Alameda CARP 2022 Greenhouse Gas Emissions Inventory

Introduction

This greenhouse gas (GHG) emissions inventory provides an overview of Alameda's current emissions and helps guide future greenhouse gas reduction and carbon sequestration policy. It includes emissions by sector (building energy use, on-road and off-road transportation, solid waste, and water and wastewater) that were emitted communitywide in 2022. Municipal emissions were not inventoried separately but are included in the community inventory. Additionally, the inventory does not include consumption-based emissions.

This report presents a summary of Alameda's 2005-2015 GHG emissions and details the 2022 data year community GHG inventory completed in 2024. It also provides an updated GHG emissions forecast for 2025-2045.

Key Findings

- **2022 GHG emissions decreased 29% compared to baseline year 2005 despite population and job increases.** Total emissions in 2022 are estimated to be 267,894 metric tons of carbon dioxide equivalent ($MTCO_2e$), a 29% decrease as compared to 2005 emissions of 375,590 $MTCO_2e$. 2022 per capita emissions are estimated to be 3.5 $MTCO_2e$ and 2.4 $MTCO_2e$ per service population.[1]
- **Energy emissions decreased 40% compared to baseline year 2005.** Total residential energy emissions decreased 32% and total nonresidential emissions decreased 52% as compared to 2005. Moreover, electricity emissions decreased 100% as a result of Alameda Municipal Power (AMP) providing 100% carbon-free electricity starting in 2020.
- **Transportation emissions decreased 25% compared to baseline year 2005.** The main drivers of transportation emissions reductions are cleaner vehicles, e.g., more hybrid and electric vehicles (EVs) on the road, more efficient off-road equipment, and a 6% reduction in vehicle miles travelled (VMT).
- **Although emissions have declined, the proportion of emissions by sector has remained fairly constant.** In 2022, transportation related emissions were the largest sector accounting for 62%, followed by building energy use (natural gas) accounting for 31%, while solid waste and water accounted for 4% and 2% respectively.
- **Emissions will continue to decrease as a result of State policies, but not enough to meet CARP targets without local measures**. Projected emissions, adjusted for State policy, are estimated to decrease an additional 10% from 2022 to 2030. To meet CARP targets, an additional 11% emissions reduction is needed from local policies.
- **Consumption-based emissions totaled approximately 1.1 million $MTCO_2e$ in 2015**. This estimate is about 267% higher than the traditional activity-based emissions approach for Alameda in the same year. The difference is largely due to the inclusion of activities within

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[1] Service population is defined as the population and number of jobs within the city.

and outside city limits, including air travel, imported foods and goods, services, and construction.[2]

Protocol and Emissions Sources

The inventory was developed based on the International Council for Local Environmental Initiative (ICLEI) U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions (Community Protocol) principles,[3] in addition to the 2022 Climate Change Scoping Plan released by the California Air Resources Board (CARB).[4] A minimum set of five "Basic Emissions Generating Activities," also known as sectors, should be included in the GHG emissions inventory, which includes: community electricity use, use of fuel in residential and commercial stationary combustion equipment, generation of solid waste by the community, on-road passenger and freight motor vehicle travel, and the use of energy in potable water and wastewater treatment and distribution. The City of Alameda also started tracking carbon sequestration in 2015 from the City's existing tree canopy which is also included in this inventory.

Table 1: GHG Emissions Sources and Scopes

Sector in 2022 GHG Inventory	GHG Emissions Source	Emissions Scope
Energy	Natural Gas (buildings and other facilities)	Scope 1
	Electricity (buildings and other facilities, vehicles, and water delivery/treatment	Scopes 1 and 2
Transportation	All trips	Scopes 1, 2, and 3
Solid Waste	Community waste generation and direct landfill emissions	Scopes 1 and 3
Water and Wastewater	Water use	Scope 3
	Water treatment	Scope 3
Sequestration	Forest land and trees	N/A

Greenhouse Gas Emissions Reduction Target

In 2008, Alameda City Council adopted a resolution to set a citywide greenhouse gas reduction goal of 25% below 2005 baseline levels by 2020. This goal was in line with California's Assembly Bill (AB) 32 goal, a statewide target to reduce emissions to 1990 levels by 2020. AB 32 was replaced by California Senate Bill (SB) 32's goal for reducing emissions by 40% below 1990 levels by 2030. Alameda's 2019 Climate Action and Resiliency Plan (CARP) set a new goal of reducing emissions by 50% below 2005 levels by 2030 and becoming carbon neutral as soon as possible. This is in line with the State's goal of achieving carbon neutrality by 2045.

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[2] Consumption-based emissions estimates for the City of Alameda derived from UC Berkeley Cool Climate Network (2015). Accessed from: https://coolclimate.berkeley.edu/inventory.

[3] ICLEI. (2014). Global Protocol for Community-Scale Greenhouse Gas Emission Inventories. Accessed from: https://ghgprotocol.org/ghg-protocol-cities.

[4] CARB. (2022) 2022 Scoping Plan for Achieving Carbon Neutrality. Accessed from: https://ww2.arb.ca.gov/sites/default/files/2023-04/2022-sp.pdf.

2005 – 2015 Communitywide Emissions Summary

The communitywide GHG emissions inventory for Alameda captures the primary sources of emissions that can be reduced through local and regional government actions. This includes energy use in homes, businesses, vehicles, off-road equipment; emissions from treating and delivering water and emissions from materials that are thrown away. The activity data is collected from service providers, local utilities, and regional and state agencies. Alameda uses the inventory to better understand emissions sources and trends and track progress towards meeting the CARP's targets. The 2005 emissions inventory is the baseline year from which subsequent inventories track progress.

Baseline 2005 Community Inventory

The City of Alameda's total 2005 GHG emissions are reinventoried to be375,590 $MTCO_2e$.[5] The inventory included building energy use (residential and commercial electricity and natural gas), transportation (on-road and off-road[6]), solid waste, and water. It also included a sequestration credit of 11,213 $MTCO_2e$. Based on new data, the sequestration credit for inventory years 2005-2022 has been revised to 3,270 $MTCO_2e$ resulting in a new 2005 baseline total of 375,590 $MTCO_2e$. Of the six sectors, on-road transportation accounted for the largest amount of GHG emissions with an estimated emissions of 195,201 $MTCO_2e$, or 52% of total emissions. The second largest was residential energy with estimated emissions of 84,325 $MTCO_2e$, or 22% of total emissions. The remaining 26% of emissions were made up by commercial energy use, solid waste, off-road transportation, and water and wastewater.

2010 and 2005 inventoried the same sectors. Total emissions and the breakdown by sector for inventory years 2005-2015 are summarized in table 2.

Table 2: Total Annual Community GHG Emissions (2005-2015)

Sector	2005 Total ($MTCO_2e$)	2005 Percent of Total	2010 Total ($MTCO_2e$)	2010 Percent of Total	2015 Total ($MTCO_2e$)	2015 Percent of Total
Residential Energy	84,325	22%	82,700	22%	95,446	23%
Nonresidential Energy	57,747	15%	58,993	16%	97,995	23%
On-road Transportation	195,201	52%	188,122	51%	185,202	44%
Off-road Transportation	26,981	7%	28,962	8%	32,418	8%
Solid Waste	12,426	3%	10,367	3%	6,951	2%

[5] 2005-2015 GHG inventories provided by the City of Alameda as part of the 2015 Community-Wide Greenhouse Gas Inventory and Projection to 2020 Goal prepared by Sustainable Analysis, LLC. in 2018.
[6] The off-road transportation sector includes lawn and garden, recreational, construction, and industrial equipment.

Water/Wastewater	2,180	0.6%	2,156	0.6%	3,207	0.8%
Sequestration	(3,270)	-	(3,270)	-	(3,270)	-
Total	**375,590**		**368,030**		**417,949**	

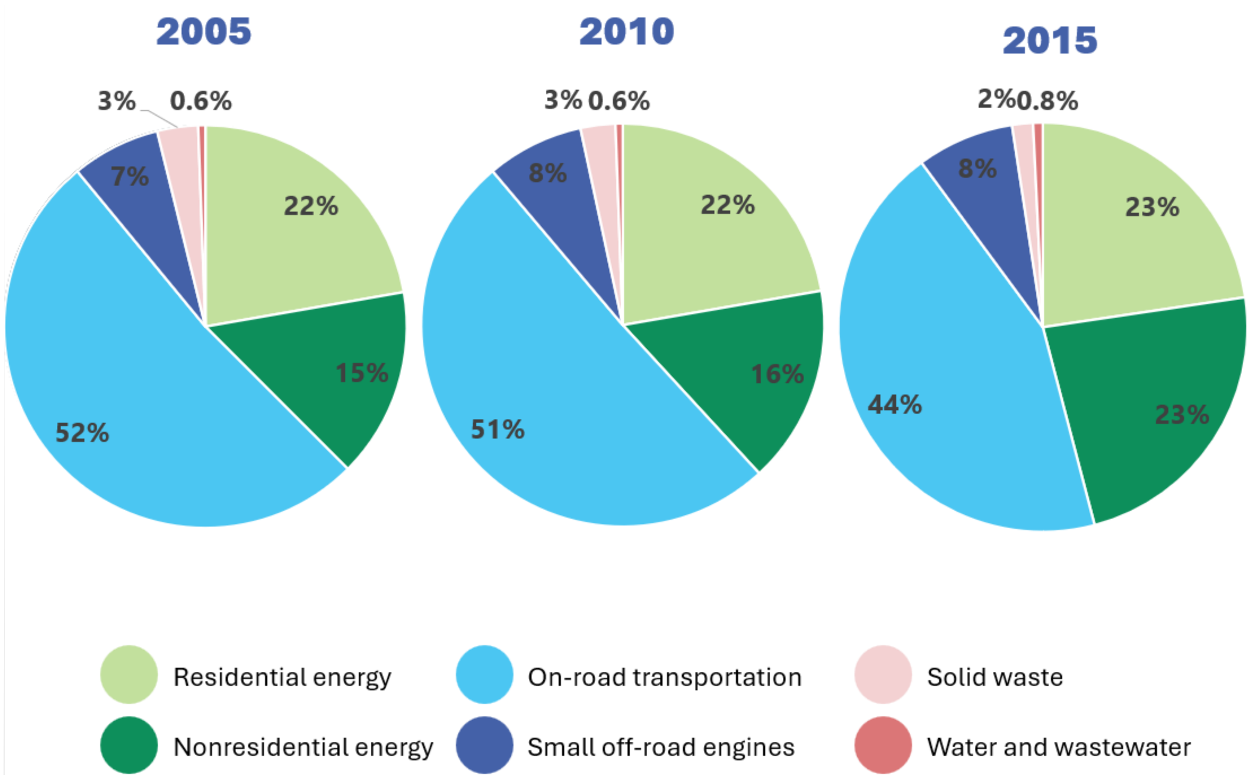
Emissions Trends 2005 to 2015

Between 2005 to 2015, Alameda's emissions increased by 42,359 $MTCO_2e$, about 10%. The service population, which is the sum of population and jobs in the city, grew from 91,153 in 2005 to 112,835 in 2015. With this, the emissions per service population remained the same: 4.0 $MTCO_2e$ to 4.0 $MTCO_2e$.

Emissions growth from 2005-2015 was largely due to increases in building energy use and off-road transportation. Emissions reductions were largely in the solid waste and water and wastewater sectors.

These changes are reflected in Figures 1, which shows the proportion of emissions by sector for the city's previous inventories. Between 2005 and 2015, the proportion of the community-wide emissions for non-residential energy grew from 15% to 23% while the proportion of emissions from on-road transportation declined from 52% to 44%.

Figure 1: Proportion of Annual Community GHG Emissions by Sector 2005-2015



2022 Communitywide Emissions Inventory Summary

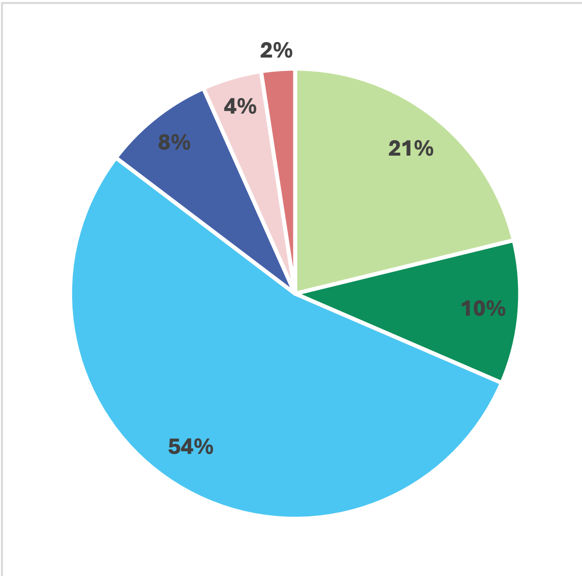
The total 2022 GHG emissions are estimated to be 267,559 $MTCO_2e$, a 35% and 27% decrease from the 2015 and 2005 inventories as shown in Table 2. Of the five sectors, on-road transportation accounted for the largest amount of GHG emissions with estimated emissions of 145,995 $MTCO_2e$, or 56% of total emissions. The second largest sector was building energy use with estimated emissions of 85,398 $MTCO_2e$, or 33% of total emissions. The remaining 11% of emissions are made up by solid waste, off-road transportation, and water and wastewater (see Figure 2). A summary of emissions and associated activity data is presented in Table 3.

Table 3: Total Annual Community GHG Emissions (2022)

Sector	Subsector	Units	Activity Data	Emissions ($MTCO_2e$)
Building Energy	Residential Electricity	kWh	133,444,603	0
	Residential Natural Gas	Therms	10,825,631	57,453
	Nonresidential Electricity	kWh	200,602,388	0
	Nonresidential Natural Gas	Therms	5,264,025	27,937
Transportation	On-road Transportation	VMT	350,826,308	145,995
	Off-road Transportation	Gallons	2,565,539	21,653
Solid Waste	Landfilled Waste	Tons	25,900	8,191
	Doolittle Landfill	-	-	3,360
Water/Wastewater	Water Use	Million Gallons	26,937	4,256
	Wastewater	Million Gallons	24,243	2,319
Sequestration[7]	Sequestration	-		(3,270)
			Total	**267,894**

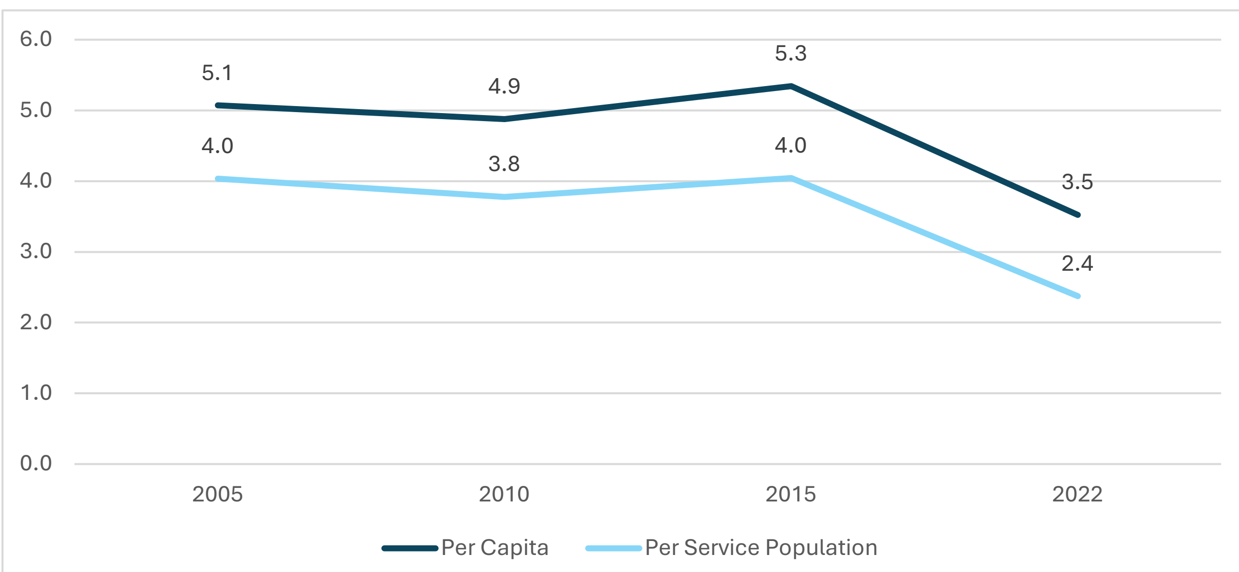
[7] The sequestration credit value includes carbon sequestered by the City's tree canopy. The 2005-2015 number is from a previous City of Alameda Tree Canopy Assessment, which could not be located. The 2022 inventory estimates a more current and accurate value for tree canopy carbon sequestration provided by the City's consultant, Dudek which utilized the US Forest Service iTree canopy tool. Available here: https://www.itreetools.org/.

Figure 2: Proportion of 2022 Annual Community GHG Emissions by Sector



Between 2005 to 2022, the population grew by 5% and the city's service population grew by 24%. Despite the city's growth, total emissions declined as did per capita and service population emissions from 5.1 $MTCO_2e$ to 3.5 $MTCO_2e$ and 4.0 $MTCO_2e$ to 2.4 $MTCO_2e$ respectively (see Figure 3).

Figure 3: Per Capita and Per Service Population Emissions (2005-2022)



2022 Communitywide Emissions Inventory Detail

Data Sources

Table 4 lists the data sources used to calculate Alameda's 2022 GHG emissions.

Table 4: 2022 Communitywide Emissions Inventory Data Sources by Sector

Sector	Subsector	Data Source
Residential Energy	Electricity	Alameda Municipal Power
	Natural Gas	PG&E
Nonresidential Energy	Electricity	Alameda Municipal Power
	Natural Gas	PG&E
Transportation	On-Road	Google Insight Explorer CARB EMFAC 2021
	Off-Road	CARB OFFROAD2021
Solid Waste	Landfilled Waste	City of Alameda CalRecycle
	Doolittle Landfill	US EPA LandGem Model
Water and Wastewater	Water use	East Bay Municipal Utility District
	Wastewater	East Bay Municipal Utility District
Sequestration	Trees	City of Alameda, Dudek iTree analysis (2024)

Energy

This section presents the GHG emissions for the energy sector, specifically emissions generated from residential and nonresidential energy use that occurred within City limits. This section provides electricity and natural gas activity data and emission estimates in both residential and nonresidential buildings for 2022 and compares it to the estimates for the years 2005, 2010, and 2015.

Building energy emissions decreased by 40% as compared to 2005. Total residential energy emissions decreased 32% and total nonresidential emissions decreased 52% as compared to 2005. Moreover, electricity emissions decreased 100% as a result of AMP providing 100% carbon-free electricity starting in 2020.

Electricity Methodology

Alameda's electricity is provided by Alameda Municipal Power (AMP), a municipally operated utility. In 2020, AMP began providing 100% clean energy to customers, which contributed to a significant reduction in emissions from building electricity use from 2015 to 2022.

To calculate GHG emissions, an emissions factor is applied to the activity data. Electricity suppliers provided carbon dioxide (CO_2) emissions factors. The electricity generation process also releases small amounts of methane (CH_4) and nitrous oxide (N_2O). Their emissions factors are provided by the EPA's Emissions & Generation Resource Integrated Database (eGRID) and Comprehensive Air Quality Model CAMX. CO_2 is the most referenced GHG; however, numerous gases have greenhouse characteristics. CH_4 and N_2O are commonly accounted for in GHG inventories. These gases have a greater global warming potential than CO_2; CH_4 traps approximately 28 times as much heat as CO_2 over a 100-year period and N_2O traps approximately 265 times as much heat. To account for these differences, a factor is applied to the gasses emissions to calculate a CO_2 equivalence (CO_2e). The emissions factors differ by electricity provider due to their energy portfolio.

Electricity Transmission and Distribution Losses

When electricity is transported through transmission wires over long distances some of the energy is lost as heat, resulting in transmission losses. Additional energy is lost when electricity is delivered to lower voltage wires for distribution to end users, resulting in distribution losses. The Community Protocols recommend reporting of transmission and distribution (T&D) losses, as this emission source can be reduced through increased distributed energy generation (i.e. solar photovoltaic) by reducing the need for electricity that is transported over long distances.

Since AMP provides 100% clean electricity, emissions associated with T&D losses are zero for the 2022 GHG inventory.

Table 5: Total Annual Community Electricity Usage and GHG Emissions

	2005		2010		2015		2022[8]	
Subsector	Usage (kWh)	Emissions ($MTCO_2e$)	Usage (kWh)	Emissions ($MTCO_2e$)	Usage (kWh)	Emissions ($MTCO_2e$)	Usage (kWh)	Emissions ($MTCO_2e$)
Residential	137,906,700	19,580	141,336,935	16,146	125,431,220	42,599	133,444,603	0
Nonresidential	223,590,100	31,771	239,017,888	27,500	216,771,565	73,987	200,602,388	0
Total	**361,496,800**	**51,351**	**380,354,823**	**43,646**	**342,202,785**	**116,586**	**334,046,991**	**0**

Table 6: Electricity Emissions Factors

	2005	2010	2015	2022[9]
Subsector	Emissions Factor ($MTCO_2e/kWh$)	Emissions Factor ($MTCO_2e/kWh$)	Emissions Factor ($MTCO_2e/kWh$)	Emissions Factor ($MTCO_2e/kWh$)
Residential	No Data	No Data	0.000325	0
Nonresidential	No Data	No Data	0.000325	0

[8] Activity data for electricity provided by AMP via data request.
[9] Emissions factor for electricity provided by AMP via data request.

Natural Gas Methodology

Natural gas is supplied to Alameda by Pacific Gas and Electric Company (PG&E). Table 7 provides the natural gas activity data in therms and the emissions estimates for 2022. The nonresidential subsector includes natural gas uses from government, commercial, and industrial accounts. As with electricity, GHG emissions are estimated from activity data by applying an emission factor. However, unlike electricity, the carbon intensity of the combustion of natural gas does not vary annually and it does not vary between residential and nonresidential. These estimates are using the most current emissions coefficient for natural gas from the US EPA.

Table 7: Total Annual Community Natural Gas Usage and GHG Emissions

	2005		**2010**		**2015**		**2022**[10]	
Subsector	**Usage (Therm)**	**Emissions ($MTCO_2e$)**	**Usage (Therm)**	**Emissions ($MTCO_2e$)**	**Usage (Therm)**	**Emissions ($MTCO_2e$)**	**Usage (Therm)**	**Emissions ($MTCO_2e$)**
Residential	12,180,175	64,745	12,520,503	66,554	9,957,908	52,847	10,825,631	57,453
Nonresidential	4,886,714	25,976	5,924,692	31,493	4,523,840	24,008	5,264,025	27,937
Total	**17,066,889**	**90,721**	**18,445,195**	**98,047**	**14,481,748**	**76,855**	**16,089,656**	**85,390**

Table 8: Natural Gas Emissions Factors

	2005	**2010**	**2015**	**2022**[11]
Subsector	**Emissions Factor ($MTCO_2e/kWh$)**	**Emissions Factor ($MTCO_2e/kWh$)**	**Emissions Factor ($MTCO_2e/kWh$)**	**Emissions Factor ($MTCO_2e/kWh$)**
Residential	No Data	No Data	0.005307085	0.005307085
Nonresidential	No Data	No Data	0.005307085	0.005307085

[10] Activity data for natural gas provided by PG&E via data request.
[11] Emissions factor for natural gas from US EPA. Available from: https://www.epa.gov/climateleadership/ghg-emission-factors-hub.

Transportation

This section presents the GHG emissions for the transportation sector, specifically emissions generated from on-road and off-road transportation activity. This section provides activity data and emission estimates for 2022 and compares it to the estimates for the years 2005-2015.

Transportation emissions decreased by 25% as compared to 2005. Between 2005 and 2022, VMT has fluctuated but decreased by 6% overall, and its associated GHG emissions decreased by 25%. Emissions decreasing faster than VMT can be due to State and Federal regulations improving fuel efficiency standards and low carbon fuel standards. Emissions have also decreased due to an increasingly efficient overall fleet of vehicles within the city (including an increased uptake of electric, hybrid, and high efficiency vehicles).

On-Road Transportation Methodology

The on-road transportation subsector looks at all on-road trips (taken by cars, trucks, buses, etc.) using the origin-destination method or induced activity method as defined by the Community Protocol.[12] This method quantifies the transportation emissions induced by the city, including trips that begin, end, or are fully contained within the city (usually excluding pass-through trips). As such, this inventory accounts for 100% of trips that occur within city boundaries and 50% of both trips that originate or terminate within the city's boundary.

Emissions are calculated by determining the VMT of in-boundary and transboundary trips and then applying an emissions factor for fuel to those trips. 2022 VMT estimates for the City of Alameda were modeled using Google Insight Explorer while emissions factors are determined using CARB's 2021 EMFAC model. EMFAC represents the state's current understanding of motor vehicle travel activities and associated emission levels from on-road vehicles including cars, trucks, and buses in California.

Table 9: Total Annual Community GHG Emissions from On-Road Transportation

	2005		2010		2015		2022	
	Total VMT	Emissions ($MTCO_2e$)	Total VMT	Emissions ($MTCO_2e$)	Total VMT	Emissions ($MTCO_2e$)	Total VMT	Emissions ($MTCO_2e$)
Transportation	373,588,845	195,201	355,048,342	188,122	358,437,257	166,455	350,826,308	145,995

[12] Induced activity method as defined in the ICLEI Global Protocol for Community-Scale Greenhouse Gas Emission Inventories. Available from https://ghgprotocol.org/sites/default/files/ghgp/standards/GHGP_GPC_0.pdf.

Table 10: On-Road Transportation Emissions Factors

2005	2010	2015	2022
Emissions Factor ($MTCO_2e/VMT$)	Emissions Factor ($MTCO_2e/VMT$)	Emissions Factor ($MTCO_2e/VMT$)	Emissions Factor ($MTCO_2e/VMT$)
0.0005169	0.0005046	0.0004644	0.0004161

Note: Emissions factors for 2005, 2010, and 2015 presented in this table may differ from the original inventory as the result of using the most recent CARB EMFAC model from 2021, updated from 2014.

Off-Road Transportation Methodology

The off-road transportation GHG emissions come from mobile sources including construction, lawn and garden, recreational, and industrial equipment use within Alameda. Off-road transportation emissions data was gathered from CARB's 2021 OFFROAD model.[13] This model applies an emissions factor for equipment within Alameda County to the amount and types of fuel used. The off-road activity data and emissions are apportioned to the City of Alameda by population.

The emissions factor used for the 2022 inventory is 0.00844 $MTCO_2e$/gallon of fuel. Between 2005 and 2022, emissions for off-road transportation fluctuated and decreased overall by 19%. This change is likely due to more efficient off-road equipment and varied levels of development within the City. Furthermore, the State is focusing on reducing off-road emissions and pollution by requiring that all small off-road engines (SORE) sold within California be zero emission starting January 1, 2024.[14]

Table 11: Total Annual GHG Emissions from Off-Road Transportation

2005		2010		2015		2022[15]	
Gallons	Emissions ($MTCO_2e$)	Gallons	Emissions ($MTCO_2e$)	Gallons	Emissions ($MTCO_2e$)	Gallons	Emissions ($MTCO_2e$)
No Data	26,981	No Data	28,962	3,563,098	32,418	2,565,539	21,653

[13] CARB. (2021). OFFROAD Model. Available from: https://arb.ca.gov/emfac/offroad/emissions-inventory/bb97cd7046d459dd9e4fdc4b5f5bf14ac3512c00.
[14] More information about SORE regulations can be found here: https://ww2.arb.ca.gov/our-work/programs/small-off-road-engines-sore.
[15] Activity data and emissions derived from CARB OFFROAD2021 model, apportioned for the City of Alameda from County data by population.

Solid Waste

Solid waste emissions include emissions associated with the decomposition of waste in landfills and compost facilities and the off-gassing of the closed Doolittle Landfill. Doolittle solid waste landfill began operation in 1953 and was closed in 1985. The landfill is currently being monitored by the City while decomposition occurs beneath the landfill cap. As shown in Table 12, the total solid waste emissions of the city increased between 2015 and 2022 by 66%, largely due to increases in municipal solid waste generation, which reflects overall growth in the city.

Methodology

The data presented in this sector came from the City of Alameda (refuse tonnage) and the US EPA LandGem Model to quantify emissions from Doolittle Landfill.[16] Solid waste emissions are mostly methane (CH_4) from the decomposition of the materials in the landfill. Emissions are estimated from activity data (tons of waste sent to landfill) by applying an emissions factor, which is different for municipal solid waste and the closed landfill because their composition varies. The waste composition comes from the CalRecycle 2015 Waste Characterization Study and the emissions factors are from the WARM model.

The recommended GHG emissions calculation methodologies are Community Protocol Methods SW.4, SW.5, and SW.7 for emissions associated with methane emissions from waste sent to landfills, landfilling process emissions and waste sent to combustion facilities, respectively. The landfill gas (LFG) capture rate of a destination landfill contributes significantly to the methane emissions generated by waste disposal. While many of the destination landfills report having LFG capture, the availability of accurate data representing current LFG capture rates is limited; therefore, the Community Protocol recommended default LFG capture rate of 75% was used for emission calculations.

Table 12: Total Annual Community GHG Emissions from Solid Waste

	2005		***2010***		***2015***		***2022[17]***	
	Tons	**Emissions ($MTCO_2e$)**	**Tons**	**Emissions ($MTCO_2e$)**	**Tons**	**Emissions ($MTCO_2e$)**	**Tons**	**Emissions ($MTCO_2e$)**
Municipal Solid Waste	49,962	5,049	37,310	4,621	27,175	2,477	25,900	8,191
Doolittle Landfill	-	7,377	-	5,745	-	4,474	-	3,360
Total	**49,962**	**12,426**	**37,310**	**10,367**	**27,175**	**6,951**	**25,900**	**11,551**

[16] More information about the US EPA LadnGem Model can be found at: https://www.epa.gov/land-research/landfill-gas-emissions-model-landgem.

[17] Municipal solid waste tonnage provided by the City of Alameda and Doolittle emissions estimated using the US EPA LandGem Model.

Table 13: Solid Waste Emissions Factor

	2005	2010	2015	2022[18]
	Emissions Factor ($MTCO_2e$/Ton)	Emissions Factor ($MTCO_2e$/Ton)	Emissions Factor ($MTCO_2e$/Ton)	Emissions Factor ($MTCO_2e$/Ton)
Municipal Solid Waste	No Data	No Data	No Data	0.3163

Water Use and Wastewater

GHG emissions in this sector come from the energy used to collect, convey, treat, and deliver water to users, and the additional energy used to collect, treat, and dispose of wastewater. The City of Alameda is supplied municipal water by the East Bay Municipal Utility District (EBMUD), which also collects and treats the city's wastewater. Water related emissions have increased since 2005 likely because of the city's continued growth and due to the use of updated methodology that more accurately captures emissions from water consumption and wastewater treatment for 2022. Inventory years 2005-2015 were not updated using the same methodology due to a lack of data.

Methodology

For water consumption, GHG emissions are calculated by determining the energy intensity of water supplied and applying the appropriate GHG emission factors for electricity to the energy used in each aspect of the water supply cycle. Energy intensity (kWh/AF) was determined using CAPCOA Table W-1.1 for the San Francisco Bay hydrologic region.[19] EBMUD water is distributed and treated within PG&E territory so the 2022 PG&E emissions factor for electricity was used.[20]

For wastewater, GHG emissions for process and fugitive emissions are calculated using Community Protocols Methods WW.1.(alt) WW.2.(alt), WW.8.(alt), and WW.12.(alt); with the primary data input being population served. Community Protocol Method WW.15 will be used to determine the amount of energy used for wastewater conveyance and treatment, using the energy intensity factor from CAPCOA Table W-1.1 for the San Francisco Bay hydrologic region and the 2022 PG&E emissions factor for electricity.

Rather than calculating emissions for Alameda, previous inventories (2005-2015) reported only wastewater emissions as a proportion of EBMUD's total wastewater emissions inventory by

[18] 2022 solid waste emission factor is presented as the average based on city's waste composition and is for solid waste sent to landfill.

[19] California Air Pollution Officers Association (CAPCOA). (2021). Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity. Available from: http://www.aqmd.gov/docs/default-source/ceqa/handbook/capcoa-quantifying-greenhouse-gas-mitigation-measures.pdf.

[20] Table E-4.3 from CAPCOA. Available from: http://www.aqmd.gov/docs/default-source/ceqa/handbook/capcoa-quantifying-greenhouse-gas-mitigation-measures.pdf.

population, which likely underestimated water related emissions.[21] The 2022 inventory was not able to recalculate previous year emissions due to a lack of available data.

Table 14: Total Annual Community GHG Emissions from Water and Wastewater

	2005		2010		2015		2022	
	Gallons	Emissions ($MTCO_2e$)	Gallons	Emissions ($MTCO_2e$)	Gallons	Emissions ($MTCO_2e$)	Gallons	Emissions ($MTCO_2e$)
Water	No Data		No Data		No Data		26,937	4,256
Wastewater Treatment	No Data		No Data		No Data		24,243	2,319
Total		**2,180**		**2,156**		**3,207**		**6,575**

Table 15: Water and Wastewater Emissions Factor

		2005	2010	2015	2022[22]
Sector	**Subsector**	**Emissions Factor ($MTCO_2e$/Gallon)**	**Emissions Factor ($MTCO_2e$/Gallon)**	**Emissions Factor ($MTCO_2e$/Gallon)**	**Emissions Factor ($MTCO_2e$/Gallon)**
Water	Water use	No Data	No Data	No Data	0.16
Wastewater	Wastewater Process and Fugitive	No Data	No Data	No Data	0.05473
	Wastewater Collection and Treatment	No Data	No Data	No Data	0.04092

[21] 2005-2015 GHG inventories provided by the City of Alameda as part of the 2015 Community-Wide Greenhouse Gas Inventory and Projection to 2020 Goal prepared by Sustainable Analysis, LLC. in 2018.
[22] 2022 water and wastewater emission factors are presented as the average from multiple Community Protocol equations.

Future Forecasts

Forecasts of the communitywide emissions were developed using demographic and socio-economic forecasts to understand how emissions would change over time. This includes two forecasts:

- A "**Business as Usual**" (BAU) GHG emissions forecast considers how Alameda's emissions would change over time if no action were taken to reduce emissions by the State or at the local level; if conditions were held constant from 2022.
- An "**Adjusted Business as Usual**" (ABAU) forecast shows how Alameda's emissions are anticipated to change accounting for the impacts of adopted State and Federal policies but without local action.

Both forecasts use a consistent set of demographic and economic projections derived from the Association of Bay Area Governments (ABAG) and the City's General Plan 2040 VMT projections. These projections assume that population, housing, employment, and transportation activity will continue to grow through 2040. Demographic and VMT projections have been extrapolated to 2045 to align with the State's GHG reduction targets. Table 16 shows the assumed demographic changes.

Table 16: Alameda Demographic Projections (2005-2045)[23]

	2005	2010	2015	2020	2022	2025	2030	2035	2040	2045
Population	72,512	73,812	76,733	76,961	76,039	82,648	88,336	94,023	99,710	104,260
Jobs	18,641	21,477	24,655	32,121	36,798	35,375	38,630	41,884	45,138	47,741
Housing Units	30,265	30,713	32,042	31,329	30,553	33,828	36,327	38,732	41,324	43,323
Service population	**91,153**	**95,289**	**101,388**	**109,082**	**112,837**	**118,024**	**126,965**	**135,907**	**144,848**	**152,001**

[23] Sources: U.S. Census American Community Survey, ABAG, Alameda General Plan 2040, Alameda 2015 Greenhouse Gas Emissions Inventory.

Business as Usual GHG Forecast

BAU forecast emissions are expected to increase from 267,894 $MTCO_2e$ in 2022 to 327,727 $MTCO_2e$ in 2045, an approximate 22% increase. Table 17 shows the forecasted BAU emission levels for each sector in future years.

Table 17: Forecasted Business as Usual Total Annual Community GHG Emissions 2025-2045 (in $MTCO_2e$)

Sector	Subsector	2025	2030	2035	2040	2045
Building Energy	Residential electricity	-	-	-	-	-
	Residential natural gas	62,446	66,743	71,040	75,338	78,775
	Nonresidential electricity	-	-	-	-	-
	Nonresidential natural gas	26,856	29,327	31,798	34,268	36,245
Transportation	On-Road Transportation	148,122	151,719	155,404	159,178	163,044
	Off-Road	22,648	24,364	26,080	27,796	29,168
Solid Waste	Solid Waste	8,567	9,217	9,866	10,515	11,034
	Doolittle	2,892	2,253	1,754	1,366	1,064
Water/Wastewater	Water Use	4,452	4,789	5,126	5,463	5,733
	Wastewater Treatment	2,365	2,444	2,522	2,601	2,663
	Total	**278,349**	**290,856**	**303,590**	**316,525**	**327,727**

Adjusted Business as Usual GHG Forecast

The Adjusted Business as Usual (ABAU) forecast shows how Alameda's emissions are anticipated to change accounting for impacts of adopted State policies if no action is taken at the local level. There are four major policies that the State has adopted to reduce GHG emissions at the local level:

1. **Transportation**: Major regulations incorporated into the CARB's 2021 transportation modeling used for forecast development include the Advanced Clean Truck Rule, SAFE Vehicle Rules and Actions, and Innovative Clean Transit Rule.[24]
2. **Title 24**: The California Code of Regulations Title 24, Part 6: California's Energy Efficiency Standards for Residential and Nonresidential Buildings is updated triennially to allow consideration and possible incorporation of new energy-efficient technologies and methods. The AB 32 Scoping Plan calls for the continuation of ongoing triennial updates to Title 24 that will yield regular increases in the mandatory energy and water savings for new construction.
    a. Calculations include: adjusted residential and nonresidential electricity activity data to reflect additional electricity demand due to all-electric building code beginning in 2030 and efficiency assumptions.[25]
3. **Renewable Portfolio Standard (SB 100)**: AMP already provides 100% carbon-free energy, so electricity is assumed to be carbon free from 2020 onward.
4. **SB 1383 Regulations:** This law requires organic waste disposal to be reduced by 50% by 2020 and 75% by 2025 in California. To achieve these targets, starting in 2022 jurisdictions must provide organic waste collection services to all residents and businesses and recycle the materials.

Under the ABAU forecast, emissions are expected to decrease from 267,894 $MTCO_2e$ in 2022 to 242,746 $MTCO_2e$ in 2030, an approximate 10% decrease. Table 18 shows the forecasted ABAU emissions for each sector in future years, while Figure 4 shows the City's actual and projected progress toward GHG reduction goals comparing the forecasted ABAU and reductions expected from CARP implementation.

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[24] California Air Resources Board. (2021). EMFAC2021 Volume III Technical Document Version 1.0.1. Accessed from: https://ww2.arb.ca.gov/sites/default/files/2021-08/emfac2021_technical_documentation_april2021.pdf.

[25] California Energy Commission. (2021). California Building Decarbonization Assessment. Accessed from: https://www.energy.ca.gov/publications/2021/california-building-decarbonization-assessment (average of moderate electrification scenario grid impacts p.62).

Table 18: Forecasted Adjusted Businesses as Usual Total Annual Community GHG Emissions in 2025-2045 (in $MTCO_2e$)

Sector	Subsector	2025	2030	2035	2040	2045
Building Energy	Residential electricity	-	-	-	-	-
	Residential natural gas	57,802	62,747	62,747	62,747	62,747
	Nonresidential electricity	-	-	-	-	-
	Nonresidential natural gas	26,856	29,327	29,327	29,327	29,327
Transportation	On-Road Transportation	118,551	108,837	102,506	99,444	98,961
	Off-Road	21,954	23,133	24,602	26,279	27,752
Solid Waste	Solid Waste	8,567	9,217	9,866	10,515	11,034
	Doolittle	2,892	2,253	1,754	1,366	1,064
Water/Wastewater	Water Use	4,452	4,789	5,126	5,463	-
	Wastewater Treatment	2,365	2,444	2,522	2,601	1,327
	Total	**243,439**	**242,746**	**238,450**	**237,743**	**232,212**

Figure 4: City of Alameda Progress Toward GHG Reduction Goals ($MTCO_2e$)