# TOWN OF ROSS

## GREENHOUSE GAS INVENTORY FOR COMMUNITY EMISSIONS FOR THE YEAR 2021

October 2023

Prepared by the
Marin Climate & Energy Partnership

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# Executive Summary

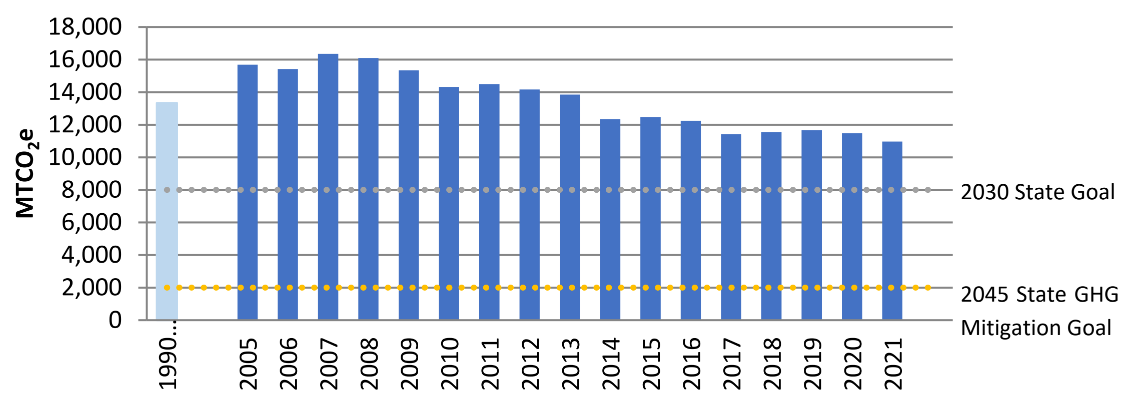
The Takeaway:

Community Emissions Down 30% Since 2005, Equivalent to 18% Below 1990 Levels

Ross publishes annual community greenhouse gas (GHG) emissions estimates through the Marin Climate & Energy Partnership (MCEP). Annual inventories help the Town to more closely monitor its progress in meeting its local goal to reduce community emissions and to meet the statewide goal to reduce emissions 40% below 1990 levels by 2030.

This report reviews emissions generated from the community from 2005 through 2021, the most recent year data is available. The inventory shows that the Ross community has reduced emissions 30% since 2005, which is equivalent to 18% below 1990 levels. Emissions dropped from about 15,690 metric tons carbon dioxide equivalents ($MTCO_2e$) in 2005 to 10,964 $MTCO_2e$ in 2021. The community emissions trend and targets are shown below. Ross needs to reduce emissions another 2,960 $MTCO_2e$ to meet the State target for 2030 and another 8,960 $MTCO_2e$ to meet the State zero net emissions mitigation goal for 2045, which includes a GHG mitigation target of 85% below 1990 levels.

Figure 1: Greenhouse Gas Emissions And Targets




Recognizing the need for a collaborative approach to greenhouse gas reductions, city and county leaders launched the Marin Climate and Energy Partnership (MCEP) in 2007. The Town of Ross is a member of MCEP and works with representatives from the County of Marin and the other 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 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 Ross community in 2021. This inventory provides a comparison to 2005 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.

## 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 seven sectors:

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

### 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 emissions factors specific to the energy source. Most emissions 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 emissions factor. Electricity that is produced solely from renewable energy sources such as solar and wind has an emissions 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 apple-to-apples comparison among the various emissions. Table 1 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 1: 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 them 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 by the Ross community resulted in approximately 15,690 metric tons of $CO_2e$. [1] In 2021, those activities resulted in approximately 10,964 metric tons of $CO_2e$, a reduction of 30% from 2005 levels, which is equivalent to 18% below 1990 levels.

The community inventory tracks emissions in seven sectors:

- The **Built Environment – Electricity** sector represents emissions generated from the use of electricity in Ross 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 Ross 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/or ending in Ross, as well as tailpipe emissions generated by medium and heavy-duty vehicles travelling on Marin County roads based on the Town's share of certain truck-generating industries. Emissions from buses serving Ross while travelling on roads within the jurisdiction are also included. Electricity used to power electric vehicles is embedded in electricity consumption reported in the Built Environment - Electricity sector.
- 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 and landscape maintenance.
- The **Water** sector represents emissions from energy used to pump, treat, and convey potable water from the water source to Ross water users.
- The **Wastewater** sector represents fugitive greenhouse gases that are created during the treatment of wastewater generated by the community and emissions created from energy used to process wastewater.

Table 2 shows how emissions in each sector have changed since 2005. The greatest reductions have occurred in the Built Environment - Electricity sector (-2,703 $MTCO_2e$), followed by the Transportation sector (-1,332 $MTCO_2e$). The likely reasons for the largest emissions decreases are described in the remainder of this report.

[1] Baseline and historical emissions are recalculated in the annual inventory to integrate new data and improved calculation methodologies and to ensure consistent comparison across each year. For this reason, emission levels may differ from levels reported in previous inventories.

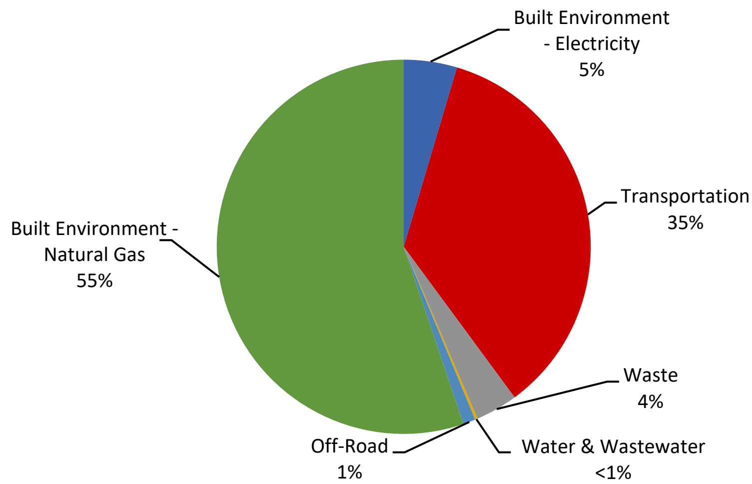
TABLE 2: EMISSIONS SUMMARY BY SECTOR ($MTCO_2E$), 2005 THROUGH 2021

| Year | Built Environment - Electricity | Built Environment – Natural Gas | Transportation | Waste | Off-Road | Water | Wastewater | Total | % Change from 2005 | % Change from 1990 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1990 (est.)[1] | | | | | | | | 13,337 | | |
| 2005 | 3,206 | 6,166 | 5,202 | 789 | 174 | 98 | 55 | 15,690 | | |
| 2006 | 3,031 | 6,202 | 5,079 | 784 | 183 | 86 | 53 | 15,419 | -2% | |
| 2007 | 4,148 | 6,109 | 4,991 | 709 | 218 | 116 | 67 | 16,358 | 4% | |
| 2008 | 4,215 | 6,111 | 4,823 | 591 | 180 | 107 | 68 | 16,095 | 3% | |
| 2009 | 3,867 | 5,960 | 4,682 | 510 | 152 | 108 | 60 | 15,338 | -2% | |
| 2010 | 2,925 | 6,286 | 4,360 | 502 | 137 | 62 | 50 | 14,322 | -9% | |
| 2011 | 2,646 | 6,754 | 4,382 | 491 | 133 | 44 | 46 | 14,495 | -8% | |
| 2012 | 2,788 | 6,154 | 4,485 | 510 | 130 | 48 | 49 | 14,166 | -10% | |
| 2013 | 2,554 | 6,103 | 4,440 | 521 | 130 | 56 | 49 | 13,852 | -12% | |
| 2014 | 2,244 | 4,967 | 4,388 | 527 | 129 | 50 | 42 | 12,348 | -21% | |
| 2015 | 2,164 | 5,173 | 4,384 | 547 | 128 | 40 | 41 | 12,477 | -20% | |
| 2016 | 1,736 | 5,428 | 4,239 | 646 | 127 | 30 | 38 | 12,244 | -22% | |
| 2017 | 818 | 5,581 | 4,196 | 675 | 125 | 9 | 28 | 11,432 | -27% | |
| 2018 | 921 | 5,759 | 4,125 | 600 | 122 | 3 | 25 | 11,555 | -26% | |
| 2019 | 963 | 5,945 | 4,055 | 572 | 118 | 3 | 21 | 11,678 | -26% | -12% |
| 2020 | 668 | 6,245 | 3,953 | 483 | 111 | 4 | 19 | 11,484 | -27% | -14% |
| 2021 | 504 | 6,048 | 3,870 | 400 | 117 | 4 | 19 | 10,964 | -30% | -18% |
| Change from 2005 | -2,703 | -118 | -1,332 | -389 | -57 | -94 | -35 | -4,727 | | |
| % Change from 2005 | -84% | -2% | -26% | -49% | -33% | -96% | -65% | -30% | | |

*Per California Air Resources Board guidance, 1990 levels are estimated at 15% below 2005 levels.*

Figure 2 shows the relative contribution of emissions from these sectors in 2021. The use of natural gas and propane in the Built Environment sector represents the largest share of communitywide emissions (55%), while the Transportation sector accounts for over one-third of emissions.

FIGURE 2: EMISSIONS BY SECTOR, 2021

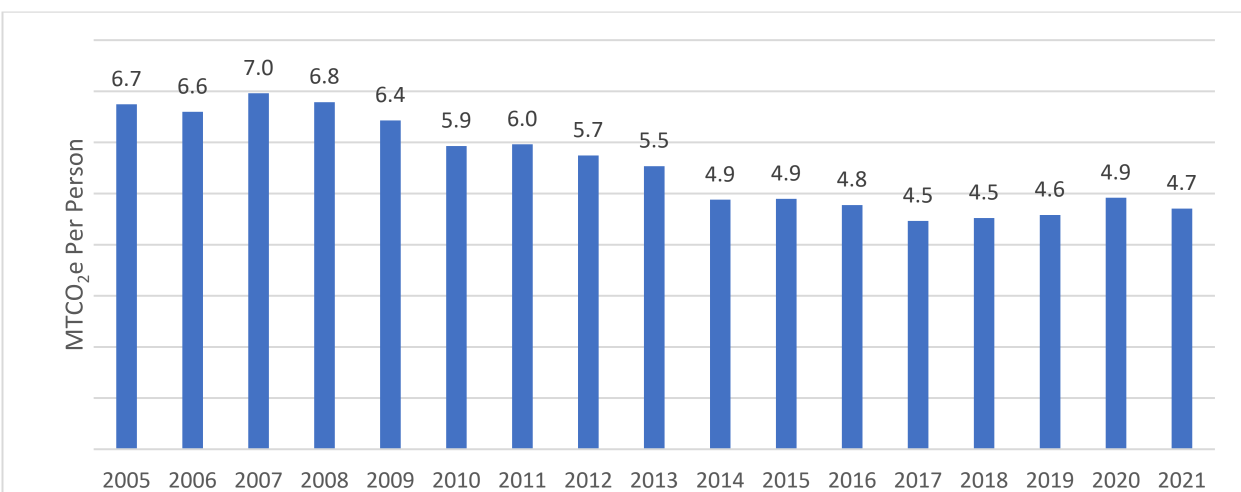



## Per Capita Emissions

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 6.7 metric tons $CO_2e$ per capita in 2005. Per capita emissions decreased 30% between 2005 and 2021, falling to 4.7 metric tons per person. Figure 3 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 Ross, which would include lifecycle emissions, emissions resulting from air travel, the manufacturing and distribution of products and food, etc.

FIGURE 3: EMISSIONS PER CAPITA



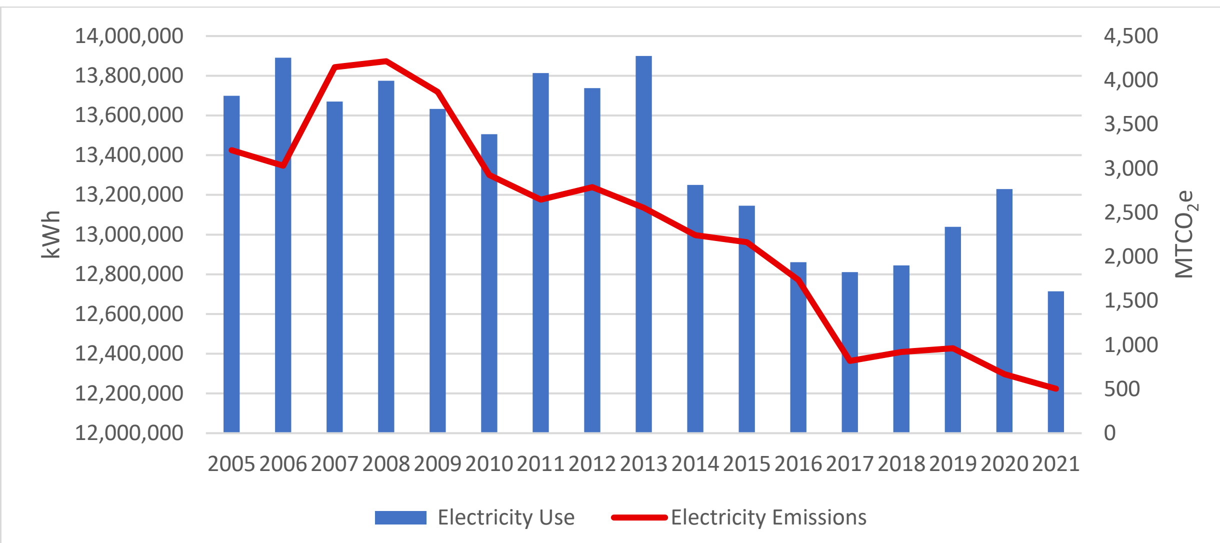
## Significant Sources of Emissions

The following sections provide a year-by-year analysis of the changes in GHG emissions from the use of electricity, natural gas, transportation, water, wastewater, and the disposal of waste. 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 Ross decreased 7% between 2005 and 2021. PG&E has been steadily increasing the amount of renewable energy in its electricity mix. In 2021, PG&E electricity came from a mix of renewable (48%), large hydroelectric (4%), nuclear (39%), and natural gas (9%) energy sources and was 91% GHG-free.[2] MCE Light Green electricity came primarily from renewable (61%) and hydroelectric (37%) sources and was 92% GHG-free.[3] In 2021, about 7.4% of MCE electricity purchased by Ross customers was 100% renewable Deep Green electricity, including electricty purchased by the Town government.

FIGURE 4: ELECTRICITY USE 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 depending on weather conditions. This variability has led natural gas use consumption in Ross to fluctuate from year to year, from a high of 1.14 million therms in 2005 to a low of 0.92 million therms in 2014. Reduction in energy use may also be attributed to energy efficiency programs and rebates, local green building ordinances, and State building codes.

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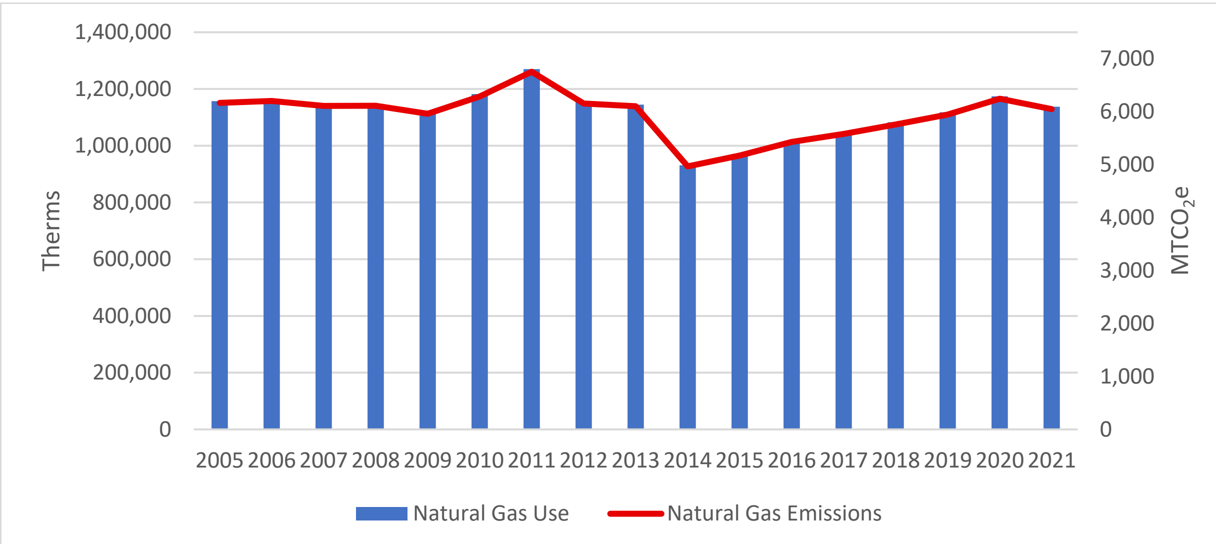
[2] PG&E 2021 Power Content Label, [2021 Power Content Label submitted by Pacific Gas and Electric Company (ca.gov)](). Nuclear and large hydro sources are considered GHG-free.

[3] MCE 2021 Power Content Label, [2021 Power Content Label submitted by MCE (ca.gov)]().

Natural gas consumption decreased 3% between 2020 and 2021 and was 2% below the 2005 level in 2021. Unlike electricity emissions which reflect the power content mix, natural gas emissions track the amount of natural gas consumed (Figure 5).

FIGURE 5: NATURAL GAS USE AND EMISSIONS




## TRANSPORTATION

Transportation activities accounted for approximately 35% of Ross' emissions in 2021. According to the transportation model and annual data the Town uses to calculate passenger and commercial vehicle miles, vehicle miles traveled (VMT) have decreased approximately 26% since 2005.

Transportation emissions have decreased 26% since 2005 due to the reduction in VMT as well as more fuel-efficient and alternatively fueled cars (Figure 6). As shown in Figure 7, most transportation emissions come from passenger vehicles, accounting for 97% of transportation emissions in 2021. Marin County continues to be a leader in zero emission vehicles (ZEVs) – second only to Santa Clara County – with 12,369 ZEVs in Marin at the end of 2021, or about 5.8% of registered automobiles. ZEVs include battery electric cars, plug-in hybrid electric cars, hydrogen fuel cell cars, and zero-emission motorcycles. Ross had 201 ZEVs by the end of 2021 or 10.5% of registered light-duty vehicles.

While it is difficult to pinpoint exactly how each land use and transportation policy affects emissions, the Town has undertaken efforts to reduce transportation emissions. The Town has made improvements to the bicycle and pedestrian network to make it easier for residents to use carbon-free modes of transportation.

FIGURE 6: VEHICLE MILES TRAVELED AND TRANSPORTATION EMISSIONS

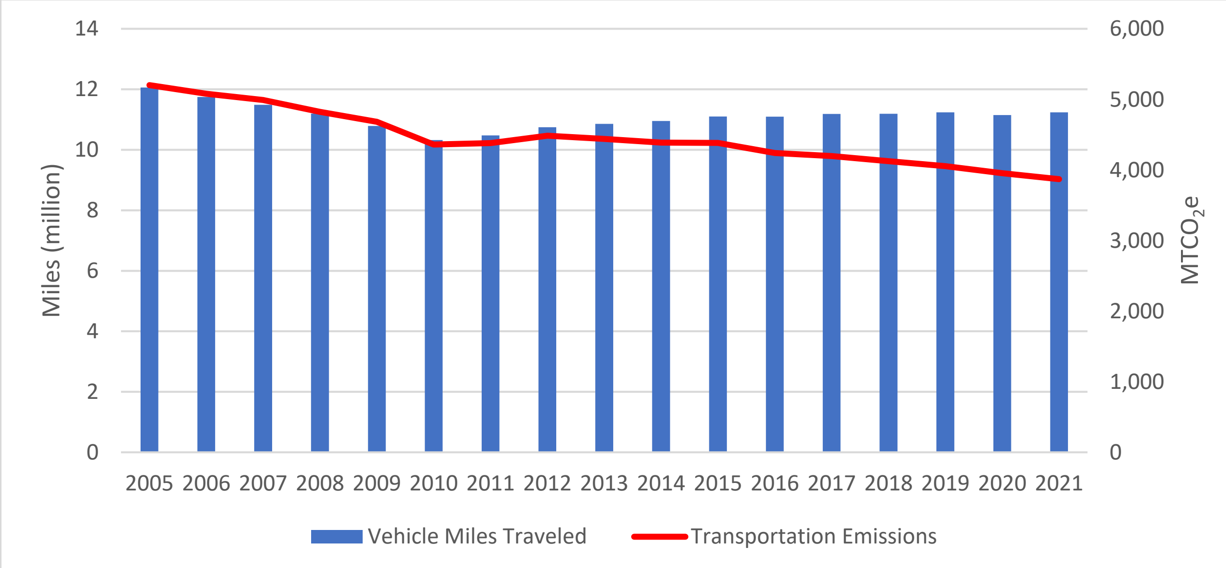
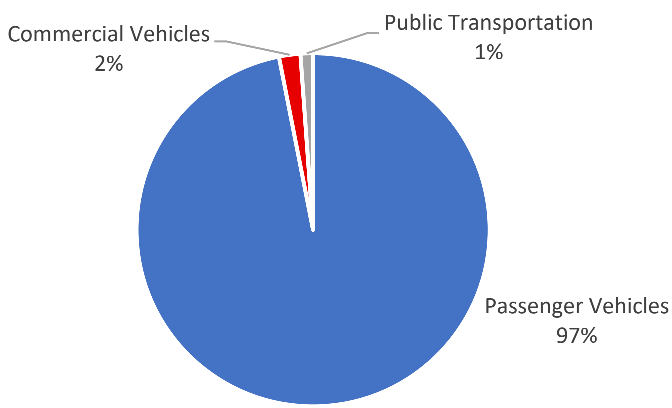



FIGURE 7: TRANSPORTATION EMISSIONS BY VEHICLE CATEGORY, 2021



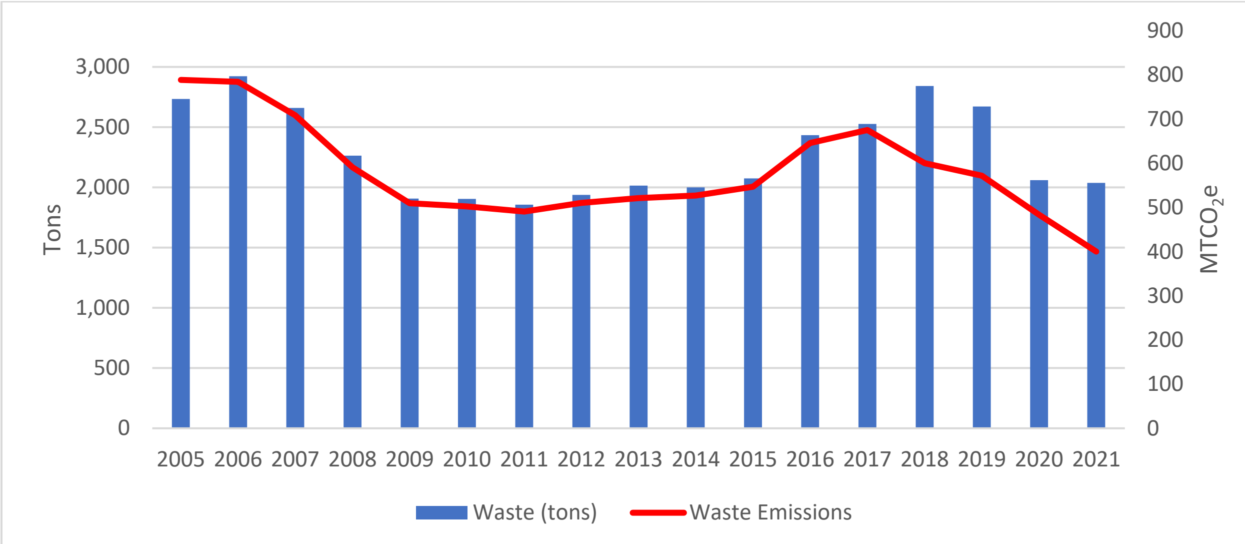

*Note: Public transportation represents emissions from Marin Transit and Golden Gate Transit fixed-route buses.*

## Waste Disposal

Waste generated by the Ross community decreased 1% between 2020 and 2021, as shown in Figure 8 (based on countywide disposal data). Total landfilled waste (including alternative daily cover)[4] was 25% below the 2005 baseline in 2021. Emissions from waste disposal decreased 49% due to the lower organic content of disposed waste and material used for alternative daily cover.

[4] 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.

FIGURE 8: DISPOSED WASTE AND EMISSIONS

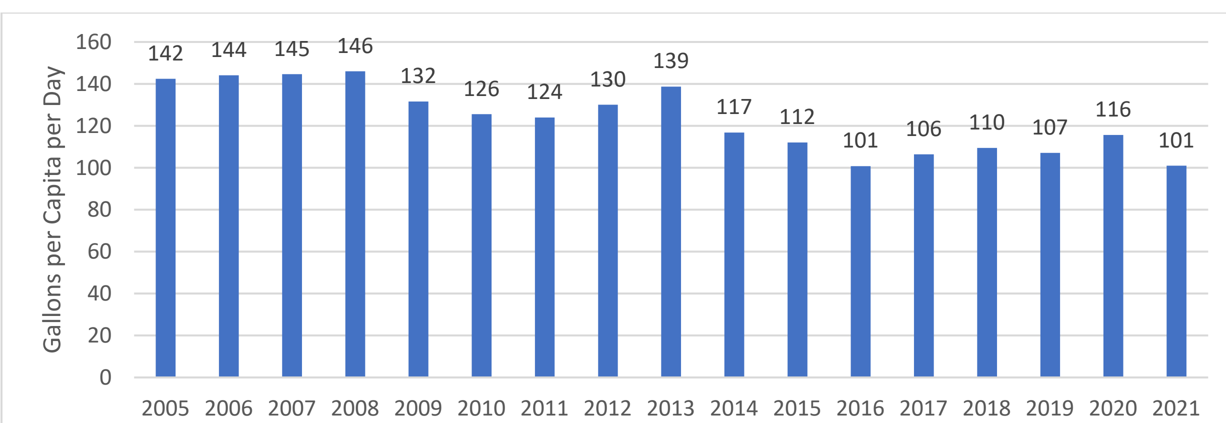



## Water Use

Per capita water use declined 29% since 2005, as shown in Figure 9 (based on water district-wide data). Emissions, which are based on an estimate of energy used to pump, treat, and convey water from the water source to the Ross water users, dropped 96% between 2005 and 2021 (see Figure 10). The additional reduction is due to the lower carbon intensity of electricity. The Marin Municipal Water District (Marin Water) began purchasing MCE Deep Green electricity in mid-2017. The Sonoma County Water Agency (SCWA), which supplied approximately 38% of Marin Water's water in 2021 uses renewable and carbon-free sources for its electricity needs; a small amount of emissions comes from stationary and mobile combustion of fuels used in SCWA's operations.

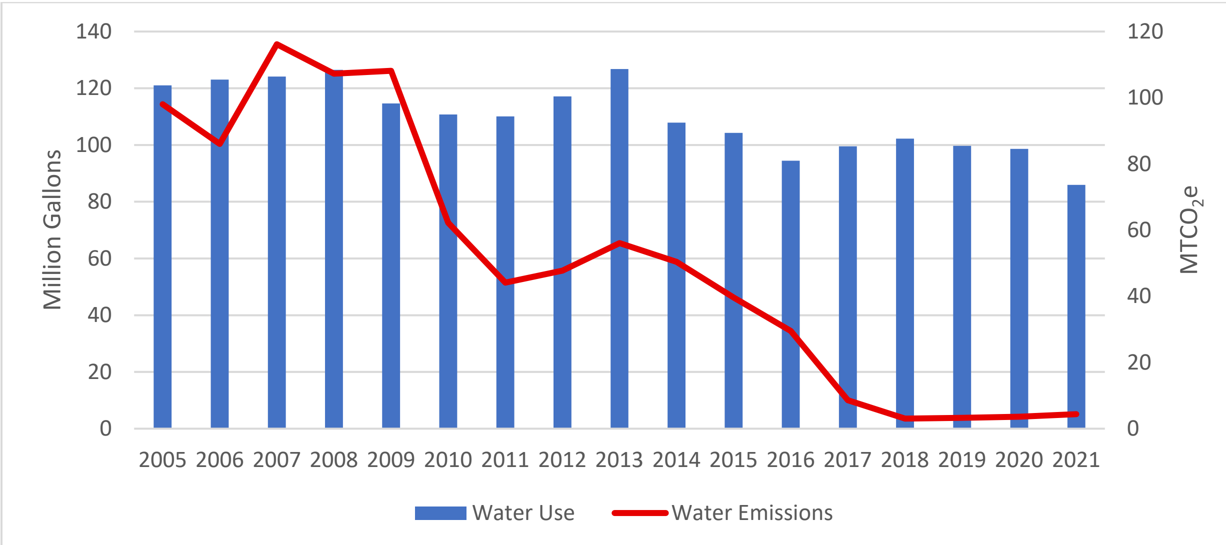
Marin Water provides rebates and programs to reduce water use. Rebates are available to replace fixtures with high-efficiency clothes washers and to purchase cisterns and rain barrels. Marin Water provides free home and landscape water-use evaluations as well as free high-efficiency showerheads and faucet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

FIGURE 9: PER CAPITA WATER USE




*Source: Marin Municipal Water District*

FIGURE 10: WATER CONSUMPTION AND EMISSIONS




## WASTEWATER

The Central Marin Sanitation Agency (CMSA), located in San Rafael, has two anaerobic digesters that process primary sludge, thickened waste-activated sludge, and organic waste to produce biogas. The biogas is used to generate heat and renewable electricity via the cogeneration system. CMSA normally produces 100% of the facility's power needs, and, at times, exports renewable energy to the grid, which is procured by MCE. As a result, emissions from the use of energy in the wastewater treatment process have essentially been eliminated.

Greenhouse gas emissions are also created from the wastewater treatment process itself. These emissions have increased 6% since 2005 as Ross's population has increased. Overall, wastewater emissions have declined 65% since 2005.

# APPENDIX

## Community GHG Emissions Summary Table

Jurisdiction: Town of Ross
Population: 2,330 (CA Department of Finance)
Number of Households: 801 (CA Department of Finance)

Inventory Year: 2021
Date Prepared: October 27, 2021
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 | ● | | | | 6.048 |
| 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 | 504 |
| 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 preferred activity-based method instead | |
| 2.2 | On-road passenger vehicles associated with community land uses | Activity | ● | | | | 3,750 |
| 2.3 | On-road freight and service vehicles operating within the community boundary | Source | | | IE | Obtained data for preferred activity-based method instead | |
| 2.4 | On-road freight and service vehicles associated with community land uses | Activity | ● | | | | 76 |
| 2.5 | On-road transit vehicles associated with community land uses | Activity | | ● | | | 44 |
| 2.6 | Transit rail vehicles operating with the community boundary | Source | | | NO | | |
| 2.7 | Use of transit rail travel by the community | Activity | | | NE | | |
| 2.8 | Inter-city passenger rail vehicles operating within the | Source | | | NO | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | community boundary | | | | | | |
| 2.9 | Freight rail vehicles operating within the community boundary | Source | | | NO | | |
| 2.10 | Marine vessels operating within the community boundary | Source | | | NO | | |
| 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 | | ● | | | 117 |
| 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 | | | NO | | |
| 3.2 | Generation and disposal of solid waste by the community | Activity | ● | | | Includes alternative daily cover | 400 |
| 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 use of potable water by the community | Activity | ● | | | | 4 |
| 4.3 | Use of energy associated with generation of wastewater by the community | Activity | ● | | | | 0 |
| 4.4 | Process emissions from operation of wastewater treatment facilities located in the community | Source | | | NO | | |
| 4.5 | Process emissions associated with generation of wastewater by the community | Activity | ● | | | | 19 |
| 4.6 | Use of septic systems in the community | Source | | | NE | | |
| 5.0 | Agriculture | | | | | | |
| 5.1 | Domesticated animal production | Source | | | NE | | |
| 5.2 | Manure decomposition and treatment | Source | | | NE | | |
| 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 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 | | |

<u>Legend</u>

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 estimate 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 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). Due to data privacy regulations, zip code data was used for non-residential natural gas consumption as a proxy. | 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 ($CO_2$, $CH_4$ & $N_2O$) | Known electricity use (meter readings by PG&E and MCE) and estimated direct access electricity consumption. Due to data privacy regulations, zip code data was used for non-residential electricity consumption as a proxy. | 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 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 and adjusted for IPCC AR5 100-year values. 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 and adjusted for IPCC AR5 100-year values. 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 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 | Estimated vehicle miles traveled within the boundary (Marin Transit and Golden Gate Transit) and estimated diesel fuel | Renewable diesel emission factor provided by NEXGEN. U.S. Community Protocol v. 1.1, Appendix D, Method TR.4.B. |

| | | | |
|---|---|---|---|
| | ($CH_4$ & $N_2O$) | efficiency for transit fleet (Golden Gate Transit). Fuel type provided by Marin Transit and Golden Gate Transit. | |
| 2.12 Off-Road Vehicles and Equipment | Off-Road Mobile Combustion ($CO_2$) | Estimated fuel use from OFFROAD 2021 v.1.0.1 for Lawn and Garden and Construction equipment. All categories are allocated by share of countywide households. | $CO_2$ emissions calculated according to 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 2021 v.1.0.1 for Lawn and Garden and Construction equipment. All categories are allocated by share of countywide households. | $CH_4$ 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 share of 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 production consumption (district-wide gpcd) and electricity usage provided by Marin Municipal Water District (MMWD). Sonoma County Water Agency (SCWA) delivery amount provided by SCWA. | 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) and electricity usage provided by Marin Municipal Water District (MMWD). | 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 Central Marin Sanitation Agency. | Emissions calculated according to U.S. Community Protocol v. 1.1, Appendix F, Method WW.1.a. |
| | 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 Central Marin Sanitation Agency. | Emissions calculated according to U.S. Community Protocol v. 1.1, Appendix F, Method WW.2.a. |
| | Process Emissions from Wastewater Treatment Plant without Nitrification or Denitrification | Estimated population served by wastewater treatment plant provided by Central Marin Sanitation Agency. | Emissions calculated according to U.S. Community Protocol v. 1.1, Appendix F, Method WW.8. |
| | Fugitive Emissions from Effluent Discharge ($N_2O$) | Estimated population served by wastewater treatment plant provided by Central Marin Sanitation Agency. Assumed significant industrial or commercial input. | Emissions calculated according to U.S. Community Protocol v. 1.1, Appendix F, Method WW.12.(alt). |