UNINCORPORATED COUNTY OF MARIN

GREENHOUSE GAS INVENTORY FOR UNINCORPORATED COMMUNITY EMISSIONS FOR THE YEAR 2023

MAY 2025

PREPARED BY THE

MARIN CLIMATE & ENERGY PARTNERSHIP

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THE TAKEAWAY:

UNINCORPORATED MARIN'S COMMUNITYWIDE EMISSIONS DOWN 37% SINCE 2005, EQUIVALENT TO 26% BELOW 1990 LEVELS.

The County publishes annual community greenhouse gas (GHG) emissions estimates through the Marin Climate & Energy Partnership (MCEP). Annual inventories help the County to monitor its progress in meeting its Climate Action Plan (CAP) goal to reduce community emissions 40% below the 1990 level by 2030 through mitigation measures[1]. The County's CAP goal also establishes targets for reducing emissions 60% below the 2005 level by 2030 through mitigation and sequestration measures. Ultimately, the County's goal is to achieve carbon neutrality by 2045.

This report reviews emissions generated from the unincorporated Marin area ("the County") from 2005 through 2023, the most recent year for which data are available. The inventory shows that the County has reduced emissions 37% since 2005, which is equivalent to 26% below estimated 1990 levels. Emissions dropped from about 501,933 metric tons carbon dioxide equivalents ($MTCO_2e$) in 2005 to 315,095 $MTCO_2e$ in 2023. The County needs to continue to reduce emissions by another 59,110 $MTCO_2e$ to meet its 2030 mitigation target. An additional reduction of 251,100 $MTCO_2e$ will be required to meet the State net zero emissions goal for 2045, which includes a GHG mitigation target of 85% below 1990 levels. (Table 1). The community emissions trend and targets are shown below (Figure 1).

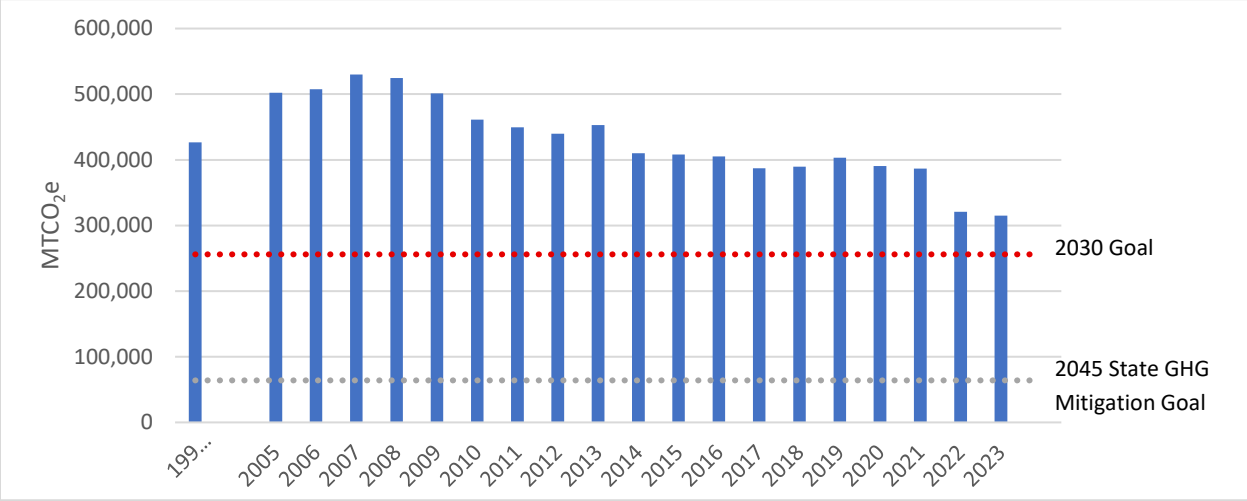
TABLE 1: UNINCORPRATED EMISSIONS AND TARGETS

Year		Level/Target Emissions ($MTCO_2e$)	Reduction Percentage
1990	Estimated Emissions[2]	426,643	
2005	Actual Emissions	501,933	
2023	**Actual Emissions**	**315,095**	**26% Below 1990 estimated levels** **37% Below 2005 levels**
2030	Mitigation Target	251,779	40% Below 1990 estimate levels
2045	State Mitigation Target	63,996	85% Below 1990 estimate levels

[1] This inventory specifically addresses the community emissions generated from the unincorporated areas of Marin County. To see countywide emissions data and inventories from the other Marin jurisdictions, visit www.marinclimate.org

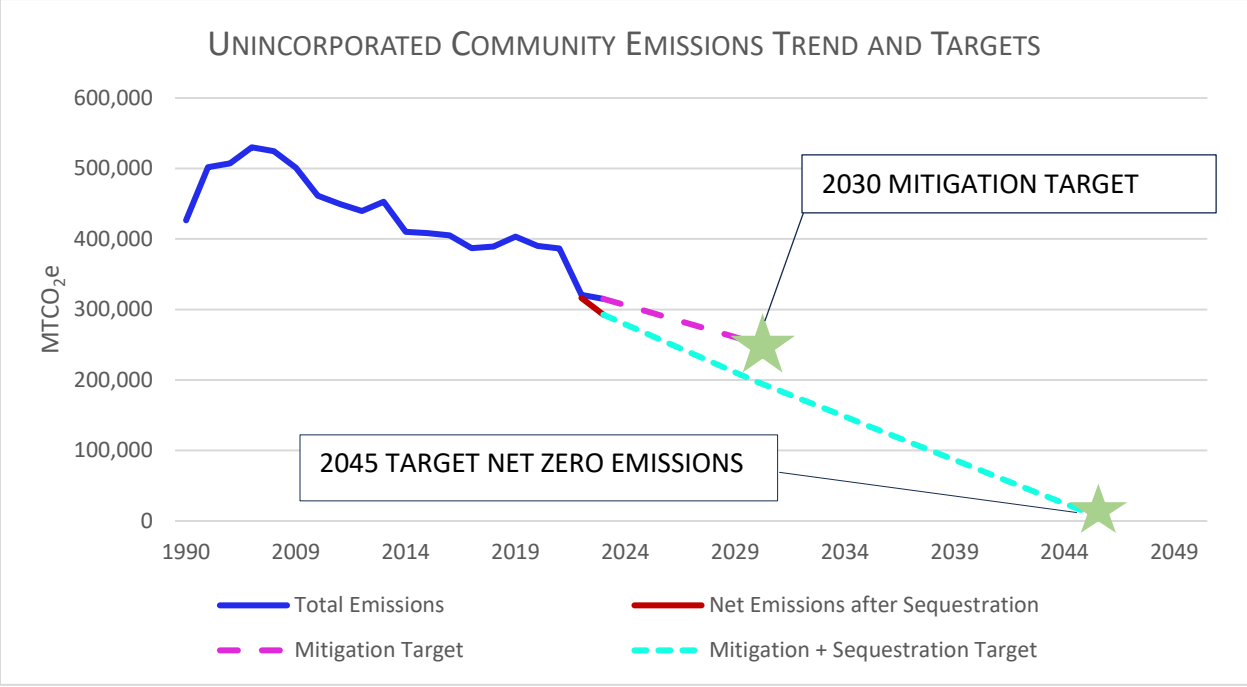
[2] Because reliable activity data is generally not available to determine 1990 emissions levels for local governments, the California Air Resources Board (CARB), in its 2008 Climate Change Scoping plan, recommended local governments pursue a target, comparable to the statewide target, to reduce emissions 15% below 'current' emissions. Given the unreliability of 1990 data, Marin jurisdictions have historically used 2005 as the baseline and estimated the 1990 emissions levels as 15% below that level.

FIGURE 1: UNINCORPORATED COUNTY GREENHOUSE GAS EMISSIONS AND TARGETS



Marin County's climate action goals aim not only to reduce GHG emissions but also to remove existing carbon dioxide already in the atmosphere through agricultural practices that sequester carbon into soil and plant material. The 2030 CAP included measures to support the carbon sequestration of Marin's agriculture and working lands. To date, an average of 22,424 metric tons of CO_2 equivalents per year has been sequestered from carbon farming practices. Figure 2 shows the County's GHG emissions trends for both mitigation and sequestration and compares progress to our CAP 2030 and statewide targets.

FIGURE 2: UNICORPORATED COMMUNITY EMISSIONS TRENDS AND TARGETS (MITIGATION AND SEQUESTRATION)



Recognizing the need for a collaborative approach to greenhouse gas reductions, town, city, and county leaders launched the Marin Climate and Energy Partnership (MCEP) in 2007. As a member of MCEP, the County of Marin works with representatives from the Marin cities and towns to address and streamline the implementation of a variety of greenhouse gas reduction measures. Funding for this inventory was provided by the Marin County Energy Watch Partnership, which administers public goods charges collected by PG&E. Community and countywide inventories are available on the MCEP website at marinclimate.org and are used to update the Marin Sustainability Tracker.

INTRODUCTION

PURPOSE OF INVENTORY

The objective of this greenhouse gas emissions inventory is to identify the sources and quantify the amounts of greenhouse gas emissions generated by the activities of the unincorporated Marin communities in 2023. This inventory provides a comparison to 2005 emissions and estimated 1990 emissions and identifies the sectors where significant reductions in greenhouse gas emissions have occurred. In some instances, previous year emissions were updated with new data and/or recalculated to ensure the same methodology was employed for all inventory years. In particular, agricultural emissions in 2022 were revised due to updated livestock data and off-road emissions were revised due to an update in the California Air Resources Board OFFROAD model.

GENERAL METHODOLOGY

This inventory uses national standards for the accounting and reporting of greenhouse gas emissions. The U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, version 1.2 (July 2019) was used for the quantification and reporting of community emissions. Quantification methodologies, emission factors, and activity and source data are detailed in the appendix.

Community emissions are categorized according to eight sectors:

- Built Environment - Electricity
- Built Environment – Natural Gas
- Transportation
- Off-Road Vehicles and Equipment
- Waste
- Water
- Wastewater
- Agriculture

CALCULATING EMISSIONS

Emissions are quantified by multiplying the measurable activity data – e.g., kilowatt hours of electricity, therms of natural gas, and gallons of diesel or gasoline – by emission factors specific to the energy source. Most emission factors are the same from year to year. Emission factors for electricity, however, change from year to year due to the specific sources that are used to produce electricity. For example, electricity that is produced from coal generates more greenhouse gases than electricity that is generated from natural gas and therefore has a higher emission factor. Electricity that is produced solely from renewable energy sources, such as solar and wind, has an emission factor of zero.

This inventory calculates individual greenhouse gases – e.g., carbon dioxide, methane, and nitrous oxide – and converts each greenhouse gas emission to a standard metric, known as "carbon dioxide equivalents" or CO_2e, to provide an apples-to-apples comparison among the various emissions. Table 2 shows the greenhouse gases identified in this inventory and their global warming potential (GWP), a measure of the amount of warming each gas causes when compared to a similar amount of carbon dioxide. Methane, for example, is 28 times as potent as carbon dioxide over 100 years; therefore, one metric ton of methane is equivalent to 28 metric tons of carbon dioxide. Greenhouse gas emissions are reported in this inventory as metric tons of carbon dioxide equivalents, or $MTCO_2e$.

TABLE 2: GREENHOUSE GASES

Gas	Chemical Formula	Emission Source	Global Warming Potential
Carbon Dioxide	CO_2	Combustion of natural gas, gasoline, diesel, and other fuels	1
Methane	CH_4	Combustion, anaerobic decomposition of organic waste in landfills and wastewater	28
Nitrous Oxide	N_2O	Combustion, wastewater treatment	265

Source: IPCC Fifth Assessment Report (2014)

Types of Emissions

Emissions from each of the greenhouse gases can come in a number of forms:

- **Stationary or mobile combustion** resulting from the on-site combustion of fuels (natural gas, diesel, gasoline, etc.) to generate heat or electricity, or to power vehicles and equipment.
- **Purchased electricity** resulting from the generation of power from utilities outside the jurisdictional boundary.
- **Fugitive emissions** resulting from the unintentional release of greenhouse gases into the atmosphere, such as leaked refrigerants and methane from waste decomposition.
- **Process emissions** from physical or chemical processing of a material, such as wastewater treatment.

Understanding Totals

The totals listed in the tables and discussed in the report are a summation of emissions using available estimation methods. Each inventoried sector may have additional emissions sources associated with it that were unaccounted for due to a lack of data or robust quantification methods. For example, greenhouse gas emissions associated with air travel and the production of goods outside the community's boundary are not included in the inventory. Additionally, the community inventory does not include refrigerants released into the atmosphere from the use of air conditioning in cars and buildings.

COMMUNITY INVENTORY

COMMUNITY INVENTORY SUMMARY

In 2005, the activities taking place in unincorporated Marin County resulted in approximately 501,933 metric tons of CO_2e. In 2023, those activities resulted in approximately 315,095 metric tons of CO_2e, a reduction of 37% from 2005 levels, which is equivalent to 26% below estimated 1990 levels.

The community inventory tracks emissions in seven sectors:

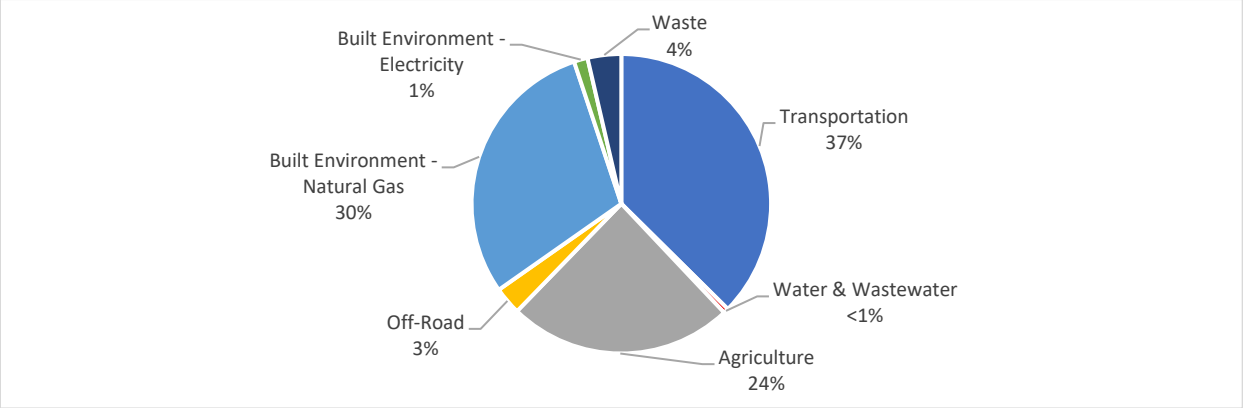
- The **Built Environment – Electricity** sector represents emissions generated from the use of electricity in unincorporated Marin homes and commercial, industrial, and governmental buildings and facilities.
- The **Built Environment – Natural Gas** sector represents emissions generated from the use of natural gas in unincorporated Marin homes and commercial, industrial, and governmental buildings and facilities. Propane used as a primary heating source is also included, although it represents less than 1% of emissions in this sector.
- The **Transportation** sector includes tailpipe emissions from passenger vehicle trips originating and ending in unincorporated Marin areas, as well as a share of tailpipe emissions generated by medium and heavy-duty vehicles and buses traveling on Marin County roads. The sector also includes emissions from Marin Transit and Golden Gate Transit buses and the SMART train as these vehicles travel within the unincorporated area. Electricity used to power electric vehicles is embedded in electricity consumption reported in the Built Environment - Electricity sectors.
- The **Waste** sector represents fugitive methane emissions that are generated over time as organic material decomposes in the landfill. Although most methane is captured or flared off at the landfill, approximately 25% escapes into the atmosphere.
- The **Off-Road** sector represents emissions from the combustion of gasoline and diesel fuel from the operation of off-road vehicles and equipment used for construction, landscape maintenance, and agricultural activities.
- The **Water** sector represents emissions from energy used to pump, treat, and convey potable water from the water source to unincorporated Marin water users.
- The **Wastewater** sector represents stationary, process, and fugitive greenhouse gases that are created during the treatment of wastewater generated by the community, as well as emissions created from electricity used to convey and treat wastewater.
- The **Agriculture** sector includes methane emissions from enteric fermentation and manure decomposition and treatment, and nitrogen oxide emissions from fertilizer application.

Table 3 shows how emissions in each sector have changed since 2005. The greatest reductions have occurred in the Built Environment - Electricity sector (76,921 $MTCO_2e$), followed by the Transportation sector (24,139 $MTCO_2e$) and the Built Environment – Natural Gas sector (16,983 $MTCO_2e$). The likely reasons for the largest emissions decreases are described in the remainder of this report. Figure 3 shows the relative contribution of emissions from these sectors in 2023. Transportation is the largest sector, representing 37% of community emissions, followed by the Built Environment – Natural Gas sector (30%) and the Agricultural sector (24%).

TABLE 3: EMISSIONS SUMMARY BY SECTOR ($MTCO_2E$), 2005 THROUGH 2023

Year	Built Environment - Electricity	Built Environment – Natural Gas	Transportation	Waste	Water	Wastewater	Off-Road	Agriculture	Total	% Change from 2005
2005	81,581	110,354	142,015	22,779	2,743	2,677	10,939	128,845	501,933	
2006	75,494	110,774	142,896	22,447	2,488	2,620	11,196	139,634	507,549	1%
2007	105,848	108,837	144,732	20,061	2,824	2,949	12,315	132,541	530,106	6%
2008	112,719	107,759	141,723	16,677	2,732	2,989	11,088	129,096	524,784	5%
2009	104,606	106,059	140,675	14,364	2,775	2,800	10,253	119,528	501,059	0%
2010	71,508	107,735	130,514	14,027	1,513	2,399	9,812	123,860	461,367	-8%
2011	64,592	109,730	130,257	13,752	1,102	2,429	9,708	118,147	449,716	-10%
2012	66,567	103,369	131,422	14,119	1,143	2,478	9,626	110,834	439,557	-12%
2013	61,456	103,192	131,542	14,191	1,312	2,475	9,556	129,132	452,857	-10%
2014	53,725	85,330	129,898	14,356	1,201	2,343	9,497	113,862	410,212	-18%
2015	51,645	85,417	128,734	14,888	946	2,316	9,427	114,823	408,198	-19%
2016	41,663	90,601	125,307	17,424	710	2,203	9,340	117,950	405,199	-19%
2017	20,579	92,996	125,322	18,228	232	1,977	9,242	118,665	387,240	-23%
2018	22,151	92,427	124,395	16,195	10	1,929	9,958	122,371	389,435	-22%
2019	21,741	94,754	124,201	15,451	15	1,790	9,742	135,585	403,280	-20%
2020	14,638	94,190	122,915	14,331	6	1,802	9,602	132,858	390,342	-22%
2021	12,760	93,630	121,750	11,565	6	1,769	9,551	135,783	386,812	-23%
2022	8,546	90,366	119,553	11,174	3	1,741	9,495	79,947	320,827	-36%
2023	4,659	93,371	117,876	11,438	0	1,730	9,439	76,582	315,095	-37%
Change from 2005	-76,921	-16,983	-24,139	-11,341	-2,742	-947	-1,500	-52,263	-186,838	
% Change from 2005	-94%	-15%	-17%	-50%	-100%	-35%	-14%	-41%	-37%	

FIGURE 3: EMISSIONS BY SECTOR, 2023

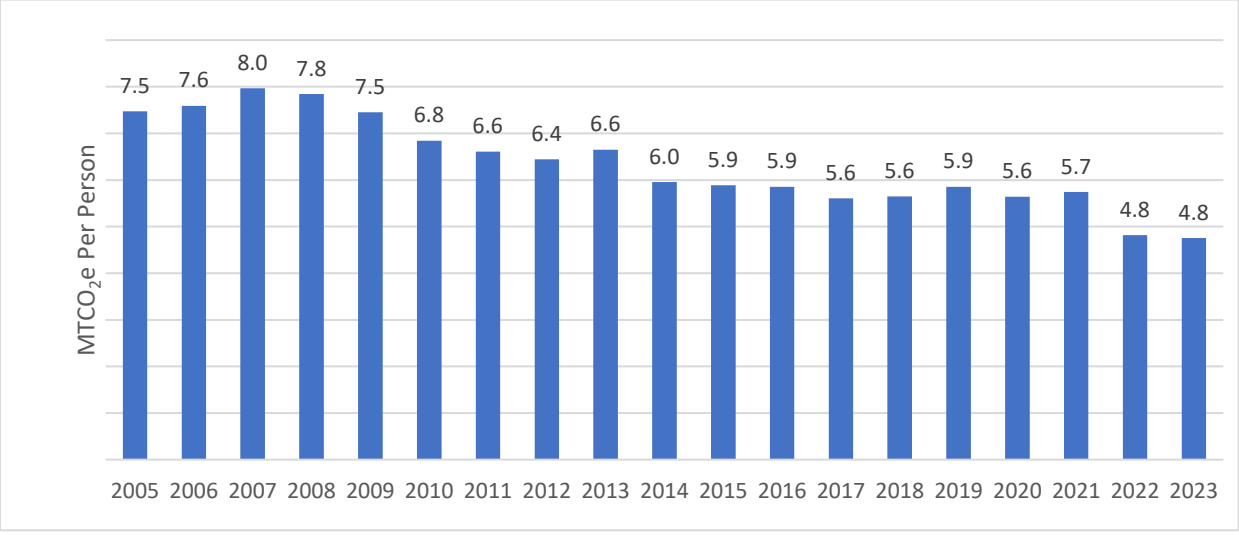


PER CAPITA EMISSIONS

Per capita emissions can be a useful metric for measuring progress in reducing greenhouse gases and for comparing one community's emissions with neighboring cities and against regional and national averages. That said, due to differences in emission inventory methods, it can be difficult to produce directly comparable per capita emissions numbers. Per capita emission rates may be compared among Marin jurisdictions, although some jurisdictions may have higher rates due to the presence of commercial and industrial uses.

Dividing the total communitywide GHG emissions by residents yields a result of 7.5 metric tons CO_2e per capita in 2005. Per capita emissions decreased 36% between 2005 and 2023, falling to 4.8 metric tons per person. Figure 4 shows the trend in per capita emissions over time. It is important to understand that this number is not the same as the carbon footprint of the average individual living in Marin, which would include lifecycle emissions, emissions resulting from air travel, the manufacturing and distribution of products and food, etc.

FIGURE 4: EMISSIONS PER CAPITA



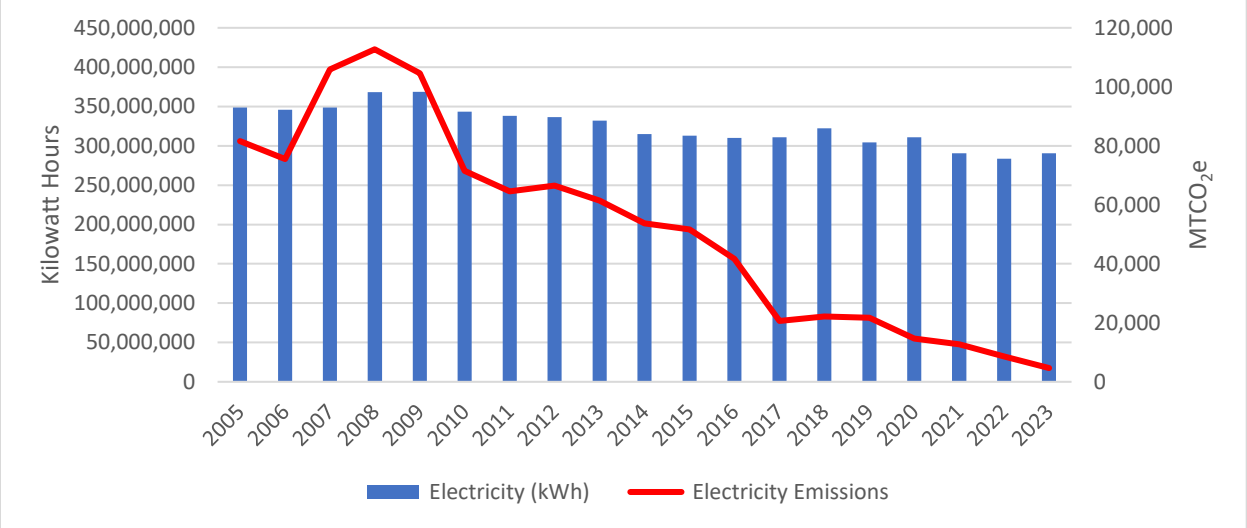
Sector Spotlights

The following sections provide a year-by-year analysis of the changes in GHG emissions from some highlighted sectors: electricity, natural gas, transportation, waste, water use, and agriculture. Whenever possible, each section discusses the change in emissions from previous years and the likely influence of state and local programs or policies and external factors on reducing emissions.

Built Environment - Electricity

Purchased electricity use in homes and businesses in unincorporated Marin decreased about 17% between 2005 and 2023. Greenhouse gas emissions from electricity consumption decreased 94% since 2005, as shown in Figure 5. This is primarily due to the lower carbon intensity of electricity. PG&E has been steadily increasing the amount of renewable energy in its electricity mix. In 2023, PG&E electricity came from a mix of renewable (33%), large hydroelectric (14%), and nuclear (53%) energy sources[3]. MCE Light Green electricity came primarily from renewable (60%) and hydroelectric (40%) sources.[4] In 2023, about 14% of MCE electricity purchased by unincorporated Marin customers was 100% renewable Deep Green electricity. The County also purchases Deep Green for its government operations.

FIGURE 5: ELECTRICITY CONSUMPTION AND EMISSIONS



Built Environment - Natural Gas

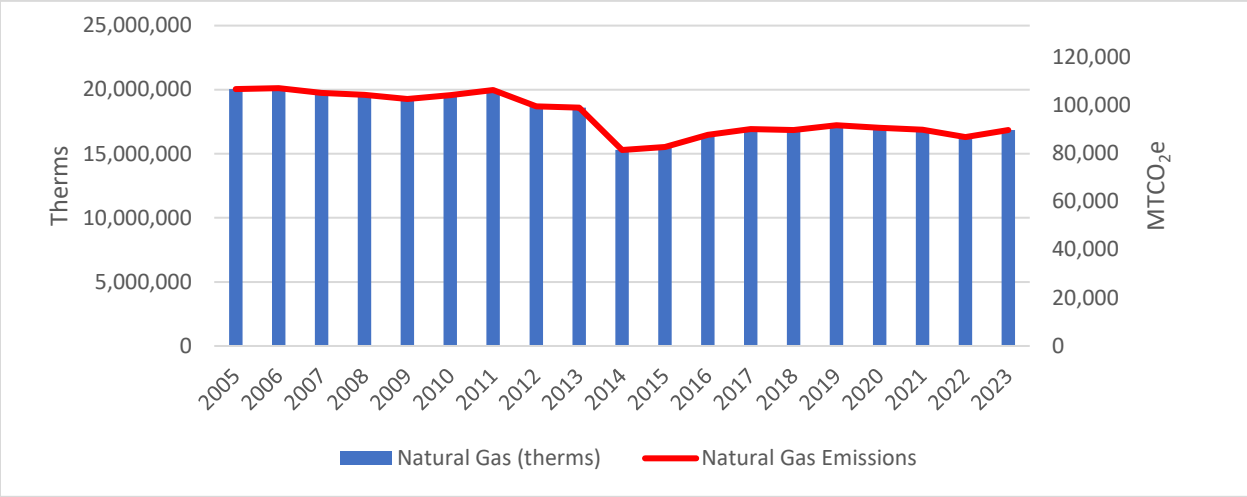
Natural gas is used in residential and commercial buildings to provide space and water heating and power appliances. Use of natural gas is highly variable, typically depending on the weather conditions. This variability has led natural gas use consumption in unincorporated Marin to fluctuate from year to year, from a high of 20.1 million therms in 2006 to a low of 15.3 million therms in 2014. Reduction in energy use may also be attributed to energy efficiency programs and rebates, the County's green building ordinances, and State building codes. Natural gas consumption increased 3% between 2022 and 2023 and was 16% below the 2005 level in 2023. Unlike electricity emissions, which

[3] PG&E 2023 Power Content Label, https://www.energy.ca.gov/filebrowser/download/7281. Nuclear and large hydro sources are considered GHG-free.

[4] MCE 2023 Power Content Label, https://www.energy.ca.gov/filebrowser/download/7276.

vary according to the power content mix, natural gas emissions track the amount of natural gas consumed (Figure 6). The County's Climate Action Plan's target is to reduce natural gas consumption and emissions 36% below the 2005 level by 2030.

FIGURE 6: NATURAL GAS CONSUMPTION AND EMISSIONS



TRANSPORTATION

Transportation activities accounted for approximately 37% of unincorporated Marin's emissions in 2023. According to the transportation model and annual data the County uses to calculate passenger and commercial vehicle miles, vehicle miles traveled (VMT) have increased approximately 6% since 2005.

On-road transportation emissions decreased 17% due to more fuel-efficient and alternatively fueled vehicles (Figure 7). As shown in Figure 8, most transportation emissions come from passenger vehicles, accounting for 82% of transportation emissions in 2023. Marin County continues to be a leader in zero-emission vehicles (ZEVs) – second only to Santa Clara County – with 19,221 ZEVs in Marin at the end of 2023, or about 9.3% of registered automobiles. ZEVs include battery electric cars, plug-in hybrid electric cars, hydrogen fuel cell cars, and zero-emission motorcycles. The County's Climate Action Plan targets 45% of passenger vehicles registered in Marin to be ZEVs by 2030 and a 58% reduction in transportation emissions.

FIGURE 7: VEHICLE MILES TRAVELED AND TRANSPORTATION EMISSIONS

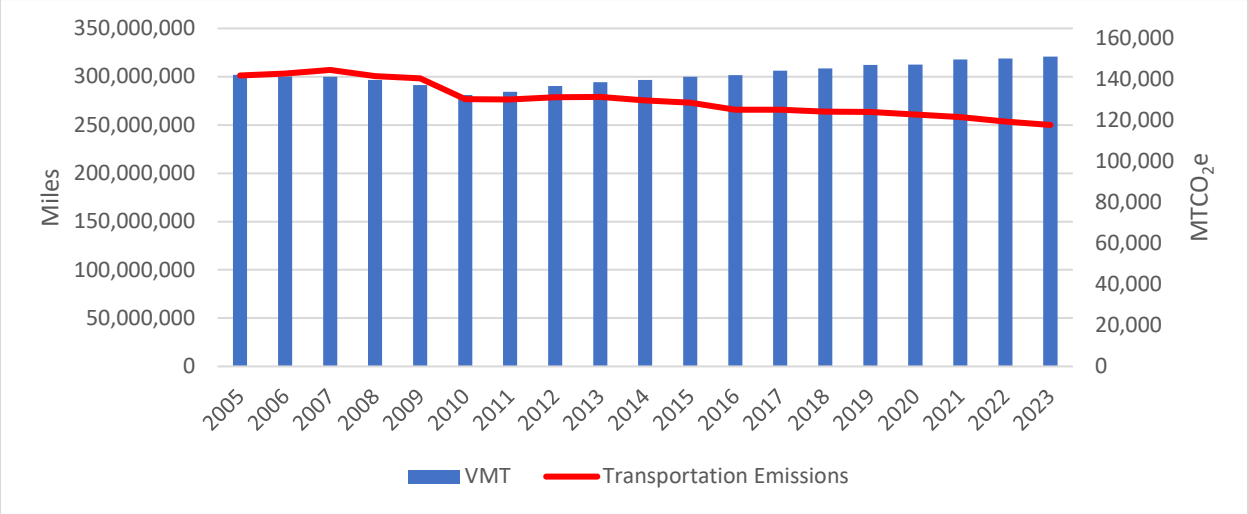
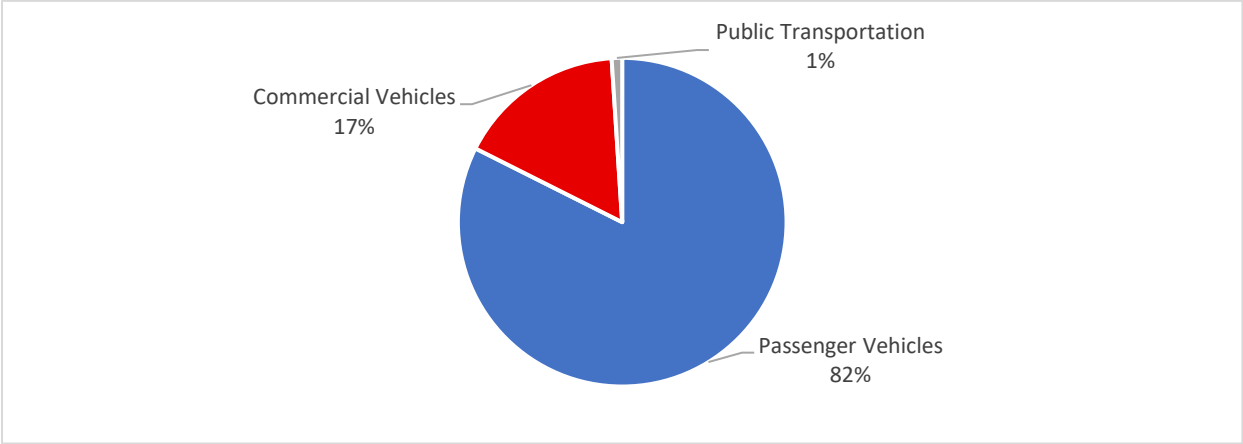


FIGURE 8: TRANSPORTATION EMISSIONS BY VEHICLE CATEGORY, 2023



While it is difficult to pinpoint exactly how each land use and transportation policy affects emissions, the County has undertaken many efforts to reduce transportation emissions. The County encourages workforce housing and has made it easier for residents to use carbon-free modes of transportation, such as bicycling and walking, through improvements to the transportation network.

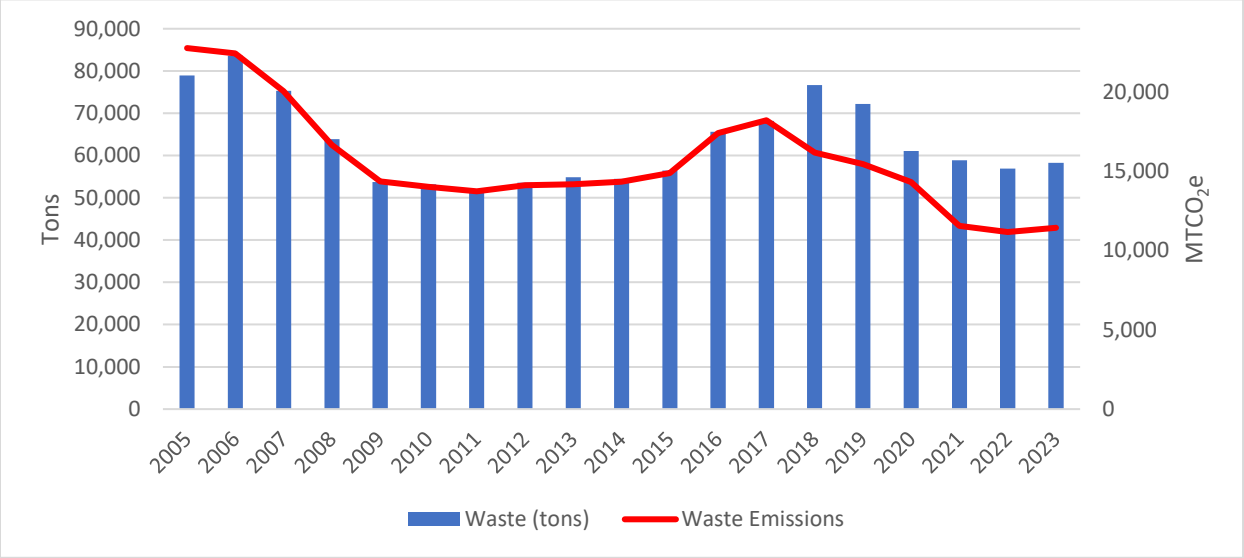
WASTE

Waste generated by the community increased 2% between 2022 and 2023 and was 26% below the 2005 level by 2023, as shown in Figure 9 (based on countywide disposal data). Total landfilled waste includes alternative daily cover.[5] Emissions from waste disposal decreased 50% due to the lower organic content of landfilled waste (based

[5] Alternative daily cover is material other than earthen material placed on the surface of the active face of a municipal solid waste landfill at the end of each operating day to control vectors, fires, odors, blowing litter, and scavenging.

on statewide waste characterization studies) and material used for alternative daily cover. The Climate Action Plan's target is to reduce waste disposal emissions 70% below the 2005 level by 2030.

FIGURE 9: DISPOSED WASTE AND EMISSIONS



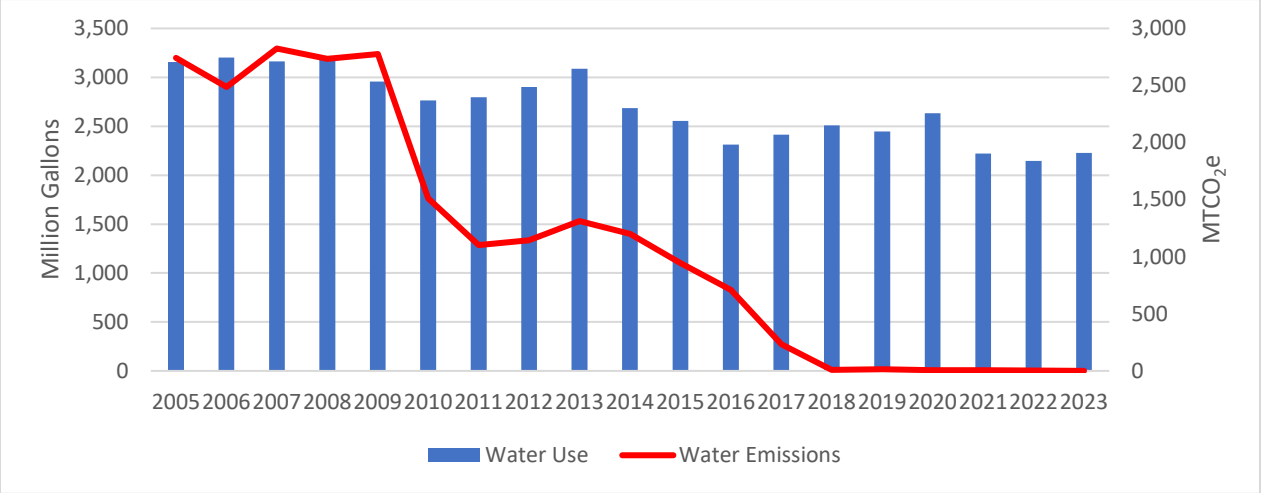
WATER

The Marin Municipal Water District (Marin Water) and the North Marin Water District (NMWD) serve most of the water customers in unincorporated Marin. Water consumption increased 4% between 2022 and 2023 and was 29% below the 2005 level in 2023. Emissions, which are based on an estimate of energy used to pump, treat, and convey water from the water source to communities, dropped nearly 100% between 2005 and 2023 due to water agencies' use of carbon-free electricity. Marin Water purchases MCE Deep Green for its electricity needs, and the Sonoma County Water Agency, which supplies approximately 25% of Marin Water's water, uses renewable and carbon-free sources for its electricity.

Marin Water and NMWD provide rebates and programs to reduce water use. MMWD provides rebates to replace fixtures with high-efficiency clothes washers and to purchase cisterns and rain barrels. MMWD also provides free home and landscape water-use evaluations as well as free high-efficiency showerheads and faucet aerators.

NMWD provides rebates and programs to reduce water use. Rebates are available to replace lawns with low water use planting and for the purchase and installation of mulch. NMWD also provides rebates for pool covers, rainwater catchment, greywater systems, weather-based irrigation controllers, and replacement of washing machines and toilets with high-efficiency fixtures. NMWD provides free home and landscape water-use evaluations.

FIGURE 10: WATER USE AND EMISSIONS



The County's Climate Action Plan's goal is to reduce annual water consumption 31% below the 2005 level to 2,192 million gallons, an amount nearly achieved in 2023.

AGRICULTURE

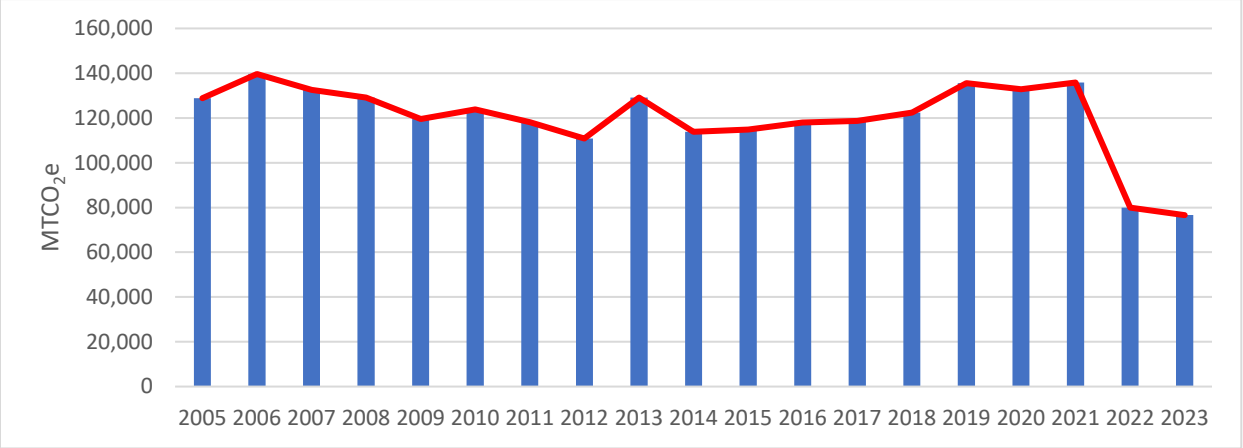
Of all the local CAPs in Marin, the unincorporated County's is the only one to include emissions from agriculture. This sector includes GHG emissions from manure management (fugitive emissions of methane and nitrous oxide), enteric fermentation (fugitive emissions of methane and nitrous oxide), and fertilizer use (fugitive emissions of nitrous oxide). Emissions from enteric fermentation and the management of manure make up the biggest share and hence drive agricultural emissions. For the purposes of this inventory, these emissions are referred to as "operational emissions". Emissions reductions from carbon sequestration efforts, which are quantified in the CAP, are calculated separately from operational emissions and are provided below.

OPERATIONAL EMISSIONS

Certain agricultural variables, such as composition of feed for cattle or chickens, can significantly alter livestock emissions factors. Detailed data on how feed proportions have changed since 2012 was not collected for the GHG assessment. As a proxy, emission factors used in the 2012 inventory are used for all inventory years. As a result, emissions are dependent upon livestock counts and acreage under agricultural production. Livestock counts can vary significantly from year to year, and some are estimated due to privacy concerns. The United States Department of Agriculture's National Agricultural Statistics Service (USDA NASS) conducts a complete census of U.S. farms and ranches every five years[6]. The livestock counts used in intervening years is an estimate based on the previous census. The NASS completed an updated census in 2022 which resulted in a significant drop in the number of livestock-cows in Marin. The count of livestock has probably been declining more steadily since the last census in 2017 as Marin dairies and ranches have reached carrying capacities, changed ownership, and/or shifted operations. As a result of the change in livestock populations, agricultural emissions have decreased 41% since 2005 (Figure 11).

[6] https://www.nass.usda.gov/AgCensus/index.php

FIGURE 11: AGRICULTURE EMISSIONS



SEQUESTERED EMISSIONS

Marin County's climate action goals aim not only to reduce GHG emissions but also to capture GHG emissions by using agricultural practices to sequester carbon into soil and plant material. The County's 2030 CAP details this strategy, AG-C1: Carbon Farming. The 2030 CAP estimated the full carbon sequestration potential of Marin's agriculture and working lands (e.g., 60 farms and ranches across 30,000 acres) to reach an annual total of 55,752 MTCO2e by 2030. However, the ability to confirm and track implemented projects against this potential remains challenging.

In 2023, the Marin Resource Conservation District (RCD) established methodology to estimate carbon sequestered on projects verified through carbon farm plans[7] as implemented through RCDs programs[8]. From 2007 to 2024, RCD evaluated 27 farm and ranch plans across over 9,000 acres of which 8,146 acres and 37,317 linear feet of practices were implemented (Table 4). RCD calculated, as of present day, an average of 22,424 metric tons of CO_2 equivalents per year was sequestered from practices implemented.

[7] Carbon farm plans are practices that farmers and ranchers can implement to sequester C on their working lands. These practices include Conservation Cover, Residue and Tillage Management (no-till). Critical Area Planting, Filter Strip Compost Application, Nutrient Management, Forage Biomass Planting Prescribed Grazing, Range Planting, Riparian Forest Buffer, Riparian Restoration, Tree & Shrub Establishment, Silvopasture Establishment, and Windbreak/Shelterbelt Establishment. For more information on carbon farming see https://www.carboncycle.org/what-is-carbon-farming/

[8] RCD accounts for public lands. It does not account for private lands or carbon farm plan projects applied through the USDA Natural Resource Conservation Service (NRCS) or California Department of Food and Agriculture's (CDFAs) Healthy Soils program.

TABLE 4: ANNUAL CARBON SEQUESTERED ACROSS BY CARBON FARM PRACTICES FROM 2007 TO 2024

Carbon Farm Practice	Area Implemented to Date (2014-2022)	Units	Annual C Sequestered (mtCO2e)
Compost Application	1,327	Acres	12,700
Nutrient Management	86	Acres	45
Conservation Cover	1	Acres	2
Critical Area Planting	2	Acres	48
Filter Strip	0	Acres	0
Forage Biomass Planting	840	Acres	2,814
Hedgerow Planting	22,099	Linear Feet	261
Prescribed Grazing	4,462	Acres	647
Range Planting	1,344	Acres	3,821
Riparian Forest Buffer	48	Acres	766
Riparian Restoration	0	Acres	0
Silvopasture Establishment	29	Acres	189
Tree & Shrub Establishment	9	Acres	873
Windbreak/Shelterbelt Establishment	15,218	Linear Feet	258
Total Acreage	8,146	**Acres**	**22,424**

Moving forward, the County of Marin and Marin RCD will continue to estimate annual carbon sequestered as data becomes available and methodology improves. The County and RCD will also support the improvement of tracking carbon sequestered from carbon farm plan projects implemented across the County. This will likely include measuring carbon sequestered from Natural Resource Conservation Service's (NRCS) and California Department of Farming and Agriculture (CDFA) programs as well as projects implemented on private land.

APPENDIX: COMMUNITY INVENTORY DETAIL

Community GHG Emissions Summary Table

Jurisdiction: Unincorporated County of Marin

Inventory Year: 2023

Population: 66,263 (CA Department of Finance) Date Prepared: March 26, 2025

Number of Households: 26,343 (CA Department of Finance) Reporting Framework: Communitywide Activities

ID	Emissions Type	Source or Activity	Included, Required Activities	Included, Optional Activities	Excluded (IE, NA, NO or NE)	Notes	Emissions ($MTCO_2e$)
1.0	Built Environment						
1.1	Use of fuel in residential and commercial stationary combustion equipment	Both	●				93,371
1.2	Industrial stationary sources	Source			NE		
1.3	Power generation in the community	Source			NO		
1.4	Use of electricity in the community	Activity	●			Includes transmission and distribution losses	4,659
1.5	District heating/cooling facilities in the community	Source			NE		
1.6	Use of district heating/cooling facilities in the community	Activity			NE		
1.7	Industrial process emissions in the community	Source			NO		
1.8	Refrigerant leakage in the community	Source			NE		
2.0	Transportation and Other Mobile Sources						
2.1	On-road passenger vehicles operating within the community boundary	Source			IE	Obtained data for the preferred activity-based method instead	
2.2	On-road passenger vehicles associated with community land uses	Activity	●				96,827
2.3	On-road freight and service vehicles operating within the community boundary	Source			IE	Obtained data for the preferred activity-based method instead	
2.4	On-road freight and service vehicles associated with community land uses	Activity	●				19,457
2.5	On-road transit vehicles associated with community land uses	Activity		●		Emissions calculated for transit vehicles operating within the community boundary	1,209
2.6	Transit rail vehicles operating within the community boundary	Source			NO		383
2.7	Use of transit rail travel by the community	Activity			NE		
2.8	Inter-city passenger rail vehicles operating within the community boundary	Source			NO		

2.9	Freight rail vehicles operating within the community boundary	Source			NO		
2.10	Marine vessels operating within the community boundary	Source			NE		
2.11	Use of ferries by the community	Activity			NE		
2.12	Off-road surface vehicles and other mobile equipment operating within the community boundary	Source		●			9,439
2.13	Use of air travel by the community	Activity			NE		
3.0	Solid Waste						
3.1	Operation of solid waste disposal facilities in the community	Source			NE		
3.2	Generation and disposal of solid waste by the community	Activity	●			Includes alternative daily cover	11,438
4.0	Water and Wastewater						
4.1	Operation of water delivery facilities in the community	Source			IE	Energy use is included in 1.1 and 1.4.	
4.2	Use of energy associated with the use of potable water by the community	Activity	●				0
4.3	Use of energy associated with the generation of wastewater by the community	Activity	●				2
4.4	Process emissions from the operation of wastewater treatment facilities located in the community	Source			NE		
4.5	Process emissions associated with the generation of wastewater by the community	Activity	●				837
4.6	Use of septic systems in the community	Source					893
5.0	Agriculture						
5.1	Domesticated animal production	Source		●			42,863
5.2	Manure decomposition and treatment	Source		●			33,447
6.0	Upstream Impacts of Communitywide Activities						
6.1	Upstream impacts of fuels used in stationary applications by the community	Activity			NE		
6.2	Upstream and transmission and distribution (T&D) impacts of purchased electricity used by the community	Activity			IE	Transmission and distribution losses are included in 1.4.	
6.3	Upstream impacts of fuels used by water and wastewater facilities for water used and wastewater generated within the community boundary	Activity			IE	Included in 4.2 and 4.3.	
6.4	Upstream impacts of select materials (concrete, food, paper, carpets, etc.) used by the whole community.	Activity			NE		

Legend

IE – Included Elsewhere: Emissions for this activity are estimated and presented in another category of the inventory. The category where these emissions are included should be noted in the explanation.

NE – Not Estimated: Emissions occur but have not been estimated or reported (e.g., data unavailable, effort required not justifiable).

NA – Not Applicable: The activity occurs but does not cause emissions; explanation should be provided.

NO – Not Occurring: The source or activity does not occur or exist within the community.

Community Emissions Data Sources and Calculation Methodologies

Sector/ID	Emissions Source	Source and/or Activity Data	Emission Factor and Methodology
1.0 Built Environment			
1.1 Stationary Combustion	Stationary Combustion (CO_2, CH_4 & N_2O)	Known and estimated fuel use (meter readings by PG&E) and estimated fuel use (American Community Survey 5-Year Estimates, and U.S. Energy Information Administration Household Site Fuel Consumption data). Industrial natural gas consumption estimated from 2016 data.	Default CO_2, CH_4 & N_2O emission factors by fuel type (U.S. Community Protocol v. 1.1 Tables B.1 and B.3). U.S. Community Protocol v. 1.1, Appendix C, Method BE.1.1 and BE.1.2.
1.4 Electricity Use	Electricity Use (CO_2, CH_4 & N_2O)	Estimated and known electricity use (meter readings by PG&E and MCE) and estimated direct access electricity consumption.	Verified utility-specific emission factors (PG&E and MCE) and eGrid subregion default emission factors. U.S. Community Protocol v. 1.1, Appendix C, Method BE.2.1.
	Electric Power Transmission and Distribution Losses (CO_2, CH_4 & N_2O)	Estimated electricity grid loss for the Western region from eGrid.	U.S. Community Protocol v. 1.1, Appendix C, Method BE.4.1.
2.0 Transportation and Other Mobile Sources			
2.2 On-Road Passenger Vehicle Operation	On-Road Mobile Combustion (CO_2)	Estimated passenger vehicle miles traveled associated with origin and destination land uses (Metropolitan Transportation Commission, CAPVMT Data Portal 2.0 (mtcanalytics.org)).	CO_2 for on-road passenger vehicles quantified in the EMFAC2021 v.1.0.2 model. Passenger vehicle emissions calculated according to U.S. Community Protocol v. 1.1, Appendix D, Method TR.1.A.
	On-Road Mobile Combustion (CH_4 & N_2O)	Estimated vehicle miles traveled associated with origin and destination land uses (Metropolitan Transportation Commission, CAPVMT Data Portal 2.0 (mtcanalytics.org))..	CH_4 and N_2O for on-road passenger vehicles quantified in the EMFAC2021 v.1.0.2 model. Passenger vehicle emissions calculated according to U.S. Community Protocol v. 1.1, Appendix D, Method TR.1.A.
2.4 On-Road Freight and Service Truck Freight Operation	On-Road Mobile Combustion (CO_2)	Estimated commercial vehicle miles traveled within the boundary (Metropolitan Transportation Commission utilizing Plan Bay Area 2050).	CO_2 for on-road commercial vehicles quantified in the EMFAC2021 v.1.0.2 model. Emissions allocated utilizing LEHD data according to U.S. Community Protocol v. 1.1, Appendix D, Method TR.2.A.
	On-Road Mobile Combustion (CH_4 & N_2O)	Estimated commercial vehicle miles traveled within the boundary (Metropolitan Transportation Commission utilizing Plan Bay Area 2050).	CH_4 and N_2O for on-road commercial vehicles quantified in the EMFAC2021 v.1.0.2 model. Emissions allocated utilizing LEHD data according to U.S. Community Protocol v. 1.1, Appendix D, Method TR.2.A.
2.5 On-Road Transit Operation	On-Road Mobile Combustion (CO_2)	Estimated vehicle miles traveled within the boundary (Marin Transit and Golden Gate Transit) and estimated diesel fuel efficiency for the transit fleet (Golden Gate Transit). Fuel type provided by Marin Transit and Golden Gate Transit.	Renewable diesel emission factor provided by NEXGEN. U.S. Community Protocol v. 1.1, Appendix D, Method TR.4.A.
	On-Road Mobile Combustion (CH_4 & N_2O)	Estimated vehicle miles traveled within the boundary (Marin Transit and Golden Gate Transit) and estimated diesel fuel efficiency for the transit fleet (Golden Gate Transit). Fuel type provided by Marin Transit and Golden Gate Transit.	Renewable diesel emission factor provided by NEXGEN. U.S. Community Protocol v. 1.1, Appendix D, Method TR.4.B.

2.6 Passenger Rail	Mobile Combustion (CO_2, CH_4 & N_2O)	Estimated train miles by multiplying the number of train cars per day (in both directions, according to the SMART published schedule) by the railway track mileage located within the community boundary (Marin Map). Average Diesel Multiple Unit fuel efficiency provided by SMART.	U.S. Community Protocol v. 1.1, Appendix D, Method TR.5. Emission factors from Equation TR.5.2.
2.12 Off-Road Vehicles and Equipment	Off-Road Mobile Combustion (CO_2)	Estimated fuel use from OFFROAD v.1.0.1 for Lawn and Garden and Construction and Agriculture equipment. Lawn and Garden and Construction categories are allocated by share of countywide households. Agricultural Tractors and ATVs were added in 2018; the 2018 data for these categories was added to prior years.	CO_2 emissions calculated according U.S. Community Protocol v. 1.1, Appendix D, Method TR.8. Emission factors provided in Table TR.1.6.
	Off-Road Mobile Combustion (CH_4 & N_2O)	Estimated fuel use from OFFROAD v.1.0.1 for Lawn and Garden and Construction and Agriculture equipment. Lawn and Garden and Construction categories are allocated by share of countywide households. Agricultural Tractors and ATVs were added in 2018; the 2018 data for these categories was added to prior years.	CH_4 and N_2O emissions calculated according to U.S. Community Protocol v. 1.1, Appendix D, Method TR.8. Emission factors provided in the Local Government Operations Protocol Table G.11 and G.14.
3.0 Solid Waste			
3.2 Solid Waste Generation and Disposal	Fugitive Emissions from Landfilled Waste (CH_4)	Estimated landfilled tons based on reporting to CalRecycle by Marin County Solid and Hazardous Waste JPA and allocated to jurisdiction based on the share of the countywide population. Waste characterization based on the Statewide Waste Characterization Study (2008, 2014, 2018, and 2021) and Alternative Daily Cover by Jurisdiction of Origin and Material Type as reported to CalRecycle.	Emission factors calculated utilizing U.S. Community Protocol for Accounting and Report of Greenhouse Gas Emissions, Version 1.1, July 2013, Appendix E, Method SW.4.
4.0 Water and Wastewater			
4.2 Water Supply & Conveyance, Treatment and Distribution	Electricity Use (CO_2)	Water consumption (district-wide gpcd) provided by Marin Municipal Water District (MMWD) and North Marin Water District (NMWD). Water consumption for Stinson Beach Water District estimated based on 2012 inventory. Electricity use estimated using CEC report, "Refining Estimates of Water-Related Energy Use in California," 2006. Assumed 3,500 kWh /MG.	Verified utility-specific emission factors (PG&E, MCE and SCWA). Emissions calculated according to U.S. Community Protocol v. 1.1, Appendix F, Method WW.14.
	Electricity Use (CH_4 & N_2O)	Water consumption (district-wide gpcd) provided by Marin Municipal Water District (MMWD) and North Marin Water District (NMWD). Water consumption for Stinson Beach Water District estimated based on 2012 inventory. Electricity use estimated using CEC report, "Refining Estimates of Water-Related Energy Use in California," 2006. Assumed 3,500 kWh /MG.	eGrid subregion default emission factors. Emissions calculated according to U.S. Community Protocol v. 1.1, Appendix F, Method WW.14.

4.5 Treatment of Wastewater	Stationary Emissions from Combustion of Digester Gas (CH_4)	Known amount of digester gas produced per day and known percent of methane in digester gas provided by Sewerage Agency of Southern Marin (SASM), Central Marin Sanitation Agency, Sausalito-Marin City Sanitation Agency, and Novato Sanitary District. Known amount of digester gas produced per day (2016) and known percent of methane in digester gas (2017) provided by Las Gallinas Valley Sanitary District. Estimated service population and percent of methane in digester gas provided by Sanitary District No. 5.	SASM emissions calculated according to U.S. Community Protocol v. 1.1, Appendix F, Method WW.1.a. Sanitary District No.5 emissions calculated according to Method WW.1.(alt).
	Stationary Emissions from Combustion of Digester Gas (N_2O)	Known amount of digester gas produced per day and known percent of methane in digester gas provided by Sewerage Agency of Southern Marin (SASM), Central Marin Sanitation Agency, Sausalito-Marin City Sanitation Agency, and Novato Sanitary District. Known amount of digester gas produced per day (2016) and known percent of methane in digester gas (2017) provided by Las Gallinas Valley Sanitary District. Estimated service population and percent of methane in digester gas provided by Sanitary District No. 5.	SASM emissions calculated according to U.S. Community Protocol v. 1.1, Appendix F, Method WW.2.a. Sanitary District No.5 emissions calculated according to Method WW.2.(alt).
	Process Emissions from Wastewater Treatment Plant without Nitrification or Denitrification	Estimated population served by the wastewater treatment plant provided by SASM and Central Marin Sanitation Agency.	Emissions calculated according to U.S. Community Protocol v. 1.1, Appendix F, Method WW.8.
	Process Emissions from Wastewater Treatment Plant with Nitrification or Denitrification	Estimated population served by the wastewater treatment plant provided by Sanitary District No. 5, Las Gallinas Valley Sanitary District, Sausalito-Marin City Sanitation Agency, and Novato Sanitary District.	Emissions calculated according to U.S. Community Protocol v. 1.1, Appendix F, Method WW.7.
	Fugitive Emissions from Effluent Discharge (N_2O)	Estimated population served by the wastewater treatment plant provided by SASM, Sanitary District No.5, Central Marin Sanitation Agency, Sausalito-Marin City Sanitation Agency, and Novato Sanitary District. Assumed significant industrial or commercial input.	Emissions calculated according to U.S. Community Protocol v. 1.1, Appendix F, Method WW.12(alt).
	Fugitive Emissions from Effluent Discharge (N_2O)	Estimated population served by wastewater treatment plant provided by Las Gallinas Valley Sanitary District. Assumed no significant industrial or commercial input.	Emissions calculated according to U.S. Community Protocol v. 1.1, Appendix F, Method WW.12.
5.0 Agriculture			
5.1	Domesticated animal production	Estimated livestock population from the County of Marin Department of Agriculture, Weights and Measures.	Emissions calculated according to 2015 CAP inventory method.
5.2	Manure decomposition and treatment	Estimated livestock population from the County of Marin Department of Agriculture, Weights and Measures.	Emissions calculated according to 2015 CAP inventory method.