructure as identified in previous City plans and the new Active Transportation Plan.	13	42	49
IN-11	Reduce emissions and air pollution associated with landscaping equipment.	2,500	5,058	5,182
IN-12	Reduce emissions and air pollution associated with diesel fuel use in off-road equipment and stationary sources.	4,450	11,258	12,481
LU-2	Reduce vehicle miles traveled (VMT) and single-occupancy vehicle trips, as identified in Fremont's General Plan.	14,004	27,118	30,959
LU-4	Increase transit ridership and promote transition to zero-emissions transit.	31,759	34,172	39,612
LU-5	Increase implementation of Transportation Demand Management (TDM) strategies as identified in Fremont's General Plan.	12,553	18,456	21,776
LU-6	Reduce the amount of parking to encourage transit-oriented development (TOD) as identified in Fremont's General Plan.	10,192	8,840	8,783
MW-3	Bolster recovery of organic and recyclable materials and increase landfill diversion rates.	14,653	31,042	35,497
NL-3	Implement the City's Urban Forestry Management Plan.	252	965	1,144
NL-5	Reduce water usage for irrigation and landscaping.	35	-	-
	Total Reductions from Measures	**307,066**	**812,681**	**948,730**
	Forecasted Citywide Emissions	1,053,414	1,076,571	1,095,984
	Forecasted Citywide Emissions with Reduction Measures	746,348	263,891	147,253
	Percent change from 2005 levels	-54.4%		
	Reduction Needed for Target (below 2018 levels, consistent with State targets)	178,119	1,076,571	1,095,984
	Gap Needed to Achieve Target*	**(128,947)**	**263,891**	**147,253**

**positive values indicate that a gap exists and target has not been achieved.*

BU-1

Transition to 100% clean electricity consumption.

	2018	2030	2045	2050
Total electricity emissions (MTCO2e)	90,690	36,179	-	-
Additional electricity emissions from other measures (MTCO2e)				
BU-2		49	-	-
BU-3		-	-	-
BU-4		9,832	-	-
BU-5		1,767	-	-
IN-3		3,543	-	-
Total GHG Reductions (MTCO2e)		51,370	-	-

BU-2

Require new residential construction to be all electric and low carbon.

	2018	2024.5	2025	2030	2045	2050
All-electric new residential development starting in 2023						
Annual residential natural gas usage with legislative reductions (therms)	26,369,188	26,424,841	26,429,122	26,471,932	27,734,186	27,932,915
New natural gas usage from 2018 (therms)		55,653	59,934	102,744	1,364,998	1,563,727
New natural gas usage starting in 2024				47,091	1,309,345	1,508,074
Percent of new residential development starting July 1, 2024 that will be all electric				100%	100%	100%
Reduced residential natural gas usage from all-electric new residential development starting in 2024 (therms)				47,091	1,309,345	1,508,074
GHG reductions from new residential natural gas savings (MTCO2e)				249	6,921	7,972
Additional electricity usage from fuel switching						
Total therms offset from natural gas heating use (therms)				47,091	1,309,345	1,508,074
Efficiency Assumptions						
Assumed average efficiency of natural gas heating (conservative) [1]	78%					
Assumed average efficiency of electric heating [2]	100%					
Total electricity needed to offset natural gas heating (MWh)				1,076	29,924	34,466
Fremont weighted residential electricity emissions factor (MTCO2e/MWh)				0.045318996	0	0
Additional GHG emissions from electricity use (MTCO2e)				49	-	-
Total GHG Reductions (MTCO2e)				200	6,921	7,972

Sources:

[1] Energy Solutions Center. 2021. Natural Gas Furnaces. Available: https://naturalgasefficiency.org/for-residential-customers/heat-gas_furnace/#:~:text=All%20furnaces%20built%20and%20sold,furnace%20with%20standing%20pilot%20%E2%80%93%2050%25

[2] U.S. DOE. 2021. Electric Resistance Heating. Available: https://www.energy.gov/energysaver/home-heating-systems/electric-resistance-heating#:~:text=Electric%20resistance%20heating%20is%20100,the%20fuel's%20energy%20into%20electricity.

BU-3

Require new nonresidential construction to be zero net energy and low carbon.

	2018	2025	2030	2045	2050
All-electric new nonresidential development starting in 2026					
Annual nonresidential natural gas usage with legislative reductions (therms)	22,445,051	21,866,095	21,452,554	25,392,982	23,862,684
New natural gas usage starting in 2026 (therms) [1]			0	3,526,887	1,996,589
Percent of new nonresidential development starting in 2026 that will be all electric			100%	100%	100%
Reduced nonresidential natural gas usage from all-electric new nonresidential development starting in 2026 (therms)			0	3,526,887	1,996,589
GHG reductions from new nonresidential natural gas savings (MTCO2e)			-	18,643	10,554
Additional electricity usage from fuel switching					
Total therms offset from natural gas heating use (therms)			0	3,526,887	1,996,589
Efficiency Assumptions					
Assumed average efficiency of natural gas heating (conservative) [2]	78%				
Assumed average efficiency of electric heating [3]	100%				
Total electricity needed to offset natural gas heating (MWh)			-	80,604	45,630
Fremont weighted nonresidential electricity emissions factor (MTCO2e/MWh)			0.045318996	0	0
Additional GHG emissions from electricity use (MTCO2e)			-	-	-
Total GHG Reductions (MTCO2e)			-	18,643	10,554

Sources:

[1] 2030 values zeroed because demographic forecasts anticipate a decline in jobs between 2018 and 2030.

[2] Energy Solutions Center. 2021. Natural Gas Furnaces. Available: https://naturalgasefficiency.org/for-residential-customers/heat gas_furnace/#:~:text=All%20furnaces%20built%20and%20sold,furnace%20with%20standing%20pilot%20%E2%80%93%2050%25

[3] U.S. DOE. 2021. Electric Resistance Heating. Available: https://www.energy.gov/energysaver/home-heating-systems/electric-resistance heating#:~:text=Electric%20resistance%20heating%20is%20100,the%20fuel's%20energy%20into%20electricity.

BU-3

Require new nonresidential construction to be zero net energy and low carbon.

	2018	2025	2030	2045	2050
All-electric new nonresidential development excluding industrial starting in 2026					
Annual nonresidential natural gas usage with legislative reductions (therms)	22,445,051	21,866,095	21,452,554	25,392,982	23,862,684
Percent nonresidential natural gas usage attributable to non-industrial uses	47%	45%	44%	41%	40%
New natural gas usage starting in 2026 (therms) [1]			0	3,526,887	1,996,589
New natural gas usage attributable to non-industrial uses [1]			0	1,447,681	798,636
Percent of new nonresidential development, excluding industrial, starting in 2026 that will be all electric			100%	100%	100%
Reduced nonresidential excluding industrial natural gas usage from all-electric new nonresidential development starting in 2026 (therms)			0	1,447,681	798,636
GHG reductions from new nonresidential excluding industrial natural gas savings (MTCO2e)			-	7,652	4,222

	2018	2030	2045	2050
All-electric new industrial from 2018				
Annual nonresidential natural gas usage with legislative reductions (therms)	22,445,051	21,452,554	25,392,982	23,862,684
Percent nonresidential natural gas usage attributable to industrial uses	53%	56%	59%	60%
New natural gas usage from 2018 (therms) [1]		0	2,947,931	1,417,633
New natural gas usage attributable to industrial uses [1]		0	1,737,894	850,580
Percent of new industrial development that will be all electric		15%	60%	75%
Reduced industrial natural gas usage from all-electric new industrial development from 2018 (therms)		0	1,042,736	637,935
GHG reductions from new industrial natural gas savings (MTCO2e)		-	5,512	3,372
Additional electricity usage from fuel switching (all nonresidential)				
Total therms offset from natural gas heating use (therms)		0	2,490,417	1,436,570
Efficiency Assumptions				
Assumed average efficiency of natural gas heating (conservative) [2]	78%			
Assumed average efficiency of electric heating [3]	100%			
Total electricity needed to offset natural gas heating (MWh)		-	56,916	32,832
Fremont weighted nonresidential electricity emissions factor (MTCO2e/MWh)		0.045319	0	0
Additional GHG emissions from electricity use (MTCO2e)		-	-	-
Total GHG Reductions (MTCO2e)		-	13,164	7,594

Percent existing nonresidential natural gas usage attributable to industrial uses	
Industrial building gross square footage in Fremont 2021 (sq. ft.) [4]	44,296,961
General heavy industry natural gas usage, historical, Title 24 (kBtu per sq. ft.) [5]	27
General light industry natural gas usage, historical, Title 24 (kBtu per sq. ft.) [5]	27
Average heavy and light industry natural gas usage, historical, Title 24 (kBtu per sq. ft.) [5]	27
Fremont industrial sector estimated natural gas usage (therms)	11,963,051
Existing nonresidential natural gas usage in 2018 (therms)	22,445,051
Percent nonresidential natural gas usage attributable to industrial uses	53%

Forecasted percent of nonresidential natural gas usage attributable to industrial uses	2018	2030	2045	2050

Based on data from the City regarding economic development trends and forecasts, it is anticipated that there will be continued growth in industrial inventory and decline in retail space over time. Thus, the share of nonresidential natural gas consumption due to industrial uses will likely increase over time. [6] 2018 percentage was calculated based on industrial square footage and the average rate of natural gas usage for industrial uses in CalEEMod Climate Zone 5 in kBtu per square foot. It is assumed that by 2050, 60% of nonresidential sector natural gas usage will be from industrial uses. The 2030 and 2045 values have been interpolated.	53%	56%	59%	60%

Sources:

[1] 2030 values zeroed because demographic forecasts anticipate a decline in jobs between 2018 and 2030
[2] Energy Solutions Center. 2021. Natural Gas Furnaces. Available: https://naturalgasefficiency.org/for-residential-customers/heat gas_furnace/#:~:text=All%20furnaces%20built%20and%20sold,furnace%20with%20standing%20pilot%20%E2%80%93%2050%25
[3] U.S. DOE. 2021. Electric Resistance Heating. Available: https://www.energy.gov/energysaver/home-heating-systems/electric-resistance heating#:~:text=Electric%20resistance%20heating%20is%20100,the%20fuel's%20energy%20into%20electricity.
[4] City of Fremont. 2021. Industrial Submarket Report
[5] CAPCOA. May 2021. CalEEMod Appendix D, Default Data Tables. Table 8.1 Energy Use by Climate Zone and Land Use Type
[6] Data provided by Donovan Lazaro, Economic Development Manager, City of Fremont. September 14, 2021

Dan alluded to this but based on demand for industrial space and our current development application pipeline, we can safely anticipate continued growth in industrial inventory for the foreseeable future. Conversely, macroeconomic shifts suggest that retail space will steadily decrease over time, perhaps significantly. Demand for office and hospitality in Fremont is much lower post-pandemic, but we could see a presumption of modest growth over time.

BU-4

Retrofit existing residential buildings to be all electric and low carbon.

	2018	2030	2045	2050
Removal of natural gas from existing residential				
Existing residential natural gas usage (therms)	26,369,188	26,369,188	26,369,188	26,369,188
Target electrification rate for existing residential [1]		36%	86%	100%
Reduction in natural gas usage (therms)		9,492,908	22,677,502	26,369,188
GHG reductions from existing residential natural gas savings (MTCO2e)		50,179	119,873	139,387
Additional electricity usage from fuel switching				
Total therms offset from natural gas heating use (therms)		9,492,908	22,677,502	26,369,188
Efficiency Assumptions				
Assumed average efficiency of natural gas heating (conservative) [2]	78%			
Assumed average efficiency of electric heating [3]	100%			
Total electricity needed to offset natural gas heating (MWh)		216,952	518,274	602,644
Fremont weighted residential electricity emissions factor (MTCO2e/MWh)		0.045318996	0	0
Additional GHG emissions from electricity use (MTCO2e)		9,832	-	-
Total GHG Reductions (MTCO2e)		40,347	119,873	139,387

Electrification target interpolation [1]	**Year**	**Target**
	2040	72%
	2045	86%
	2050	100%

Sources:

[1] Mozingo. 2021. Zero-Carbon Buildings in California: A Feasibility Study
[2] Energy Solutions Center. 2021. Natural Gas Furnaces. Available: https://naturalgasefficiency.org/for-residential-customers/heat-gas_furnace/#:~:text=All%20furnaces%20built%20and%20sold,furnace%20with%20standing%20pilot%20%E2%80%93%2050%25
[3] U.S. DOE. 2021. Electric Resistance Heating. Available: https://www.energy.gov/energysaver/home-heating-systems/electric-resistance-heating#:~:text=Electric%20resistance%20heating%20is%20100,the%20fuel's%20energy%20into%20electricity.

BU-5

Retrofit existing nonresidential buildings to be all electric and low carbon.

	2018	2030	2045	2050
Removal of natural gas from existing nonresidential				
Existing nonresidential natural gas usage (therms)	22,445,051	22,445,051	22,445,051	22,445,051
Target electrification rate for existing nonresidential [1]		13%	49%	65%
Reduction in natural gas usage (therms)		2,917,857	10,885,850	14,589,283
GHG reductions from existing nonresidential natural gas savings (MTCO2e)		15,424	57,542	77,119
Additional electricity usage from fuel switching				
Total therms offset from natural gas heating use (therms)		2,917,857	10,885,850	14,589,283
Efficiency Assumptions				
Assumed average efficiency of natural gas heating (conservative) [2]	78%			
Assumed average efficiency of electric heating [3]	100%			
Total electricity needed to offset natural gas heating (MWh)		66,685	248,786	333,425
Fremont weighted nonres electricity emissions factor (MTCO2e/MWh)		0.026494685	0	0
Additional GHG emissions from electricity use (MTCO2e)		1,767	-	-
Total GHG Reductions (MTCO2e)		13,657	57,542	77,119

Electrification target interpolation [1]	**Year**	**Target**
	2040	32%
	2045	49%
	2050	65%

Sources:

[1] Mozingo. 2021. Zero-Carbon Buildings in California: A Feasibility Study

[2] Energy Solutions Center. 2021. Natural Gas Furnaces. Available: https://naturalgasefficiency.org/for-residential-customers/heat-gas_furnace/#:~:text=All%20furnaces%20built%20and%20sold,furnace%20with%20standing%20pilot%20%E2%80%93%2050%25

[3] U.S. DOE. 2021. Electric Resistance Heating. Available: https://www.energy.gov/energysaver/home-heating-systems/electric-resistance-heating#:~:text=Electric%20resistance%20heating%20is%20100,the%20fuel's%20energy%20into%20electricity.

BU-5

Retrofit existing nonresidential buildings to be all electric and low carbon.

	2018	2030	2045	2050
Removal of natural gas from existing nonresidential excluding industrial				
Existing nonresidential excluding industrial natural gas usage (therms)	10,482,000	10,482,000	10,482,000	10,482,000
Target electrification rate for existing nonresidential excluding industrial [1]		13%	49%	65%
Reduction in natural gas usage (therms)		1,362,660	5,083,770	6,813,300
GHG reductions from existing nonresidential excluding industrial natural gas savings (MTCO2e)		7,203	26,873	36,015
Removal of natural gas from existing industrial				
Existing industrial natural gas usage (therms)	11,963,051	11,963,051	11,963,051	11,963,051
Target electrification rate for existing industrial [1]		10%	40%	50%
Reduction in natural gas usage (therms)		1,196,305	4,785,220	5,981,525
GHG reductions from existing industrial natural gas savings (MTCO2e)		6,324	25,295	31,618
Additional electricity usage from fuel switching				
Total therms offset from natural gas heating use (therms)		2,558,965	9,868,990	12,794,826
Efficiency Assumptions				
Assumed average efficiency of natural gas heating (conservative) [2]	78%			
Assumed average efficiency of electric heating [3]	100%			
Total electricity needed to offset natural gas heating (MWh)		58,483	225,547	292,414
Fremont weighted nonres electricity emissions factor (MTCO2e/MWh)		0.026494685	0	0
Additional GHG emissions from electricity use (MTCO2e)		1,549	-	-
Total GHG Reductions (MTCO2e)		11,977	52,167	67,633

Electrification target interpolation [1]	**Year**	**Target**
	2040	32%
	2045	49%
	2050	65%

Percent existing nonresidential natural gas usage attributable to industrial uses	
Industrial building gross square footage (sq. ft.) [4]	44,296,961
General heavy industry natural gas usage, historical, Title 24 (kBtu per sq. ft.) [5]	27
General light industry natural gas usage, historical, Title 24 (kBtu per sq. ft.) [5]	27
Fremont industrial sector estimated natural gas usage (therms)	11,963,051
Existing nonresidential natural gas usage in 2018 (therms)	22,445,051
Percent nonresidential natural gas usage attributable to industrial uses	53%

Sources:

[1] Mozingo. 2021. Zero-Carbon Buildings in California: A Feasibility Study

[2] Energy Solutions Center. 2021. Natural Gas Furnaces. Available: https://naturalgasefficiency.org/for-residential-customers/heat gas_furnace/#:~:text=All%20furnaces%20built%20and%20sold,furnace%20with%20standing%20pilot%20%E2%80%93%2050%25

[3] U.S. DOE. 2021. Electric Resistance Heating. Available: https://www.energy.gov/energysaver/home-heating-systems/electric-resistance heating#:~:text=Electric%20resistance%20heating%20is%20100,the%20fuel's%20energy%20into%20electricity.

[4] City of Fremont. 2021. Industrial Submarket Report

[5] CAPCOA. May 2021. CalEEMod Appendix D, Default Data Tables. Table 8.1 Energy Use by Climate Zone and Land Use Type

BU-13

Reduce water consumption in buildings.

Establish ultra-low-flow water fixture retrofit requirements for low-rise residential, and small multifamily and commercial buildings.

	2018	2030	2045	2050
Water-related electricity usage in new development [1]				
PG&E electricity usage (MWh)	2,404	2,475	2,931	3,002
EBCE electricity usage (MWh)	7,662	7,891	9,341	9,569
PG&E electricity usage in new development (MWh)		72	527	598
EBCE electricity usage in new development (MWh)		228	1,679	1,907
Percent reduction in water usage in new development [2]		50%	50%	50%
PG&E reduced electricity usage (MWh)		36	263	299
EBCE reduced electricity usage (MWh)		114	839	953
PG&E emissions factor (MTCO2e/MWh)		0.051779	0	0
EBCE emissions factor (MTCO2e/MWh)		0	0	0
GHG reductions in new development (MTCO2e)		1.9	-	-
Water-related electricity usage in existing development				
PG&E electricity usage (MWh)		2,404	2,404	2,404
EBCE electricity usage (MWh)		7,662	7,662	7,662
Percent reduction in water usage in existing development [2]		30%	40%	50%
PG&E reduced electricity usage (MWh)		721	962	1,202
EBCE reduced electricity usage (MWh)		2,299	3,065	3,831
PG&E emissions factor (MTCO2e/MWh)		0.051779	0	0
EBCE emissions factor (MTCO2e/MWh)		0	0	0
GHG reductions in existing development (MTCO2e)		37.3	-	-
Total GHG Reductions (MTCO2e)		39.2	-	-

Sources:

[1] Electricity-use related to water usage is quantified in this measure

[2] CAPCOA. 2010. Quantifying Greenhouse Gas Mitigation Measures. WUW-1. Available: http://www.capcoa.org/wp-content/uploads/downloads/2010/09/CAPCOA-Quantification-Report-9-14-Final.pdf

WUW-1: 20% for residential and 31% for nonresidential low-flow fixtures. Assuming increase for ultra-low-flow, especially in new development

BU-14

Increase the capture and use of rainwater and use of greywater.

	2018	2030	2045	2050
Fremont population	232,685	239,610	283,656	290,591
Residential Water Use (estimate) (Million gallons per year)	6,170	6,354	7,522	7,706
Percent of households reusing grey water		20%	30%	40%
Percent reduction in potable water use from participating households		30%	40%	45%
Total Forecasted Water Use in Fremont (all sectors) (HCF)		11,787,910	13,954,805	14,295,959
Total Forecasted Water Use in Fremont (all sectors) (gal)		8,817,356,627	10,438,193,945	10,693,377,610
Residential Water Reduction Under Measure (gallons per year)		381,224,302	902,604,572	1,387,005,967
Emissions factor for water supply (g CO2e/gal)		1.45E-02	0.00E+00	0.00E+00
Total GHG Reductions (MTCO2e)		5.54	-	-

Grey water produced per person [1]	35
Percent Reduction in Household water use [1]	30%
Percent Reduction in Greywater Treatment Plant [2]	45%

Alameda County Water District Residential Per-Capita Water Use [3]	gallons per capita per day in 2018	Days per month	Total Gallons per capita
January	56	31	1736
February	60	28	1680
March	57	31	1767
April	61	30	1830
May	80	31	2480
June	90	30	2700
July	92	31	2852
August	90	31	2790
September	85	30	2550
October	78	31	2418
November	68	30	2040
December	54	31	1674
	Annual Per-Capita Water Use (gallons per capita)		26,517

Sources:

[1] Eva Eriksson , Karina Auffarth, Mogens Henze, Anna Ledin. Characteristics of Grey Wastewater. Urban Water, 4 85–104, 2002.

[2] D. Michael Revitt, Eva Eriksson, Erica Donner. The implications of household greywater treatment and reuse for municipal wastewaterflows and micropollutant loads. Water Research 45 2011.

[3] Pacific Institute. California Urban Water Use. Alameda County Water District. https://pacinst.org/gpcd/table/

IN-3

Install infrastructure to support electric vehicle (EV) charging and other zero-emission vehicle (ZEV) refueling needs.

	2018	2030	2045	2050
State-level EV Forecasts and Targets				
Statewide Light Duty Population [1]	26,707,072	27,823,204	30,102,489	30,588,748
Statewide Light Duty EV population [1]	218,339	1,413,449	2,333,152	2,441,372
Statewide Light Duty EV Population Target under EO N-79-20 (5 million baseline scenario, 8 million high scenario) [2]		8,000,000	25,587,116	27,529,873
Target Percent EVs in Passenger Vehicles		**29%**	**85%**	**90%**
Target Percent EVs in Passenger Vehicles for Fremont		29%	85%	90%
EMFAC2021 Forecasts				
Light Duty eVMT in Alameda County [1]		1,061,787,205	1,386,626,054	1,433,418,678
Light Duty VMT in Alameda County [1]		13,052,492,156	14,302,117,716	14,647,998,431
Percent eVMT in Alameda County		**8.1%**	**9.7%**	**9.8%**
Forecasted eVMT in Fremont				
Fremont Passenger VMT after reduction from other measures		1,127,594,993	1,205,550,993	1,208,304,231
Forecasted eVMT in Fremont		91,726,999	116,881,182	118,241,810
Target eVMT in Fremont		324,217,151	1,024,718,344	1,087,473,808
Additional eVMT needed to meet State Targets		**232,490,152**	**907,837,162**	**969,231,997**
Additional GHG emissions from EV charger use				
Additional eVMT needed to meet State Targets		232,490,152	907,837,162	969,231,997
Average Efficiency of EV LDV (kWh/100-mi) [3]		34	34	34
Residential Electricity emissions factor (MTCO2e/MWh)		0.04532	-	-
Charged amount (kWh)		78,181,798	305,287,520	325,933,378
Additional GHG emissions from EVs (MTCO2e)		3,543	-	-
Emissions from Equivalent Gasoline/Diesel Vehicles				
Additional eVMT needed to meet State Targets		232,490,152	907,837,162	969,231,997
Avg emissions factor for non-electric light-duty vehicles (MTCO2e/mi)		0.0002979	0.0002740	0.0002729
Equivalent GHG emissions avoided from increased EV chargers (MTCO2e)		69,251	248,787	264,490
GHG Reductions from IN-3 (MTCO2e)		65,708	248,787	264,490

Sources:

[1] EMFAC 2021. Statewide light duty EV population. EMFAC 2021 does not account for statewide targets under EO N-79-20

[2] Assembly Bill 2127 Electric Vehicle Charging Infrastructure

[3] https://www.driveclean.ca.gov/pev/Charging.php

State-level EV Forecasts and Targets (Medium- and Heavy-Duty)	**2030**	**2045**	**2050**
Statewide Medium- and Heavy-Duty Population [1]	1,958,573	2,281,720	2,281,720
Statewide Medium- and Heavy-Duty EV population [1]	107,184	797,170	977,062
Statewide MDV EV Population Target under 2020 MSS [2]	40,788	582,910	750,000
Statewide HDV EV Population Target under EO N-79-20 [3]	171,176	827,867	960,000
Statewide Target Percent Increase in Commercial EVs	**11%**	**62%**	**75%**
Fremont Target Percent Increase in Commercial EVs	11%	62%	75%
EMFAC2021 Forecasts			
MDV and HDV eVMT in Alameda County [1]	111,181,867	636,645,858	735,244,799
MDV and HDV VMT in Alameda County [1]	1,615,808,201	2,086,807,810	2,258,493,248
Percent eVMT in Alameda County	6.9%	30.5%	32.6%
Forecasted eVMT in Fremont			
Fremont Commercial VMT after Measures	324,445,098	379,428,786	394,461,491
Forecasted Commercial eVMT in Fremont	22,324,687	115,756,594	128,415,597
Target eVMT in Fremont	35,112,678	234,599,108	295,623,045
Additional eVMT needed to meet State Targets	12,787,991	118,842,513	167,207,447
Emissions from Equivalent Gasoline/Diesel Vehicles			
Additional eVMT needed to meet State Targets	12,787,991	118,842,513	167,207,447

Avg emissions factor for non-electric MDV & HDV vehicles (MTCO2e/mi)	0.001265254	0.001217146	0.001227674
Equivalent GHG emissions avoided from increased EV chargers (MTCO2e)	16,180	144,649	205,276

Sources:

[1] EMFAC 2021. Statewide EV population. (EMFAC 2021 does not account for statewide targets under EO N-79-20)

[2] Assembly Bill 2127 Electric Vehicle Charging InfrastructureAssessment (Staff Report). January 2021.

[3] 2020 Mobile Source Strategy

IN-4

Increase the use of smart mobility and modernize transportation infrastructure as identified in the City's Mobility Action Plan.

	2018	2030	2045	2050
Annual passenger vehicle miles traveled (VMT) (Existing only)	1,309,215,427	1,309,215,427	1,309,215,427	1,309,215,427
Passenger VMT Reductions from Other Measures				
LU-4		134,849,189	163,651,928	193,763,883
LU-5		54,987,048	91,645,080	109,974,096
LU-6		44,644,246	44,644,246	44,644,246
IN-5		85,277	379,367	453,999
Total VMT Reductions from Other Measures		234,565,760	300,320,621	348,836,224
Adjusted new VMT		1,074,649,668	1,008,894,806	960,379,203
Conservative percent reduction in VMT [1]		7%	7%	7%
Emissions per mile for passenger vehicles (MTCO2e/mi)		2.28E-04	1.98E-04	1.97E-04
Total GHG Reductions (MTCO2e)		17,173	13,984	13,225

Source:

[1] CAPCOA. 2010. Quantifying Greenhouse Gas Mitigation Measures. RPT-2. Available: http://www.capcoa.org/wp-content/uploads/downloads/2010/09/CAPCOA-Quantification-Report-9-14-Final.pdf

IN-5

Improve pedestrian and bicycle infrastructure as identified in previous City plans and the new Active Transportation Plan.

	2018	2030	2045	2050	
New bike lanes in Fremont					
New bikeway miles proposed in 2018 Bicycle Master Plan by 2040 (119 by 2040) [1]		50	119	130	
Days per year that new bicycle lanes would be used?		365	365	365	
HPMS Daily Vehicle Miles of Travel in Fremont [2]		1,929,250	1,929,250	1,929,250	
HPMS Maintained Miles in Fremont [2]		499	499	499	
AADT on Roadways in Fremont		3,863	3,863	3,863	
Annual Average Daily Traffic on Parallel Roadways near bike paths (based on average AADT on Fremont roadways)		387	919	1,005	< Based on HPMS Data. Subject to verification.
Bicycle Adjustment factor [3]		0.0038	0.0038	0.0038	< Conservative adjustment factor based on low AADT
Bicycle Activity Center Credit [3]		0.0005	0.0005	0.0005	< assumed that new lanes would be placed near at least 3 activity centers within a half a mile of facilities
Annual Vehicle Trips reduced		607	1,442	1,578	
Annual VMT Reduced		30,348	171,323	205,149	
New pedestrian paths in Fremont					
New pedestrian path miles proposed in 2016 Pedestrian Master Plan by 2035 (53 miles) [4]		45	55	60	
Days per year that new pedestrian paths would be used?		365	365	365	
HPMS Daily Vehicle Miles of Travel in Fremont [2]		1,929,250	1,929,250	1,929,250	
HPMS Maintained Miles in Fremont [2]		499	499	499	
AADT on Roadways in Fremont		3,863	3,863	3,863	
Annual Average Daily Traffic on Parallel Roadways near bike paths (based on average AADT on Fremont roadways)		348	425	464	< Based on HPMS Data. Subject to verification.
Pedestrian Adjustment Factor		0.0038	0.0038	0.0038	< Conservative adjustment factor based on low AADT
Activity Center Credit		0.0005	0.0005	0.0005	< assumed that new lanes would be placed near at least 3 activity centers within a half a mile of facilities
Annual Vehicle Trips reduced		546	668	728	
Annual VMT Reduced		24,581	36,720	43,700	
Total Annual VMT Reduced		54,929	208,044	248,850	
Emissions per mile for passenger vehicles (MTCO2e/mi)		0.00022828	0.00020138	0.00019801	
GHG emissions reductions from active transportation (MTCO2e)		13	42	49	
GHG Reductions from IN-5 (MTCO2e)		13	42	49	

Sources:

[1] Fremont Bicycle Master Plan. Table B-1. https://www.fremont.gov/government/departments/transportation-engineering/walking-bicycling/bicycle-master-plan

[2] https://dot.ca.gov/-/media/dot-media/programs/research-innovation-system-information/documents/california-public-road-data/prd-2019-a11y.pdf

[3] https://www.tpl.org/sites/default/files/Climate-smart%20Cities%20Methodology%20Active%20Transport%20exec%20summary.pdf

[4] https://www.fremont.gov/government/departments/transportation-engineering/walking-bicycling/pedestrian-master-plan

	Facility Length (mi)
AADT on parallel roadway	>2

Table 6

2019 Maintained Miles & Daily Vehicle Miles of Travel Estimates by Jurisdiction

COUNTY	JURISDICTION	MAINTAINED MILES RURAL	MAINTAINED MILES URBANIZED	MAINTAINED MILES TOTAL	DAILY VEHICLE MILES OF TRAVEL (DVMT) [1,000] RURAL	DAILY VEHICLE MILES OF TRAVEL (DVMT) [1,000] URBANIZED	DAILY VEHICLE MILES OF TRAVEL (DVMT) [1,000] TOTAL
ALAMEDA							
Cities:	ALAMEDA		136.18	136.18		423.45	423.45
	ALBANY		25.89	25.89		73.57	73.57
	BERKELEY		220.22	220.22		800.13	800.13
	DUBLIN	5.25	102.19	107.44	14.90	446.89	461.79
	EMERYVILLE		17.93	17.93		67.85	67.85
	FREMONT		499.44	499.44		1,929.25	1,929.25
	HAYWARD		287.17	287.17		1,518.74	1,518.74
	LIVERMORE	0.49	317.95	318.44	1.68	1,022.19	1,023.87
	NEWARK		101.91	101.91		444.80	444.80
	OAKLAND		826.14	826.14		3,070.63	3,070.63
	PIEDMONT		37.25	37.25		66.05	66.05
	PLEASANTON		211.92	211.92		733.30	733.30
	SAN LEANDRO		187.77	187.77		564.84	564.84
	UNION		135.57	135.57		482.74	482.74
Other:	ALAMEDA COUNTY	157.10	332.99	490.10	589.09	1,420.22	2,009.31
	STATE HIGHWAYS	28.90	174.12	203.01	2,602.39	22,333.17	24,935.56
	STATE PARK SERVICE		1.15	1.15		0.52	0.52
	U.S. ARMY		3.48	3.48		1.57	1.57
	U.S. FISH AND WILDLIFE		1.10	1.10		0.49	0.49
	U.S. NAVY/MARINES	0.69	5.80	6.48	0.05	2.61	2.66
ALAMEDA TOTAL		**192.43**	**3,626.16**	**3,818.59**	**3,208.11**	**35,402.99**	**38,611.10**

$VT_{B,P}$ = (BIKE x D x AADT x [A + C]) + (PED x D x AADT x [A + C])

Where:

$VT_{B,P}$ = Annual vehicle trips reduced due to bicycling and walking

BIKE = Binary variable indicating whether the project has a bicycle component

PED = Binary variable indicating whether the project has a pedestrian component

D = Number of days per year that people use the facility

AADT = Annual average daily traffic on a parallel roadway

A = Adjustment factor (based on AADT, facility length, and whether the project is located in a university area; see Table 1)

C = Activity center credit (based on the number of activity centers located within a quarter- or half-mile of the project; see Table 2)

2.2.3 REDUCED VMT

The methodology calculates reduced vehicle miles traveled (VMT) by multiplying the number of trips shifted to bicycling, walking, and transit by the average trip lengths for each mode:

$VMT = VT_B * L_B + VT_P * L_P + VT_T * L_T$

Where:

VMT = Annual VMT reduced

VT_B = Annual vehicle trip reductions due to bicycling

L_B = Average length of bicycle trips

VT_P = Annual vehicle trip reductions due to walking

L_P = Average length of pedestrian trips

VT_T = Annual vehicle trip reductions due to transit

L_T = Average length of transit trips

12,000	0.0038	
24,000	0.0027	
3,000	0.0019	

Table 1 and Table 2 summarize the adjustment factors and activity center credits used in the methodology.

TABLE 1: ADJUSTMENT FACTORS (A) BY AADT, FACILITY LENGTH, AND WHETHER THE PROJECT IS LOCATED IN A UNIVERSITY AREA

AADT on parallel roadway	Facility length (mi)		
	<1	1–2	>2
NON-UNIVERSITY AREA			
12,000	0.0019	0.0029	0.0038
24,000	0.0014	0.002	0.0027
30,000	0.001	0.0014	0.0019
UNIVERSITY AREA			
12,000	0.0104	0.0155	0.0207
24,000	0.0073	0.0109	0.0145
30,000	0.0052	0.0078	0.0104

TABLE 2: ACTIVITY CENTER CREDITS (C) BY NUMBER OF ACTIVITY CENTERS AND DISTANCE FROM THE FACILITY

Number of activity centers	Within 1/2 mile of the facility	Within 1/4 mile of the facility
<3	0	0
3	0.0005	0.001
4–6	0.001	0.002
>6	0.0015	0.003

IN-11

Reduce emissions and air pollution associated with landscaping equipment.

	2018	2023	2030	2045	2050
Requiring zero-emission new landscaping equipment starting in 2024					
Lawn and garden emissions (MTCO2e)	4,063	4,094	4,138	5,058	5,182
New lawn and garden emissions since 2018 (MTCO2e)		31	75	995	1,119
New lawn and garden emissions starting in 2024 (MTCO2e)			44	964	1,088
Percent of new landscaping equipment converted to electric			100%	100%	100%
GHG reductions from requiring zero-emission equipment in 2024 (MTCO2e)			44	964	1,088
Replacing old landscaping equipment with zero-emission alternatives					
Existing lawn and garden emissions (MTCO2e)			4,094	4,094	4,094
Replacement rate for existing equipment			60%	100%	100%
GHG reductions from replacing old equipment (MTCO2e)			2,456	4,094	4,094
Total GHG Reductions (MTCO2e)			2,500	5,058	5,182

Sources:

[1] average for 4 stroke engine

[2] https://www.energy.gov/sites/prod/files/2014/04/f15/10097517.pdf

IN-12

Reduce emissions and air pollution associated with diesel fuel use in off-road equipment and stationary sources.

	2018	2030	2045	2050
Renewable diesel or alternative fuels construction equipment				
Construction emissions (MTCO2e)	9,934	11,028	13,917	14,533
Percent conversion to renewable diesel or alternatives		40%	80%	85%
GHG reductions from renewable diesel or alternatives (MTCO2e)		4,411	11,134	12,353
Elimination of fossil fuel backup generators [1]				
Existing backup generator natural gas usage (mcf)	33	32	41	42
Existing backup generator natural gas usage (therms)	347	332	423	434
Existing backup generator diesel usage (gallons)	9,790	9,357	11,935	12,226
Target elimination rate for backup generators		40%	100%	100%
Reduced natural gas use from elimination of backup generator permits by 2030 (therms)		133	423	434
Reduced diesel use from elimination of backup generator permits by 2030 (gallons)		3,743	11,935	12,226
Backup generator natural gas emissions factor (MTCO2e/therms)		0.00529	0.00529	0.00529
Backup generator diesel emissions factor (MTCO2e/gallon)		0.01023	0.01023	0.01023
GHG reductions from backup generator natural gas savings (MTCO2e)		0.70	2.24	2.29
GHG reductions from backup generator diesel savings (MTCO2e)		38.28	122.07	125.05
Total GHG Reductions (MTCO2e)		4,450	11,258	12,481

[1] Note that additional emissions from electricity are not quantified in this draft. These emissions would only occur in 2030 and would be negated by BU-1. Additional emissions from electricity use would likely be marginal for this measure.

LU-2

Reduce vehicle miles traveled (VMT) and single-occupancy vehicle trips, as identified in Fremont's General Plan.

	2018	2030	2045	2050
SB 743 requires a 15% reduction in new VMT (New VMT)				
Annual passenger vehicle miles traveled (VMT)	1,309,215,427	1,384,190,409	1,564,511,455	1,627,908,920
New passenger VMT		74,974,982	255,296,028	318,693,492
Percent VMT reduction from SB 743		15%	15%	15%
Reduced passenger VMT from SB 743		11,246,247	38,294,404	47,804,024
Passenger vehicle emissions factor (MTCO2e/mile)		0.000228283	0.000201383	0.000198008
GHG reductions from new passenger vehicles (MTCO2e)		2,567	7,712	9,466
Annual commercial vehicle miles traveled (VMT)	263,167,145	335,258,854	399,945,546	417,631,081
New commercial VMT		72,091,709	136,778,400	154,463,936
Percent VMT reduction from SB 743		15%	15%	15%
Reduced commercial VMT from SB 743		10,813,756	20,516,760	23,169,590
Commercial vehicle emissions factor (MTCO2e/mile)		0.001057569	0.000945873	0.000927641
GHG reductions from new commercial vehicles (MTCO2e)		11,436	19,406	21,493
Total GHG Reductions (MTCO2e)		14,004	27,118	30,959

LU-4

Increase transit ridership and promote transition to zero-emissions transit.

	2018	2030	2045	2050
Expanded transit ridership				
Annual passenger vehicle miles traveled (Existing VMT)	1,309,215,427	1,309,215,427	1,309,215,427	1,309,215,427
Percent reduction in citywide VMT from comprehensive expansion of transit network (estimated 5.8% to 14.8%) [1] [2]		10.3%	12.5%	14.8%
Passenger VMT reduction		134,849,189	163,651,928	193,763,883
Passenger vehicle emissions factor (MTCO2e/mi)		0.0002283	0.0002014	0.0001980
GHG reductions from passenger vehicles (MTCO2e)		30,784	32,957	38,367
BART 100% clean electricity				
Total existing and forecasted emissions from BART (MTCO2e) [3]	997	1,027	1,216	1,245
Percent reduction [4]		95%	100%	100%
GHG reductions from BART 100% clean electricity		976	1,216	1,245
Total GHG Reductions (MTCO2e)		31,759	34,172	39,612

Sources:

[1] Mozingo. 2021. Zero-Carbon Buildings in California: A Feasibility Study. The Center for Resource Efficient Communities and the Center for the Built Environment, UC Berkeley *5.8% to 14.8%*

[2] Handy, S. et al. (2013). Impacts of Transit Service Strategies on Passenger Vehicle Use and Greenhouse Gas Emissions - Policy Brief and Technical Background Document. California Air Resources Board. Retrieved from: https://arb.ca.gov/cc/sb375/policies/policies.htm *0.5% to 10.5%*

[3] Based on emission factor per passenger mile from Inventory (EBEW/Stopwaste). Assuming non-train emissions are negligible.

[3] Bay Area Rapid Transit. 2017. BART Wholesale Electricity Portfolio Policy. Available: https://www.bart.gov/sites/default/files/docs/BART%20Wholesale%20Electricity%20Portfolio%20Policy%204.27.17.pdf

LU-5

Increase implementation of Transportation Demand Management (TDM) strategies as identified in Fremont's General Plan.

	2018	2030	2045	2050
Annual passenger vehicle miles traveled (Existing VMT)	1,309,215,427	1,309,215,427	1,309,215,427	1,309,215,427
Percent of household VMT for commuting [1]		28%	28%	28%
Passenger VMT from commuting		366,580,320	366,580,320	366,580,320
Percent reduction in passenger commute VMT from TDM measures		15%	25%	30%
Reduction in passenger commute VMT from TDM measures		54,987,048	91,645,080	109,974,096
Passenger vehicle emissions factor (MTCO2e/mi)		0.0002283	0.0002014	0.0001980
GHG reductions in passenger commute VMT (MTCO2e)		12,553	18,456	21,776
Total GHG Reductions (MTCO2e)		12,553	18,456	21,776

Source:

[1] https://traveltrends-dev.transportation.org/wp-content/uploads/sites/62/2019/07/B2_CIA_Role-Overall-Travel_web_2.pdf

LU-6

Reduce the amount of parking to encourage transit-oriented development (TOD) as identified in Fremont's General Plan.

	2018	2030	2045	2050
Annual passenger vehicle miles traveled (Existing VMT)	1,309,215,427	1,309,215,427	1,309,215,427	1,309,215,427
Percent of household VMT for commuting [1]		34%	34%	34%
Passenger VMT from commuting		446,442,461	446,442,461	446,442,461
Target percent VMT reduction from parking reduction and management measures [2]		10%	10%	10%
VMT reductions under this measure		44,644,246	44,644,246	44,644,246
Emissions per mile for passenger vehicles (MTCO2e/mile)		0.000228	0.000198	0.000197
Total GHG Reductions (MTCO2e)		10,192	8,840	8,783

Sources:

[1] AASHTO. 2021. Commuting in America, The National Report on Commuting Patterns and Trends. Available: https://traveltrends.transportation.org/wp-content/uploads/sites/62/2021/04/CA01-5.pdf

[2] Mozingo. 2021. Zero-Carbon Buildings in California: A Feasibility Study. Appendix C Measures 12a, 12b, 12c, 13a

VMT Reduction Check				
CAPCOA's Maximum VMT Reduction in Urban Areas		75%		
CAPCOA's Maximum VMT Reduction in Suburban Areas		20%		
		2030	**2040**	**2045**
IN-5: Improve pedestrian and bicycle infrastructure as identified in previous City plans and the new Active Transportation Plan.		*54,929*	*208,044*	*248,850*
LU-2: SB 743 requires a 15% reduction in new VMT.	*(New VMT)*	*22,060,004*	*58,811,164*	*70,973,614*
LU-4: Expanded transit facilities	*(Existing VMT)*	*134,849,189*	*163,651,928*	*193,763,883*
LU-5: Increase implementation of transportation demand management (TDM) strategies	*(Existing VMT)*	*54,987,048*	*91,645,080*	*109,974,096*
LU-6: Reduce the amount of parking such that it meets the needs of residents, workers, visitors, and shoppers in a way that is consistent with broader goals related to sustainability and community character.	*(Existing VMT)*	*44,644,246*	*44,644,246*	*44,644,246*
Total VMT Reduction from Measures		*256,595,416*	*358,960,462*	*419,604,689*
TOTAL Passenger VMT Forecast		1,384,190,409	1,564,511,455	1,627,908,920
%Reduction in VMT from measures		**19%**	**23%**	**26%**
Total Passenger VMT with Reductions		**1,127,594,993**	**1,205,550,993**	**1,208,304,231**
Exceeds CAPCOA Maximum VMT Reduction? (max ~50)		**NO**	**NO**	**NO**

MW-3

Bolster recovery of organic and recyclable materials and increase landfill diversion rates.

	2018	2030	2045	2050
Total forecasted emissions from solid waste	57,018	33,934	40,172	40,048
Estimated diversion rate for Fremont	56%			
Targeted diversion rate		75%	90%	95%
Adjusted forecasted emissions from solid waste (MTCO2e)		19,281	9,130	4,551
Total GHG Reductions (MTCO2e)		**14,653**	**31,042**	**35,497**

NL-3

Implement the City's Urban Forestry Management Plan.

	2018	2030	2045	2050	2052	2062
Percent tree coverage (existing and targets) [1]	14%	15%	16%	17%	17%	24%
New tree coverage (acres)		123	473	560		
Additional sequestration from new tree coverage		252	965	1,144		
Total GHG Reductions (MTCO2e)		**252**	**965**	**1,144**		

Fremont Tree Canopy Assessment Info for Urbanized Areas[1]	**2018**	**Percent Tree Coverage**
Fremont urban tree canopy (acres)	3,239	14%
Possible planting area (acres)	3,826	17%
Unsuitable area (acres)	15,488	69%
Total land area (acres)	22,553	
Fremont trees total carbon storage (tons of carbon)	235,000	
Fremont trees annual carbon sequestration (tons of CO2/year)	6,000	
Carbon sequestration per area (MTCO2e/acre)	2.04	

Source:

[1] City of Fremont. 2020. Urban Tree Canopy Assessment

Email from Kit	**2020**	**Percent Tree Coverage**
Fremont citywide tree canopy (acres)	5,346	13%
Possible planting area (acres)	14,836	
Public (acres)	10,252	
Private (acres)	4,584	

Fremont citywide tree canopy total carbon storage (pounds of carbon)	46,141,637
Fremont trees annual carbon sequestration (pounds of CO2/year)	
Carbon sequestration per area (MTCO2e/acre)	

Draft canopy goal of 30% by 2062 = 1,741 new canopy acres every 10 years or 174 acres per year.
It is recommended the canopy goals and planting be a shared commitment between the City, partners, and property owners. Generally, it is recommended cities plant approximately 60% of the total trees. The remainder would be planted by partners and property owners. This equates to approximately 13,350 trees to plant per year or ~104 acres of canopy per year (based on future canopy of planted trees and mortality rates).

NL-5

Reduce water usage for irrigation and landscaping.

	2018	2030	2045	2050
Fremont population	232,685	239,610	283,656	290,591
Estimated annual water demand for landscaping (HCF)	6,097,263	6,278,725	7,432,902	7,614,615
In existing development		6,097,263	6,097,263	6,097,263
In new development		181,462	1,335,639	1,517,352
Percent reduction in outdoor landscaping water from Water Efficient Landscape and Water Conservation Ordinances, drought-tolerant and water-conserving native landscaping, and water-efficient irrigation equipment programs				
In existing development		50%	80%	90%
In new development		80%	90%	100%
Annual water reduction (HCF)				
In existing development		3,048,631	4,877,810	5,487,537
In new development		145,170	1,202,076	1,517,352
Total annual water reduction (HCF)		3,193,801	6,079,886	7,004,889
Emissions factor for water supply (g CO2e/gal)		1.45E-02	0.00E+00	0.00E+00
Emissions factor for water supply (MTCO2e/HCF)		1.08736E-05	0	0
Total GHG Reductions (MTCO2e)		34.73	-	-

Conversion Factors and Assumptions

Water Year	2011	2012	2013	2014	2015
Residential Exterior Water Use (millions of acre feet)	2.3	2.4	2.5	2.4	1.9
Population (from the Department of Finance)	37,561,624	37,924,661	38,269,864	38,556,731	38,870,150
Landscaping irrigation water use per capita per day (gallons)	53.70				

Source:

[1] https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/California-Water-Plan/Docs/Update2018/Final/SupportingDocs/Water-Portfolios and-Balances.pdf

California GHG Emissions Inventory (by scoping plan sector)

Included Emissions	2005	2018
Agriculture	33.70	32.70
Commercial and Residential	43.10	41.40
Electric Power	107.80	63.10
High GWP	9.30	20.40
Industrial	95.50	89.20
Recycling and Waste	7.80	8.70
Transportation	186.60	169.60

Source: CARB 2022. California GHG Emissions for 2000 to 2019. https://www.arb.ca.gov/cc/inventory/data/data.htm

CARB Scoping Plan Emissions Targets by Sector

	CARB GHG Inventory			2030 Scoping Plan Ranges	
Sectors	**1990**	**2005**	**2018**	**Low Scenario**	**High Scenario**
Agriculture	26	34	33	24	25
Residential and Commercial	44	43	41	38	40
Electric Power	108	108	63	30	53
High GWP	3	9	20	8	11
Industrial	98	96	89	83	90
Recycling and Waste	7	8	9	8	9
Transportation	152	187	170	103	111
Cap-and-Trade Program	n/a	n/a		-34	-79
Natural and Working Lands Net Sink*	-7				
Total	**431**	**484**	**425**	**260**	**260**

Source: 2017 Climate Change Scoping Plan. Table 3. https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf
Note: the Scoping Plan-reported emissions by sector reflect rounding.

Applicable Emission Sectors

Emission Sectors	Applicable to City of Fremont?
Agriculture	No
Residential and Commercial	Yes
Electric Power	Yes
High GWP	No
Industrial	Yes
Recycling and Waste	Yes
Transportation	Yes
Cap and Trade	No

GHG Reduction Targets

	All Sectors			Low Selected Sectors		High Selected Sectors		Low Selected Sectors		High Selected Sectors	
Milestone Year	Statewide Existing and Target Emissions (MMTCO2e)	Target Percent Reduction from 2005	Target Percent Reduction from 2018	Statewide Existing and Target Emissions (MMTCO2e)	Target Percent Reduction from 2005	Statewide Existing and Target Emissions (MMTCO2e)	Target Percent Reduction from 2005	Statewide Existing and Target Emissions (MMTCO2e)	Target Percent Reduction from 2018	Statewide Existing and Target Emissions (MMTCO2e)	Target Percent Reduction from 2018
1990	431	NA	NA								
2005	484	NA	NA	441	NA	441	NA	441	NA	441	
2018	425	12%	NA	372	16%	372	16%	372	NA	372	NA
2020	431	11%	-1%	409	7%	409	7%	409	-10%	409	-10%
2030	259	47%	39%	262	**41%**	303	**31%**	262	**30%**	303	**19%**
2040	77	82%	80%	NA	80%	NA	77%	NA	77%	NA	73%
2045	-	100%	100%	0	**100%**	0	**100%**	0	**100%**	0	**100%**

Notes: CARB statewide inventory current through 2018. 2040 target interpolated between 2030 target and 2045 goal under AB32, SB32, and EO B-55-18
Source: CARB 2021. California GHG Emissions for 2000 to 2019. https://www.arb.ca.gov/cc/inventory/data/data.htm

Fremont Mass Emissions Levels Using 2005 Baseline							
Low			High				
Year	Emissions	Target Percent Reduction from 2005	Year	Emissions	Target Percent Reduction from 2005	Difference from Leg-Adj BAU	< amount needed to be reduced
2005	1,634,965	--	2005	1,634,965	--		
2018	1,242,786	24%	2018	1,242,786	24%		
2020	1,517,016	7%	2020	1,517,016	7%	(463,602)	
2030	971,780	41%	2030	1,123,853	31%	81,634	
2040	323,927	80%	2040	374,618	77%		
2045	-	100%	2045	-	100%	1,076,571	

Fremont Mass Emissions Levels Using 2018 Baseline							
Low			High				
Year	Emissions	Target Percent Reduction from 2018	Year	Emissions	Target Percent Reduction from 2018	Difference from Leg-Adj BAU	< amount needed to be reduced
2005	1,634,965	--	2005	1,634,965	--		
2018	1,242,786	--	2018	1,242,786	--		
2020	1,366,396	-10%	2020	1,366,396	-10%	(312,982)	
2030	875,295	30%	2030	1,012,269	19%	178,119	
2040	291,765	77%	2040	337,423	73%		
2045	-	100%	2045	-	100%	1,076,571	

55% Below 2005 Levels by 2030 Target

Year	Emissions Level	% Reduction Needed Below 2005 Levels	Emissions Reduction Needed Below ABAU	
2005	1,634,965			
2030	735,734	55%	317,680	
2040	245,245	85%	823,607	<Interpolated
2045	-	100%	1,076,571	
2050	-	100%	1,095,984	

Fremont Mass Emissions Levels Using 2018 Baseline						
	Low		High			
	Emissions	Target Percent Reduction from 2018	Emissions	Target Percent Reduction from 2019	Difference from Leg-Adj BAU	< amount needed to be reduced
2018	1,242,786	--	1,242,786	--		
2020	1,366,396	-10%	1,517,016	-22%		
2030	875,295	30%	1,012,269	19%	178,119	
2040	291,765	77%	337,423	73%		
2045	-	100%	-	100%	1,076,571	

Conversion and Emissions Factors
Fremont Greenhouse Gas Forecast

Conversion Factors	
Category	**Value**
g/MT	1000000
g/lb	453.592
lb/MT	2204.622622
kg/MT	1000
MT/ton	1.10231
g/ton	907185
lb/kg	2.20462
gallon/acrefoot	325851.429
kwh/therm	29.3001111
gal/HCF	748
mcf/therms	10.37
MMBTU/gallon (diesel)	0.1374
therms/scf	0.01037
Btu/therm	99976

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				
	2018	**2030**	**2045/2050**	**Source**
PG&E EF (lb CO2/MWh)	206	113.0356164	0	https://www.theclimateregistry.org/our-members/cris-public-reports/
CAMX EF (lb CH4/MWh)	0.034	0.018888889	0	eGRID 2018 (https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid)
CAMX EF (lb N2O/MWh)	0.004	0.002222222	0	eGRID 2018 (https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid)
Fremont Weighted Residential EF (MTCO2e/MWh	0.088558844	0.045318996	0	EBEW GHG Inventory 2018
Fremont Weighted Non-Residential EF (MTCO2e/M	0.071364529	0.026494685	0	EBEW GHG Inventory 2018
PG&E EF (MTCO2e/MWh)	0.094484198	0.051779109	0	calculated

RPS Requirements				
RPS Target Year	**2018**	**2020**	**2030**	**2045**
PG&E				
Percent Renewable	27%	33%	60%	100%
Increase in Renewables (from 2018)		6%	33%	
EBCE				
Percent Renewable	41%	41%	100%	100%
Increase in Renewables (from 2018)		0%	59%	

Fuel Emission Factors			
Fuel	**Emission Factor**	**Unit**	**Source**
Diesel	10.21	kg CO2/gal	Climate Registry 2019 Default Emission Factors
	0.9	g CH4/MMBTU	
	0.4	g N2O/MMBTU	
	22.5091702	lb CO2/gal	
	0.000272586	lb CH4/gal	
	0.000121149	lb N2O/gal	
	0.010228012	MTCO2/gal	
Natural Gas	0.05444	kg CO2/scf	
	0.9	g CH4/MMBTU	
	0.9	g N2O/MMBTU	
	11.57372351	lb CO2/therm	
	0.000272586	lb CH4/therm	
	0.000272586	lb N2O/therm	
	0.00528598	MTCO2/therm	

Source: EMFAC2021 (v1.0.1) Emissions Inventory
Region Type: Statewide
Region: California
Calendar Year: 2018, 2030, 2045, 2050
Season: Annual
Vehicle Classification: EMFAC2011 Categories
Units: miles/day for CVMT and EVMT, trips/day for Trips, kWh/day for Energy Consumption, tons/day for Emissions, 1000 gallons/day for Fuel Consumption

Region	Calendar Y	Vehicle Categ	Model Year	Speed	Fuel	Population	Total VMT	CVMT	EVMT	Trips	Energy Consu	NOx_RUNEX	NOx_IDLEX	NOx_STREX	NOx_TOTEX
Statewide	2018	All Other Buse	Aggregate	Aggregate	Diesel	8387.965693	448848.4903	448848.4903	0	74652.8947	0	3.643022221	0.076398396	0.0341484	3.753569042
Statewide	2018	All Other Buse	Aggregate	Aggregate	Natural Ga	473.0343057	30521.82211	30521.82211	0	4210.00532	0	0.006715453	0.000821636	0	0.007537089
Statewide	2018	LDA	Aggregate	Aggregate	Gasoline	13941722.43	518760540.9	518760540.9	0	65176045.6	0	51.14149375	0	25.177486	76.31897979
Statewide	2018	LDA	Aggregate	Aggregate	Diesel	61467.65632	1934626.84	1934626.84	0	268007.035	0	0.917136632	0	0	0.917136632
Statewide	2018	LDA	Aggregate	Aggregate	Electricity	215328.9854	7904341.645	0	7904341.64	1093103.2	3051728.256	0	0	0	0
Statewide	2018	LDA	Aggregate	Aggregate	Plug-in Hyb	170226.3331	7961284.548	4313992.832	3647291.72	703885.887	1101590.805	0.031632607	0	0.087863	0.11949564
Statewide	2018	LDT1	Aggregate	Aggregate	Gasoline	1489629.168	49263752.23	49263752.23	0	6627585.67	0	14.60075574	0	4.0837286	18.6844843
Statewide	2018	LDT1	Aggregate	Aggregate	Diesel	2393.401439	45628.07032	45628.07032	0	8378.82192	0	0.068745703	0	0	0.068745703
Statewide	2018	LDT1	Aggregate	Aggregate	Electricity	2045.200735	57179.57203	0	57179.572	9482.31865	22076.03409	0	0	0	0
Statewide	2018	LDT1	Aggregate	Aggregate	Plug-in Hyb	19.73876113	945.9266195	512.5706158	433.356004	81.6197773	130.8864292	3.779E-06	0	1.023E-05	1.40134E-05
Statewide	2018	LDT2	Aggregate	Aggregate	Gasoline	5563436.713	202680869.1	202680869.1	0	25889042.9	0	42.2967385	0	17.143664	59.44040276
Statewide	2018	LDT2	Aggregate	Aggregate	Diesel	18603.81227	785585.1202	785585.1202	0	90804.3538	0	0.08666879	0	0	0.08666879
Statewide	2018	LDT2	Aggregate	Aggregate	Electricity	575.8117591	15369.65083	0	15369.6508	2717.02236	5933.953745	0	0	0	0
Statewide	2018	LDT2	Aggregate	Aggregate	Plug-in Hyb	2049.865376	99024.14738	53658.35776	45365.7896	8476.19333	13701.82058	0.000394755	0	0.0010594	0.001454128
Statewide	2018	LHD1	Aggregate	Aggregate	Gasoline	552302.3709	19542010.86	19542010.86	0	8228482.4	0	7.288929663	0.025073353	6.4690338	13.78303681
Statewide	2018	LHD1	Aggregate	Aggregate	Diesel	397993.4043	14475025.3	14475025.3	0	5006256.35	0	50.99393053	1.097154693	0	52.09108522
Statewide	2018	LHD2	Aggregate	Aggregate	Gasoline	78487.75591	2702307.125	2702307.125	0	1169350.62	0	0.9345201	0.003591853	0.9225164	1.860628323
Statewide	2018	LHD2	Aggregate	Aggregate	Diesel	131186.983	4974951.363	4974951.363	0	1650167.21	0	13.48275918	0.359494905	0	13.84225409
Statewide	2018	MCY	Aggregate	Aggregate	Gasoline	695309.6063	4057325.912	4057325.912	0	1390619.21	0	3.165533399	0	0.2870964	3.452629828
Statewide	2018	MDV	Aggregate	Aggregate	Gasoline	4326880.297	149661300.7	149661300.7	0	19878720.4	0	42.26801973	0	16.744687	59.01270676
Statewide	2018	MDV	Aggregate	Aggregate	Diesel	53592.43997	2201750.153	2201750.153	0	260697.593	0	0.274336102	0	0	0.274336102
Statewide	2018	MDV	Aggregate	Aggregate	Electricity	389.46343	7659.822652	0	7659.82265	1669.96619	2957.323743	0	0	0	0
Statewide	2018	MDV	Aggregate	Aggregate	Plug-in Hyb	10002.95578	477765.9435	258887.7255	218878.218	41362.2222	66107.74547	0.001889921	0	0.0051678	0.007057769
Statewide	2018	MH	Aggregate	Aggregate	Gasoline	117354.3805	989500.075	989500.075	0	11740.1322	0	0.822384738	0	0.0048768	0.827261574
Statewide	2018	MH	Aggregate	Aggregate	Diesel	36044.02755	347874.0342	347874.0342	0	3604.40275	0	1.921504879	0	0	1.921504879
Statewide	2018	Motor Coach	Aggregate	Aggregate	Diesel	2408.999999	270420.852	270420.852	0	55358.82	0	1.545684984	0.256878138	0.0762359	1.878799063
Statewide	2018	OBUS	Aggregate	Aggregate	Gasoline	16298.82103	791703.8255	791703.8255	0	326106.811	0	0.722617552	0.001162765	0.1507791	0.87455939
Statewide	2018	PTO	Aggregate	Aggregate	Diesel	0	573057.1721	573057.1721	0	0	0	5.159219056	0	0	5.159219056
Statewide	2018	SBUS	Aggregate	Aggregate	Gasoline	7125.1765	356985.3603	356985.3603	0	28500.706	0	0.534078944	0.007098674	0.0191169	0.560294468
Statewide	2018	SBUS	Aggregate	Aggregate	Diesel	19788.58879	444889.0815	444889.0815	0	286538.766	0	3.44077511	0.624637034	0.0941977	4.159609869
Statewide	2018	SBUS	Aggregate	Aggregate	Natural Ga	3450.251199	88711.26224	88711.26224	0	49959.6374	0	0.088878773	0.020158711	0	0.109037485
Statewide	2018	T6 CAIRP heav	Aggregate	Aggregate	Diesel	1668.41506	305682.0786	305682.0786	0	38340.1781	0	0.909449057	0.01029886	0.0159503	0.935698255
Statewide	2018	T6 CAIRP heav	Aggregate	Aggregate	Natural Ga	0.410569001	84.14673263	84.14673263	0	9.43487565	0	1.52481E-05	7.16538E-07	0	1.59647E-05
Statewide	2018	T6 CAIRP smal	Aggregate	Aggregate	Diesel	1151.330749	81001.45704	81001.45704	0	26457.5806	0	0.229055747	0.008154871	0.0110192	0.248229834
Statewide	2018	T6 instate hea	Aggregate	Aggregate	Diesel	50581.96584	2233493.326	2233493.326	0	608322.319	0	11.86079495	1.503906699	0.4802725	13.84497413
Statewide	2018	T6 instate hea	Aggregate	Aggregate	Natural Ga	447.1597853	27547.23064	27547.23064	0	5499.58153	0	0.004239035	0.002710583	0	0.006949619
Statewide	2018	T6 instate sma	Aggregate	Aggregate	Diesel	193354.1199	7395141.756	7395141.756	0	2410205.14	0	37.81653193	6.278515593	1.8921577	45.9872052
Statewide	2018	T6 instate sma	Aggregate	Aggregate	Natural Ga	467.3916376	20262.90221	20262.90221	0	5903.89238	0	0.004015999	0.002846862	0	0.006862861
Statewide	2018	T6 OOS heavy	Aggregate	Aggregate	Diesel	956.1743656	203087.5441	203087.5441	0	21972.8869	0	0.632199786	0.0059016	0.0091417	0.647243128
Statewide	2018	T6 OOS small	Aggregate	Aggregate	Diesel	659.669248	46410.79057	46410.79057	0	15159.1993	0	0.131242993	0.004672434	0.0063136	0.142229025
Statewide	2018	T6 Public	Aggregate	Aggregate	Diesel	24313.98915	990495.614	990495.614	0	124730.764	0	9.29338193	1.238378096	0.0579319	10.5896919
Statewide	2018	T6 Public	Aggregate	Aggregate	Natural Ga	666.0108525	38089.47676	38089.47676	0	3416.63567	0	0.00635505	0.005984592	0	0.012339642
Statewide	2018	T6 Utility	Aggregate	Aggregate	Diesel	3719.056071	150041.2988	150041.2988	0	47603.9177	0	0.275099589	0.053665851	0.0570028	0.38576821
Statewide	2018	T6 Utility	Aggregate	Aggregate	Natural Ga	20.94392915	882.3852093	882.3852093	0	268.082293	0	0.000214295	0.000100457	0	0.000314752
Statewide	2018	T6TS	Aggregate	Aggregate	Gasoline	55429.29566	2648242.906	2648242.906	0	1109029.35	0	3.235760683	0.005335535	0.5924637	3.83355988
Statewide	2018	T7 CAIRP	Aggregate	Aggregate	Diesel	45280.27584	9936058.182	9936058.182	0	1040540.74	0	47.8995511	6.796507126	1.6862918	56.38235005
Statewide	2018	T7 CAIRP	Aggregate	Aggregate	Natural Ga	55.58188041	13130.08048	13130.08048	0	1277.27161	0	0.005508468	0.004079328	0	0.009587797
Statewide	2018	T7 NNOOS	Aggregate	Aggregate	Diesel	43888.97566	11762911.04	11762911.04	0	1008568.66	0	51.43252385	7.293611804	1.8747727	60.60090832
Statewide	2018	T7 NOOS	Aggregate	Aggregate	Diesel	16926.12984	4273250.297	4273250.297	0	388962.464	0	21.60742416	3.141506511	0.6306261	25.37955676
Statewide	2018	T7 Other Port	Aggregate	Aggregate	Diesel	1464.187711	240251.4435	240251.4435	0	23954.111	0	1.2567408	0.106396139	0.0273415	1.390478465
Statewide	2018	T7 POAK	Aggregate	Aggregate	Diesel	3927.715913	408714.8875	408714.8875	0	64257.4323	0	2.402121967	0.294813	0.0726766	2.769611584
Statewide	2018	T7 POAK	Aggregate	Aggregate	Natural Ga	6.327438598	666.9780698	666.9780698	0	103.516895	0	0.000520097	0.000156448	0	0.000676546
Statewide	2018	T7 POLA	Aggregate	Aggregate	Diesel	13617.70565	1761378.72	1761378.72	0	222785.664	0	9.395036012	0.98707214	0.2565057	10.63861381
Statewide	2018	T7 POLA	Aggregate	Aggregate	Natural Ga	688.2943496	88536.3612	88536.3612	0	11260.4956	0	0.054301632	0.01700298	0	0.071304612
Statewide	2018	T7 Public	Aggregate	Aggregate	Diesel	23296.90553	983132.8626	983132.8626	0	119513.125	0	14.06105809	1.076533408	0.1618015	15.299393
Statewide	2018	T7 Public	Aggregate	Aggregate	Natural Ga	1137.09447	62274.74763	62274.74763	0	5833.29463	0	0.038682625	0.009864923	0	0.048547547
Statewide	2018	T7 Single	Aggregate	Aggregate	Diesel	49948.90534	2769790.402	2769790.402	0	470518.688	0	18.95243701	1.532011391	0.6698493	21.15429773
Statewide	2018	T7 Single	Aggregate	Aggregate	Natural Ga	1489.952688	116240.0614	116240.0614	0	14035.3543	0	0.055296915	0.019630628	0	0.074927542
Statewide	2018	T7 SWCV	Aggregate	Aggregate	Diesel	9488.754524	626927.1302	626927.1302	0	43648.2708	0	9.186087079	0.550843193	0.032592	9.769522292
Statewide	2018	T7 SWCV	Aggregate	Aggregate	Natural Ga	6252.245475	412717.1969	412717.1969	0	28760.3292	0	1.587522381	0.068623322	0	1.656145702
Statewide	2018	T7 Tractor	Aggregate	Aggregate	Diesel	74394.03368	5756598.229	5756598.229	0	1080945.31	0	38.71412648	3.829556343	2.195767	44.73944983
Statewide	2018	T7 Tractor	Aggregate	Aggregate	Natural Ga	1341.490354	118825.6257	118825.6257	0	19491.8548	0	0.070283688	0.033281753	0	0.103565441
Statewide	2018	T7 Utility	Aggregate	Aggregate	Diesel	1661.999118	82237.66827	82237.66827	0	21273.5887	0	0.253745302	0.022399768	0.0840248	0.360169915
Statewide	2018	T7IS	Aggregate	Aggregate	Gasoline	572.9555857	19463.62777	19463.62777	0	11463.6954	0	0.24941294	0	0.0084217	0.257834627
Statewide	2018	UBUS	Aggregate	Aggregate	Gasoline	2722.663337	236499.7884	236499.7884	0	10890.6533	0	0.04760293	0	0.0106422	0.05824515
Statewide	2018	UBUS	Aggregate	Aggregate	Diesel	4065.703012	404503.7707	404503.7707	0	16262.812	0	2.085821692	0	0	2.085821692
Statewide	2018	UBUS	Aggregate	Aggregate	Electricity	129.4599298	6549.819887	0	6549.81989	517.839719	12855.68117	0	0	0	0
Statewide	2018	UBUS	Aggregate	Aggregate	Natural Ga	7288.064338	827479.9184	827479.9184	0	29152.2574	0	2.474172727	0	0	2.474172727
Statewide	2030	All Other Buse	Aggregate	Aggregate	Diesel	8918.051439	458000.7961	458000.7961	0	79370.6578	0	0.73070908	0.029878649	0.1051968	0.865784569
Statewide	2030	All Other Buse	Aggregate	Aggregate	Natural Ga	880.2708985	48107.03378	48107.03378	0	7834.411	0	0.006082697	0.001479827	0	0.007562524
Statewide	2030	LDA	Aggregate	Aggregate	Gasoline	12575247.61	492664868.9	492664868.9	0	58223662.6	0	15.19966392	0	13.100236	28.29989998
Statewide	2030	LDA	Aggregate	Aggregate	Diesel	24084.43217	732019.638	732019.638	0	103149.932	0	0.081119585	0	0	0.081119585
Statewide	2030	LDA	Aggregate	Aggregate	Electricity	1164061.096	52461375.57	0	52461375.6	5658628.22	20254420.84	0	0	0	0
Statewide	2030	LDA	Aggregate	Aggregate	Plug-in Hyb	490724.9583	21318733.91	9499151.853	11819582.1	2029147.7	3569866.06	0.069392294	0	0.2537938	0.323186126
Statewide	2030	LDT1	Aggregate	Aggregate	Gasoline	1152397.047	39443600.95	39443600.95	0	5028509.51	0	3.990658234	0	1.7701878	5.760846064
Statewide	2030	LDT1	Aggregate	Aggregate	Diesel	24.68469089	511.1963881	511.1963881	0	80.2207278	0	0.000383422	0	0	0.000383422
Statewide	2030	LDT1	Aggregate	Aggregate	Electricity	9083.711075	429317.9483	0	429317.948	44803.085	165752.1616	0	0	0	0
Statewide	2030	LDT1	Aggregate	Aggregate	Plug-in Hyb	7050.691645	335357.9818	138646.0762	196711.906	29154.61	59412.85844	0.001015193	0	0.0036417	0.004656909
Statewide	2030	LDT2	Aggregate	Aggregate	Gasoline	6843054.714	268210579.7	268210579.7	0	31829791.6	0	13.04310596	0	8.9289413	21.97204729
Statewide	2030	LDT2	Aggregate	Aggregate	Diesel	25220.65433	1006193.467	1006193.467	0	118695.525	0	0.038766099	0	0	0.038766099
Statewide	2030	LDT2	Aggregate	Aggregate	Electricity	119982.6031	4012421.603	0	4012421.6	597712.94	1549125.902	0	0	0	0
Statewide	2030	LDT2	Aggregate	Aggregate	Plug-in Hyb	106489.2142	4766713.476	2035727.24	2730986.24	440332.901	824839.2395	0.014893919	0	0.055052	0.069945942
Statewide	2030	LHD1	Aggregate	Aggregate	Gasoline	494523.9123	18579164.67	18579164.67	0	7367669.45	0	2.118352715	0.017345878	4.3858716	6.521570193
Statewide	2030	LHD1	Aggregate	Aggregate	Diesel	361601.3654	13321740.12	13321740.12	0	4548490.28	0	16.7740294	0.679128187	0	17.45315759
Statewide	2030	LHD1	Aggregate	Aggregate	Electricity	46756.35114	2806052.741	0	2806052.74	654341.188	1696272.814	0	0	0	0
Statewide	2030	LHD2	Aggregate	Aggregate	Gasoline	68456.6737	2454718.171	2454718.171	0	1019902.44	0	0.232307016	0.002377167	0.6185611	0.853245285
Statewide	2030	LHD2	Aggregate	Aggregate	Diesel	156171.2771	5799017.371	5799017.371	0	1964438.2	0	5.762772852	0.280715503	0	6.043488354
Statewide	2030	LHD2	Aggregate	Aggregate	Electricity	11985.53484	686911.2688	0	686911.269	158945.277	411562.2702	0	0	0	0
Statewide	2030	MCY	Aggregate	Aggregate	Gasoline	709779.2989	4090022.284	4090022.284	0	1419558.6	0	2.415125512	0	0.1791295	2.594254972
Statewide	2030	MDV	Aggregate	Aggregate	Gasoline	4248539.778	157637225.9	157637225.9	0	19446035.8	0	10.41758138	0	6.6285449	17.04612624
Statewide	2030	MDV	Aggregate	Aggregate	Diesel	61500.62674	2209689.375	2209689.375	0	280163.811	0	0.115170974	0	0	0.115170974
Statewide	2030	MDV	Aggregate	Aggregate	Electricity	120321.8685	3998042.094	0	3998042.09	598206.509	1543574.225	0	0	0	0
Statewide	2030	MDV	Aggregate	Aggregate	Plug-in Hyb	66886.5195	2911270.131	1249447.602	1661822.53	276575.758	501919.934	0.009126759	0	0.0345775	0.043704294
Statewide	2030	MH	Aggregate	Aggregate	Gasoline	63938.3747	611241.4189	611241.4189	0	6396.39501	0	0.15216236	0	0.0033456	0.155507965
Statewide	2030	MH	Aggregate	Aggregate	Diesel	34816.19507	318540.9956	318540.9956	0	3481.61951	0	1.270114995	0	0	1.270114995
Statewide	2030	Motor Coach	Aggregate	Aggregate	Diesel	2416.935449	286139.4823	286139.4823	0	55541.1766	0	0.457423353	0.098693419	0.1116116	0.667728341
Statewide	2030	OBUS	Aggregate	Aggregate	Gasoline	10523.58177	418671.522	418671.522	0	210555.824	0	0.166924087	0.000682915	0.0915223	0.25912928
Statewide	2030	OBUS	Aggregate	Aggregate	Electricity	537.1611211	43467.50107	0	43467.5011	10747.5197	47011.7289	0	0	0	0
Statewide	2030	PTO	Aggregate	Aggregate	Diesel	0	593816.3881	593816.3881	0	0	0	1.849063229	0	0	1.849063229
Statewide	2030	PTO	Aggregate	Aggregate	Electricity	0	64865.72172	0	64865.7217	0	134370.5599	0	0	0	0
Statewide	2030	SBUS	Aggregate	Aggregate	Gasoline	6765.951314	356420.5962	356420.5962	0	27063.8053	0	0.176103209	0.006419559	0.0239233	0.206446025
Statewide	2030	SBUS	Aggregate	Aggregate	Diesel	17890.5539	385614.7266	385614.7266	0	259055.22	0	1.418583513	0.405504439	0.1471573	1.971245222
Statewide	2030	SBUS	Aggregate	Aggregate	Electricity	1404.810356	43250.16124	0	43250.1612	17599.5966	47293.33613	0	0	0	0
Statewide	2030	SBUS	Aggregate	Aggregate	Natural Ga	5149.804832	119886.2275	119886.2275	0	74569.174	0	0.079692449	0.029376353	0	0.109068802
Statewide	2030	T6 CAIRP heav	Aggregate	Aggregate	Diesel	1739.882047	343948.0919	343948.0919	0	39982.4894	0	0.104000132	0.005481417	0.0216553	0.13113683
Statewide	2030	T6 CAIRP heav	Aggregate	Aggregate	Electricity	137.293634	29860.59047	0	29860.5905	3155.00771	32095.70438	0	0	0	0
Statewide	2030	T6 CAIRP heav	Aggregate	Aggregate	Natural Ga	0.321753131	61.68915725	61.68915725	0	7.39388695	0	4.94859E-06	5.32417E-07	0	5.48101E-06
Statewide	2030	T6 CAIRP smal	Aggregate	Aggregate	Diesel	1563.902017	84887.64728	84887.64728	0	35938.4683	0	0.022642831	0.004949702	0.019593	0.047185491
Statewide	2030	T6 CAIRP smal	Aggregate	Aggregate	Electricity	220.5468683	14155.48545	0	14155.4854	5068.16703	15214.99202	0	0	0	0
Statewide	2030	T6 instate hea	Aggregate	Aggregate	Diesel	55698.86584	2468357.02	2468357.02	0	669319.104	0	2.08212595	0.648032144	1.2504774	3.980635447
Statewide	2030	T6 instate hea	Aggregate	Aggregate	Electricity	2342.073432	158555.5659	0	158555.566	27985.5673	167386.7962	0	0	0	0
Statewide	2030	T6 instate hea	Aggregate	Aggregate	Natural Ga	1078.206262	49538.43436	49538.43436	0	13043.3375	0	0.006367111	0.006522178	0	0.012889289
Statewide	2030	T6 instate sma	Aggregate	Aggregate	Diesel	207880.6244	7831596.17	7831596.17	0	2589734.65	0	4.282804212	2.405166661	4.4047276	11.09269851
Statewide	2030	T6 instate sma	Aggregate	Aggregate	Electricity	18926.77917	862888.1068	0	862888.107	234423.052	910814.4955	0	0	0	0
Statewide	2030	T6 instate sma	Aggregate	Aggregate	Natural Ga	985.5555095	39617.50996	39617.50996	0	12315.6562	0	0.003236347	0.005743119	0	0.008979466
Statewide	2030	T6 OOS heavy	Aggregate	Aggregate	Diesel	956.4768461	248047.3789	248047.3789	0	21979.8379	0	0.080175614	0.00301281	0.0144675	0.097655966
Statewide	2030	T6 OOS small	Aggregate	Aggregate	Diesel	1028.916147	56685.28322	56685.28322	0	23644.4931	0	0.017724368	0.003289011	0.0155682	0.036581589
Statewide	2030	T6 Public	Aggregate	Aggregate	Diesel	22864.34945	916252.0679	916252.0679	0	117294.113	0	2.26356461	0.642224607	0.1689444	3.074733613
Statewide	2030	T6 Public	Aggregate	Aggregate	Electricity	1873.586317	96627.02147	0	96627.0215	9611.4978	110099.217	0	0	0	0
Statewide	2030	T6 Public	Aggregate	Aggregate	Natural Ga	1948.841332	83241.75675	83241.75675	0	9997.55604	0	0.006955449	0.016773087	0	0.023728537
Statewide	2030	T6 Utility	Aggregate	Aggregate	Diesel	3300.885544	136373.2958	136373.2958	0	42251.335	0	0.038698576	0.028629737	0.0530788	0.120407081
Statewide	2030	T6 Utility	Aggregate	Aggregate	Electricity	530.0192479	24208.21052	0	24208.2105	6784.24637	26348.82185	0	0	0	0
Statewide	2030	T6 Utility	Aggregate	Aggregate	Natural Ga	15.94571493	636.1542066	636.1542066	0	204.105151	0	6.18597E-05	7.25497E-05	0	0.000134409
Statewide	2030	T6TS	Aggregate	Aggregate	Gasoline	42084.29552	2234914.9	2234914.9	0	842022.585	0	0.487876492	0.003638694	0.3287601	0.820275261
Statewide	2030	T6TS	Aggregate	Aggregate	Electricity	2817.255536	251043.1022	0	251043.102	56367.6488	276833.7095	0	0	0	0
Statewide	2030	T7 CAIRP	Aggregate	Aggregate	Diesel	55918.89743	11306897.76	11306897.76	0	1285016.26	0	16.15124109	7.602326345	2.7129492	26.46651661
Statewide	2030	T7 CAIRP	Aggregate	Aggregate	Electricity	4858.587822	1034039.059	0	1034039.06	111650.348	1873468.114	0	0	0	0
Statewide	2030	T7 CAIRP	Aggregate	Aggregate	Natural Ga	82.41377675	16462.86684	16462.86684	0	1893.86859	0	0.003106197	0.005795076	0	0.008901273
Statewide	2030	T7 NNOOS	Aggregate	Aggregate	Diesel	52956.07068	14610017.1	14610017.1	0	1216930.5	0	21.74512393	8.935380481	3.1641937	33.84469813
Statewide	2030	T7 NOOS	Aggregate	Aggregate	Diesel	22914.44866	5307528.811	5307528.811	0	526574.03	0	8.094079769	3.866345282	1.368735	13.32916004
Statewide	2030	T7 Other Port	Aggregate	Aggregate	Diesel	1476.324345	343515.5262	343515.5262	0	24152.6663	0	0.500200527	0.065741042	0.0591044	0.625045967
Statewide	2030	T7 Other Port	Aggregate	Aggregate	Electricity	74.41280785	23309.51037	0	23309.5104	1217.39354	42341.73764	0	0	0	0
Statewide	2030	T7 POAK	Aggregate	Aggregate	Diesel	4477.242527	487378.0377	487378.0377	0	73247.6877	0	0.757844786	0.199372576	0.1810066	1.13822396
Statewide	2030	T7 POAK	Aggregate	Aggregate	Electricity	219.2930935	22576.25062	0	22576.2506	3587.63501	41088.03646	0	0	0	0
Statewide	2030	T7 POAK	Aggregate	Aggregate	Natural Ga	4.552426963	493.8492144	493.8492144	0	74.4777051	0	9.40337E-05	0.000104347	0	0.000198381
Statewide	2030	T7 POLA	Aggregate	Aggregate	Diesel	19264.19228	2794717.272	2794717.272	0	315162.186	0	4.487931433	0.857838641	0.7943318	6.140101907
Statewide	2030	T7 POLA	Aggregate	Aggregate	Electricity	436.6625829	58859.6235	0	58859.6235	7143.79986	105018.6908	0	0	0	0
Statewide	2030	T7 POLA	Aggregate	Aggregate	Natural Ga	362.8499448	52486.39664	52486.39664	0	5936.2251	0	0.014331602	0.008482287	0	0.022813889
Statewide	2030	T7 Public	Aggregate	Aggregate	Diesel	21058.58959	879577.3466	879577.3466	0	108030.565	0	5.612267057	0.645601994	0.494956	6.75282507
Statewide	2030	T7 Public	Aggregate	Aggregate	Electricity	1526.535918	93023.398	0	93023.398	7831.12926	176728.5187	0	0	0	0
Statewide	2030	T7 Public	Aggregate	Aggregate	Natural Ga	3046.209958	139404.3339	139404.3339	0	15627.0571	0	0.040446092	0.025242515	0	0.065688607
Statewide	2030	T7 Single	Aggregate	Aggregate	Diesel	56980.24213	2831979.689	2831979.689	0	536753.881	0	3.62042884	1.392999947	1.8041063	6.817535056
Statewide	2030	T7 Single	Aggregate	Aggregate	Electricity	4564.188891	326676.7402	0	326676.74	42994.6593	589492.0063	0	0	0	0
Statewide	2030	T7 Single	Aggregate	Aggregate	Natural Ga	3101.795145	158598.3359	158598.3359	0	29218.9103	0	0.042967314	0.039703974	0	0.082671288
Statewide	2030	T7 SWCV	Aggregate	Aggregate	Diesel	4491.577447	291337.6298	291337.6298	0	20661.2563	0	2.540415668	0.203089823	0.0586692	2.802174654

Statewide	2030	T7 SWCV	Aggregate	Aggregate	Electricity	975.5140524	62052.59182	0	62052.5918	4487.36464	113048.5389	0	0
Statewide	2030	T7 SWCV	Aggregate	Aggregate	Natural Ga	11562.35192	749263.8814	749263.8814	0	53186.8188	0	0.731585862	0.048170559
Statewide	2030	T7 Tractor	Aggregate	Aggregate	Diesel	101770.4646	6668002.802	6668002.802	0	1478724.85	0	10.04918147	4.59415519
Statewide	2030	T7 Tractor	Aggregate	Aggregate	Electricity	3986.220487	313596.929	0	313596.929	57919.7837	566505.08	0	0
Statewide	2030	T7 Tractor	Aggregate	Aggregate	Natural Ga	3291.155884	209842.3628	209842.3628	0	47820.495	0	0.066803911	0.078594884
Statewide	2030	T7 Utility	Aggregate	Aggregate	Diesel	1914.93876	80728.57375	80728.57375	0	24511.2161	0	0.094537963	0.015871167
Statewide	2030	T7 Utility	Aggregate	Aggregate	Electricity	117.1004056	7120.998282	0	7120.99828	1498.88519	13079.9213	0	0
Statewide	2030	T7IS	Aggregate	Aggregate	Gasoline	65.91173305	6853.576406	6853.576406	0	1318.76195	0	0.024744048	0
Statewide	2030	T7IS	Aggregate	Aggregate	Electricity	2.607115879	701.6743814	0	701.674381	52.1631745	1316.616951	0	0
Statewide	2030	UBUS	Aggregate	Aggregate	Gasoline	2778.166863	236786.139	236786.139	0	11112.6675	0	0.031415693	0
Statewide	2030	UBUS	Aggregate	Aggregate	Diesel	2683.330658	257542.1705	257542.1705	0	10733.3226	0	0.100301938	0
Statewide	2030	UBUS	Aggregate	Aggregate	Electricity	2891.441517	324715.6013	0	324715.601	11565.7661	624445.0045	0	0
Statewide	2030	UBUS	Aggregate	Aggregate	Natural Ga	6742.175282	773872.01	773872.01	0	26968.7011	0	0.202485352	0
Statewide	2045	All Other Buse	Aggregate	Aggregate	Diesel	9701.154793	478867.2221	478867.2221	0	86340.2777	0	0.396113194	0.020167262
Statewide	2045	All Other Buse	Aggregate	Aggregate	Natural Ga	1052.127215	53795.63115	53795.63115	0	9363.93222	0	0.005094018	0.001736604
Statewide	2045	LDA	Aggregate	Aggregate	Gasoline	12765276.65	497148656.4	497148656.4	0	59369327	0	10.75533378	0
Statewide	2045	LDA	Aggregate	Aggregate	Diesel	8803.722366	300272.4512	300272.4512	0	38832.6054	0	0.007722466	0
Statewide	2045	LDA	Aggregate	Aggregate	Electricity	1739473.586	69887031.25	0	69887031.3	8182997.85	26982162.15	0	0
Statewide	2045	LDA	Aggregate	Aggregate	Plug-in Hyb	597981.1131	23648188.87	9661687.352	13986501.5	2472651.9	4224340.322	0.070686366	0
Statewide	2045	LDT1	Aggregate	Aggregate	Gasoline	977494.5143	34854646.37	34854646.37	0	4396912.44	0	0.862946712	0
Statewide	2045	LDT1	Aggregate	Aggregate	Diesel	10.74282371	403.0902837	403.0902837	0	49.6533073	0	1.54095E-05	0
Statewide	2045	LDT1	Aggregate	Aggregate	Electricity	27212.29185	1087971.914	0	1087971.91	128280.047	420046.9539	0	0
Statewide	2045	LDT1	Aggregate	Aggregate	Plug-in Hyb	20822.71672	814621.2185	331701.2303	482919.988	86101.9336	145856.2297	0.002431978	0
Statewide	2045	LDT2	Aggregate	Aggregate	Gasoline	7654516.663	286882303.4	286882303.4	0	35294410.3	0	7.364653934	0
Statewide	2045	LDT2	Aggregate	Aggregate	Diesel	29111.72005	1096783.774	1096783.774	0	134722.081	0	0.03614769	0
Statewide	2045	LDT2	Aggregate	Aggregate	Electricity	295076.2069	8187172.023	0	8187172.02	1392723.6	3160924.125	0	0
Statewide	2045	LDT2	Aggregate	Aggregate	Plug-in Hyb	203444.3722	7813805.232	3188062.473	4625742.76	841242.479	1397112.182	0.023356415	0
Statewide	2045	LHD1	Aggregate	Aggregate	Gasoline	339775.568	11778277.7	11778277.7	0	5062149.7	0	0.282715537	0.009407421
Statewide	2045	LHD1	Aggregate	Aggregate	Diesel	244164.2117	8224312.164	8224312.164	0	3071278.62	0	2.576506361	0.278960623
Statewide	2045	LHD1	Aggregate	Aggregate	Electricity	354826.953	15621566.93	0	15621566.9	4961444.36	9483361.37	0	0
Statewide	2045	LHD2	Aggregate	Aggregate	Gasoline	43334.84567	1455788.313	1455788.313	0	645624.632	0	0.037691274	0.001054594
Statewide	2045	LHD2	Aggregate	Aggregate	Diesel	120624.9929	3885951.054	3885951.054	0	1517310.66	0	1.781842257	0.149393694
Statewide	2045	LHD2	Aggregate	Aggregate	Electricity	91503.85189	3886304.252	0	3886304.25	1210982.41	2333824.515	0	0
Statewide	2045	MCY	Aggregate	Aggregate	Gasoline	760274.5994	4116645.18	4116645.18	0	1520549.2	0	2.147015915	0
Statewide	2045	MDV	Aggregate	Aggregate	Gasoline	4495436.221	162014289.2	162014289.2	0	20505694.7	0	4.807795489	0
Statewide	2045	MDV	Aggregate	Aggregate	Diesel	50648.273	1782762.67	1782762.67	0	229075.426	0	0.028162155	0
Statewide	2045	MDV	Aggregate	Aggregate	Electricity	271389.7459	7437827.378	0	7437827.38	1275357.94	2871615.245	0	0
Statewide	2045	MDV	Aggregate	Aggregate	Plug-in Hyb	128944.5048	4808574.65	1963454.318	2845120.33	533185.527	859311.1384	0.014373522	0
Statewide	2045	MH	Aggregate	Aggregate	Gasoline	46081.56603	489416.4407	489416.4407	0	4609.99987	0	0.101049059	0
Statewide	2045	MH	Aggregate	Aggregate	Diesel	30489.84918	282005.3335	282005.3335	0	3048.98492	0	0.710016423	0
Statewide	2045	Motor Coach	Aggregate	Aggregate	Diesel	2445.172074	310538.6268	310538.6268	0	56190.0543	0	0.325868019	0.052333704
Statewide	2045	OBUS	Aggregate	Aggregate	Gasoline	5954.304657	186428.122	186428.122	0	119133.728	0	0.054303115	0.000334923
Statewide	2045	OBUS	Aggregate	Aggregate	Electricity	3144.141893	202824.4368	0	202824.437	62907.991	219475.6838	0	0
Statewide	2045	PTO	Aggregate	Aggregate	Diesel	0	462360.6419	462360.6419	0	0	0	1.297693287	0
Statewide	2045	PTO	Aggregate	Aggregate	Electricity	0	434866.5341	0	434866.534	0	900834.187	0	0
Statewide	2045	SBUS	Aggregate	Aggregate	Gasoline	4352.344542	221970.8428	221970.8428	0	17409.3782	0	0.035164277	0.00339087
Statewide	2045	SBUS	Aggregate	Aggregate	Diesel	10946.95755	223917.7059	223917.7059	0	158511.945	0	0.099105289	0.117089635
Statewide	2045	SBUS	Aggregate	Aggregate	Electricity	10919.81245	320337.5368	0	320337.537	138062.99	350307.2756	0	0
Statewide	2045	SBUS	Aggregate	Aggregate	Natural Ga	4239.401519	86135.1912	86135.1912	0	61386.534	0	0.029460785	0.023572571
Statewide	2045	T6 CAIRP heav	Aggregate	Aggregate	Diesel	2077.038079	424538.84	424538.84	0	47730.3351	0	0.089250895	0.006537898
Statewide	2045	T6 CAIRP heav	Aggregate	Aggregate	Electricity	635.2270867	135096.4494	0	135096.449	14597.5185	145280.4542	0	0
Statewide	2045	T6 CAIRP heav	Aggregate	Aggregate	Natural Ga	0.332197413	67.32310892	67.32310892	0	7.63389655	0	3.32272E-06	5.37829E-07
Statewide	2045	T6 CAIRP smal	Aggregate	Aggregate	Diesel	1110.967951	61285.13488	61285.13488	0	25530.0435	0	0.011796442	0.003497027
Statewide	2045	T6 CAIRP smal	Aggregate	Aggregate	Electricity	1479.245053	86987.37975	0	86987.3797	33993.0513	93543.91292	0	0
Statewide	2045	T6 instate hea	Aggregate	Aggregate	Diesel	53069.39204	2478423.851	2478423.851	0	636917.525	0	1.112205511	0.601971515
Statewide	2045	T6 instate hea	Aggregate	Aggregate	Electricity	22815.84961	1295477.592	0	1295477.59	276943.838	1368255.018	0	0
Statewide	2045	T6 instate hea	Aggregate	Aggregate	Natural Ga	1036.852197	47882.03018	47882.03018	0	12493.3071	0	0.003845351	0.006116629
Statewide	2045	T6 instate sma	Aggregate	Aggregate	Diesel	158249.5111	5808101.449	5808101.449	0	1969133.86	0	1.603612663	1.765627142
Statewide	2045	T6 instate sma	Aggregate	Aggregate	Electricity	158286.8289	6540778.509	0	6540778.51	1969908.93	6907592.919	0	0
Statewide	2045	T6 instate sma	Aggregate	Aggregate	Natural Ga	1061.859238	39156.27904	39156.27904	0	13311.2281	0	0.002238735	0.006083299
Statewide	2045	T6 OOS heavy	Aggregate	Aggregate	Diesel	1321.017531	370354.2644	370354.2644	0	30356.9829	0	0.09288572	0.004158149
Statewide	2045	T6 OOS small	Aggregate	Aggregate	Diesel	1498.894851	84635.59044	84635.59044	0	34444.6037	0	0.020200198	0.004718286
Statewide	2045	T6 Public	Aggregate	Aggregate	Diesel	15884.91477	600854.2294	600854.2294	0	81489.6128	0	0.301781476	0.285168445
Statewide	2045	T6 Public	Aggregate	Aggregate	Electricity	11331.59963	493798.1262	0	493798.126	58131.1061	563796.5082	0	0
Statewide	2045	T6 Public	Aggregate	Aggregate	Natural Ga	1652.366369	62783.42483	62783.42483	0	8476.63947	0	0.00401568	0.014033757
Statewide	2045	T6 Utility	Aggregate	Aggregate	Diesel	1711.441514	70147.30483	70147.30483	0	21906.4514	0	0.012737023	0.014805273
Statewide	2045	T6 Utility	Aggregate	Aggregate	Electricity	2340.754213	100273.0704	0	100273.07	29961.6539	109286.2006	0	0
Statewide	2045	T6 Utility	Aggregate	Aggregate	Natural Ga	7.237774635	296.5779885	296.5779885	0	92.6435153	0	1.59962E-05	3.21825E-05
Statewide	2045	T6TS	Aggregate	Aggregate	Gasoline	23972.28545	1155978.901	1155978.901	0	479637.487	0	0.089401757	0.001567877
Statewide	2045	T6TS	Aggregate	Aggregate	Electricity	18277.06767	1265201.54	0	1265201.54	365687.57	1397881.289	0	0
Statewide	2045	T7 CAIRP	Aggregate	Aggregate	Diesel	71140.4674	14950780.94	14950780.94	0	1634807.94	0	19.25599387	9.669117782
Statewide	2045	T7 CAIRP	Aggregate	Aggregate	Electricity	19867.45656	4332123.624	0	4332123.62	456554.152	7847800.107	0	0
Statewide	2045	T7 CAIRP	Aggregate	Aggregate	Natural Ga	99.85487057	21021.52833	21021.52833	0	2294.66493	0	0.003550543	0.006986178
Statewide	2045	T7 NNOOS	Aggregate	Aggregate	Diesel	79012.11233	22820721.56	22820721.56	0	1815698.34	0	32.49536573	13.3285811
Statewide	2045	T7 NOOS	Aggregate	Aggregate	Diesel	33992.14594	8290217.899	8290217.899	0	781139.514	0	12.14062813	5.734128889
Statewide	2045	T7 Other Port	Aggregate	Aggregate	Diesel	1493.633369	360931.1683	360931.1683	0	24435.8419	0	0.484951059	0.066511816
Statewide	2045	T7 Other Port	Aggregate	Aggregate	Electricity	343.9079315	91269.68337	0	91269.6834	5626.33376	165841.7805	0	0
Statewide	2045	T7 POAK	Aggregate	Aggregate	Diesel	4929.518585	571478.7135	571478.7135	0	80646.9241	0	0.808866071	0.219512527
Statewide	2045	T7 POAK	Aggregate	Aggregate	Electricity	1142.042674	130882.1976	0	130882.198	18683.8181	238201.3116	0	0
Statewide	2045	T7 POAK	Aggregate	Aggregate	Natural Ga	7.083584129	820.3727996	820.3727996	0	115.887436	0	0.000156207	0.000162364
Statewide	2045	T7 POLA	Aggregate	Aggregate	Diesel	16562.20655	2888344.644	2888344.644	0	270957.699	0	3.716681408	0.737518633
Statewide	2045	T7 POLA	Aggregate	Aggregate	Electricity	3051.168759	525657.1937	0	525657.194	49917.1209	939982.3073	0	0
Statewide	2045	T7 POLA	Aggregate	Aggregate	Natural Ga	633.2681534	110598.7312	110598.7312	0	10360.267	0	0.019290621	0.014525922
Statewide	2045	T7 Public	Aggregate	Aggregate	Diesel	14505.1047	574957.2077	574957.2077	0	74411.1871	0	1.289987194	0.284356081
Statewide	2045	T7 Public	Aggregate	Aggregate	Electricity	9668.632682	459319.1557	0	459319.156	49600.0857	874323.7048	0	0
Statewide	2045	T7 Public	Aggregate	Aggregate	Natural Ga	3350.768473	137074.8296	137074.8296	0	17189.4423	0	0.028954411	0.027311189
Statewide	2045	T7 Single	Aggregate	Aggregate	Diesel	48081.24672	2205509.534	2205509.534	0	452925.344	0	2.362739486	1.168060275
Statewide	2045	T7 Single	Aggregate	Aggregate	Electricity	37351.22759	2190074.788	0	2190074.79	351848.564	3952759.222	0	0
Statewide	2045	T7 Single	Aggregate	Aggregate	Natural Ga	2691.877823	123031.0768	123031.0768	0	25357.4891	0	0.024355374	0.033810612
Statewide	2045	T7 SWCV	Aggregate	Aggregate	Diesel	1560.124597	101198.8115	101198.8115	0	7176.57315	0	0.387865648	0.049389544
Statewide	2045	T7 SWCV	Aggregate	Aggregate	Electricity	7025.273617	454139.148	0	454139.148	32316.2586	827200.2064	0	0
Statewide	2045	T7 SWCV	Aggregate	Aggregate	Natural Ga	9305.191311	603118.5776	603118.5776	0	42803.88	0	0.21909165	0.013236047
Statewide	2045	T7 Tractor	Aggregate	Aggregate	Diesel	140600.2757	9088273.123	9088273.123	0	2042922.01	0	11.54157445	6.331155773
Statewide	2045	T7 Tractor	Aggregate	Aggregate	Electricity	25423.69523	1830733.032	0	1830733.03	369406.292	3308573.591	0	0
Statewide	2045	T7 Tractor	Aggregate	Aggregate	Natural Ga	3761.412257	240163.9734	240163.9734	0	54653.3201	0	0.04483027	0.087427483
Statewide	2045	T7 Utility	Aggregate	Aggregate	Diesel	1300.994112	53162.64768	53162.64768	0	16652.7246	0	0.054625183	0.010774397
Statewide	2045	T7 Utility	Aggregate	Aggregate	Electricity	835.0219994	39893.21285	0	39893.2129	10688.2816	73368.58355	0	0
Statewide	2045	T7IS	Aggregate	Aggregate	Gasoline	33.58426878	3944.822118	3944.822118	0	671.95405	0	0.009278299	0
Statewide	2045	T7IS	Aggregate	Aggregate	Electricity	24.36956848	4057.085818	0	4057.08582	487.586326	7628.418709	0	0
Statewide	2045	UBUS	Aggregate	Aggregate	Gasoline	1923.357089	179245.6814	179245.6814	0	7693.42836	0	0.003319156	0
Statewide	2045	UBUS	Aggregate	Aggregate	Diesel	67.50585049	3672.363318	3672.363318	0	270.023402	0	0.000814895	0
Statewide	2045	UBUS	Aggregate	Aggregate	Electricity	16876.09552	1854150.056	0	1854150.06	67504.3821	3587653.68	0	0
Statewide	2045	UBUS	Aggregate	Aggregate	Natural Ga	253.3101394	18444.73233	18444.73233	0	1013.24056	0	0.003054401	0
Statewide	2050	All Other Buse	Aggregate	Aggregate	Diesel	9851.253446	481918.8376	481918.8376	0	87676.1557	0	0.307274279	0.017822024
Statewide	2050	All Other Buse	Aggregate	Aggregate	Natural Ga	1090.031782	55137.86131	55137.86131	0	9701.28286	0	0.004891424	0.001793406
Statewide	2050	LDA	Aggregate	Aggregate	Gasoline	12955078.89	500531731.4	500531731.4	0	60280110.2	0	10.6777051	0
Statewide	2050	LDA	Aggregate	Aggregate	Diesel	8270.794529	292362.5082	292362.5082	0	37049.5519	0	0.003407563	0
Statewide	2050	LDA	Aggregate	Aggregate	Electricity	1802523.436	71014337.9	0	71014337.9	8444493.39	27417395.56	0	0
Statewide	2050	LDA	Aggregate	Aggregate	Plug-in Hyb	610876.9213	23809130.04	9697502.244	14111627.8	2525976.07	4262132.188	0.070920353	0
Statewide	2050	LDT1	Aggregate	Aggregate	Gasoline	976830.1073	34749369.35	34749369.35	0	4409241.42	0	0.797019383	0
Statewide	2050	LDT1	Aggregate	Aggregate	Diesel	11.27726334	414.6495567	414.6495567	0	51.8728082	0	1.34209E-05	0
Statewide	2050	LDT1	Aggregate	Aggregate	Electricity	30411.55048	1157486.365	0	1157486.37	141339.85	446885.2696	0	0
Statewide	2050	LDT1	Aggregate	Aggregate	Plug-in Hyb	23138.66513	868038.1304	353180.1642	514857.966	95678.3803	155502.451	0.002588269	0
Statewide	2050	LDT2	Aggregate	Aggregate	Gasoline	7787615.711	288887957.9	288887957.9	0	35896548.9	0	6.990118927	0
Statewide	2050	LDT2	Aggregate	Aggregate	Diesel	29899.69571	1108867.522	1108867.522	0	137853.576	0	0.03603088	0
Statewide	2050	LDT2	Aggregate	Aggregate	Electricity	316975.8993	8493583.383	0	8493583.38	1482109.79	3279224.199	0	0
Statewide	2050	LDT2	Aggregate	Aggregate	Plug-in Hyb	215228.8062	8050473.278	3278620.476	4771852.8	889971.114	1441241.77	0.024009018	0
Statewide	2050	LHD1	Aggregate	Aggregate	Gasoline	301498.7401	10691036.99	10691036.99	0	4491881.99	0	0.178570583	0.00789675
Statewide	2050	LHD1	Aggregate	Aggregate	Diesel	216951.8075	7413722.086	7413722.086	0	2728980.81	0	1.532697722	0.215432917
Statewide	2050	LHD1	Aggregate	Aggregate	Electricity	428139.7972	17604208.39	0	17604208.4	5981876.13	10695066.12	0	0
Statewide	2050	LHD2	Aggregate	Aggregate	Gasoline	38433.5185	1311919.259	1311919.259	0	572602.16	0	0.028315789	0.000853879
Statewide	2050	LHD2	Aggregate	Aggregate	Diesel	109198.4322	3527295.355	3527295.355	0	1373578.91	0	1.072576474	0.121622408
Statewide	2050	LHD2	Aggregate	Aggregate	Electricity	111287.8273	4415718.651	0	4415718.65	1472330.27	2653015.382	0	0
Statewide	2050	MCY	Aggregate	Aggregate	Gasoline	751898.9766	4102973.011	4102973.011	0	1503797.95	0	2.086305826	0
Statewide	2050	MDV	Aggregate	Aggregate	Gasoline	4525945.345	162516082.6	162516082.6	0	20712180.5	0	4.074202791	0
Statewide	2050	MDV	Aggregate	Aggregate	Diesel	50618.16341	1772512.003	1772512.003	0	228926.133	0	0.021176471	0
Statewide	2050	MDV	Aggregate	Aggregate	Electricity	291460.9114	7705208.465	0	7705208.46	1356175.12	2974846.413	0	0
Statewide	2050	MDV	Aggregate	Aggregate	Plug-in Hyb	137244.3216	4972064.436	2025329.007	2946735.43	567505.27	890001.9265	0.01482051	0
Statewide	2050	MH	Aggregate	Aggregate	Gasoline	45271.3367	482893.1737	482893.1737	0	4528.94452	0	0.111256605	0
Statewide	2050	MH	Aggregate	Aggregate	Diesel	29447.47369	275006.9349	275006.9349	0	2944.74737	0	0.644716674	0
Statewide	2050	Motor Coach	Aggregate	Aggregate	Diesel	2533.614172	319125.5494	319125.5494	0	58222.4537	0	0.328043857	0.049211938
Statewide	2050	OBUS	Aggregate	Aggregate	Gasoline	4753.666894	163536.8819	163536.8819	0	95111.3672	0	0.045081241	0.000248563
Statewide	2050	OBUS	Aggregate	Aggregate	Electricity	3635.949527	219208.1747	0	219208.175	72748.0781	237256.0291	0	0
Statewide	2050	PTO	Aggregate	Aggregate	Diesel	0	471024.2993	471024.2993	0	0	0	1.259152433	0
Statewide	2050	PTO	Aggregate	Aggregate	Electricity	0	531676.086	0	531676.086	0	1101376.991	0	0
Statewide	2050	SBUS	Aggregate	Aggregate	Gasoline	2664.228963	131130.3833	131130.3833	0	10656.9159	0	0.01267753	0.001505749
Statewide	2050	SBUS	Aggregate	Aggregate	Diesel	8596.970847	179518.3677	179518.3677	0	124484.138	0	0.058279897	0.091435225
Statewide	2050	SBUS	Aggregate	Aggregate	Electricity	14508.77285	412455.8475	0	412455.847	183698.125	451074.694	0	0
Statewide	2050	SBUS	Aggregate	Aggregate	Natural Ga	3218.339421	67334.47782	67334.47782	0	46601.5548	0	0.013865536	0.017639067
Statewide	2050	T6 CAIRP heav	Aggregate	Aggregate	Diesel	2363.59116	483508.6815	483508.6815	0	54315.3249	0	0.100542552	0.007439782
Statewide	2050	T6 CAIRP heav	Aggregate	Aggregate	Electricity	750.0542483	158341.2103	0	158341.21	17236.2466	170289.547	0	0
Statewide	2050	T6 CAIRP heav	Aggregate	Aggregate	Natural Ga	0.37253473	75.54661632	75.54661632	0	8.56084809	0	3.67647E-06	6.02823E-07
Statewide	2050	T6 CAIRP smal	Aggregate	Aggregate	Diesel	1194.304265	66934.24449	66934.24449	0	27445.112	0	0.012630474	0.003759277
Statewide	2050	T6 CAIRP smal	Aggregate	Aggregate	Electricity	1779.961749	103120.168	0	103120.168	40903.521	110900.3848	0	0
Statewide	2050	T6 instate hea	Aggregate	Aggregate	Diesel	54510.62602	2619072.149	2619072.149	0	653722.058	0	0.984307759	0.61660061
Statewide	2050	T6 instate hea	Aggregate	Aggregate	Electricity	30953.51214	1645713.556	0	1645713.56	375609.166	1738155.026	0	0
Statewide	2050	T6 instate hea	Aggregate	Aggregate	Natural Ga	1042.028448	49748.55135	49748.55135	0	12536.9191	0	0.00344383	0.006104724
Statewide	2050	T6 instate sma	Aggregate	Aggregate	Diesel	157324.3648	5905051.352	5905051.352	0	1957419.06	0	1.531671487	1.754904701
Statewide	2050	T6 instate sma	Aggregate	Aggregate	Electricity	199544.6629	8008765.447	0	8008765.45	2483119.17	8457793.036	0	0
Statewide	2050	T6 instate sma	Aggregate	Aggregate	Natural Ga	1077.786364	40215.71517	40215.71517	0	13520.3493	0	0.002231637	0.006165636
Statewide	2050	T6 OOS heavy	Aggregate	Aggregate	Diesel	1514.233445	424386.1336	424386.1336	0	34797.0846	0	0.106017269	0.004766286
Statewide	2050	T6 OOS small	Aggregate	Aggregate	Diesel	1721.213154	96983.27911	96983.27911	0	39553.4783	0	0.022990946	0.005417936
Statewide	2050	T6 Public	Aggregate	Aggregate	Diesel	14142.19308	544341.1173	544341.1173	0	72549.4505	0	0.182496157	0.237343413
Statewide	2050	T6 Public	Aggregate	Aggregate	Electricity	13534.12957	567430.2036	0	567430.204	69430.0847	648119.4449	0	0

Statewide	2050	T6 Public	Aggregate	Aggregate	Natural Ga	1485.434243	57316.11517	57316.11517	0	7620.27767	0	0.003502383	0.012590852	0	0.016093236	8.5979E-05	4.66776E-05	0	0.000132657	0.000189541	0.000985225	0.001307	9.35E-05	5.08E-05	0	0.000144277	0.000758	0.002815	0.003717	55.50434	10.82676	0	66.33109	0.045285	0.02934	0	0.074624	0.011315	0.002207	0	0.013522	0.000647	0.000419	0	0.001066	0	0	0	0.001066	0.046216	0.029943	0	0.07616	0	0	0	0.07616	0.15327	0.09294	0	0.246211	0	0	0	0	0.066971	7.666863
Statewide	2050	T6 Utility	Aggregate	Aggregate	Diesel	1617.338789	67211.30747	67211.30747	0	20701.9365	0	0.012035307	0.013991212	0.0186494	0.044675917	0.00019874	3.34123E-06	0	0.000202083	0.000222263	0.001147785	0.001572	0.000208	3.49E-06	0	0.00021122	0.000889	0.003279	0.00438	73.83873	2.498875	0	76.33761	1.53E-05	1.12E-05	0	2.65E-05	0.011633	0.000394	0	0.012027	0.000328	0.000242	0	0.00057	0	0	0	0.00057	0.000374	0.000275	0	0.000649	0	0	0	0.000649	0.002258	0.010235	0	0.012493	0.000699	2.37E-05	0	0.000723	0.016299	6.819208
Statewide	2050	T6 Utility	Aggregate	Aggregate	Electricity	2475.888776	104911.4655	0	104911.466	31691.3763	114375.5303	0	0	0	0	0	0	0	0	0.000346935	0.000895813	0.001243	0	0	0	0	0.001388	0.002559	0.003947	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Statewide	2050	T6 Utility	Aggregate	Aggregate	Natural Ga	6.829996422	283.7392708	283.7392708	0	87.4239542	0	1.53164E-05	3.03693E-05	0	4.56857E-05	3.9748E-07	1.15079E-07	0	5.1256E-07	9.38307E-07	4.81602E-06	6.27E-06	4.32E-07	1.25E-07	0	5.57456E-07	3.75E-06	1.38E-05	1.81E-05	0.260386	0.026185	0	0.286572	0.000203	6.99E-05	0	0.000273	5.31E-05	5.34E-06	0	5.84E-05	2.9E-06	9.98E-07	0	3.9E-06	0	0	0	3.9E-06	0.000207	7.13E-05	0	0.000278	0	0	0	0.000278	0.00068	0.00023	0	0.000909	0	0	0	0	0.000332	0.033123
Statewide	2050	T6TS	Aggregate	Aggregate	Gasoline	20973.59538	1040535.219	1040535.219	0	419639.696	0	0.07176576	0.001294206	0.2240986	0.297158566	0.0013559	0	0.000217226	0.00157313	0.003440981	0.017649937	0.022664	0.001475	0	0.00023625	0.001710922	0.013764	0.050428	0.065903	1670.705	10.63879	16.76053	1698.104	0.002793	0.006294	0.017109	0.026195	0.007551	0.000127	0.017014	0.024691	0.010369	0.023626	0.083741	0.117736	0.052456	0.006488	0.101706	0.278386	0.01513	0.034474	0.091686	0.141291	0.052456	0.006488	0.101706	0.301941	0.176547	0.34371	1.404143	1.9244	0.016517	0.000105	0.000166	0.016787	0.051615	179.063
Statewide	2050	T6TS	Aggregate	Aggregate	Electricity	21659.34114	1389090.558	0	1389090.56	433360.098	1535360.182	0	0	0	0	0	0	0	0	0.004593631	0.011784046	0.016378	0	0	0	0	0.018375	0.033669	0.052043	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Statewide	2050	T7 CAIRP	Aggregate	Aggregate	Diesel	82833.70076	17363156.49	17363156.49	0	1903518.44	0	22.35066712	11.25839574	3.2926152	36.90167809	0.53174308	0.003879263	0	0.535622343	0.172256434	0.549435259	1.257314	0.555786	0.004055	0	0.559840809	0.689026	1.569815	2.818682	24336.2	1832.32	0	26168.52	0.009888	0.044252	0	0.05414	3.834179	0.288683	0	4.122861	0.212882	0.952734	0	1.165615	0	0	0	1.165615	0.24235	1.084615	0	1.326964	0	0	0	1.326964	0.716484	14.07742	0	14.7939	0.230449	0.017351	0	0.2478	4.210712	2337.624
Statewide	2050	T7 CAIRP	Aggregate	Aggregate	Electricity	23331.19075	5060132.674	0	5060132.67	536150.763	9165807.359	0	0	0	0	0	0	0	0	0.050200573	0.080069433	0.13027	0	0	0	0	0.200802	0.22877	0.429572	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Statewide	2050	T7 CAIRP	Aggregate	Aggregate	Natural Ga	117.1190523	24584.79146	24584.79146	0	2691.39582	0	0.004149056	0.008193729	0	0.012342785	4.872E-05	3.10472E-05	0	7.9767E-05	0.000243901	0.000791635	0.001115	5.3E-05	3.38E-05	0	8.67539E-05	0.000976	0.002262	0.003324	27.79928	6.192082	0	33.99136	0.025304	0.01885	0	0.044153	0.005667	0.001262	0	0.006929	0.000362	0.000269	0	0.000631	0	0	0	0.000631	0.025824	0.019237	0	0.045062	0	0	0	0.045062	0.08227	0.061972	0	0.144241	0	0	0	0	0.028726	3.928883
Statewide	2050	T7 NNOOS	Aggregate	Aggregate	Diesel	92047.35106	26536659.16	26536659.16	0	2115248.13	0	37.78746542	15.52744698	5.540803	58.85571541	0.8030341	0.00535023	0	0.808384331	0.263264936	0.839662003	1.911311	0.839344	0.005592	0	0.844935883	1.05306	2.399034	4.29703	35594.83	2421.923	0	38016.75	0.01469	0.061032	0	0.075722	5.60798	0.381575	0	5.989555	0.316282	1.313998	0	1.630279	0	0	0	1.630279	0.360063	1.495886	0	1.855949	0	0	0	1.855949	1.064754	19.41537	0	20.48013	0.337062	0.022934	0	0.359996	6.435363	3396.021
Statewide	2050	T7 NOOS	Aggregate	Aggregate	Diesel	39654.06391	9640095.181	9640095.181	0	911250.389	0	14.12373532	6.689228808	2.3870451	23.20000925	0.3088702	0.002304883	0	0.311175085	0.095637474	0.305056903	0.711869	0.322836	0.002409	0	0.325245041	0.38255	0.871591	1.579386	12927.8	1043.123	0	13970.93	0.005507	0.026293	0	0.031799	2.036781	0.164344	0	2.201125	0.118554	0.566071	0	0.684625	0	0	0	0.684625	0.134965	0.644429	0	0.779394	0	0	0	0.779394	0.39902	8.364164	0	8.763184	0.122419	0.009878	0	0.132296	2.337804	1248.017
Statewide	2050	T7 Other Port	Aggregate	Aggregate	Diesel	1539.868885	365959.4004	365959.4004	0	25192.255	0	0.493422872	0.068570694	0.0510132	0.613006816	0.0064251	2.36272E-05	0	0.006448728	0.003630611	0.013232416	0.023312	0.006716	2.47E-05	0	0.006740311	0.014522	0.037807	0.05907	552.2002	11.07241	0	563.2726	0.000187	0.00027	0	0.000457	0.086999	0.001744	0	0.088744	0.004029	0.005803	0	0.009832	0	0	0	0.009832	0.004587	0.006606	0	0.011193	0	0	0	0.011193	0.025076	0.08574	0	0.110816	0.005229	0.000105	0	0.005334	0.088748	50.31692
Statewide	2050	T7 Other Port	Aggregate	Aggregate	Electricity	355.0271971	92165.19218	0	92165.1922	5808.24494	167468.9668	0	0	0	0	0	0	0	0	0.000914353	0.001666262	0.002581	0	0	0	0	0.003657	0.004761	0.008418	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Statewide	2050	T7 POAK	Aggregate	Aggregate	Diesel	5488.788244	632645.7211	632645.7211	0	89796.5757	0	0.895316477	0.244416925	0.1810537	1.32078706	0.0114112	8.42179E-05	0	0.011495421	0.006276353	0.022981963	0.040754	0.011927	8.8E-05	0	0.012015193	0.025105	0.065663	0.102783	952.9436	39.48225	0	992.4259	0.000332	0.000961	0	0.001292	0.150137	0.00622	0	0.156357	0.007138	0.020684	0	0.027821	0	0	0	0.027821	0.008126	0.023547	0	0.031672	0	0	0	0.031672	0.04516	0.305617	0	0.350778	0.009024	0.000374	0	0.009398	0.153422	88.65301
Statewide	2050	T7 POAK	Aggregate	Aggregate	Electricity	1281.432992	146058.0296	0	146058.03	20964.2438	265820.8287	0	0	0	0	0	0	0	0	0.001449013	0.002652907	0.004102	0	0	0	0	0.005796	0.00758	0.013376	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Statewide	2050	T7 POAK	Aggregate	Aggregate	Natural Ga	7.887240059	908.179697	908.179697	0	129.035247	0	0.000172926	0.000180785	0	0.000353711	2.3235E-06	6.85053E-07	0	3.00859E-06	9.00987E-06	3.29912E-05	4.5E-05	2.53E-06	7.45E-07	0	3.27211E-06	3.6E-05	9.43E-05	0.000134	1.152964	0.136613	0	1.289577	0.001174	0.000416	0	0.00159	0.000235	2.78E-05	0	0.000263	1.68E-05	5.94E-06	0	2.27E-05	0	0	0	2.27E-05	0.001199	0.000424	0	0.001623	0	0	0	0.001623	0.004982	0.001367	0	0.00635	0	0	0	0	0.001061	0.149055
Statewide	2050	T7 POLA	Aggregate	Aggregate	Diesel	16641.79806	2844154.077	2844154.077	0	272259.816	0	3.600989066	0.74106286	0.5807398	4.922791708	0.06787929	0.000255345	0	0.068134631	0.028216289	0.094702475	0.191053	0.070948	0.000267	0	0.071215377	0.112865	0.270578	0.454659	4219.785	119.8448	0	4339.63	0.001442	0.002913	0	0.004355	0.664829	0.018882	0	0.683711	0.031043	0.062712	0	0.093755	0	0	0	0.093755	0.03534	0.071393	0	0.106733	0	0	0	0.106733	0.137159	0.92662	0	1.063779	0.039959	0.001135	0	0.041094	0.689731	387.6575
Statewide	2050	T7 POLA	Aggregate	Aggregate	Electricity	3361.115803	568694.0118	0	568694.012	54987.8545	1016965.134	0	0	0	0	0	0	0	0	0.005641901	0.009489238	0.015131	0	0	0	0	0.022568	0.027112	0.04968	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Statewide	2050	T7 POLA	Aggregate	Aggregate	Natural Ga	652.8658761	111752.4794	111752.4794	0	10680.8857	0	0.019100935	0.014965589	0	0.034066524	0.00022654	5.66781E-05	0	0.000283222	0.001108674	0.003673088	0.005065	0.000246	6.16E-05	0	0.000308029	0.004435	0.010495	0.015237	128.1222	11.31756	0	139.4398	0.117572	0.034439	0	0.152011	0.026119	0.002307	0	0.028426	0.00168	0.000492	0	0.002172	0	0	0	0.002172	0.119991	0.035147	0	0.155138	0	0	0	0.155138	0.407234	0.113126	0	0.52036	0	0	0	0	0.130577	16.11711
Statewide	2050	T7 Public	Aggregate	Aggregate	Diesel	12660.2416	508251.8151	508251.8151	0	64947.0394	0	0.804104841	0.217575451	0.3732648	1.394945064	0.00522055	8.44454E-05	0	0.005305	0.005042266	0.020194676	0.030542	0.005457	8.83E-05	0	0.005544869	0.020169	0.057699	0.083413	879.2833	35.36738	0	914.6507	0.000573	0.000776	0	0.001348	0.138531	0.005572	0	0.144104	0.012327	0.016699	0	0.029026	0	0	0	0.029026	0.014033	0.019011	0	0.033044	0	0	0	0.033044	0.069615	0.240224	0	0.309839	0.008326	0.000335	0	0.008661	0.119082	81.70538
Statewide	2050	T7 Public	Aggregate	Aggregate	Electricity	11879.04065	538706.999	0	538706.999	60939.4785	1025778.711	0	0	0	0	0	0	0	0	0.005344405	0.010496247	0.015841	0	0	0	0	0.021378	0.029989	0.051367	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Statewide	2050	T7 Public	Aggregate	Aggregate	Natural Ga	3276.070733	135396.8443	135396.8443	0	16806.2429	0	0.02745011	0.026659935	0	0.054110045	0.0002873	9.73783E-05	0	0.000384673	0.001343245	0.004529182	0.006257	0.000312	0.000106	0	0.000418367	0.005373	0.012941	0.018732	167.3967	20.71487	0	188.1115	0.153559	0.062654	0	0.216213	0.034125	0.004223	0	0.038348	0.002194	0.000895	0	0.003089	0	0	0	0.003089	0.156718	0.063943	0	0.220661	0	0	0	0.220661	0.613679	0.193559	0	0.807238	0	0	0	0	0.158204	21.74282
Statewide	2050	T7 Single	Aggregate	Aggregate	Diesel	46947.86139	2246543.66	2246543.66	0	442248.854	0	2.256820737	1.139767331	1.2163434	4.612931508	0.03801202	0.000392976	0	0.038405	0.022287514	0.07516531	0.135858	0.039731	0.000411	0	0.040141504	0.08915	0.214758	0.34405	3581.5	193.7276	0	3775.228	0.001051	0.004478	0	0.005528	0.564267	0.030522	0	0.594789	0.022619	0.096402	0	0.119021	0	0	0	0.119021	0.02575	0.109747	0	0.135497	0	0	0	0.135497	0.110402	1.423751	0	1.534152	0.033915	0.001834	0	0.035749	0.544801	337.2396
Statewide	2050	T7 Single	Aggregate	Aggregate	Electricity	48504.25316	2677627.042	0	2677627.04	456910.065	4832255.923	0	0	0	0	0	0	0	0	0.026564207	0.045178085	0.071742	0	0	0	0	0.106257	0.12908	0.235337	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Statewide	2050	T7 Single	Aggregate	Aggregate	Natural Ga	2640.065317	125628.8607	125628.8607	0	24869.4153	0	0.023415258	0.03306498	0	0.056480238	0.00026691	0.000122797	0	0.000389706	0.001246339	0.004195134	0.005831	0.00029	0.000134	0	0.000423841	0.004985	0.011986	0.017395	152.8053	25.7188	0	178.5241	0.139452	0.076971	0	0.216423	0.03115	0.005243	0	0.036393	0.001992	0.0011	0	0.003092	0	0	0	0.003092	0.142321	0.078554	0	0.220875	0	0	0	0.220875	0.530679	0.244553	0	0.775232	0	0	0	0	0.146791	20.63467
Statewide	2050	T7 SWCV	Aggregate	Aggregate	Diesel	1071.644481	68663.15631	68663.15631	0	4929.56461	0	0.106859431	0.024296288	0.0230726	0.154228275	0.00133968	1.18246E-05	0	0.001351507	0.000681194	0.005563081	0.007596	0.0014	1.24E-05	0	0.001412616	0.002725	0.015895	0.020032	248.8864	3.54828	0	252.4347	9.78E-05	7.13E-05	0	0.000169	0.039212	0.000559	0	0.039771	0.002106	0.001534	0	0.003641	0	0	0	0.003641	0.002398	0.001747	0	0.004145	0	0	0	0.004145	0.0047	0.021046	0	0.025747	0.002357	3.36E-05	0	0.00239	0.014772	22.54989
Statewide	2050	T7 SWCV	Aggregate	Aggregate	Electricity	8328.997825	538776.3365	0	538776.337	38313.39	981566.6393	0	0	0	0	0	0	0	0	0.005345093	0.021825797	0.027171	0	0	0	0	0.02138	0.062359	0.08374	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Statewide	2050	T7 SWCV	Aggregate	Aggregate	Natural Ga	8624.942518	559796.7338	559796.7338	0	39674.7356	0	0.116177417	0.009170712	0	0.125348129	0.00050991	1.19148E-05	0	0.000521824	0.005553632	0.045354665	0.05143	0.000555	1.3E-05	0	0.000567532	0.022215	0.129585	0.152367	693.5792	60.26609	0	753.8453	0.231609	0.033453	0	0.265062	0.141391	0.012286	0	0.153676	0.003456	0.000484	0	0.00394	0	0	0	0.00394	0.236541	0.034148	0	0.270689	0	0	0	0.270689	4.934159	0.352276	0	5.286435	0	0	0	0	0.357901	87.13302
Statewide	2050	T7 Tractor	Aggregate	Aggregate	Diesel	159548.4661	10397074.51	10397074.51	0	2318239.21	0	12.991762	7.183511778	8.436831	28.61210479	0.24444777	0.002475132	0	0.246922901	0.103147315	0.342093117	0.692163	0.255501	0.002587	0	0.258087659	0.412589	0.977409	1.648086	14459.2	1165.242	0	15624.44	0.005327	0.028234	0	0.033561	2.278053	0.183584	0	2.461637	0.114681	0.607873	0	0.722554	0	0	0	0.722554	0.130555	0.692017	0	0.822572	0	0	0	0.822572	0.492034	8.981452	0	9.473486	0.13692	0.011034	0	0.147954	2.521377	1395.725
Statewide	2050	T7 Tractor	Aggregate	Aggregate	Electricity	32300.39131	2275480.195	0	2275480.19	469324.686	4112004.388	0	0	0	0	0	0	0	0	0.022574588	0.037556248	0.060131	0	0	0	0	0.090298	0.107304	0.197602	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Statewide	2050	T7 Tractor	Aggregate	Aggregate	Natural Ga	4183.164144	270027.136	270027.136	0	60781.375	0	0.048155984	0.097044904	0	0.145200888	0.0005691	0.000364894	0	0.000933993	0.002678886	0.008899213	0.012512	0.000619	0.000397	0	0.001015803	0.010716	0.025426	0.037158	314.8246	73.38282	0	388.2075	0.294374	0.224277	0	0.518651	0.064179	0.01496	0	0.079139	0.004206	0.003204	0	0.007411	0	0	0	0.007411	0.300431	0.228891	0	0.529321	0	0	0	0.529321	1.048039	0.727714	0	1.775753	0	0	0	0	0.315513	44.87086
Statewide	2050	T7 Utility	Aggregate	Aggregate	Diesel	1191.978329	49118.38277	49118.38277	0	15257.3226	0	0.04943953	0.009869668	0.0661575	0.125466731	0.00052846	3.39951E-06	0	0.000531855	0.000487294	0.00177275	0.002792	0.000552	3.55E-06	0	0.000555903	0.001949	0.005065	0.00757	81.21631	1.73922	0	82.95553	2.47E-05	3.88E-05	0	6.35E-05	0.012796	0.000274	0	0.01307	0.000532	0.000835	0	0.001367	0	0	0	0.001367	0.000606	0.00095	0	0.001556	0	0	0	0.001556	0.003945	0.012332	0	0.016276	0.000769	1.65E-05	0	0.000786	0.011912	7.410385
Statewide	2050	T7 Utility	Aggregate	Aggregate	Electricity	979.3936139	44875.6076	0	44875.6076	12536.2383	82553.53237	0	0	0	0	0	0	0	0	0.000445202	0.000828025	0.001273	0	0	0	0	0.001781	0.002366	0.004147	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Statewide	2050	T7IS	Aggregate	Aggregate	Gasoline	29.48127632	3609.663539	3609.663539	0	589.861377	0	0.009421454	0	0.0012725	0.010693955	4.6534E-06	0	3.06709E-07	4.96006E-06	1.98949E-05	0.000127933	0.000153	5.06E-06	0	3.3357E-07	5.39452E-06	7.96E-05	0.000366	0.00045	6.731993	0	0.027575	6.759567	0.00031	0	7.9E-07	0.000311	0.0004	0	5.98E-05	0.000459	0.001403	0	4.54E-06	0.001408	6.16E-05	7.76E-06	0.00012	0.001598	0.002048	0	4.97E-06	0.002053	6.16E-05	7.76E-06	0.00012	0.002243	0.108234	0	0.003161	0.111395	6.66E-05	0	2.73E-07	6.68E-05	0.000179	0.712788
Statewide	2050	T7IS	Aggregate	Aggregate	Electricity	29.62884459	4457.888623	0	4457.88862	592.813923	8385.736274	0	0	0	0	0	0	0	0	2.45699E-05	7.91873E-05	0.000104	0	0	0	0	9.83E-05	0.000226	0.000325	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Statewide	2050	UBUS	Aggregate	Aggregate	Gasoline	2077.487278	196478.228	196478.228	0	8309.94911	0	0.003929935	0	0.0026298	0.006559745	0.00023404	0	1.22512E-06	0.000235261	0.00043316	0.006898079	0.007567	0.000255	0	1.3324E-06	0.000255868	0.001733	0.019709	0.021697	147.4184	0	0.316135	147.7345	0.000193	0	0.00026	0.000453	0.000697	0	0.000454	0.001151	0.000494	0	0.000859	0.001352	0.00086	0.000232	0.000896	0.00334	0.00072	0	0.00094	0.001661	0.00086	0.000232	0.000896	0.003648	0.11581	0	0.054046	0.169856	0.001457	0	3.13E-06	0.001461	0.009746	15.57842
Statewide	2050	UBUS	Aggregate	Aggregate	Diesel	67.68085092	3683.258291	3683.258291	0	270.723404	0	0.000878041	0	0	0.000878041	7.1641E-05	0	0	7.16409E-05	1.21803E-05	0.000129314	0.000213	7.49E-05	0	0	7.48802E-05	4.87E-05	0.000369	0.000493	2.684784	0	0	2.684784	1.91E-05	0	0	1.91E-05	0.000423	0	0	0.000423	0.000411	0	0	0.000411	0	0	0	0.000411	0.000467	0	0	0.000467	0	0	0	0.000467	0.000974	0	0	0.000974	2.54E-05	0	0	2.54E-05	0.000893	0.239831
Statewide	2050	UBUS	Aggregate	Aggregate	Electricity	18441.39146	2038168.128	0	2038168.13	73765.5659	3961687.244	0	0	0	0	0	0	0	0	0.017714872	0.043248894	0.060964	0	0	0	0	0.070859	0.123568	0.194428	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Statewide	2050	UBUS	Aggregate	Aggregate	Natural Ga	280.4867967	20557.96795	20557.96795	0	1121.94719	0	0.003138638	0	0	0.003138638	0.00021767	0	0	0.000217669	6.79838E-05	0.000721762	0.001007	0.000228	0	0	0.000227511	0.000272	0.002062	0.002562	13.74052	0	0	13.74052	5.96E-05	0	0	5.96E-05	0.002801	0	0	0.002801	0.001283	0	0	0.001283	0	0	0	0.001283	0.00146	0	0	0.00146	0	0	0	0.00146	0.002157	0	0	0.002157	0	0	0	0	0.021981	1.588195

Light-Duty Vehicles

LDV EV Population

	LDA	LDT1	LDT2	MCY	MH	MDV	Total
2018	215,329	2,045	576	-	-	389	218,339
2030	1,164,061	9,084	119,983	-	-	120,322	1,413,449
2045	1,739,474	27,212	295,076	-	-	271,390	2,333,152
2050	1,802,523	30,412	316,976	-	-	291,461	2,441,372

LDV All Fuels Population

	LDA	LDT1	LDT2	MCY	MH	MDV	Total
2018	14,388,745	1,494,088	5,584,666	695,310	153,398	4,390,865	26,707,072
2030	14,254,118	1,168,556	7,094,747	709,779	98,755	4,497,249	27,823,204
2045	15,111,535	1,025,540	8,182,149	760,275	76,571	4,946,419	30,102,489
2050	15,376,750	1,030,392	8,349,720	751,899	74,719	5,005,269	30,588,748

Medium- and Heavy-Duty Vehicles

MDV & HDV EV Population

	LHD1	LHD2	PTO	T6	T7	Motor Coach	OBUS	SBUS	UBUS	All Other Buses	Total MDV & HDV
2018	-	-	-	-	-	-	-	-	129	-	129
2030	46,756	11,986	-	26,848	16,761	-	537	1,405	2,891	-	107,184
2045	354,827	91,504	-	215,167	104,733	-	3,144	10,920	16,876	-	797,170
2050	428,140	111,288	-	270,698	130,350	-	3,636	14,509	18,441	-	977,062

MDV & HDV All Fuels Population

	LHD1	LHD2	PTO	T6	T7	Motor Coach	OBUS	SBUS	UBUS	All Other Bus	Total MDV & HDV
2018	950,296	209,675	-	333,436	295,440	2,409	16,299	30,364	14,206	8,861	1,860,985
2030	902,882	236,613	-	367,995	381,501	2,417	11,061	31,211	15,095	9,798	1,958,573
2045	938,767	255,464	-	477,821	537,794	2,445	9,098	30,459	19,120	10,753	2,281,720
2050	946,590	258,920	-	529,671	609,508	2,534	8,390	28,988	20,867	10,941	2,416,409

Appendix C

Municipal GHG Inventory, Forecasts, and Measure Quantification Memo

Memo

1111 Broadway, Suite 300
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Date: March 8, 2022

To: Rachel DiFranco (City of Fremont)

From: Angie Xiong, Hannah Kornfeld, and Honey Walters (Ascent Environmental)

Subject: City of Fremont Climate Action Plan Update Technical Memorandum #3: Municipal Emissions Forecasts and Measures

---

INTRODUCTION

This technical memorandum summarizes the greenhouse gas (GHG) emissions resulting from the City of Fremont's (City) municipal operations and facilities. The purpose of the gap analysis is to confirm and quantify the suite of GHG reduction measures that would set the City on course to meet its reduction targets for 2030, 2045, and 2050 for municipal operations. The gap analysis includes the following steps in the climate action planning process, which are listed below and addressed in subsequent sections.

- Section 1: Municipal Greenhouse Gas Inventory and Forecasts presents an overview of the City's 2018 municipal GHG emissions inventory as well as the forecasted municipal GHG emissions for 2030, 2045, and 2050.
- Section 2: Gap Analysis illustrates the emissions gap between the forecasted municipal GHG emissions and the City's GHG reduction targets. This gap indicates the quantity of emissions reductions that will need to be met through local action.
- Section 3: Municipal Greenhouse Gas Reduction Measures quantifies the estimated GHG reductions resulting from implementation of the City's municipal GHG reduction measures. This section also describes the specific actions required to support each measure.

1 MUNICIPAL GREENHOUSE GAS INVENTORY AND FORECASTS

The City prepared the 2018 Municipal GHG Emissions Inventory using ICLEI's ClearPath Tool. Municipal operations and facilities generated 7,209 metric tons of carbon dioxide equivalent ($MTCO_2e$) in 2018. Major emissions sectors included employee commute, buildings and facilities, street lights and traffic signals, vehicle fleet, solid waste facilities, and water and wastewater treatment. Table 1 and Figure 1 present the 2018 municipal GHG emissions inventory by sector.

Table 1 2018 City of Fremont Municipal Greenhouse Gas Inventory

Sector	2018 Emissions ($MTCO_2e$/year)	Percent of Total
Employee Commute	2,505	35%
Buildings and Facilities	1,271	18%
Street Lights & Traffic Signals	178	2%
Vehicle Fleet	2,241	31%
Solid Waste Facilities	930	13%
Water and Wastewater Treatment	84	1%
Total Municipal Emissions	**7,209**	**100%**

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

Source: 2018 Municipal GHG Emissions Inventory adapted from City of Fremont ClearPath by Ascent Environmental in 2021.

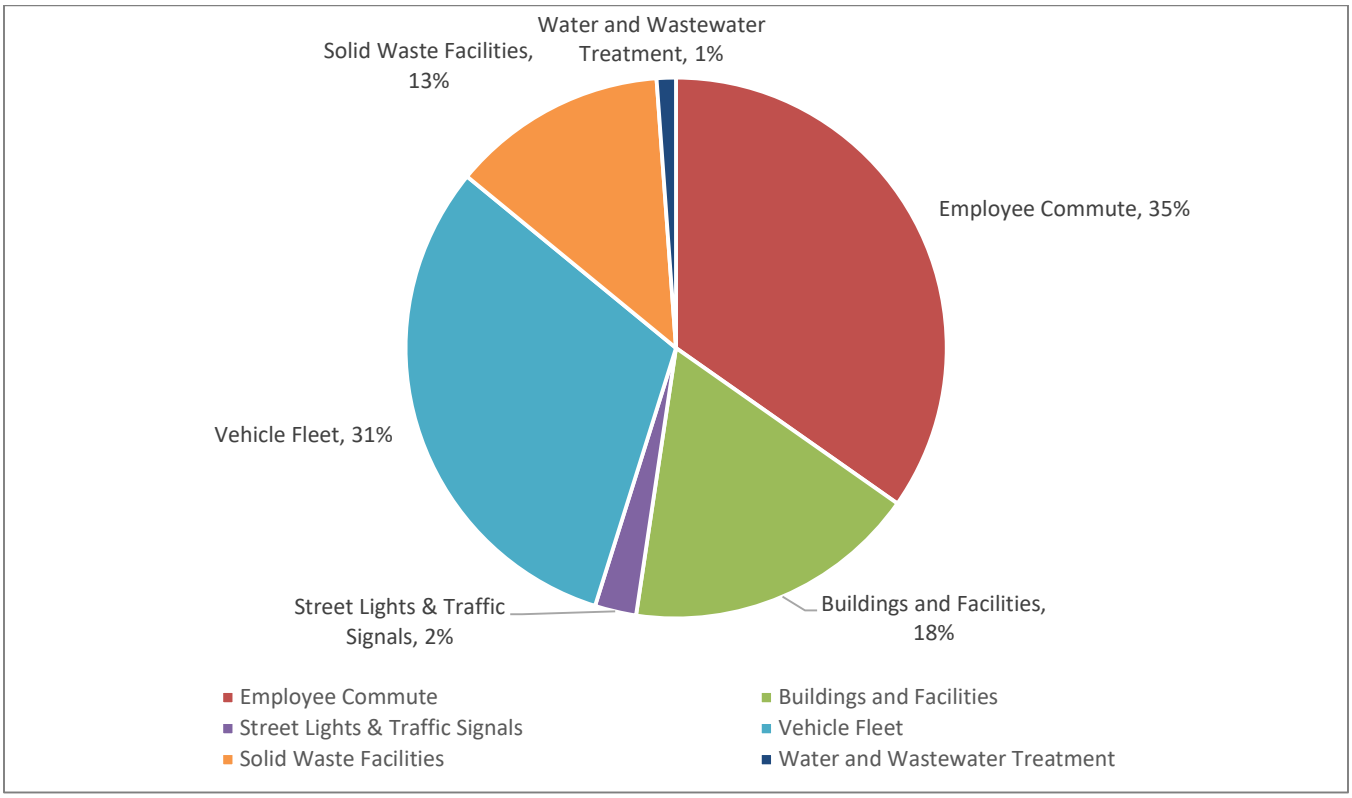

Figure 1 2018 City of Fremont Municipal Greenhouse Gas Inventory

Municipal GHG emissions forecasts were calculated to estimate future levels, absent City-specific reduction measures. Emissions forecasts were prepared for a legislative-adjusted "business-as-usual" (BAU) scenario for 2030, 2045, and 2050. The legislative-adjusted BAU forecast scenario accounts for future growth in emissions associated with municipal employment growth, along with legislative actions to reduce emissions due to State and federal regulations, programs, or other mandated actions. The same set of legislative reductions as those applied to the communitywide emissions were applied to the municipal emissions, as applicable. A summary of legislative reductions applied in the legislative-adjusted BAU forecast scenario is provided in the "Fremont CAP 2.0 Emissions Forecast Scenarios Memo," dated February 26, 2021.

Municipal employment growth rates were used to estimate future activity levels for each emissions sector. The historic average annual employment growth rate between 2016 and 2021 was 1.35 percent. It was assumed that employment growth will slow between 2030 and 2050 as the City becomes increasingly built out and new staff are hired to maintain existing services rather than expand or provide new services. Thus, a reasonable annual employment growth rate of 0.5 percent was used beyond 2030. Municipal employment growth rates were applied to each emissions sector based on the percent change from 2018 activity levels for each target year. Refer to Attachment A for detailed calculations of scaling factors and forecasts.

The legislative-adjusted BAU forecasts for the City's GHG emissions are summarized alongside the 2005 and 2018 municipal emissions inventories in Table 2. Under the legislative-adjusted BAU forecast, municipal GHG emissions are projected to decrease by approximately 17 percent between 2018 and 2050, despite a 28 percent increase in municipal employment. This is largely due to regulations that require a greater percentage of renewable electricity, increase energy efficiency standards, and improve vehicle fuel efficiency (e.g., California's Renewables Portfolio Standard, California Building Energy Efficiency Standards, Advanced Clean Car Standards, Fuel Efficiency Standards for Medium- and Heavy-Duty Vehicles).

Table 2 City of Fremont 2005 and 2018 Municipal Greenhouse Gas Emissions Inventories and Legislative-Adjusted BAU Forecasts ($MTCO_2e$)

Sector	2005	2018	2030	2040	2045
Employee Commute	2,572	2,505	1,994	1,864	1,899
Buildings and Facilities	2,769	1,271	1,229	1,102	1,117
Street Lights & Traffic Signals	1,754	178	113	-	-
Vehicle Fleet	2,371	2,241	1,784	1,668	1,699
Solid Waste Facilities	722	930	1,081	1,165	1,195
Water and Wastewater Treatment	203	84	84	72	74
Total Municipal Emissions	**10,391**	**7,209**	**6,286**	**5,872**	**5,983**

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

Source: 2005 Municipal GHG Emissions Inventory prepared by City of Fremont, ClearPath. 2018 Municipal GHG Emissions Inventory adapted from City of Fremont ClearPath by Ascent Environmental in 2021. Forecasts prepared by Ascent Environmental in 2021.

2 GAP ANALYSIS

The City's GHG reduction targets are as follows:

- 2030 target: 55 percent below 2005 levels for communitywide emissions; and
- 2045 target: municipal and community-scale carbon neutrality.

The City is aligning its 2030 municipal GHG reductions target with the 2030 communitywide target of 55 percent below 2005 levels. Based on the City's 2005 municipal inventory (shown in Table 2), applying the above targets to the

2005 baseline would mean that the City's municipal emissions would need to be reduced to 5,715 metric tons of carbon dioxide equivalent ($MTCO_2e$) by 2030 and 0 $MTCO_2e$ by 2045. The City's municipal targets, along with the estimated reductions required to achieve the targets, are summarized in Table 3.

Table 3 City of Fremont Municipal GHG Emissions Reduction Targets and Legislative-Adjusted BAU Summary

Source	2005	2018	2030	2045	2050
Municipal Emissions and Legislative-Adjusted BAU Forecasts ($MTCO_2e$)	10,391	7,209	6,286	5,872	5,983
Municipal Target Percent Reduction Below 2005 Levels	NA	NA	55%	Carbon Neutrality	Carbon Neutrality
Municipal Target Annual Emissions ($MTCO_2e$)	NA	NA	5,715	0	0
Reduction Needed to Meet Target ($MTCO_2e$)	NA	NA	571	5,872	5,983

Notes: BAU = business-as-usual; GHG = greenhouse gas; $MTCO_2e$ = metric tons of carbon dioxide equivalent per year; NA = not applicable.

Source: Calculations conducted by Ascent Environmental in 2021.

Figure 2 depicts the municipal legislative-adjusted BAU GHG emissions forecasts by sector, as distinguished by colored wedges, and the City's municipal emissions reduction targets relative to the 2005 municipal emissions inventory. The space between the trajectory of the black line (i.e., targets) and the top of the colored wedges (i.e., forecasted emissions) represents the gap in emissions that will need to be addressed through municipal actions for the City to meet its municipal GHG reduction targets.

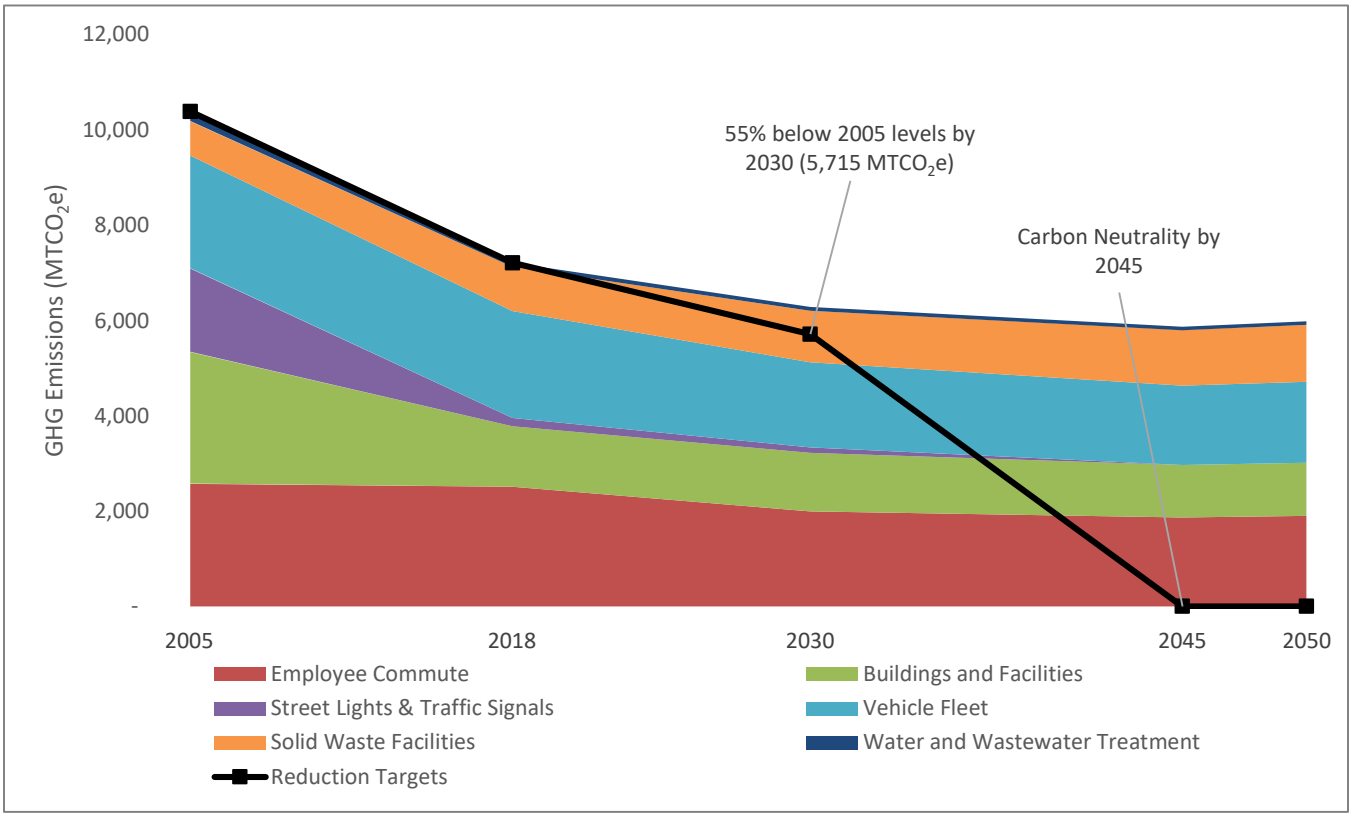

Figure 2 City of Fremont Municipal Legislative-Adjusted BAU Emissions Forecast by Sector and Emissions Reduction Targets: 2030, 2045, and 2050

3 MUNICIPAL GREENHOUSE GAS EMISSIONS REDUCTION MEASURES

As discussed above, additional GHG reductions are needed to achieve the municipal operations emissions reduction targets for 2030, 2045, and 2050. Ascent worked with City staff to develop a draft list of recommended municipal GHG reduction measures based existing measures from the City's 2012 CAP, as well as new measures informed by community outreach and current best practices.

The measures presented below are organized under six categories that generally align with the emissions sectors included in the municipal inventories: buildings and energy (includes buildings and facilities, and street lights and traffic signals), on-road transportation (includes employee commute and vehicle fleet), water and wastewater treatment, solid waste facilities, infrastructure, and carbon sequestration. Each sector includes one or more broad strategies, and each strategy includes one or more measures to reduce GHG emissions and adapt to climate change. For measures that are quantifiable, clear performance indicators have been included that can be tracked and monitored to help the City meet its reduction targets. To assist with implementation, measures are broken down into specific actions and supporting actions that the City would take to reduce GHG emissions.

GHG reductions associated with these recommended measures were calculated in a stepwise manner for the future years of 2030, 2045, and 2050. In other words, GHG reductions (in $MTCO_2e$) are assessed during a snapshot in time in years 2030, 2045, and 2050. Measures are quantified for a single year rather than adding cumulative reductions from prior years, which aligns with the methodology used to derive the City's GHG reduction targets.

GHG emissions reductions were quantified for measures wherever substantial evidence and reasonable assumptions were available to support calculations. City staff and Ascent also identified measures that were not quantifiable due to lack of available data or quantification methods but would still be expected to reduce GHG emissions. These are listed in this memo and will be discussed qualitatively in the CAP 2.0 document.

Preliminary estimates of municipal GHG emissions reductions, along with an estimated emissions gap are summarized in Table 4 below and illustrated in Figure 3. Descriptions of the measures and actions are provided in the following sections. Detailed measure calculations and assumptions supporting the GHG reduction estimates are provided in Attachment B.

Table 4 Municipal Greenhouse Gas Emissions Reduction Measures

Measure Number	Strategy	Measure	GHG Reductions ($MTCO_2e$)		
			2030	2040	2045
Buildings and Energy					
BU-1	Clean and Renewable Power Use	Transition to 100 percent clean electricity consumption.	367	-	-
BU-6	Building Electrification and Low-Carbon Design	Require new City buildings to be all electric and low carbon.	59	155	186
BU-7		Retrofit existing City buildings to be all electric and low carbon.	346	785	982
BU-8	Building Energy Efficiency and Demand Management	Reduce energy consumption in buildings and operations.	NA	NA	NA
BU-10		Reduce overall demand on the electrical grid.	NA	NA	NA
BU-11	Building Energy Resilience	Increase the development of microgrids at emergency facilities.	NA	NA	NA
BU-13	Water Conservation in Buildings	Reduce water consumption in buildings.	1	-	-
BU-14		Increase the capture of rainwater and use of greywater.	NA	NA	NA

Measure Number	Strategy	Measure	GHG Reductions ($MTCO_2e$)		
			2030	2040	2045
BU-15	Waste Reduction in Building and Construction Demolition	Increase sustainable materials use and recovery in construction and demolition (C&D).	-	-	-
		Buildings and Energy Subtotal	***773***	***940***	***1,168***
Infrastructure and Equipment					
IN-6	Clean Mobility Infrastructure	Replace the City's gasoline and diesel-powered fleet vehicles and other equipment with low-emission and zero-emission vehicles.	683	1,458	1,587
IN-10	Critical Infrastructure Protection	Assess local vulnerabilities to climate change and incorporate climate adaptation and resiliency into City planning, policies, and infrastructure projects.	NA	NA	NA
IN-11	Clean Landscaping and Off-Road Equipment	Reduce emissions and air pollution associated with landscaping equipment.	NA	NA	NA
		Infrastructure and Equipment Subtotal	***683***	***1,458***	***1,587***
Land Use and Mobility					
LU-1	Clean and Multimodal Mobility and Connectivity	Promote and enhance active transportation options as identified in the City's Active Transportation Plan and Mobility Action Plan.	NA	NA	NA
LU-2		Reduce vehicle miles traveled (VMT) and single-occupancy vehicle trips, as identified in Fremont's General Plan.	222	386	497
LU-3		Encourage the adoption of zero-emission passenger vehicles.	102	133	154
LU-4		Increase transit ridership and promote transition to zero-emission transit.	NA	NA	NA
		Land Use and Mobility Subtotal	***324***	***519***	***651***
Materials Reuse and Plastic Waste Reduction					
MW-1	Materials Reuse and Plastic Waste Reduction	Promote responsible consumption of products and materials and reduce disposable packaging use.	NA	NA	NA
MW-2		Encourage repair, reuse, and upcycling of materials.	NA	NA	NA
MW-5	Managing Recycling and Organics	Establish and advance zero waste targets and policies.	467	900	1,059
		Materials Reuse and Plastic Waste Reduction Subtotal	***467***	***900***	***1,059***
Natural and Urban Landscapes					
NL-1	Carbon Sequestration	Increase soil carbon content.	NA	NA	NA
NL-3		Implement the City's Urban Forest Management Plan.	482	1,085	1,286
NL-5	Water Conservation in Landscapes	Reduce water usage for irrigation and landscaping.	NA	NA	NA
		Natural and Urban Landscapes Subtotal	***482***	***1,085***	***1,286***
Green Economy					
GE-2	Green Businesses and Jobs	Incentivize and promote green business practices.	NA	NA	NA
		Green Economy Subtotal	***NA***	***NA***	***NA***
Total Reductions from Measures			**2,730**	**4,903**	**5,750**
Reduction Needed to Meet Target			571	5,872	5,983
Target Met?			Yes	No	No

Measure Number	Strategy	Measure	GHG Reductions ($MTCO_2e$)		
			2030	2040	2045
Remaining Gap to Target			(2,159)	968	233

Notes: Total may not sum exactly due to independent rounding. $MTCO_2e$ = metric tons of carbon dioxide equivalent; NA = not applicable. Parentheses indicate target has been met with a surplus of reductions.

Source: Calculations conducted by Ascent Environmental in 2021.

3.1 BUILDINGS AND ENERGY

CLEAN AND RENEWABLE POWER USE

Measure BU-1: Transition to 100 percent clean electricity consumption.

Quantification assumptions: This measure assumes that all electricity consumed by municipal facilities is carbon-free by 2030.

BUILDING ELECTRIFICATION AND LOW-CARBON DESIGN

Measure BU-6: Require new City buildings to be all electric and low carbon.

Quantification assumptions: This measure assumes that all municipal development built in 2026 or later is all-electric.

Measure BU-7: Retrofit existing City buildings to be all electric and low carbon.

Quantification assumptions: According to Zero-Carbon Buildings in California: A Feasibility Study, achievable targets for retrofitting existing nonresidential buildings are 13 percent by 2030 and 65 percent by 2045 (Mozingo 2021). Given the City's ability to control and manage their own facilities, and the natural gas uses typical in municipal facilities (HVAC, water heating) which are easier to convert to all-electric, more aggressive retrofit targets were chosen. This measure assumes that 40 percent of existing municipal buildings are retrofitted by 2030, 80 percent are retrofitted by 2045, and 100 percent are retrofitted by 2050.

BUILDING ENERGY EFFICIENCY AND DEMAND MANAGEMENT

Measure BU-8: Reduce energy consumption in buildings and operations.

Quantification assumptions: Not quantified.

Measure BU-10: Reduce overall demand on the electrical grid.

Quantification assumptions: Not quantified.

BUILDING ENERGY RESILIENCE

Measure BU-11: Increase the development of microgrids at emergency facilities.

Quantification assumptions: Not quantified.

WATER CONSERVATION IN BUILDINGS

Measure BU-13: Reduce water consumption in buildings.

Quantification assumptions: This measure assumes that 5 percent of municipal water consumption is for indoor uses and 95 percent is for outdoor uses such as landscaping and turf irrigation based on data from the City's 2019 and 2020 municipal water use. Regarding indoor water consumption in new municipal facilities, this measure assumes a 50 percent reduction by 2030 based on the CAPCOA Quantifying Greenhouse Gas Mitigation Measures Report, Measure WUW-1 (CAPCOA 2010). This measure assumes a 30 percent reduction in indoor water consumption by 2030, 40 percent by 2045, and 50 percent by 2050 in existing municipal facilities. Regarding outdoor water consumption, this measure assumes a 50 percent reduction by 2030, 75 percent by 2045, and 80 percent by 2050 at new and existing municipal facilities.

Measure BU-14: Increase the capture of rainwater and use of greywater.

Quantification assumptions: Not quantified.

WASTE REDUCTION IN BUILDING AND CONSTRUCTION DEMOLITION

Measure BU-15: Increase sustainable materials use and recovery in construction and demolition (C&D).

Quantification assumptions: Not quantified.

3.2 INFRASTRUCTURE AND EQUIPMENT

CLEAN MOBILITY INFRASTRUCTURE

Measure IN-6: Replace the City's gasoline- and diesel-powered fleet vehicles with alternative fuel vehicles (renewable diesel, hydrogen, hybrids, electric vehicles).

Quantification assumptions: This measure assumes that the City's gasoline vehicle fleet will be converted to electric vehicles (EVs) at a rate of 40 percent by 2030 and 100 percent by 2045. This measure assumes that the City's diesel vehicle fleet will be converted to electric vehicles (EVs) at a rate of 40 percent by 2030, 50 percent by 2045, and 75 percent by 2050.

CRITICAL INFRASTRUCTURE PROTECTION

Measure IN-10: Assess local vulnerabilities to climate change and incorporate climate adaptation and resiliency into City planning, policies, and infrastructure projects.

Quantification assumptions: Not quantified.

CLEAN LANDSCAPING AND OFF-ROAD EQUIPMENT

Measure IN-11: Reduce emissions and air pollution associated with landscaping equipment.

Quantification assumptions: Not quantified.

3.2.1 Land Use and Mobility

CLEAN AND MULTIMODAL MOBILITY AND CONNECTIVITY

Measure LU-1: Promote and enhance active transportation options as identified in the City's Active Transportation Plan and Mobility Action Plan.

Quantification assumptions: Not quantified.

Measure LU-2: Reduce vehicle miles traveled (VMT) and single-occupancy vehicle trips, as identified in Fremont's General Plan.

Quantification assumptions: This measure references the following CAPCOA Handbook measures:

- T-7. Provide Ridesharing Program. Achieves a 0-8.0 percent reduction in vehicle miles traveled (VMT).
- T-8. Implement Subsidized or Discounted Transit Program Achieves a 0-5.5 percent reduction in VMT.
- T-9. Provide End-of-Trip Bicycle Facilities. Achieves a 0.1-4.4 percent reduction in VMT. This reduction was not applied to long-distance employee commute VMT (CAPCOA 2021).

Additionally, it was assumed that half of employees commuting 5 days per week would telecommute one day per week by 2030. Using data from the City's 2017 Employee Commute Survey, this would result in a 5.6 percent reduction in overall employee commute VMT. Accounting for interaction between trip reduction measures, this measure assumes an overall reduction rate of 12 percent local commute VMT by 2030, 21 percent by 2045, and 27 percent by 2050. This measure assumes an overall reduction rate of 8 percent long-distance commute VMT by 2030, 18 percent by 2045, and 23 percent by 2050.

Measure LU-3: Encourage the adoption of zero-emission passenger vehicles.

Quantification assumptions: This measure uses guidance from the California Air Pollution Control Officers Association (CAPCOA) Public Draft Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity (Draft Handbook) which quantifies the range of potential emissions reductions achieved through implementation of various GHG reduction measures (CAPCOA 2021). CAPCOA measure T-13, Provide EV Charging Infrastructure, achieves a 0-11.9 percent reduction in gasoline VMT. Based on CAPCOA measure T-13, this measure assumes a target conversion rate for employee gasoline commute miles traveled to EV miles traveled (eVMT) of 6 percent by 2030, 9 percent by 2045, and 11 percent by 2050. These reductions are applied on the reduced amount of employee commute miles after application of municipal Measure LU-2.

Measure LU-4: Increase transit ridership and promote transition to zero-emission transit.

Quantification assumptions: Not quantified.

3.3 MATERIALS REUSE AND PLASTIC WASTE REDUCTION

MATERIALS REUSE AND PLASTIC WASTE REDUCTION

Measure MW-1: Promote responsible consumption of products and materials and reduce disposable packaging use.

Quantification assumptions: Not quantified.

Measure MW-2: Encourage repair, reuse, and upcycling of materials.

Quantification assumptions: Not quantified.

MANAGINING RECYCLING AND ORGANICS

Measure MW-5: Establish and advance zero waste targets and policies.

Quantification assumptions: The City's communitywide estimated waste diversion rate for 2018 was 56 percent. This measure uses the same current waste diversion rate for municipal waste and assumes that diversion rates will increase to 75 percent by 2030, 90 percent by 2045, and 95 percent by 2050.

3.3.1 Natural and Urban Landscapes

CARBON SEQUESTRATION

Measure NL-1: Increase soil carbon content.

Quantification assumptions: Not quantified.

Measure NL-3: Implement the City's Urban Forest Management Plan.

Quantification assumptions: According to the City's 2020 Urban Tree Assessment, the tree canopy covers 14 percent of the City's land area. The Tree Assessment identified an additional 17 percent of the City's land area as possible planting areas, while the remaining 69 percent was deemed unsuitable for plantings (City of Fremont 2020). This measure assumes an increase in total tree canopy coverage to 21 percent of the City's land area by 2030, 29 by 2045, and 31 by 2050. This measure assumes that 20 percent of new tree plantings will occur on City-owned land and right-of-way.

WATER CONSERVATION IN LANDSCAPES

Measure MW-10: Reduce water usage for irrigation and landscaping.

Quantification assumptions: Not quantified.

3.3.2 Green Economy

Green Businesses and Jobs

Measure GE-2: Incentivize and promote green business practices.

Quantification assumptions: Not quantified.

3.4 CONCLUSION

The total estimated GHG emissions reductions from all municipal measures quantified would be 2,730 $MTCO_2e$ in 2030; 4,903 $MTCO_2e$ in 2045; and 5,750 $MTCO_2e$ in 2050. This would result in total municipal GHG emissions of 3,556 $MTCO_2e$ in 2030; 968 $MTCO_2e$ in 2045; and 233 $MTCO_2e$ in 2050. Therefore, the total estimated reductions from all

proposed municipal GHG reduction measures would be sufficient to meet and exceed the 2030 target of 5,715 $MTCO_2e$.

The scale of reductions required to achieve the carbon neutrality target for 2045 discussed earlier would require significant improvements in the availability and/or cost of near-zero and zero-emissions technologies, as well as potential increased reductions from ongoing State and federal legislative actions that are currently unknown. Progress toward meeting future targets that could be set by the State would be part of the ongoing monitoring and updates to the CAP 2.0 as new legislation or future updates to the State's Climate Change Scoping Plan are adopted.

Figure 3 shows the GHG reductions achieved by the proposed measures, organized by the same sectors used for the inventory and forecasts. The chart shows the estimated GHG reductions due to carbon sequestered through measure MCS-16 as a dashed line that is not associated with any particular emissions sector. Figure 3 shows the City's achievement of the 2030 target with the proposed GHG reduction measures and demonstrates progress toward the 2045 carbon neutrality target.

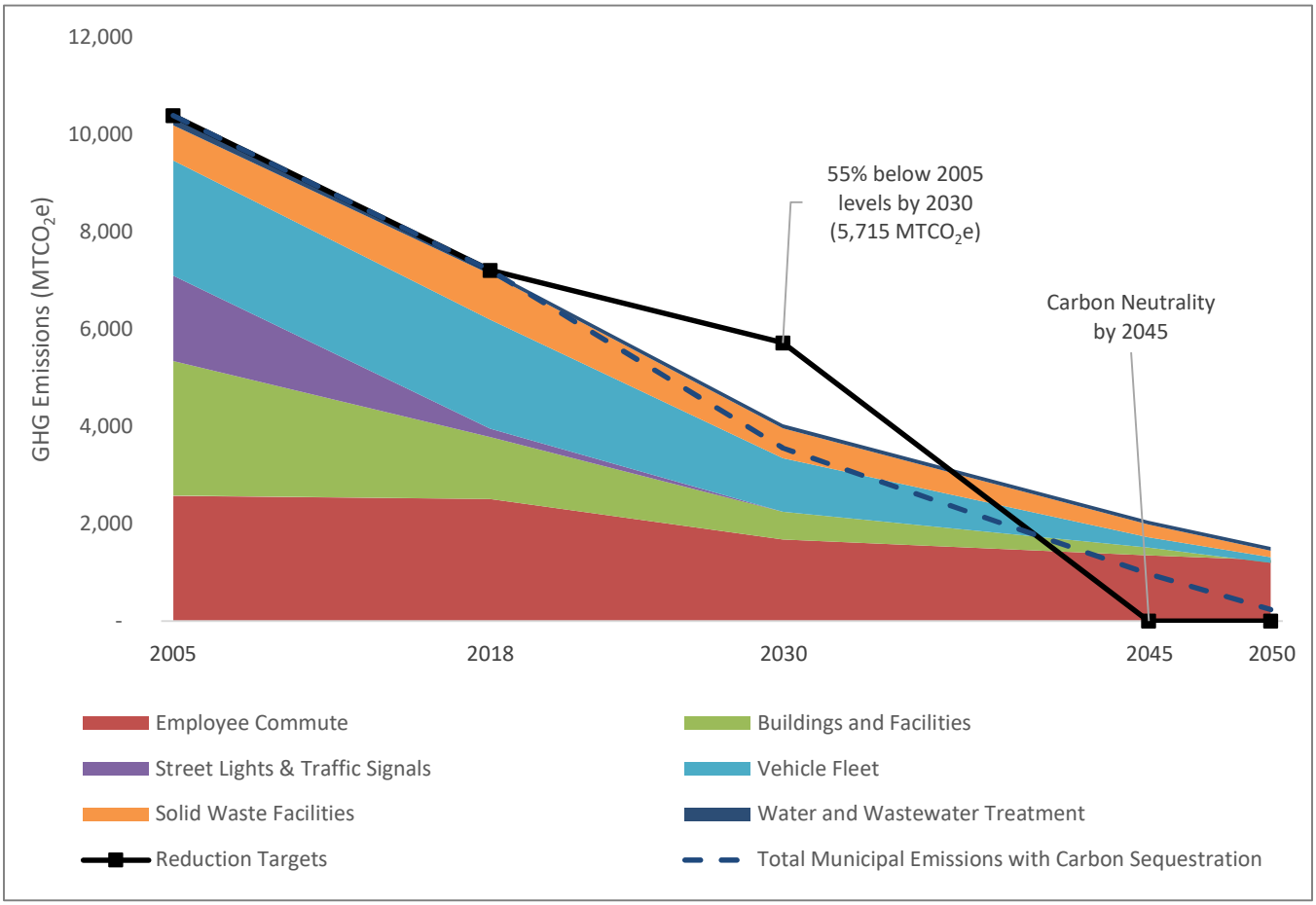

Figure 3 City of Fremont Legislative-Adjusted BAU Municipal Emissions Forecast by Sector with Implementation of Proposed GHG Reduction Measures and Emissions Reduction Targets: 2030, 2045 and 2050

REFERENCES

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Appendix C - Attachment I

Municipal GHG Forecast Data and Calculations

Charts

Fremont Municipal Operations Greenhouse Gas Inventory and Forecasts

Sector	2018 Emissions (MTCO2e/year)	Percent of Total
Employee Commute	2,505	35%
Buildings and Facilities	1,271	18%
Street Lights & Traffic Signals	178	2%
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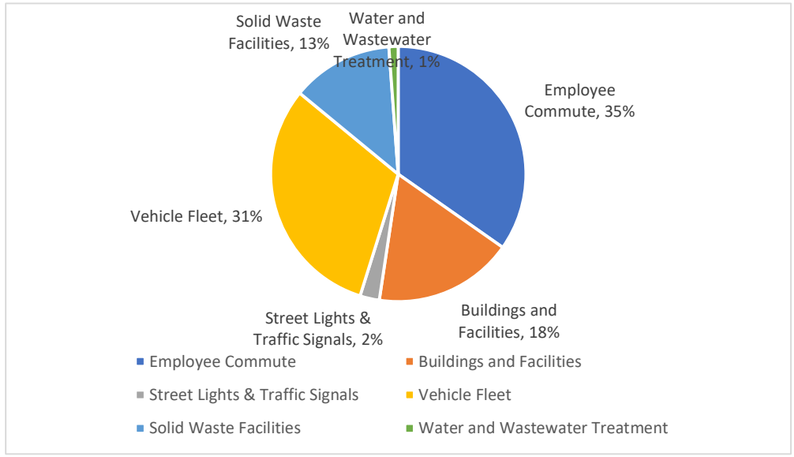

Sector	2005	2018	2030	2045	2050
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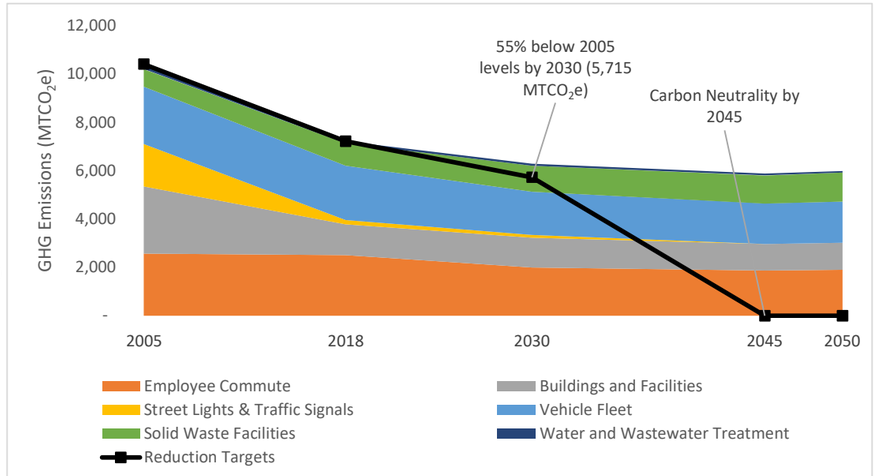
Solid Waste Facilities	722	930	1,081	1,165	1,195
Water and Wastewater Trea	203	84	84	72	74
Axis					
Total Municipal Emissions	10,391	7,209	6,286	5,872	5,983
Reduction Targets	10,391	7,209	5,715.05	0	0



Municipal Inventory and Forecasts Summary

Fremont Municipal Operations Greenhouse Gas Inventory and Forecasts

Emissions Sector	2005 GHG Emissions	2018 GHG Emissions					2030 GHG Emissions						2045 GHG Emissions						2050 GHG Emissions					
									BAU		Leg-Adjust BAU				BAU		Leg-Adjust BAU				BAU		Leg-Adjust BAU	
	MT CO_2e from Clearpath	Activity	Units	MT CO_2e from Clearpath	MT CO_2e (Ascent calcs)	CO2e % 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
Employee Commute	**2,572**	**7511608**	**VMT**	**2,999.21**	**2,504.85**	**34.7%**	**8734802**	**VMT**	**2,912.74**	**34.7%**	**1,994.01**	**31.7%**	**9413345**	**VMT**	**3,139.01**	**34.7%**	**1,863.91**	**31.7%**	**9651044**	**VMT**	**3,218.27**	**34.7%**	**1,898.60**	**31.7%**
Employee Commute (Local)-Gas		6563707	VMT	2,620.74	2,188.76	30.4%	7632544	VMT	2,545.18	30.4%	1,742.38	27.7%	8225461	VMT	2,742.89	30.4%	1,628.70	27.7%	8433164	VMT	2,812.15	30.4%	1,659.01	27.7%
Employee Commute (Distance)-Gas		947901	VMT	378.47	316.09	4.4%	1102258	VMT	367.56	4.4%	251.63	4.0%	1187884	VMT	396.12	4.4%	235.21	4.0%	1217880	VMT	406.12	4.4%	239.59	4.0%
Buildings and Facilities	**2,769**			**1,264.94**	**1,271.29**	**17.6%**			**1,478.31**	**17.6%**	**1,229.06**	**19.6%**			**1,593.15**	**17.6%**	**1,102.30**	**18.8%**			**1,633.38**	**17.6%**	**1,116.83**	**18.7%**
Electricity - PG&E		2918915	kWh	277.33	285.20	4.0%	3394232	kWh	331.65	4.0%	168.22	2.7%	3657906	kWh	357.41	4.0%	-	0.0%	3750272	kWh	366.44	4.0%	-	0.0%
Electricity - EBCE (Brilliant 100)		2328068	kWh	-	-	0.0%	2707172	kWh	-	0.0%	-	0.0%	2917472	kWh	-	0.0%	-	0.0%	2991142	kWh	-	0.0%	-	0.0%
Natural Gas - ABAG Power		185688	therms	987.61	986.09	13.7%	215926	therms	1,146.66	13.7%	1,060.84	16.9%	232699	therms	1,235.74	13.7%	1,102.30	18.8%	238575	therms	1,266.94	13.7%	1,116.83	18.7%
Street Lights & Traffic Signals	**1,754**			**173.07**	**177.98**	**2.5%**			**206.97**	**2.5%**	**113.47**	**1.8%**			**223.04**	**2.5%**	**-**	**0.0%**			**228.68**	**2.5%**	**-**	**0.0%**
Streetlights - PG&E		1513530	kWh	143.80	147.89	2.1%	1759994	kWh	171.97	2.1%	94.28	1.5%	1896715	kWh	185.33	2.1%	-	0.0%	1944610	kWh	190.01	2.1%	-	0.0%
Streetlights - EBCE (Brilliant 100)		1520376	kWh	-	-	0.0%	1767955	kWh	-	0.0%	-	0.0%	1905294	kWh	-	0.0%	-	0.0%	1953405	kWh	-	0.0%	-	0.0%
Traffic Control - PG&E		308033	kWh	29.27	30.10	0.4%	358193	kWh	35.00	0.4%	19.19	0.3%	386019	kWh	37.72	0.4%	-	0.0%	395766	kWh	38.67	0.4%	-	0.0%
Traffic Control - EBCE (Brilliant 100)		298960	kWh	-	-	0.0%	347643	kWh	-	0.0%	-	0.0%	374649	kWh	-	0.0%	-	0.0%	384109	kWh	-	0.0%	-	0.0%
Vehicle Fleet	**2,371**			**2,225.26**	**2,240.96**	**31.1%**			**2,605.88**	**31.1%**	**1,783.94**	**28.4%**			**2,808.32**	**31.1%**	**1,667.55**	**28.4%**			**2,879.23**	**31.1%**	**1,698.58**	**28.4%**
Fleet Vehicles - Gasoline		190262	gallons	1,681.44	1,690.60	23.5%	221244	gallons	1,965.90	23.5%	1,345.82	21.4%	238431	gallons	2,118.61	23.5%	1,258.01	21.4%	244452	gallons	2,172.11	23.5%	1,281.42	21.4%
Fleet Vehicles - Diesel		52009	gallons	531.01	537.40	7.5%	60478	gallons	624.91	7.5%	427.80	6.8%	65176	gallons	673.45	7.5%	399.89	6.8%	66821	gallons	690.46	7.5%	407.33	6.8%
Fleet Vehicles - Flex Fuel		1717	gallons	12.81	12.97	0.2%	1997	gallons	15.08	0.2%	10.32	0.2%	2152	gallons	16.25	0.2%	9.65	0.2%	2206	gallons	16.66	0.2%	9.83	0.2%
Fleet Vehicles - Electric		71074	VMT	-	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Solid Waste Facilities	**722**			**929.92**	**-**	**12.9%**			**1,081.35**	**12.9%**	**1,081.35**	**17.2%**			**1,165.35**	**12.9%**	**1,165.35**	**19.8%**			**1,194.78**	**12.9%**	**1,194.78**	**20.0%**
Landfilled waste		5872	tons	882.13	--	12.2%	6828	tons	1,025.78	12.2%	1,025.78	16.3%	7359	tons	1,105.46	12.2%	1,105.46	18.8%	7544	tons	1,133.38	12.2%	1,133.38	18.9%
Composted waste		686	tons	47.79	--	0.7%	798	tons	55.57	0.7%	55.57	0.9%	860	tons	59.89	0.7%	59.89	1.0%	882	tons	61.40	0.7%	61.40	1.0%
Water and Wastewater Treatment	**203**			**76.83**	**84.20**	**1.2%**			**97.91**	**1.2%**	**84.03**	**1.3%**			**105.52**	**1.2%**	**72.39**	**1.2%**			**108.18**	**1.2%**	**74.22**	**1.2%**
ACWD Energy Usage (electricity)		192233	kWh	8.78	4.49	0.1%	223536	kWh	5.22	0.1%	2.86	0.0%	240901	kWh	5.62	0.1%	-	0.0%	246984	kWh	5.76	0.1%	-	0.0%
USD Energy Consumption (electricity)		224665	kWh	10.27	21.95	0.3%	261250	kWh	25.53	0.3%	14.00	0.2%	281544	kWh	27.51	0.3%	-	0.0%	288653	kWh	28.20	0.3%	-	0.0%
USD Energy Consumption (natural gas)		1913	therms	10.17	10.16	0.1%	2225	therms	11.81	0.1%	11.81	0.2%	2397	therms	12.73	0.1%	12.73	0.2%	2458	therms	13.05	0.1%	13.05	0.2%
USD Flaring		--	--	8.96	--	0.1%	--	--	10.42	0.1%	10.42	0.2%	--	--	11.23	0.1%	11.23	0.2%	--	--	11.51	0.1%	11.51	0.2%
USD Combustion		--	--	0.45	--	0.0%	--	--	0.52	0.0%	0.52	0.0%	--	--	0.56	0.0%	0.56	0.0%	--	--	0.58	0.0%	0.58	0.0%
USD Nitrification/Denitrification		--	--	4.71	--	0.1%	--	--	5.48	0.1%	5.48	0.1%	--	--	5.90	0.1%	5.90	0.1%	--	--	6.05	0.1%	6.05	0.1%
USD Discharge to Rivers & Estuaries		--	--	33.48	--	0.5%	--	--	38.94	0.5%	38.94	0.6%	--	--	41.96	0.5%	41.96	0.7%	--	--	43.02	0.5%	43.02	0.7%
Total Municipal Emissions	**10,391**			**7,669.23**	**7,209.21**	**100.0%**			**8,383.16**	**100.0%**	**6,285.85**	**100.0%**			**9,034.39**	**100.0%**	**5,871.50**	**100.0%**			**9,262.52**	**100.0%**	**5,983.01**	**100.0%**

2005 Total Municipal GHG Emissions	10,391
2030 GHG Reduction Target	55%
2030 GHG Municipal Emissions Target	5,715.05
2030 Forecasted Municipal GHG Emissions	6,285.85
2030 Gap	570.80
2045 GHG Reduction Target	0%
2045 Gap	5,871.50
2050 Gap	5,983.01

Employee Commute	2018			2030			2045			2050		
Source	**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 (Local)-Gas	6,563,707	2,189	Employment	7,632,544	2,545	1,742	8,225,461	2,743	1,629	8,433,164	2,812	1,659
Employee Commute (Distance)-Gas	947,901	316		1,102,258	368	252	1,187,884	396	235	1,217,880	406	240
Total	**7,511,608**	**2,505**		**7,632,544**	**2,913**	**1,994**	**8,225,461**	**3,139**	**1,864**	**8,433,164**	**3,218**	**1,899**

Source: Municipal commute inventory data provided in ClearPath

Buildings and Facilities

Fremont Municipal Operations Greenhouse Gas Inventory and Forecasts

Electricity

Electricity	2018						2030							2045							2050						
Source	MWh/year	Emission Factor (lb CO2/MWh)	Emission Factor (lb CH4/MWh)	Emission Factor (lb N2O/MWh)	Total MT CO2e/year	Scale Factor	BAU MWh/year	Leg-Adjust BAU MWh/year	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)	BAU MWh/year	Leg-Adjust BAU MWh/year	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)	BAU MWh/year	Leg-Adjust BAU MWh/year	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)
Electricity - PG&E	2,919	206.29	0.034	0.004	285	Employment	3,394	3,140	113.0356	0.0189	0.0022	332	168	3,658	3,263	0	0	0	357	-	3,750	3,306	0	0	0	366	-
Electricity - EBCE (Brilliant 100)	2,328	0	0	0	-		2,707	2,505	0	0	0	-	-	2,917	2,602	0	0	0	-	-	2,991	2,637	0	0	0	-	-
Total					**285**							**332**	**168**					**Total**	**357**	**-**					**Total**	**366**	**-**

Source: Municipal building energy data provided in ClearPath

Natural Gas

Natural Gas	2018						2030				2045				2050			
Source	therms/year	Emission Factors (lb/therm)			Total MT CO2e/year	Scale Factor	BAU therms/year	Leg-Adjus BAU therms/year	BAU Total CO2e (MT/year)	Leg-Adjust BAU Total CO2e (MT/year)	BAU therms/year	Leg-Adjus BAU therms/year	BAU Total CO2e (MT/year)	Leg-Adjust BAU Total CO2e (MT/year)	BAU therms/year	Leg-Adjus BAU therms/year	BAU Total CO2e (MT/year)	Leg-Adjust BAU Total CO2e (MT/year)
		CO_2	CH_4	N_2O														
Natural Gas - ABAG Power	185,688	11.7	0.000226742	0.000005	986	Employment	215,926	199,764	1,147	1,061	232,699	207,572	1,236	1,102	238,575	210,307	1,267	1,117
Total					**986**				1,147	1,061			1,236	1,102			1,267	1,117

Source: Municipal building energy data provided in ClearPath

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
	Energy efficiency improvement of 2016 code above 2013 code	5%		http://www.energy.ca.gov/title24/2016standards/rulemaking/docu
	Energy efficiency improvement of 2019 code above 2016 code	30%		

0.443696501

Commercial Reduction	53.45%

Street Lights and Traffic Signals

Fremont Municipal Operations Greenhouse Gas Inventory and Forecasts

Electricity	2018						2030						2045						2050					
Source	**MWh/year**	**Emission Factor (lb CO2/MWh)**	**Emission Factor (lb CH4/MWh)**	**Emission Factor (lb N2O/MWh)**	**Total MT CO2e/year**	**Scale Factor**	**BAU MWh/year**	**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)**	**BAU MWh/year**	**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)**	**BAU MWh/year**	**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)**
Streetlights - PG&E	1,514	206.29	0.034	0.004	148	Employment	1,760	113.0356	0.0189	0.0022	172	94	1,897	0	0	0	185	-	1,945	0	0	0	190	-
Streetlights - EBCE (Brilliant 100)	1,520	0	0	0	-		1,768	0	0	0	-	-	1,905	0	0	0	-	-	1,953	0	0	0	-	-
Traffic Control - PG&E	308	206.29	0.034	0.004	30		358	113.0356	0.0189	0.0022	35	19	386	0	0	0	38	-	396	0	0	0	39	-
Traffic Control - EBCE (Brilliant 100)	299	0	0	0	-		348	0	0	0	-	-	375	0	0	0	-	-	384	0	0	0	-	-
Total					**178**						**207**	**113**				**Total**	**223**	**-**				**Total**	**229**	**-**

Source: Municipal street light and traffic signal data provided in ClearPath

Vehicle Fleet	2018							2030			2045			2050		
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**	**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**
Fleet Vehicles - Gasoline	190,262	8.78	1670.50	0.0000237	0.0000429	1690.60	Employment	221,244	1965.90	1345.82	238,431	2118.61	1258.01	244,452	2172.11	1281.42
Fleet Vehicles - Diesel	52,009	10.21	531.01	0.0000237	0.0000429	537.40		60,478	624.91	427.80	65,176	673.45	399.89	66,821	690.46	407.33
Fleet Vehicles - Flex Fuel	1,717	7.46	12.81	0.0000237	0.0000429	12.97		1,997	15.08	10.32	2,152	16.25	9.65	2,206	16.66	9.83
Source: Municipal vehicle fleet data provided in ClearPath					**Total**	**2,228**		**Total**	**2,591**	**1,774**	**Total**	**2,792**	**1,658**	**Total**	**2,863**	**1,689**

Solid Waste Facilities

Fremont Municipal Operations Greenhouse Gas Inventory and Forecasts

Municipal-Generated Solid Waste	2018	2030	2045	2050
Landfilled waste (tons)	5872.00	6828.20	7358.63	7544.45
Composted waste (tons)	686.37	798.14	860.14	881.86
Landfilled waste emissions (MTCO2e/year)	882.13	1025.78	1105.46	1133.38
Composted waste emissions (MTCO2e/year)	47.79	55.57	59.89	61.40
Total Emissions (MTCO2e/year)	929.92	1081.35	1165.35	1194.78

Source: Municipal waste data provided in ClearPath

Water and Wastewater

Fremont Municipal Operations Greenhouse Gas Inventory and Forecasts

Electricity

		2018						2030						2045						2050					
Source	**Source**	**MWh/year**	**Emission Factor (lb CO2/MWh)**	**Emission Factor (lb CH4/MWh)**	**Emission Factor (lb N2O/MWh)**	**Total MT CO2e/year**	**Scale Factor**	**BAU MWh/year**	**Emission Factor (lb CO2/MWh)**	**Emission Factor (lb CH4/MWh)**	**Emission Factor (lb N2O/MWh)**	**BAU Total CO2e (MT/year)**	**Leg-Adjust BAU Total MT CO2e/year**	**BAU MWh/year**	**Emission Factor (lb CO2/MWh)**	**Emission Factor (lb CH4/MWh)**	**Emission Factor (lb N2O/MWh)**	**BAU Total CO2e (MT/year)**	**Leg-Adjust BAU Total MT CO2e/year**	**BAU MWh/year**	**Emission Factor (lb CO2/MWh)**	**Emission Factor (lb CH4/MWh)**	**Emission Factor (lb N2O/MWh)**	**BAU Total CO2e (MT/year)**	**Leg-Adjust BAU Total MT CO2e/year**
ACWD Energy Usage	Electricity - PG&E	46	206.29	0.034	0.004	4	Employment	53	113.0356	0.0189	0.0022	5	3	58	0	0	0	6	-	59	0	0	0	6	-
ACWD Energy Usage	Electricity - EBCE (Brilliant 100)	146	0	0	0	-		170	0	0	0	-	-	183	0	0	0	-	-	188	0	0	0	-	-
USD Energy Consumption (electricity)	Electricity - PG&E	225	206.29	0.034	0.004	22		261	113.0356	0.0189	0.0022	26	14	282	0	0	0	28	-	289	0	0	0	28	-
Total						**26**						**31**	**17**				**Total**	**33**	**-**				**Total**	**34**	**-**

Source: Municipal water and wastewater energy usage data provided in ClearPath

ACWD Electricity Breakdown	**2018**
Total electricity consumption (kWh)	15254249
Number of PG&E accounts	16
Number of EBCE accounts	51
Electricity consumption from PG&E (%)	24%
Electricity consumption from EBCE (%)	76%

Natural Gas

	2018						2030		2045		2050	
Source	**therms/year**	**Emission Factors (lb/therm)**			**Total MT CO2e/year**	**Scale Factor**	**BAU therms/year**	**BAU Total CO2e (MT/year)**	**BAU therms/year**	**BAU Total CO2e (MT/year)**	**BAU therms/year**	**BAU Total CO2e (MT/year)**
		CO_2	**CH_4**	**N_2O**								
USD Energy Consumption (natural gas)	1,913	11.7	0.000226742	0.000005	10	Employment	2,225	12	2,397	13	2,458	13
Total					**10**			12		13		13

Source: Municipal water and wastewater energy data provided in ClearPath

Wastewater Treatment Processes

	2018	**2020**	**2030**	**2045**	**2050**
USD Flaring	8.96	9.22	10.42	11.23	11.51
USD Combustion	0.45	0.46	0.52	0.56	0.58
USD Nitrification/Denitrification	4.71	4.84	5.48	5.90	6.05
USD Discharge to Rivers & Estuaries	33.48	34.44	38.94	41.96	43.02
Total Emissions (MTCO2e/year)	**47.61**	**48.96**	**55.36**	**59.66**	**61.16**

Source: Municipal wastewater treatment process data provided in ClearPath

Municipal Employees	2016	2017	2018	2019	2020	2021	2030	2045	2050
Fremont Total Positions	904	922	937	955	963	965	1089	1174	1204
Percent Growth from prior year	--	2%	2%	2%	1%	0%	--	--	--
Percent Growth from 2018	--	--	--	2%	3%	3%	16%	25%	28%

Employment Average Annual Growth Rate 2 1.35%
Employment Growth Rate 2030 to 2050 0.50% *By 2030 the City will be built out and staff growth is likely to slow. Assuming a lower growth rate post-2030*

Assumptions and Conversion Factors

Milpitas Municipal Operations Greenhouse Gas Inventories and Forecasts

Conversion Factors	
Category	**Value**
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
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	2018	2020	2030	2045/2050	Source
PG&E EF (lb CO2/MWh)	206.29	189.33	113.04	0	https://www.theclimateregistry.org/our-members/cris-public-reports/
CAMX EF (lb CH4/MWh)	0.034	0.03148	0.01889	0	eGRID (https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid)
CAMX EF (lb N2O/MWh)	0.004	0.00370	0.00222	0	eGRID (https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid)
CAMX EF (lb CO2/MWh)	496.50	459.72222	275.83333	0	eGRID (https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid)

RPS Requirements				
RPS Target Year	2018	2020	2030	2045
PG&E				
Percent Renewable	27%	33%	60%	100%

Fuel Emission Factors			
Fuel	Emission Factor/Emission Ratio	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	
Ethanol (transport fuel)	0.01	MT CO2e/gal	City of Fremont 2018 Municipal Inventory, ClearPath

2018 EMFAC Emission Factors			
Light-duty Passenger Vehicle	0.000333464	MTCO2e/VMT	Fremont 2018 Communitywide Inventory

All Vehicles Emission Factor - 2020

Vehicle type	VMT/year	Percent VMT	gCO2/VMT	gCH4/VMT	gN2O/VMT	MTCO2e/VMT	Class
All other buses	4,643,937	0.04%	1193.683482	0.0233614	0.188459806	0.0012443	Heavy
LDA	6,523,779,149	52.93%	288.1538262	0.0166093	0.011155815	0.0002916	Light
LDT1	575,438,288	4.67%	361.7542018	0.0301902	0.019117867	0.0003677	Light
LDT2	2,664,434,919	21.62%	386.0414891	0.0190418	0.014438587	0.0003904	Light
LHD1	278,090,315	2.26%	864.4030568	0.0278325	0.059663021	0.0008810	Heavy
LHD2	63,709,752	0.52%	911.2839473	0.0194857	0.087502027	0.0009350	Heavy
MCY	44,428,850	0.36%	216.5727495	0.2847786	0.048151733	0.0002373	Light
MDV	1,348,846,725	10.94%	468.5948162	0.0278804	0.019926921	0.0004747	Light
MH	6,828,824	0.06%	1732.530466	0.0258245	0.072556971	0.0017525	Heavy
Motor coach	3,044,582	0.02%	1841.30317	0.0055946	0.290098064	0.0019183	Heavy
OBUS	10,874,868	0.09%	1839.622447	0.0360699	0.039799326	0.0018512	Heavy
PTO	7,288,124	0.06%	2167.435195	0.0068904	0.341480298	0.0022581	Heavy
SBUS	4,340,155	0.04%	1189.488691	0.2241499	0.170771787	0.0012410	Heavy
T6	206,888,860	1.68%	1308.500327	0.0223864	0.17622473	0.0013558	Heavy
T7	549,249,541	4.46%	1754.69119	0.0939824	0.278600405	0.0018312	Heavy
UBUS	34,387,589	0.28%	1243.451202	0.1238886	0.168828324	0.0012917	Heavy
Total	12,326,274,478	100%				0.0004466	All
Total						0.0003410	Light
Total						0.0014545	Heavy

Source: EMFAC2021 (v1.0.1) Emissions Inventory
Region Type: County
Region: Alameda
Calendar Year: 2020, 2030, 2045, 2050
Season: Annual
Vehicle Classification: EMFAC2011 Categories

All Vehicles Emission Factor - 2030

Vehicle type	VMT/day	Percent VMT	gCO2/VMT	gCH4/VMT	gN2O/VMT	MTCO2e/VMT	Class
All other buses	24,738	0.05%	931.5833	0.0004654	0.1464319	0.0009704	Heavy
LDA	26,909,427	56.10%	203.42916	0.0010266	0.0032703	0.0002043	Light
LDT1	2,607,643	5.44%	245.70082	0.001708	0.0038413	0.0002468	Light
LDT2	8,159,751	17.01%	252.42055	0.0016913	0.0040108	0.0002535	Light
LHD1	986,654	2.06%	706.99308	0.0053992	0.0391495	0.0007175	Heavy
LHD2	258,642	0.54%	694.84406	0.0053524	0.060985	0.0007112	Heavy
MCY	238,682	0.50%	214.7024	0.3339695	0.0663462	0.0002416	Light
MDV	5,085,692	10.60%	303.00336	0.0017412	0.0052327	0.0003044	Light
MH	32,332	0.07%	1350.8768	0.0049012	0.0515752	0.0013647	Heavy
Motor coach	12,890	0.03%	1312.5561	0.0008681	0.2063155	0.0013673	Heavy
OBUS	23,055	0.05%	1572.2952	0.007304	0.0151664	0.0015765	Heavy
PTO	15,737	0.03%	1868.9257	0.0012272	0.2937691	0.0019468	Heavy
SBUS	18,887	0.04%	889.24015	0.0032136	0.0890285	0.0009129	Heavy
T6	1,213,717	2.53%	945.85316	0.0008124	0.1304328	0.0009804	Heavy
T7	2,294,071	4.78%	1193.3168	0.0300227	0.188729	0.0012442	Heavy
UBUS	81,851	0.17%	1613.5378	1.7952825	0.2781594	0.0017375	Heavy
Total	47,963,769					0.0003141	All
Total						0.0002283	Light
Total						0.0010576	Heavy

Source: EMFAC2017 (v1.0.2) Emission Rates
Region Type: County
Region: Alameda
Calendar Year: 2020, 2030, 2045
Season: Annual
Vehicle Classification: EMFAC2011 Categories

All Vehicles Emission Factor - 2045

Vehicle type	VMT/day	Percent VMT	gCO2/VMT	gCH4/VMT	gN2O/VMT	MTCO2e/VMT	Class
All other buses	30,997	0.06%	865.486218	0.000481	0.1360424	0.0009016	Heavy
LDA	30,129,146	55.77%	178.994777	0.0005611	0.002979	0.0001798	Light
LDT1	2,931,472	5.43%	212.668747	0.000612	0.0029162	0.0002135	Light
LDT2	9,015,765	16.69%	213.055215	0.0008033	0.0031118	0.0002139	Light
LHD1	1,120,599	2.07%	625.819081	0.0038652	0.0385823	0.0006362	Heavy
LHD2	304,489	0.56%	614.924291	0.0047671	0.0583718	0.0006305	Heavy
MCY	265,951	0.49%	214.360642	0.3288461	0.0659558	0.0002410	Light
MDV	5,773,301	10.69%	257.237625	0.0008146	0.0042174	0.0002584	Light
MH	37,816	0.07%	1224.27964	0.0036976	0.0520417	0.0012382	Heavy
Motor coach	15,131	0.03%	1171.63987	0.0008405	0.1841655	0.0012205	Heavy
OBUS	22,797	0.04%	1404.47506	0.0039152	0.0235599	0.0014108	Heavy
PTO	15,502	0.03%	1554.7661	0.001217	0.2443876	0.0016196	Heavy
SBUS	26,550	0.05%	754.699341	0.0018792	0.0570307	0.0007699	Heavy
T6	1,434,418	2.66%	844.380401	0.0006497	0.1168183	0.0008754	Heavy
T7	2,813,936	5.21%	1023.60757	0.0269193	0.1618208	0.0010672	Heavy
UBUS	82,036	0.15%	1612.57342	1.7952821	0.2781898	0.0017366	Heavy
Total	54,019,908					0.0002778	All
						0.0001980	Light
						0.0009276	Heavy

Source: EMFAC2017 (v1.0.2) Emission Rates
Region Type: County
Region: Alameda
Calendar Year: 2020, 2030, 2045
Season: Annual
Vehicle Classification: EMFAC2011 Categories

All Vehicles Emission Factor - 2050

Vehicle type	VMT/day	Percent VMT	gCO2/VMT	gCH4/VMT	gN2O/VMT	MTCO2e/VMT	Class
All other buses	32,833	0.06%	856.84795	0.0004807	0.1346846	0.0008926	Heavy
LDA	30,992,468	55.69%	178.25158	0.0005501	0.0029743	0.0001791	Light
LDT1	3,020,220	5.43%	210.85703	0.0005887	0.0029125	0.0002116	Light
LDT2	9,271,052	16.66%	211.05779	0.0007728	0.0030806	0.0002119	Light
LHD1	1,154,582	2.07%	618.41905	0.0038405	0.0389837	0.0006289	Heavy
LHD2	315,261	0.57%	607.76173	0.0047344	0.0581372	0.0006233	Heavy
MCY	273,281	0.49%	214.3227	0.3282176	0.0659018	0.0002410	Light
MDV	5,937,385	10.67%	254.52164	0.0007567	0.0041569	0.0002556	Light
MH	39,242	0.07%	1211.9398	0.0028185	0.051501	0.0012257	Heavy
Motor coach	15,877	0.03%	1167.3374	0.0008429	0.1834892	0.0012160	Heavy
OBUS	23,198	0.04%	1391.1008	0.0020621	0.0238274	0.0013975	Heavy
PTO	15,986	0.03%	1494.9819	0.0012041	0.2349903	0.0015573	Heavy
SBUS	27,077	0.05%	724.03205	0.0016924	0.0502326	0.0007374	Heavy
T6	1,487,978	2.67%	833.20265	0.0005761	0.1152659	0.0008638	Heavy
T7	2,966,702	5.33%	1017.412	0.0263809	0.1608182	0.0010608	Heavy
UBUS	82,036	0.15%	1612.5736	1.7952824	0.2782234	0.0017366	Heavy
Total	55,655,179					0.0002768	All
						0.0001967	Light
						0.0009205	Heavy

Source: EMFAC2017 (v1.0.3) Emission Rates
Region Type: County
Region: Alameda
Calendar Year: 2050
Season: Annual
Vehicle Classification: EMFAC2011 Categories

Appendix C - Attachment II

Municipal GHG Measure Quantification Calculations

Measure Number	Measure	2030	2045	2050
BU-1	Transition to 100 percent clean electricity consumption.	367	-	-
BU-6	Require new City buildings to be all electric and low carbon.	59	155	186
BU-7	Retrofit existing City buildings to be all electric and low carbon.	346	785	982
BU-13	Reduce water consumption in buildings.	1	-	-
IN-6	Replace the City's gasoline and diesel-powered fleet vehicles and other equipment with low-emission and zero-emission vehicles.	683	1,458	1,587
LU-2	Reduce vehicle miles traveled (VMT) and single-occupancy vehicle trips, as identified in Fremont's General Plan.	222	386	497
LU-3	Encourage the adoption of zero-emission passenger vehicles.	102	133	154
MW-5	Establish and advance zero waste targets and policies.	467	900	1,059
NL-3	Implement the City's Urban Forest Management Plan.	482	1,085	1,286
	Total Reductions from Measures	2,730	4,903	5,750
	Reduction Needed for Target	571	5,872	5,983
	Gap Needed to Achieve Target*	(2,159)	968	233
	Total Municipal Emissions	3,556	968	233

**negative numbers mean target has been achieved; positive values means there is a gap*

BU-1

Transition to 100 percent clean electricity consumption.

	2018	2030	2045	2050
Total electricity emissions from Buildings and Facilities (MTCO2e)	285	168	-	-
Total electricity emissions from Street Lights and Traffic Signals (MTCO2e)	178	113	-	-
Additional electricity emissions from other measures (MTCO2e)				
ME-2		8	-	-
ME-3		47	-	-
MVF-7		26	-	-
MEC-8		4	-	-
Total GHG Reductions (MTCO2e)		367	-	-

BU-6

Require new City buildings to be all electric and low carbon.

	2018	2025	2030	2045	2050
All-electric new municipal development starting in 2026					
Annual municipal natural gas usage with legislative reductions (therms)	185,688	203,327	215,926	232,699	238,575
New natural gas usage starting in 2026 (therms)			12,599	29,373	35,249
Percent of new municipal development starting in 2026 that will be all electric			100%	100%	100%
Reduced municipal natural gas usage from all-electric new nonresidential development starting in 2026 (therms)			12,599	29,373	35,249
GHG reductions from new municipal natural gas savings (MTCO2e)			67	155	186
Additional electricity usage from fuel switching					
Total therms offset from natural gas heating use (therms)			12,599	29,373	35,249
Efficiency Assumptions					
Assumed average efficiency of natural gas heating (conservative) [1]	78%				
Assumed average efficiency of electric heating [2]	100%				
Total electricity needed to offset natural gas heating (MWh)			288	671	806
Fremont weighted municipal electricity emissions factor (MTCO2e/MWh)			0.03	0	0
Additional GHG emissions from electricity use (MTCO2e)			8	-	-
Total GHG Reductions (MTCO2e)			59	155	186

Sources:

[1] Energy Solutions Center. 2021. Natural Gas Furnaces. Available: https://naturalgasefficiency.org/for-residential-customers/heat-gas_furnace/#:~:text=All%20furnaces%20built%20and%20sold,furnace%20with%20standing%20pilot%20%E2%80%93%2050%25

[2] U.S. DOE. 2021. Electric Resistance Heating. Available: https://www.energy.gov/energysaver/home-heating-systems/electric-resistance-heating#:~:text=Electric%20resistance%20heating%20is%20100,the%20fuel's%20energy%20into%20electricity.

BU-7

Retrofit existing City buildings to be all electric and low carbon.

	2018	2030	2045	2050
Removal of natural gas from existing municipal				
Existing municipal natural gas usage (therms)	185,688	185,688	185,688	185,688
Target electrification rate for existing non-residential [1]		13%	49%	65%
Target electrification rate for existing municipal		40%	80%	100%
Reduction in natural gas usage (therms)		74,275	148,550	185,688
GHG reductions from existing municipal natural gas savings (MTCO2e)		393	785	982
Additional electricity usage from fuel switching				
Total therms offset from natural gas heating use (therms)		74,275	148,550	185,688
Efficiency Assumptions				
Assumed average efficiency of natural gas heating (conservative) [2]	78%			
Assumed average efficiency of electric heating [3]	100%			
Total electricity needed to offset natural gas heating (MWh)		1,697	3,395	4,244
Fremont weighted municipal electricity emissions factor (MTCO2e/MWh)		0.03	0	0
Additional GHG emissions from electricity use (MTCO2e)		47	-	-
Total GHG Reductions (MTCO2e)		346	785	982

Electrification target interpolation [1]	**Year**	**Target**
	2040	32%
	2045	49%
	2050	65%

Sources:

[1] Mozingo. 2021. Zero-Carbon Buildings in California: A Feasibility Study

[2] Energy Solutions Center. 2021. Natural Gas Furnaces. Available: https://naturalgasefficiency.org/for-residential-customers/heat-gas_furnace/#:~:text=All%20furnaces%20built%20and%20sold,furnace%20with%20standing%20pilot%20%E2%80%93%2050%25

[3] U.S. DOE. 2021. Electric Resistance Heating. Available: https://www.energy.gov/energysaver/home-heating-systems/electric-resistance-heating#:~:text=Electric%20resistance%20heating%20is%20100,the%20fuel's%20energy%20into%20electricity.

BU-13

Reduce water consumption in buildings.

	2018	2030	2045	2050
Annual total municipal water use (MG) [1]	163.51	190.14	204.91	210.09
Annual total municipal water-related electricity use (kWh) [1]	192,233	223,536	240,901	246,984
Percent municipal employment growth from 2018		16%	25%	28%
Indoor - Annual total municipal water use (MG)	8.18	9.51	10.25	10.50
Indoor - Annual total municipal water-related electricity use (kWh) [1]	9,612	11,177	12,045	12,349
Outdoor - Annual total municipal water use (MG)	155.34	180.63	194.67	199.58
Outdoor - Annual total municipal water-related electricity use (kWh) [1]	182,621	212,359	228,856	234,635
Percent of municipal water usage for indoor use	5%			
Percent of municipal water usage for outdoor use	95%			
Electricity consumption from PG&E (%)	24%			
Electricity consumption from EBCE (%)	76%			

INDOOR WATER USAGE	**2018**	**2030**	**2045**	**2050**
Water-related electricity usage in new municipal facilities [1]				
PG&E electricity usage (kWh)	2,295	2,669	2,876	2,949
EBCE electricity usage (kWh)	7,316	8,508	9,169	9,400
PG&E electricity usage in new municipal facilities (kWh)		374	581	654
EBCE electricity usage in new municipal facilities (kWh)		1,191	1,852	2,084
Percent reduction in water usage in new development [2]		50%	50%	50%
PG&E reduced electricity usage (kWh)		187	291	327
EBCE reduced electricity usage (kWh)		596	926	1,042
PG&E emissions factor (MTCO2e/MWh)		0.051779109	0	0
EBCE emissions factor (MTCO2e/MWh)		0	0	0
GHG reductions in new municipal facilites (MTCO2e)		0.01	-	-
Water-related electricity usage in existing municipal facilites				
PG&E electricity usage (kWh)	2,295	2,295	2,295	2,295
EBCE electricity usage (kWh)	7,316	7,316	7,316	7,316
Percent reduction in water usage in existing municipal facilites [2]		30%	40%	50%
PG&E reduced electricity usage (kWh)		689	918	1,148
EBCE reduced electricity usage (kWh)		2,195	2,927	3,658
PG&E emissions factor (MTCO2e/MWh)		0.051779109	0	0
EBCE emissions factor (MTCO2e/MWh)		0	0	0
GHG reductions in existing municipal facilites (MTCO2e)		0.0	-	-

Sources:

[1] Cityof Fremont, 2018 Municipal Inventory, ClearPath

[2] CAPCOA. 2010. Quantifying Greenhouse Gas Mitigation Measures. WUW-1. Available: http://www.capcoa.org/wp-content/uploads/downloads/2010/09/CAPCOA-Quantification-Report-9-14-Final.pdf
WUW-1: 20% for residential and 31% for nonresidential low-flow fixtures. Assuming increase for ultra-low-flow, especially in new development

OUTDOOR WATER USAGE	**2018**	**2030**	**2045**	**2050**
PG&E electricity usage (kWh)	43,611	50,713	54,652	56,032
EBCE electricity usage (kWh)	139,010	161,647	174,204	178,603
Percent reduction in water usage in new development [2]		50%	75%	80%
PG&E reduced electricity usage (kWh)		25,356	40,989	44,826
EBCE reduced electricity usage (kWh)		80,823	130,653	142,882
PG&E emissions factor (MTCO2e/MWh)		0.051779109	0	0
EBCE emissions factor (MTCO2e/MWh)		0	0	0
GHG reductions in new municipal facilites (MTCO2e)		1.3	-	-
Total GHG Reductions (MTCO2e)		1.4	-	-

Source:

[1] https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/California-Water-Plan/Docs/Update2018/Final/SupportingDocs/Water-Portfolios-and-

IN-6

Replace the City's gasoline and diesel-powered fleet vehicles and other equipment with low-emission and zero-emission vehicles.

Conversion of Gasoline Vehicles to EVs	**2018**	**2030**	**2045**	**2050**
Fleet vehicles - Gasoline VMT [1]	2,505,392	2,913,371	3,139,690	3,218,971
Percent municipal employment growth from 2018		16%	25%	28%
Fleet vehicles - Gasoline emissions (MTCO2e) [1]	1,691	1,346	1,258	1,281
Fleet vehiles - Gasoline consumption (gallons) [1]	190,262	221,244	238,431	244,452
Gasoline miles/gallon	13.17	13.17	13.17	13.17
Target conversion rate to EV		40%	100%	100%
Gasoline equivalent eVMT		1,165,348	3,139,690	3,218,971
Equivalent GHG emissions avoided from converting gasoline vehicles to EVs (MTCO2e)		538	1,258	1,281
Additional GHG emissions from EV charger use				
Average Efficiency of EV LDV (kWh/100-mi) [2]		34	34	34
Charged amount (kWh)		391,883	1,055,815	1,082,476
Fremont weighted municipal electricity emissions factor (MTCO2e/MWh)		0.03	-	-
Additional GHG emissions from EVs (MTCO2e)		11	-	-
Subtotal GHG Reductions (MTCO2e)		528	1,258	1,281

CONVERSION OF DIESEL VEHICLES TO EVS	**2018**	**2030**	**2045**	**2050**
Fleet vehicles - Diesel consumption (gallons) [1]	52,009	60,478	65,176	66,821
Fleet vehicles - Diesel emissions (MTCO2e) [1]	537	428	400	407
Diesel miles/gallon [3]		39	41	41
Diesel VMT		2,368,925	2,640,063	2,714,283
Target conversion rate to EV		40%	50%	75%
Diesel equivalent eVMT		947,570	1,320,032	2,035,712
Equivalent GHG emissions avoided from converting diesel vehicles to EVs (MTCO2e)		171	200	305
Additional GHG emissions from EV charger use				
Average Efficiency of EV LDT (kWh/100-mi) [4]		58	58	58
Charged amount (kWh)		549,591	765,618	1,180,713
Fremont weighted municipal electricity emissions factor (MTCO2e/MWh)		0.03	-	-
Additional GHG emissions from EVs (MTCO2e)		15	-	-
Subtotal GHG Reductions (MTCO2e)		156	200	305

TOTAL GHG REDUCTIONS (MTCO2e)	**683**	**1,458**	**1,587**

Sources:

[1] City of Fremont. 2018 Municipal Inventory, ClearPath

[2] fueleconomy.gov, all-electric LDV
[3] EMFAC2021
[4] fueleconomy.gov, all-electric pickup trucks

LU-2

Reduce vehicle miles traveled (VMT) and single-occupancy vehicle trips, as identified in Fremont's General Plan.

Employee Commute (Local)	**2018**	**2030**	**2045**	**2050**
Employee Commute (local) VMT	6,563,707	7,632,544	8,225,461	8,433,164
Percent reduction in employee commute (local) VMT from TDM measures		12%	21%	27%
Reduction in employee commute (local) VMT from TDM measures		889,361	1,741,972	2,241,468
Employee commute (local) emissions factor (MTCO2e/mi)		0.0002283	0.0001980	0.0001967
Subtotal GHG Reductions (MTCO2e)		203	345	441

Employee Commute (Distance)	**2018**	**2030**	**2045**	**2050**
Employee Commute (distance) VMT	947,901	1,102,258	1,187,884	1,217,880
Percent reduction in employee commute (distance) VMT from TDM measures		8%	18%	23%
Reduction in employee commute (distance) VMT from TDM measures		83,617	208,474	282,548
Employee commute (distance) emissions factor (MTCO2e/mi)		0.0002283	0.0001980	0.0001967
Subtotal GHG Reductions (MTCO2e)		19	41	56
Total GHG Reductions (MTCO2e)		222	386	497

Source:
[1] fueleconomy.gov, all-electric LDV

Actions and Associated VMT Reduction Assumptions	**2030**	**2045**	**2050**	**Rationale**
Telecommuting: provide flexible work schedules and telecommuting.	6%	15%	20%	According to employee commute survey data, 51.45% of employees work 5 days a week. Assuming the rest commute 4 days a week, the 5-day a week employees make up 57% of the total VMT. If half of the 5-day a week employees go down to 4-days in the office per week, that constitutes a 20% reduction in their VMT, or overall a .2*57/2 = 5.7% reduction in overall VMT.
Biking: Provide secure bicycle parking, showers, lockers and other amenities at City facilities to promote bicycle use by both employees and visitors.	4%	4%	4%	CAPCOA measure T-9. Provide End-of-Trip Bicycle Facilities (0.1% - 4.4%). Max reduction achieved if City provides parking, showers, bike lockers, and personal lockers. This would not apply to employee commute (distance)
Transit: Expand and improve existing incentives for City employees to choose alternatives to single-occupant auto commuting, such as transit incentives and subsidies, and ridesharing services and subsidies	2%	3%	4%	CAPCOA measure T-7. Provide Ridesharing Program (0-8.0%) CAPCOA measure T-8. Implement Subsidized or Discounted Transit Program (0-5.5%). Max reduction achieved if 100% of transit fare is subsidized and all employees are eligible.
Shared Mobility and Transit: Continue to partner with carshare and bikeshare companies to pilot employee and public transit alternatives	--	--	--	According to Draft CAPCOA 2021, these types of measures yield minimal GHG reductions. Not quantified here.
Employee commute (local) combined reduction	12%	21%	27%	
Employee commute (distance) combined reduction	8%	18%	23%	

Reduction = 1−[(1−A) × (1−B) × (1−C)]
Where A, B, and C are the individual measure reduction percentages for the measures to be combined in each subsector.

LU-3

Encourage the adoption of zero-emission passenger vehicles.

Conversion of MEC-9 Reduced Employee Commute VMT to eVMT	2018	2030	2045	2050
MEC-9 Reduced Employee Commute (local) VMT	6,563,707	6,743,184	6,483,489	6,191,697
MEC-9 Reduced Employee Commute (distance) VMT	947,901	1,018,640	979,410	935,332
Total MEC-9 Reduced Employee Commute VMT	7,511,608	7,761,824	7,462,900	7,127,028
Target conversion rate to from gasoline VMT to eVMT		6%	9%	11%
Gasoline equivalent eVMT		465,709	671,661	783,973
Total employee commute emissions factor (MTCO2e/mi)		0.0002283	0.0001980	0.0001967
Subtotal GHG Reductions (MTCO2e)		106	133	154
Additional GHG emissions from EV charger use				
Average Efficiency of EV LDV (kWh/100-mi) [1]		34	34	34
Charged amount (kWh)		156,609	225,866	263,635
Fremont weighted municipal electricity emissions factor (MTCO2e/MWh)		0.03	-	-
Additional GHG emissions from EVs (MTCO2e)		4	-	-
Subtotal GHG Reductions (MTCO2e)		102	133	154

Source:
[1] fueleconomy.gov, all-electric LDV

Actions and Associated VMT Reduction Assumptions	2030	2045	2050	Rationale
EV/Alternatively-Fueled Vehicles: Provide preferential parking and/or other benefits for carpool and alternative fuel vehicles at City facilities, to encourage and reward carpooling and ownership of alternative fuel vehicles.	6%	9%	11%	2017 Employee Commute survey data: 12.15% of employees who take a motor vehicle to work have a hybrid, PHEV, or PBEV. CAPCOA measure T-13. Provide EV Charging Infrastructure (0-11.9%).

MW-5

Establish and advance zero waste targets and policies.

	2018	2030	2045	2050
Total forecasted emissions from solid waste	930	1,081	1,165	1,195
Estimated diversion rate for Fremont	56%			
Targeted diversion rate		75%	90%	95%
Adjusted forecasted emissions from solid waste (MTCO2e)		614	265	136
Total GHG Reductions (MTCO2e)		**467**	**900**	**1,059**

NL-3

Implement the City's Urban Forest Management Plan.

	2018	2030	2045	2050
Percent tree coverage communitywide (existing and targets) [1]	14%	21%	29%	31%
New tree coverage communitywide (acres)		1,435	3,228	3,826
Percent new tree coverage acres on City-owned land or right-of-way		20%	20%	20%
Additional sequestration from new tree coverage on City-owed land or right-of-way		482	1,085	1,286
Total GHG Reductions (MTCO2e)		**482**	**1,085**	**1,286**

Fremont Tree Canopy Assessment Info [1]	**2018**	**Percent Tree Coverage**
Fremont urban tree canopy (acres)	3,239	14%
Possible planting area (acres)	3,826	17%
Unsuitable area (acres)	15,488	69%
Total land area (acres)	22,553	
Fremont trees total carbon storage (tons of carbon)	235,000	
Fremont trees annual carbon sequestration (tons of CO2/year)	6,000	
Carbon sequestration per area (MTCO2e/acre)	1.68	

Source:

[1] City of Fremont. 2020. Urban Tree Canopy Assessment

Assumptions and Conversion Factors

Milpitas Municipal Operations Greenhouse Gas Inventories and Forecasts

Conversion Factors	
Category	**Value**
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
MMBTU/gallon (diesel)	0.1374
MMBTU/scf (natural gas)	0.001037
therms/scf	0.01037
kwh/therm	29.3001111

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	2018	2020	2030	2045/2050	Source
PG&E EF (lb CO2/MWh)	206.29	189.33	113.04	0	https://www.theclimateregistry.org/our-members/cris-public-reports/
CAMX EF (lb CH4/MWh)	0.034	0.03148	0.01889	0	eGRID (https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid)
CAMX EF (lb N2O/MWh)	0.004	0.00370	0.00222	0	eGRID (https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid)
CAMX EF (lb CO2/MWh)	496.50	459.72222	275.83333	0	eGRID (https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid)
PG&E EF (MTCO2e/MWh)	0.094484198	0.086725782	0.051779109	0	calculated

RPS Requirements				
RPS Target Year	2018	2020	2030	2045
PG&E				
Percent Renewable	27%	33%	60%	100%
Increase in Renewables (from 2018)		6%	33%	

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	

Fuel Emission Factors			
Fuel	**Emission Factor**	**Unit**	**Source**
Diesel	10.21	kg CO2/gal	Climate Registry 2019 Default Emission Factors
	0.9	g CH4/MMBTU	
	0.4	g N2O/MMBTU	
	22.5091702	lb CO2/gal	
	0.000272586	lb CH4/gal	
	0.000121149	lb N2O/gal	
	0.010228012	MTCO2/gal	
Natural Gas	0.05444	kg CO2/scf	
	0.9	g CH4/MMBTU	
	0.9	g N2O/MMBTU	
	11.57372351	lb CO2/therm	
	0.000272586	lb CH4/therm	
	0.000272586	lb N2O/therm	
	0.00528598	MTCO2/therm	

All Vehicles Emission Factor - 2020

Vehicle type	VMT/year	Percent VMT	gCO2/VMT	gCH4/VMT	gN2O/VMT	MTCO2e/VMT	Class
All other buses	4,643,937	0.04%	1193.683482	0.0233614	0.188459806	0.0012443	Heavy
LDA	6,523,779,149	52.93%	288.1538262	0.0166093	0.011155815	0.0002916	Light
LDT1	575,438,288	4.67%	361.7542018	0.0301902	0.019117867	0.0003677	Light
LDT2	2,664,434,919	21.62%	386.0414891	0.0190418	0.014438587	0.0003904	Light
LHD1	278,090,315	2.26%	864.4030568	0.0278325	0.059663021	0.0008810	Heavy
LHD2	63,709,752	0.52%	911.2839473	0.0194857	0.087502027	0.0009350	Heavy
MCY	44,428,850	0.36%	216.5727495	0.2847786	0.048151733	0.0002373	Light
MDV	1,348,846,725	10.94%	468.5948162	0.0278804	0.019926921	0.0004747	Light
MH	6,828,824	0.06%	1732.530466	0.0258245	0.072556971	0.0017525	Heavy
Motor coach	3,044,582	0.02%	1841.30317	0.0055946	0.290098064	0.0019183	Heavy
OBUS	10,874,868	0.09%	1839.622447	0.0360699	0.039799326	0.0018512	Heavy
PTO	7,288,124	0.06%	2167.435195	0.0068904	0.341480298	0.0022581	Heavy
SBUS	4,340,155	0.04%	1189.488691	0.2241499	0.170771787	0.0012410	Heavy
T6	206,888,860	1.68%	1308.500327	0.0223864	0.17622473	0.0013558	Heavy
T7	549,249,541	4.46%	1754.69119	0.0939824	0.278600405	0.0018312	Heavy
UBUS	34,387,589	0.28%	1243.451202	0.1238886	0.168828324	0.0012917	Heavy
Total	12,326,274,478	100%				0.0004466	All
Total						0.0003410	Light
Total						0.0014545	Heavy

Diesel VMT/gallon

Diesel VMT (VMT/year)	Diesel Fuel Consumption (gallons/year)	Diesel VMT/gallon
33,998,638	904,087	37.61

Source: EMFAC2021 (v1.0.1) Emissions Inventory
Region Type: County
Region: Alameda
Calendar Year: 2020, 2030, 2045, 2050
Season: Annual
Vehicle Classification: EMFAC2011 Categories
Units: miles/year for CVMT and EVMT, trips/year for Trips, kWh/year for Energy Consumption, tons/year for Emissions, 1000 gallons/year for Fuel Consumption

All Vehicles Emission Factor - 2030

Vehicle type	VMT/year	Percent VMT	gCO2/VMT	gCH4/VMT	gN2O/VMT	MTCO2e/VMT	Class
All other buses	5,048,009	0.03%	1088.82781	0.01696887	0.172163849	0.0011349	Heavy
LDA	8,077,583,907	50.88%	227.582619	0.00721152	0.006474534	0.0002295	Light
LDT1	527,671,000	3.32%	308.332289	0.01293127	0.010166327	0.0003114	Light
LDT2	3,750,714,998	23.63%	314.942564	0.00932588	0.008352279	0.0003174	Light
LHD1	392,438,641	2.47%	683.85618	0.01195015	0.045922024	0.0006964	Heavy
LHD2	95,830,306	0.60%	730.700381	0.00869108	0.077865567	0.0007516	Heavy
MCY	54,355,964	0.34%	202.627937	0.20472371	0.039991822	0.0002190	Light
MDV	2,049,823,289	12.91%	374.766147	0.01028102	0.009304585	0.0003775	Light
MH	8,247,238	0.05%	1662.30685	0.00632622	0.067909844	0.0016805	Heavy
Motor coach	3,195,968	0.02%	1736.15565	0.00218131	0.273532029	0.0018087	Heavy
OBUS	7,121,581	0.04%	1582.16775	0.02631065	0.027390499	0.0015902	Heavy
PTO	7,906,550	0.05%	1737.20969	0.00074758	0.273698093	0.0018098	Heavy
SBUS	5,371,083	0.03%	1026.18439	0.18265872	0.129593269	0.0010656	Heavy
T6	229,133,682	1.44%	1121.402	0.01736624	0.15104364	0.0011619	Heavy
T7	625,014,742	3.94%	1470.8522	0.08155496	0.234201078	0.0015352	Heavy
UBUS	35,416,574	0.22%	875.955425	0.51999983	0.119086168	0.0009221	Heavy
Total	15,874,873,534	100.00%				0.0003562	All
Total						0.0002762	Light
Total						0.0011737	Heavy

Diesel VMT/gallon

Diesel VMT (VMT/year)	Diesel Fuel Consumption (gallons/year)	Diesel VMT/gallon
24,279,348	619,841	39.17

Source: EMFAC2021 (v1.0.1) Emissions Inventory
Region Type: County
Region: Alameda
Calendar Year: 2020, 2030, 2045, 2050
Season: Annual
Vehicle Classification: EMFAC2011 Categories
Units: miles/year for CVMT and EVMT, trips/year for Trips, kWh/year for Energy Consumption, tons/year for Emissions, 1000 gallons/year for Fuel Consumption

All Vehicles Emission Factor - 2045

Vehicle type	VMT/year	Percent VMT	gCO2/VMT	gCH4/VMT	gN2O/VMT	MTCO2e/VMT	Class
All other buses	5,582,522	0.03%	1020.06419	0.0182995	0.161497881	0.0010634	Heavy
LDA	8,768,494,212	49.23%	206.164787	0.0044261	0.005476711	0.0002077	Light
LDT1	489,752,190	2.75%	266.736522	0.0053686	0.006489817	0.0002686	Light
LDT2	4,233,335,225	23.77%	284.220509	0.0063055	0.007057227	0.0002863	Light
LHD1	463,347,325	2.60%	389.156595	0.0050211	0.02669299	0.0003964	Heavy
LHD2	114,457,401	0.64%	424.227241	0.0038401	0.047954081	0.0004370	Heavy
MCY	58,974,790	0.33%	198.640467	0.1777807	0.036889116	0.0002134	Light
MDV	2,439,511,347	13.70%	337.839204	0.0065569	0.007587464	0.0003400	Light
MH	9,258,351	0.05%	1642.19937	0.0041285	0.072638145	0.0016616	Heavy
Motor coach	3,468,488	0.02%	1597.21461	0.0019501	0.251641812	0.0016640	Heavy
OBUS	5,374,982	0.03%	772.25735	0.0151389	0.015625464	0.0007768	Heavy
PTO	10,005,144	0.06%	910.67592	0.0003522	0.143477362	0.0009487	Heavy
SBUS	6,492,354	0.04%	583.057465	0.0914948	0.062766286	0.0006023	Heavy
T6	284,859,672	1.60%	590.063626	0.0114326	0.082596621	0.0006123	Heavy
T7	883,680,249	4.96%	1168.27036	0.0383447	0.185638309	0.0012185	Heavy
UBUS	35,930,250	0.20%	170.022639	0.0005451	0.003123721	0.0001709	Heavy
Total	17,812,524,501					0.0003112	All
						0.0002506	Light
						0.0008427	Heavy

Diesel VMT/gallon

Diesel VMT (VMT/year)	Diesel Fuel Consumption (gallons/year)	Diesel VMT/gallon
19,682,755	485,911	40.51

Source: EMFAC2021 (v1.0.1) Emissions Inventory
Region Type: County
Region: Alameda
Calendar Year: 2020, 2030, 2045, 2050
Season: Annual
Vehicle Classification: EMFAC2011 Categories
Units: miles/year for CVMT and EVMT, trips/year for Trips, kWh/year for Energy Consumption, tons/year for Emissions, 1000 gallons/year for Fuel Consumption

All Vehicles Emission Factor - 2050

Vehicle type	VMT/year	Percent VMT	gCO2/VMT	gCH4/VMT	gN2O/VMT	MTCO2e/VMT	Class
All other buses	5,718,999	0.03%	1009.3993	0.0185403	0.15985494	0.0010523	Heavy
LDA	8,979,216,593	48.93%	205.44141	0.0043277	0.0054554	0.0002070	Light
LDT1	497,679,491	2.71%	263.78894	0.005031	0.00634699	0.0002656	Light
LDT2	4,337,878,521	23.64%	282.50978	0.0061401	0.00698807	0.0002845	Light
LHD1	476,699,600	2.60%	349.92175	0.0042131	0.02395125	0.0003564	Heavy
LHD2	118,028,420	0.64%	382.38518	0.0032179	0.04344246	0.0003940	Heavy
MCY	60,068,926	0.33%	197.26127	0.1709468	0.03626986	0.0002117	Light
MDV	2,504,755,748	13.65%	335.56149	0.0061945	0.00743657	0.0003377	Light
MH	9,558,462	0.05%	1640.7917	0.0033023	0.07269138	0.0016601	Heavy
Motor coach	3,564,398	0.02%	1588.7946	0.0019627	0.25031524	0.0016552	Heavy
OBUS	5,328,976	0.03%	670.28276	0.0102795	0.01259928	0.0006739	Heavy
PTO	10,876,537	0.06%	813.32055	0.0003039	0.12813898	0.0008473	Heavy
SBUS	6,686,808	0.04%	424.78579	0.0505959	0.04162195	0.0004372	Heavy
T6	306,564,068	1.67%	526.40732	0.0101547	0.07426091	0.0005464	Heavy
T7	991,354,425	5.40%	1152.3352	0.0349847	0.18300219	0.0012018	Heavy
UBUS	35,930,250	0.20%	170.02681	0.0005786	0.00316872	0.0001709	Heavy
Total	18,349,910,222					0.0003111	All
						0.0002493	Light
						0.0008247	Heavy

Diesel VMT/gallon

Diesel VMT (VMT/year)	Diesel Fuel Consumption (gallons/year)	Diesel VMT/gallon
20,057,136	493,775	40.62

Source: EMFAC2021 (v1.0.1) Emissions Inventory
Region Type: County
Region: Alameda
Calendar Year: 2020, 2030, 2045, 2050
Season: Annual
Vehicle Classification: EMFAC2011 Categories
Units: miles/year for CVMT and EVMT, trips/year for Trips, kWh/year for Energy Consumption, tons/year for Emissions, 1000 gallons/year for Fuel Consumption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