CITY OF LARKSPUR

GREENHOUSE GAS INVENTORY FOR COMMUNITY EMISSIONS FOR THE YEAR 2021

October 2023

Prepared by the
Marin Climate & Energy Partnership

MARIN CLIMATE & ENERGY PARTNERSHIP

Table of Contents

EXECUTIVE SUMMARY

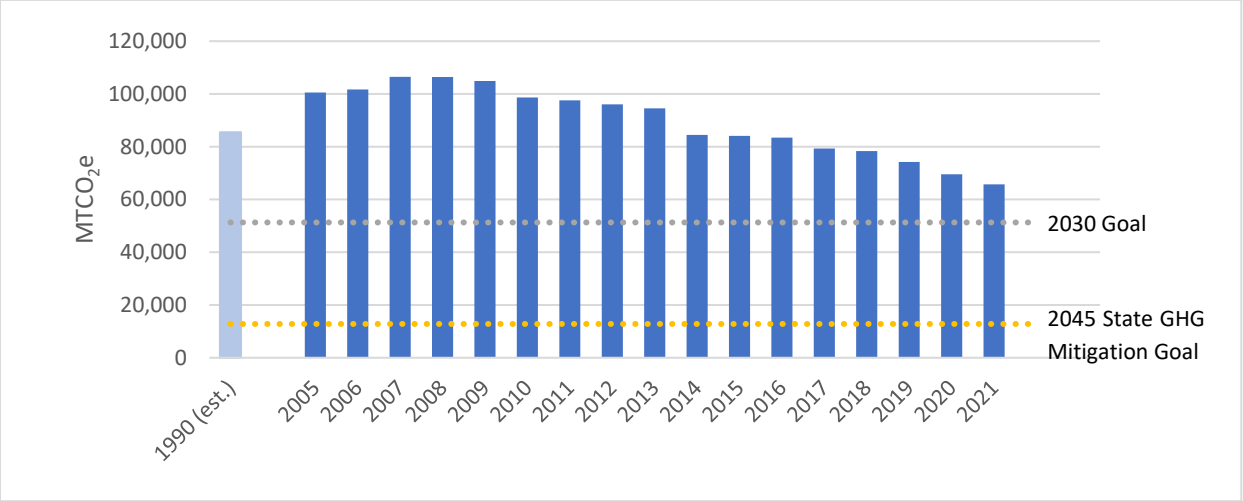
THE TAKEAWAY:

COMMUNITY EMISSIONS DOWN 35% SINCE 2005 AND ARE 23% BELOW 1990 LEVELS

Larkspur publishes annual community greenhouse gas (GHG) emissions estimates through the Marin Climate & Energy Partnership (MCEP). Annual inventories help the City to more closely monitor its progress in meeting its local goal to reduce community emissions at least 40% below 1990 levels by 2030, similar to the statewide goal. In addition to the community inventories, MCEP periodically prepares inventories for government operations emissions. Municipal emissions accounted for less than 1% of community emissions when the municipal inventory was last conducted for year 2015.

This report reviews emissions generated from the community from 2005 through 2021, the most recent year data is available. The inventory shows that the Larkspur community has reduced emissions 35% since 2005, which is equivalent to 23% below 1990 levels. Emissions dropped from about 100,567 metric tons carbon dioxide equivalents ($MTCO_2e$) in 2005 to 65,748 $MTCO_2e$ in 2021. The community emissions trend and targets are shown below. Larkspur needs to reduce emissions another 14,460 $MTCO_2e$ to meet its 2030 target and another 52k930 $MTCO_2e$ to meet the State's zero-net emission goal for 2045, which includes a GHG mitigation target of 85% below 1990 levels.

FIGURE 1: LARKSPUR COMMUNITYWIDE EMISSIONS TREND



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 City of Larkspur 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 Larkspur 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 Larkspur community resulted in approximately 100,567 metric tons of CO_2e.[1] In 2021, those activities resulted in approximately 65,748 metric tons of CO_2e, a reduction of 35% from 2005 levels and 23% from 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 Larkspur 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 Larkspur 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 Larkspur, as well as tailpipe emissions generated by medium and heavy-duty vehicles travelling on Marin County roads based on the City's share of certain truck-generating industries. Emissions from buses serving Larkspur while travelling on roads within the jurisdiction are included, as well as half of the emissions generated from public ferries serving the Larkspur ferry terminal. Electricity used to power electric vehicles is embedded in electricity consumption reported in the Residential and Non-Residential 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 and landscape maintenance.
- The **Water** sector represents emissions from energy used to pump, treat, and convey potable water from the water source to Larkspur 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.

Table 2 shows how emissions in each sector have changed since 2005. The greatest reductions have occurred in the Built Environment – Electricity sector (-16,361 $MTCO_2e$), followed by the Transportation sector (-12,355 $MTCO_2e$).

[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

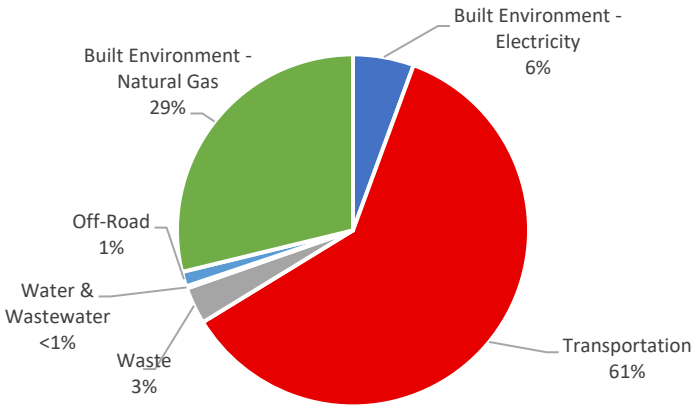
Year	Built Environment - Electricity	Built Environment – Natural Gas	Transportation	Waste	Off-Road	Water	Wastewater	Total	% Change from 2005	% Change from 1990[2]
1990 (est.)[1]								85,482		
2005	20,045	22,210	52,235	3,966	1,344	493	275	100,567		
2006	18,442	23,299	53,945	3,925	1,399	430	264	101,705	1%	
2007	23,090	22,097	55,197	3,522	1,649	577	332	106,464	6%	
2008	23,502	22,278	55,481	2,931	1,347	532	339	106,410	6%	
2009	21,258	22,719	56,437	2,522	1,132	535	299	104,902	4%	
2010	16,111	23,091	55,434	2,481	1,011	307	246	98,681	-2%	
2011	15,625	23,917	54,167	2,419	982	218	227	97,554	-3%	
2012	16,130	22,545	53,449	2,511	962	235	242	96,074	-4%	
2013	17,482	21,872	51,167	2,540	951	273	237	94,522	-6%	
2014	13,198	18,648	48,656	2,564	944	245	204	84,458	-16%	
2015	12,782	18,685	48,626	2,679	942	194	201	84,108	-16%	
2016	10,281	19,885	48,883	3,156	929	144	184	83,462	-17%	
2017	6,204	20,360	48,350	3,296	912	42	138	79,302	-21%	
2018	6,009	20,726	47,663	2,911	883	15	122	78,330	-22%	
2019	5,690	20,941	43,837	2,767	855	16	103	74,209	-26%	-13%
2020	4,420	19,847	41,588	2,706	848	20	109	69,537	-31%	-19%
2021	3,684	18,934	39,880	2,226	892	24	108	65,748	-35%	-23%
Change from 2005	-16,361	-3,276	-12,355	-1,739	-452	-469	-167	-34,819		
% Change from 2005	-82%	-15%	-24%	-44%	-34%	-95%	-61%	-35%		

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

[2] *In 2021, Larkspur adopted an updated Climate Action Plan that established a goal to reduce emissions at least 40% below 1990 levels by 2030. This column will track that progress over time.*

Figure 2 shows the relative contribution of emissions from these sectors in 2021. The likely reasons for the largest emissions decreases are described in the remainder of this report.

FIGURE 2: EMISSIONS BY SECTOR, 2021

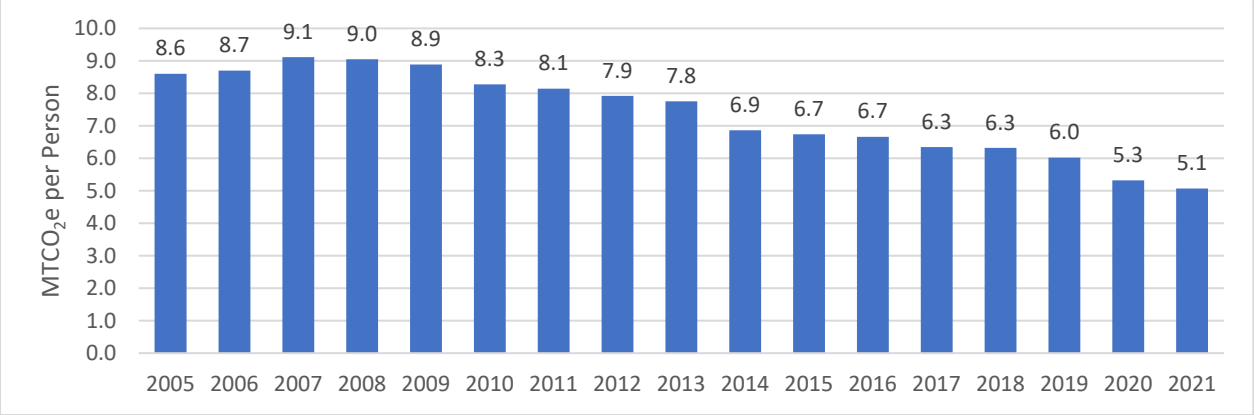


PER CAPITA EMISSIONS

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 8.6 metric tons CO_2e per capita in 2005. Per capita emissions decreased 41% between 2005 and 2021, falling to 5.1 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 Larkspur, which would include lifecycle emissions, emissions resulting from air travel, the manufacturing and distribution of products and food, etc.

FIGURE 3: EMISSIONS PER CAPITA



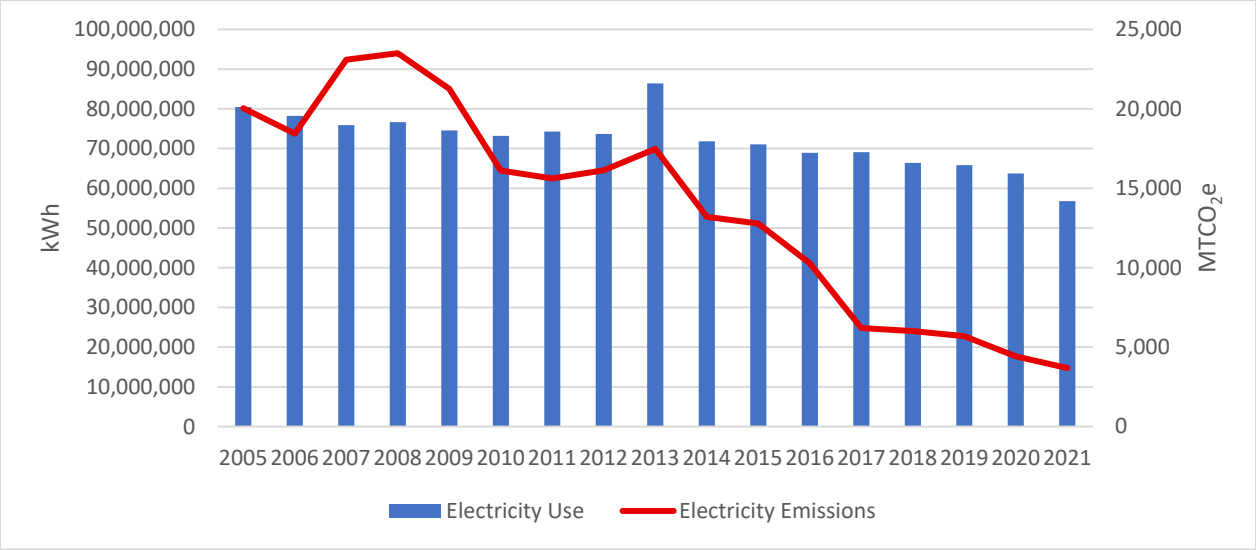
Major Sources of Emissions

The following sections provide a year-by-year analysis of the changes in source GHG emissions in the Built Environment, Transportation, Waste, Water and Wastewater sectors. 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 Larkspur decreased 29% between 2005 and 2021.[2] Greenhouse gas emissions from electricity consumption decreased 82% since 2005, as shown in Figure 4. Greenhouse gas emissions from purchased electricity consumption decreased 83% since 2005, as shown in Figure 4. 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 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.[3] MCE Light Green electricity came primarily from renewable (61%) and hydroelectric (37%) sources and was 92% GHG-free.[4] In 2021, about 9% of MCE electricity purchased by Larkspur customers was 100% renewable Deep Green electricity, including electricty purchased by the City government.

FIGURE 4: ELECTRICITY USE AND EMISSIONS



[2] Due to California Public Utility Commission data privacy rules, PG&E-generated electricity usage by commercial customers was not reported in 2021. This artificially reduces the total amount of electricity purchased by the community, but most likely does not significantly affect the overall GHG emissions due to the high GHG-free content of PG&E electricity in 2021.

[3] 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.

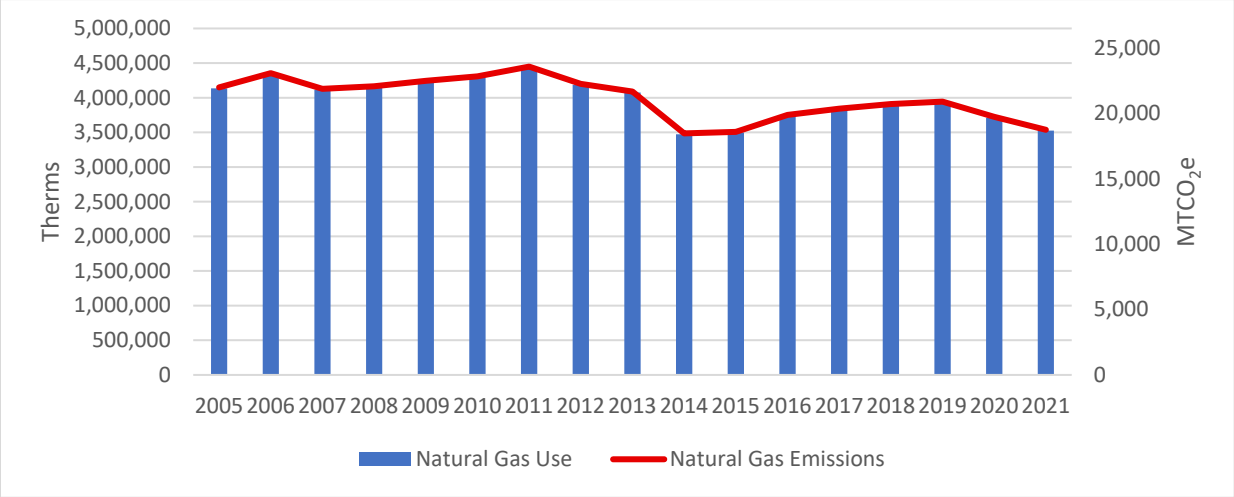
[4] MCE 2021 Power Content Label, 2021 Power Content Label submitted by MCE (ca.gov).

Built Environment - Natural Gas

Natural gas is used in residential, commercial, and industrial buildings to provide space and water heating and power appliances. Use of natural gas is highly variable depending on the weather conditions. This variability has led natural gas use consumption in Larkspur to fluctuate from year to year, from a high of 4.4 million therms in 2011 to a low of 3.5 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.

Natural gas consumption declined 5% between 2020 and 2021 and was 15% 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 61% of Larkspur's emissions in 2021. According to the transportation model and annual data the City uses to calculate passenger and commercial vehicle miles, vehicle miles traveled (VMT) have increased approximately 7% since 2005.

On-road transportation emissions have decreased 15% since 2005 due to more fuel-efficient and alternatively fueled cars (Figure 6). As shown in Figure 7, most transportation emissions come from passenger vehicles, accounting for 81% 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. Larkspur had 390 ZEVs by the end of 2021, or 7.1% of registered light-duty vehicles.

While it is difficult to pinpoint exactly how each land use and transportation policy affects emissions, the City has undertaken many efforts to reduce transportation emissions. The City 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.

FIGURE 6: ON-ROAD VEHICLE MILES TRAVELED AND TRANSPORTATION EMISSIONS

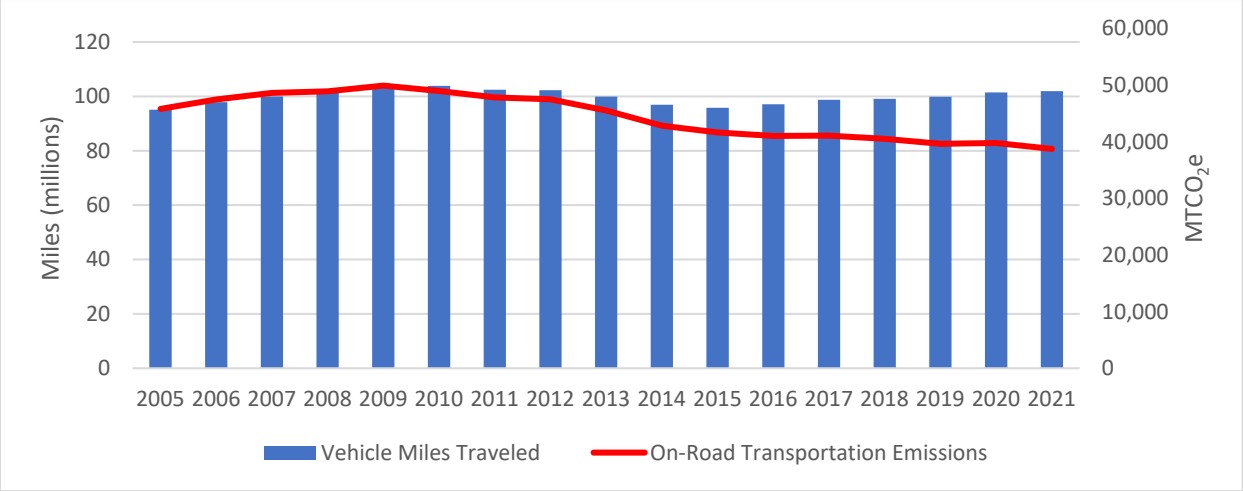
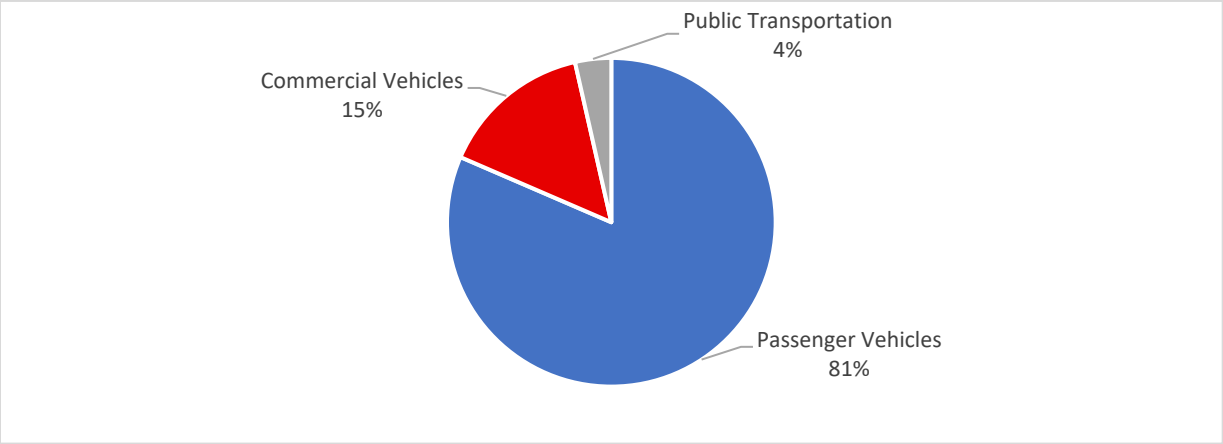


FIGURE 7: TRANSPORTATION EMISSIONS BY VEHICLE CATEGORY, 2021

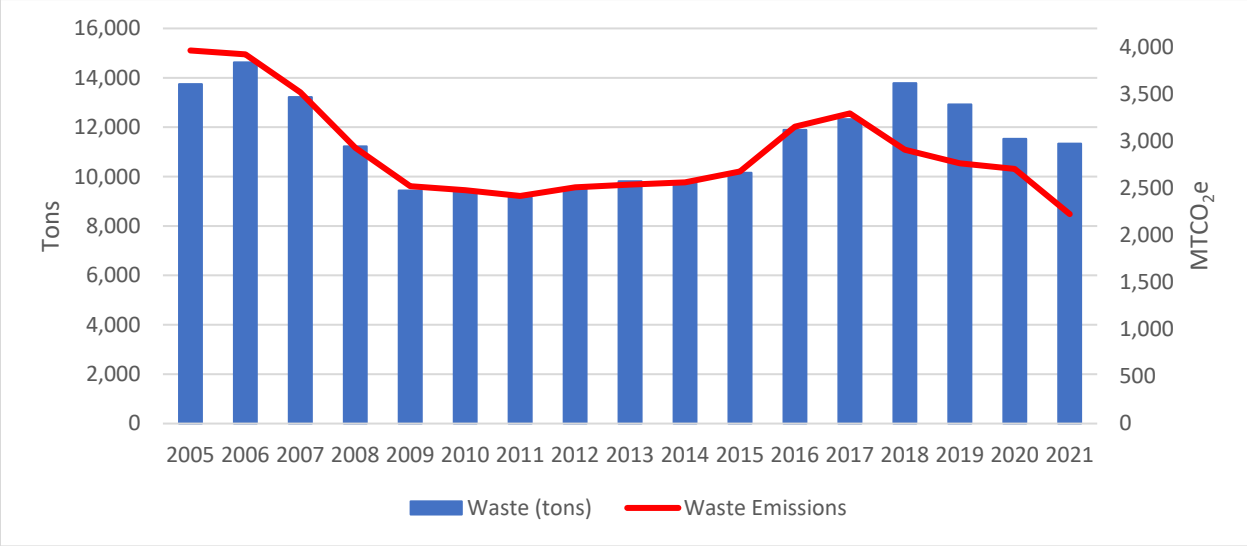


WASTE DISPOSAL

Waste generated by the community decreased 2% between 2020 and 2021 and was 18% below the 2005 level by 2021 as shown in Figure 8 (based on countywide disposal data). Total landfilled waste includes alternative daily cover.[5] Emissions from waste disposal decreased 44% due to the lower organic content of landfilled waste and material used for alternative daily cover.

[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.

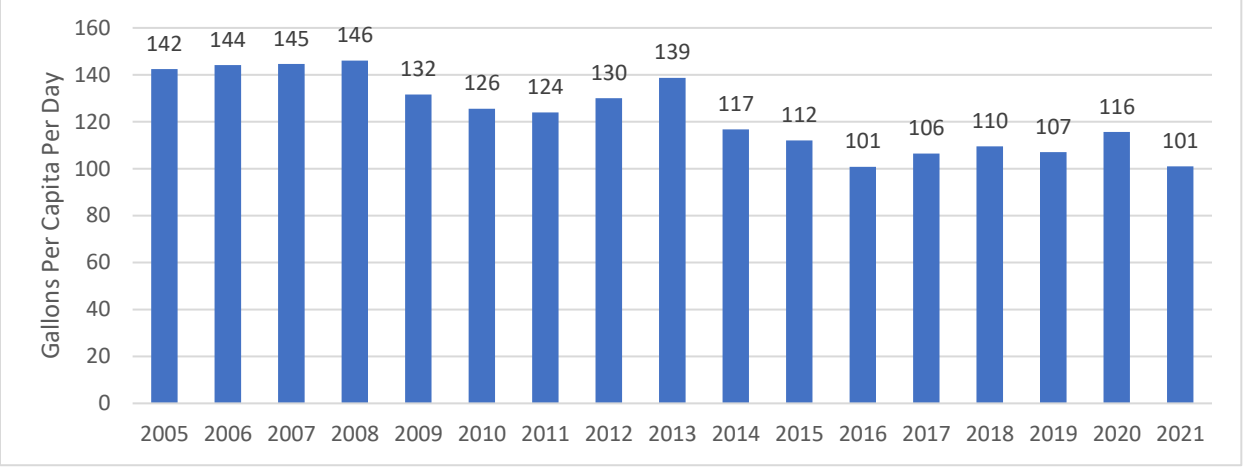
FIGURE 8: DISPOSED WASTE AND EMISSIONS



WATER USE

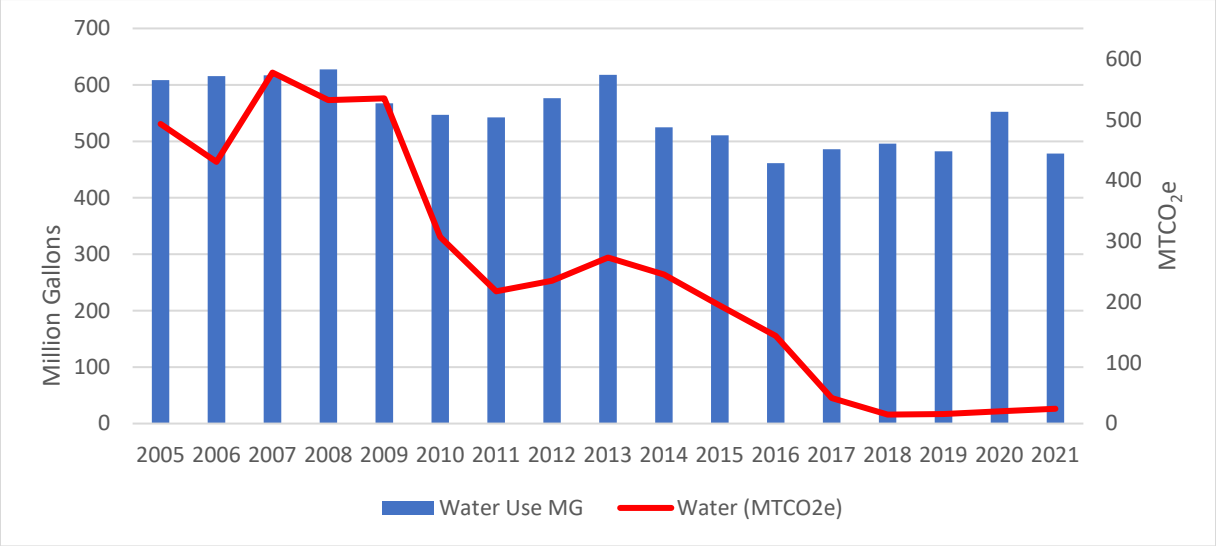
Per capita water use declined 29% since 2005, as shown in Figure 9 (based on Marin Water district-wide data). Emissions, which are based on an estimate of energy used to pump, treat, and convey water from the water source to the City limits, dropped 95% between 2005 and 2021 (see Figure 10). The additional reduction is due to the lower carbon intensity of electricity. 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.

FIGURE 9: PER CAPITA WATER USE



Source: Marin Water

FIGURE 10: WATER USE AND EMISSIONS



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.

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 8% since 2005 as Larkspur's population has increased. Overall, wastewater emissions have declined 61% since 2005.

APPENDIX: COMMUNITY INVENTORY

Community GHG Emissions Summary Table

Jurisdiction: City of Larkspur
Population: 12,963 (CA Department of Finance)
Number of Households: 6,102 (CA Department of Finance)

Inventory Year: 2021
Date Prepared: October 16, 2023
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	●				18,934
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	3,684
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	●				32,497
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	●				5,965
2.5	On-road transit vehicles associated with community land uses	Activity		●			265
2.6	Transit rail vehicles operating with the community boundary	Source			NO		
2.7	Use of transit rail travel by the community	Activity		●			17
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		1,137
2.12	Off-road surface vehicles and other mobile equipment operating within the community boundary	Source		●			892
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	2,226
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	●				24
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	●				108
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		

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 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 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 failed the CPUC 15/15 rule and was not reported or included in this report.	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. Commercial (non-governmental) PG&E electricity consumption failed the CPUC 15/15 rule and was not reported or included in this report.	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. 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 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 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.
2.11 Ferries	Mobile Combustion (CO_2)	Estimated vehicle miles traveled and fuel type provided by Golden Gate Transit.	Renewable diesel emission factor provided by NEXGEN. U.S. Community Protocol v. 1.1, Appendix D, Method TR.4.E.
	Mobile Combustion (CH_4 & N_2O)	Estimated vehicle miles traveled and fuel type provided by Golden Gate Transit.	Renewable diesel emission factor provided by NEXGEN. U.S. Community Protocol v. 1.1, Appendix D, Method TR.4.E.
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 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	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.

and Distribution	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).