CITY OF BELVEDERE

COMMUNITY GREENHOUSE GAS EMISSIONS INVENTORY FOR THE YEAR 2021

October 2023

Prepared by the
Marin Climate & Energy Partnership

MARIN CLIMATE & ENERGY PARTNERSHIP

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EXECUTIVE SUMMARY

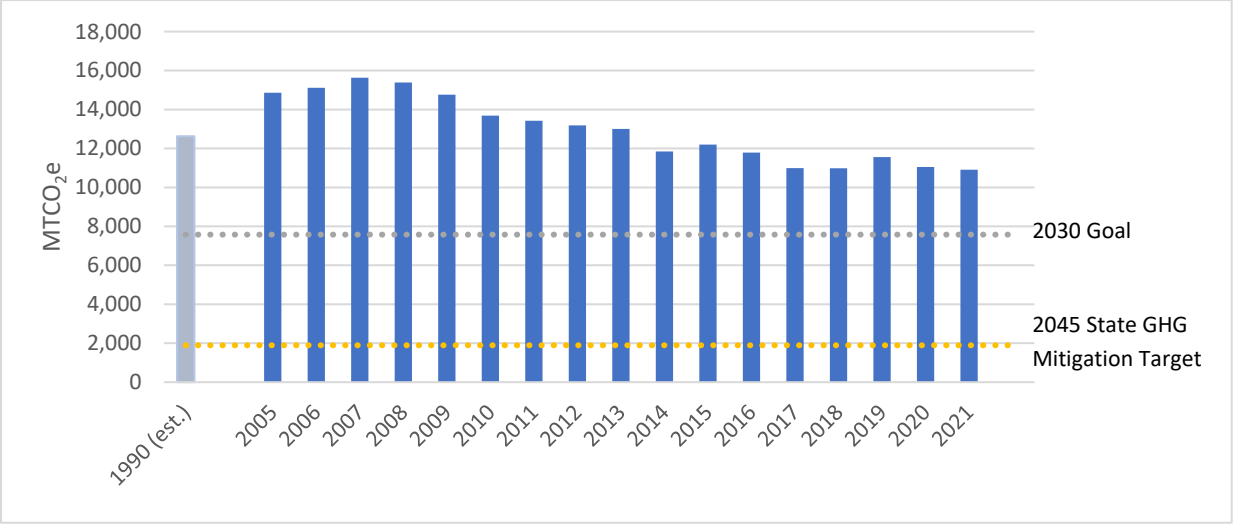
THE TAKEAWAY:

COMMUNITY EMISSIONS ARE DOWN 27% SINCE 2005 AND ARE 14% BELOW 1990 LEVELS

Belvedere publishes annual community greenhouse gas (GHG) emissions estimates through the Marin Climate & Energy Partnership (MCEP). Annual inventories help the City to monitor its progress more closely in meeting its GHG reduction goal to reduce emissions to reduce emissions 40% below 1990 levels by 2030. 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 are available. The inventory shows that the Belvedere community has reduced emissions 27% since 2005, equivalent to 14% below 1990 levels. Emissions dropped from about 14,855 metric tons carbon dioxide equivalents ($MTCO_2e$) in 2005 to 10,906 $MTCO_2e$ in 2021. The community emissions trend and targets are shown below. The community needs to reduce emissions another 3,329 $MTCO_2e$ to meet the 2030 goal and another 9,012 $MTCO_2e$ to meet the State's net zero emissions target for 2045, which includes a GHG mitigation target of 85% below 1990 levels.

FIGURE 1: BELVEDERE GHG EMISSIONS AND TARGETS



Recognizing the need for a collaborative approach to greenhouse gas reductions, city, town, and county leaders launched the Marin Climate and Energy Partnership (MCEP) in 2007. The City of Belvedere 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 Belvedere 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. In particular, the Metropolitan Transportation Commission released an updated traffic model in 2023, which raised vehicle miles traveled (VMT) estimates after 2015.

GENERAL METHODOLOGY

This inventory uses the national standard for the accounting and reporting of community-wide greenhouse gas emissions, the U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, version 1.2 (July 2019). 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, gallons of diesel or gasoline, etc. – by emissions factors specific to the greenhouse gas-generating 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 – i.e., 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 over 100 years. 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), 100-year values

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 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 Belvedere community resulted in approximately 14,855 metric tons of CO_2e.[1] In 2021, those activities resulted in approximately 10,906 metric tons of CO_2e, a reduction of 27% from 2005 levels, which is equivalent to 14% 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 Belvedere homes and commercial and governmental buildings and facilities.
- The **Built Environment – Natural Gas** sector represents emissions generated from the use of natural gas in Belvedere 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 Belvedere, as well as a share of tailpipe emissions generated by medium and heavy-duty vehicles travelling on Marin County roads. The sector also includes emissions from Marin Transit buses as these vehicles travel within Belvedere's boundaries. 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 Belvedere 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 (2,106 $MTCO_2e$), followed by the Transportation sector (735 $MTCO_2e$). 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

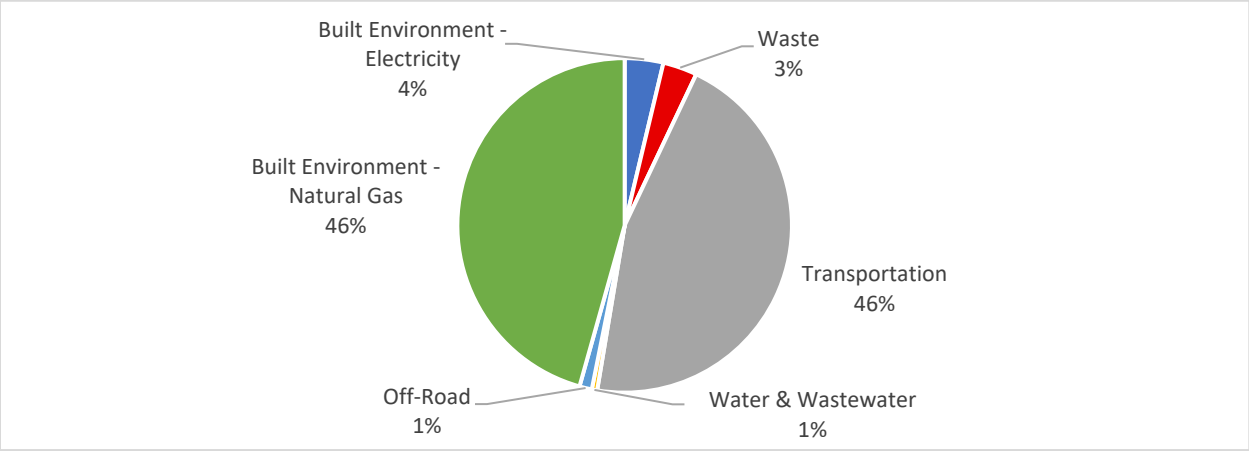
Year	Built Environment - Electricity	Built Environment – Natural Gas	Transportation	Waste	Off-Road	Water	Wastewater	Total	% Change from 2005	% Change from 1990[2]
1990 (est.)[1]								12,627		
2005	2,512	5,559	5,707	699	212	87	79	14,855		
2006	2,388	5,787	5,877	689	220	76	77	15,114	2%	
2007	3,204	5,440	5,922	617	259	101	89	15,631	5%	
2008	3,235	5,450	5,792	512	212	93	90	15,383	4%	
2009	3,033	5,425	5,509	440	178	93	83	14,762	-1%	
2010	2,133	5,518	5,315	430	159	53	73	13,681	-8%	
2011	1,975	5,573	5,194	420	154	38	70	13,423	-10%	
2012	2,083	5,204	5,192	435	151	40	75	13,181	-11%	
2013	2,012	5,161	5,116	441	148	47	77	13,002	-12%	
2014	1,830	4,412	4,903	440	147	42	72	11,847	-20%	
2015	1,776	4,614	5,101	461	145	33	71	12,201	-18%	
2016	1,449	4,839	4,733	536	143	24	63	11,788	-21%	
2017	649	4,824	4,750	559	140	7	59	10,988	-26%	
2018	701	4,883	4,705	494	136	3	59	10,979	-26%	
2019	831	4,987	5,090	469	131	3	49	11,561	-22%	
2020	482	4,910	5,030	439	125	3	57	11,047	-26%	-13%
2021	407	4,978	4,972	361	131	4	53	10,906	-27%	-14%
Change from 2005	-2,106	-581	-735	-338	-80	-83	-27	-3,950		
% Change from 2005	-84%	-10%	-13%	-48%	-38%	-95%	-33%	-27%		

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

[2] *In 2022, Belvedere adopted a Climate Action Plan that established a goal to reduce emissions 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 use of natural gas and propane in the Built Environment and the Transportation sector both represent the largest share of communitywide emissions at 46% each.

FIGURE 2: EMISSIONS BY SECTOR, 2021

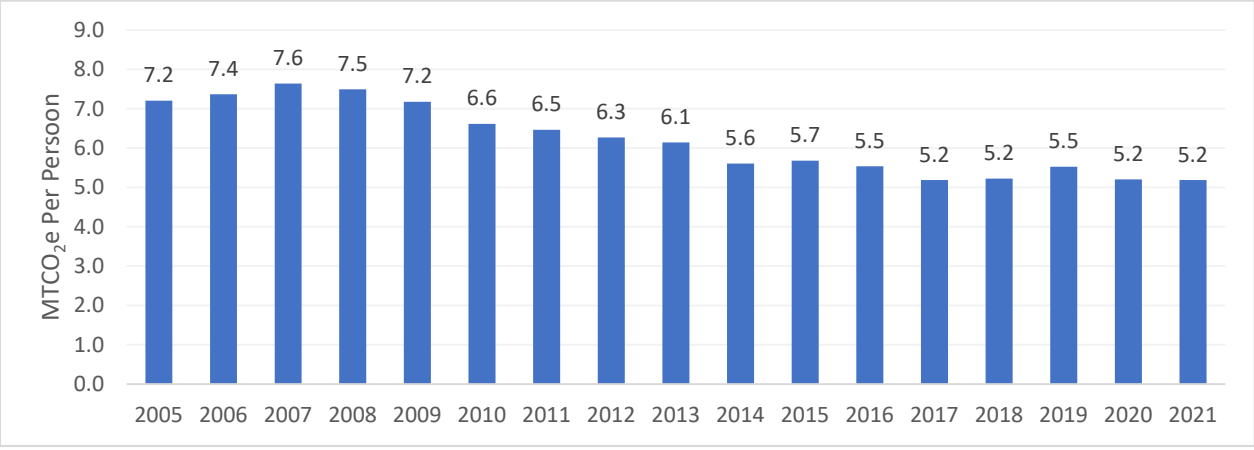


Per Capita Emissions

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 7.2 metric tons CO_2e per capita in 2005. Per capita emissions decreased 28% between 2005 and 2021, falling to 5.2 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 Belvedere, which would include lifecycle emissions, emissions resulting from air travel, the manufacturing and distribution of products and food, etc.

FIGURE 3: EMISSIONS PER CAPITA



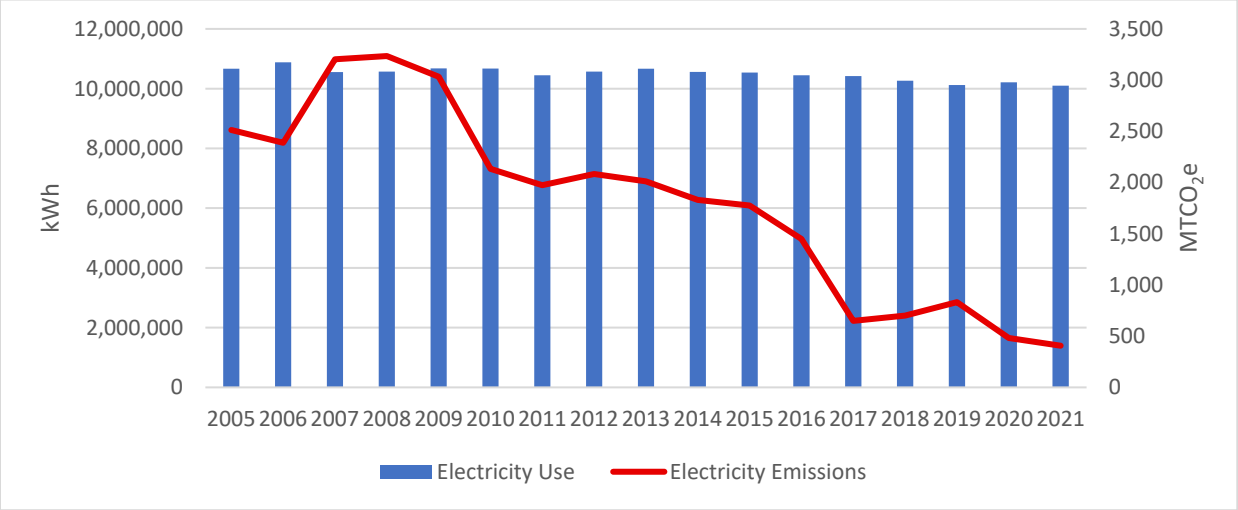
Significant Sources of Emissions

The following sections provide a year-by-year analysis of the changes in source GHG emissions in the Built Environment, Transportation, Waste and Water 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 used in homes and businesses in Belvedere decreased about 5% between 2005 and 2021. Greenhouse gas emissions from electricity consumption decreased 84% since 2005, as shown in Figure 3. 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.[2] MCE Light Green electricity came primarily from renewable (61%) and hydroelectric (37%) sources and was 92% GHG-free.[3] In 2021, about 3.4% of MCE electricity purchased by Belvedere customers was 100% renewable Deep Green electricity, including electricty purchased by the City government.

FIGURE 4: ELECTRICITY USE AND EMISSIONS



Built Environment - Natural Gas

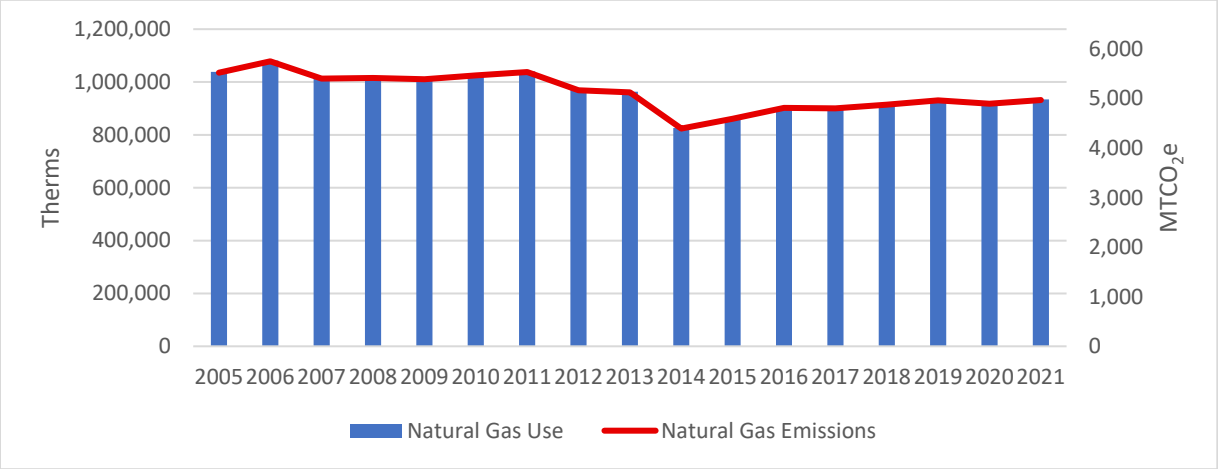
Natural gas is used in residential and commercial buildings to provide space and water heating and power appliances. Use of natural gas is highly variable depending on the weather conditions. This variability has led natural gas use consumption in Belvedere to fluctuate from year to year, from a high of 1.04 million therms in 2011 to a low of 0.83 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.

[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).

Estimated natural gas consumption increased 2% between 2020 and 2021 and was 10% 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 46% of Belvedere'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 3% since 2005.

Transportation emissions have decreased by 19% 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 83% 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. Approximately 10.1% of registered light-duty vehicles in Belvedere were ZEVs by the end of 2021 (based on zip code 94920 data).

While it is difficult to pinpoint exactly how each land use and transportation policy affects emissions, the City has undertaken 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. The City has also encouraged electric vehicle adoption by installing chargers at City Hall.

FIGURE 6: VEHICLE MILES TRAVELED AND TRANSPORTATION EMISSIONS

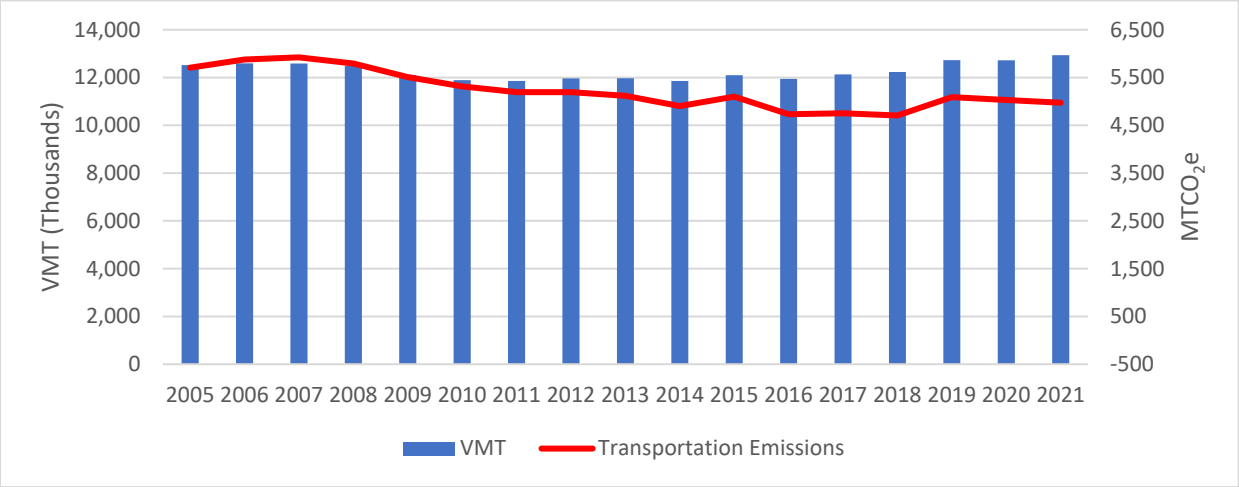
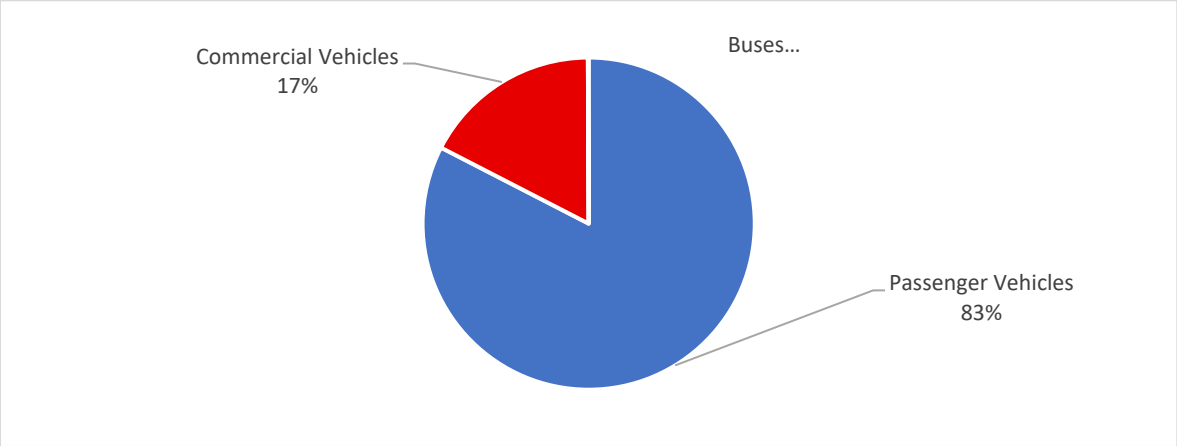


FIGURE 7: TRANSPORTATION EMISSIONS BY VEHICLE CATEGORY, 2021



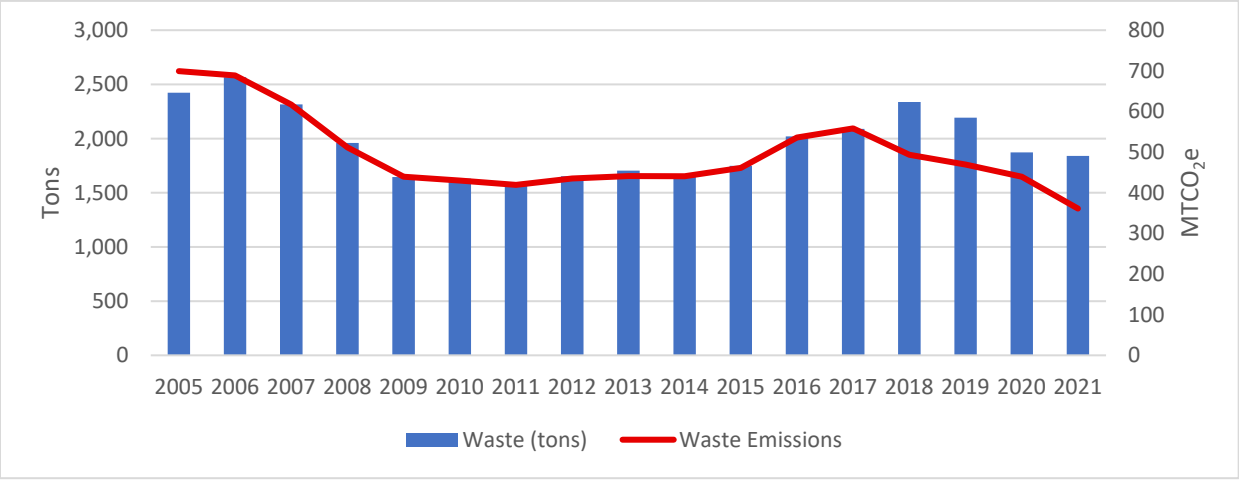
Note: Public Transportation represents emissions from Marin Transit fixed-route buses.

Waste Disposal

Waste generated by the community decreased 2% between 2020 and 2021 and was 24% below the 2005 level by 2021 as shown in Figure 8 (based on countywide disposal data). Total landfilled waste includes alternative daily cover.[4] Emissions from waste disposal decreased 48% due to the lower organic content of landfilled 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.

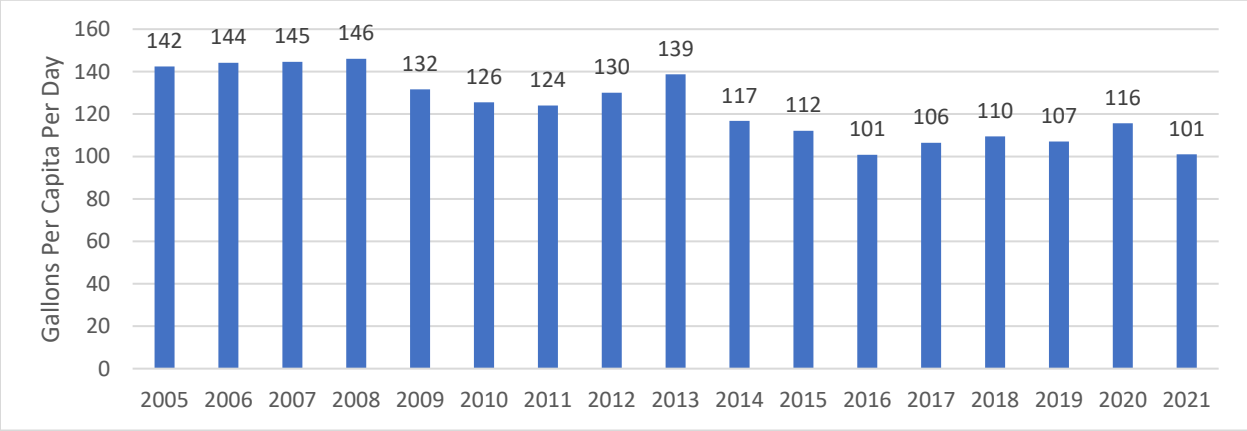
FIGURE 8: DISPOSED WASTE AND EMISSIONS



WATER USE

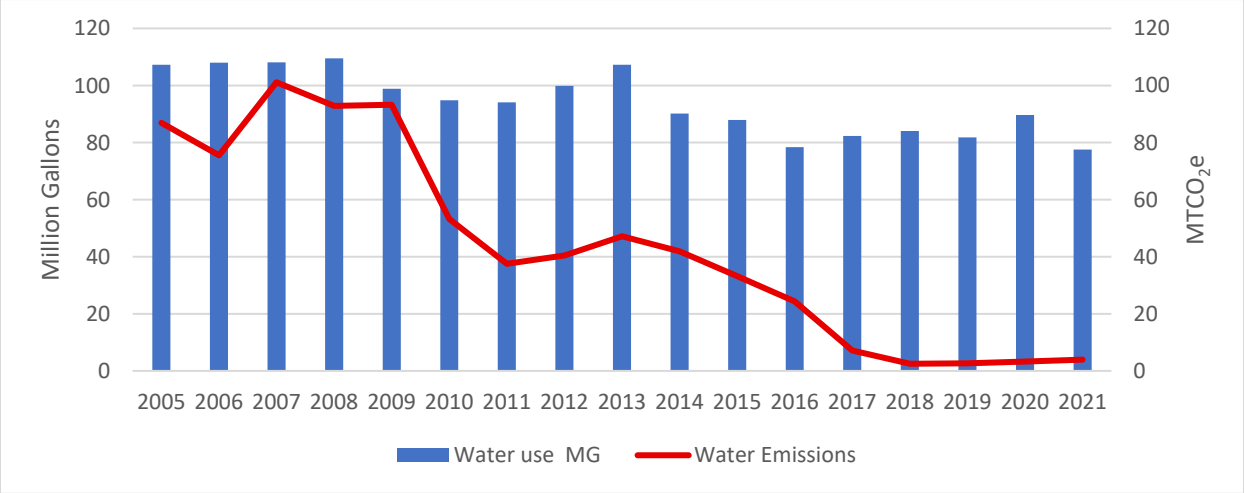
Per capita water use declined 29% since 2005, as shown in Figure 9 (based on Marin Water district-wide data). Emissions, which are based on an estimate of energy used to pump, treat, and convey water from the water source to the City limits, dropped 95% between 2005 and 2021 (see Figure 10). The additional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

FIGURE 10: WATER USE AND EMISSIONS



MMWD 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. MMWD provides free home and landscape water-use evaluations as well as free high-efficiency showerheads and faucet aerators.

APPENDIX: COMMUNITY INVENTORY

Community GHG Emissions Summary Table

Jurisdiction: City of Belvedere
Population: 2,103 (CA Department of Finance)
Number of Households: 894 (CA Department of Finance)

Inventory Year: 2021
Date Prepared: October 10, 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	●				4,978
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	407
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	●				4,105
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	●				863
2.5	On-road transit vehicles associated with community land uses	Activity		●			4
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 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		●			131
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	361
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	●				5
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	●				48
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		
6.4	Upstream impacts of select materials (concrete, food, paper, carpets, etc.) sued 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 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). Commercial natural gas consumption failed the CPUC 15/15 rule and was estimated using alternative sources.	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 PG&E electricity consumption failed the CPUC 15/15 rule and was estimated using alternative sources.	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.
2.12 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. 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 consumption (district-wide gpcd) and electricity usage provided by Marin Municipal Water District (MMWD). Sonoma County Water Agency (SCWA) water 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)	Estimated service population and percent of methane in digester gas provided by Sanitary District No. 5.	Sanitary District No.5 emissions calculated according to U.S. Community Protocol v. 1.1, Appendix F, Method WW.1.(alt).
	Stationary Emissions from Combustion of Digester Gas (N_2O)	Estimated service population and percent of methane in digester gas provided by Sanitary District No. 5.	Sanitary District No.5 emissions calculated according to U.S. Community Protocol v. 1.1, Appendix F, Method WW.2.(alt).

	Process Emissions from Wastewater Treatment Plant with Nitrification or Denitrification	Estimated population served by wastewater treatment plant provided by Sanitary District No. 5.	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 wastewater treatment plant provided by Sanitary District No.5. Assumed significant industrial or commercial input.	Emissions calculated according to U.S. Community Protocol v. 1.1, Appendix F, Method WW.12(alt).