

City of Belvedere

CLIMATE ACTION PLAN 2030









Adopted
June 13, 2022



Table of Contents

Section 1: Introduction	1
What is a Climate Action Plan?	1
Background	1
What are Greenhouse Gas Emissions and How Do They Contribute to Climate Change?.....	3
How will Climate Change Impact California and Marin?	5
What Role Does Government Play?.....	0
Belvedere’s Actions to Date.....	1
Belvedere’s Current Emissions and Trend	1
Consumption-Based Inventory	4
Emissions Forecast and Reduction Targets.....	6
State Pillars	7
Actions to Reduce Greenhouse Gas Emissions.....	8
Summary of State Actions.....	8
Summary of Local Strategies.....	9
Social Equity	10
Section 2: Measures.....	11
Local Measures to Reduce Greenhouse Gas Emissions.....	11
Low Carbon Transportation	12
Renewable Energy and Electrification	17
Energy Efficiency	20
Waste Reduction.....	23
Water Conservation	28
Sequestration and Adaptation.....	30
Community Engagement	33
Implementation and Monitoring	36
Acknowledgments.....	37
Appendix A: Program Calculations.....	A-1
Appendix B: 2019 Greenhouse Gas Inventory Report for Communitywide Emissions	B-1

WHAT YOU CAN DO

LOW CARBON TRANSPORTATION	
	<ul style="list-style-type: none"> • Drive an all-electric or plug-in hybrid vehicle. • Bike, walk, or take transit whenever possible. • Shut your car off when you are sitting idle. • Use electric tools, including leaf blowers and lawn mowers, wherever possible.
RENEWABLE ENERGY & ELECTRIFICATION	
	<ul style="list-style-type: none"> • Switch to MCE Deep Green or PG&E Solar Choice 100% renewable electricity. • Install a solar energy system on your home or business and consider battery storage. • Replace appliances that use natural gas for ones that use electricity. • Investigate heat pump technology so you can swap out water heaters and furnaces that use natural gas when it is time to replace them.
ENERGY EFFICIENCY	
	<ul style="list-style-type: none"> • Replace indoor and outdoor lights with LED bulbs and turn them off when not in use. • Have an energy assessment done for your home or business. • Upgrade insulation, seal leaks, and install a programmable thermostat. • Purchase Energy Star appliances and equipment. • Unplug electronic appliances when not in use and set the thermostat to use less heat and air conditioning.
WASTE REDUCTION	
	<ul style="list-style-type: none"> • Buy only as much as you need. • Buy locally grown food and eat less meat. • Put your food scraps in the green can and/or compost them at home. • Donate extra food and used clothing and housewares. • Consult the waste hauler's website to understand what to recycle and compost.
WATER CONSERVATION	
	<ul style="list-style-type: none"> • Replace your lawn with a drought-tolerant garden. • Install a drip irrigation system and check it regularly for leaks. • Install low water flow faucets, showerheads, and toilets. • Buy water-efficient dishwashers and clothes washers when it is time to replace them.
SEQUESTRATION AND ADAPTATION	
	<ul style="list-style-type: none"> • Plant trees appropriate to you situation. • Add compost to your soil • Purchase carbon offsets for airplane flights and other emissions that are difficult to mitigate. • Find out if your home or business is vulnerable to sea level rise at Our Coast Our Future. • Prepare for more wildfires. Join a Firewise Community, create a defensible space, harden your home, and have an emergency evacuation plan. Learn how at www.firesafemarin.org • Install solar with battery storage to get through power outages.
COMMUNITY ENGAGEMENT	
	<ul style="list-style-type: none"> • Sign up for Resilient Neighborhoods and join a Climate Action Team. • Commit to reducing your carbon footprint by taking the actions identified in this Plan. • Spread the word – advocate to your neighbors, employees, co-workers, etc.
IMPLEMENTATION AND MONITORING	
	<ul style="list-style-type: none"> • Get involved! Attend City Council meetings, Climate Action Plan implementation forums, and other public forums to voice your support for actions contained in this Plan.

SECTION 1: INTRODUCTION

What is a Climate Action Plan?

A Climate Action Plan (CAP) is a tool that any organization can use to develop the programs and actions needed to reduce greenhouse gas emissions (GHGs), which are the pollutants that cause climate change, and other negative impacts to the environment. Generally, these CAPs are focused on this *'mitigation'* aspect of climate change, but some also lay out a strategy for *'adaptation'*, or how the organization will plan to deal with the effects of climate change such as sea level rise, or increased flooding, heat waves, and wildfires. Belvedere's CAP is primarily focused on mitigation measures, but in addition it sets out a proposed adaptation plan for improvement of levees that house critical infrastructure, ingress and egress routes for the entire City while protecting houses located in the flood plain.

Background

The City of Belvedere understands that climate change has the potential to significantly affect Belvedere's residents and businesses, as well as other communities around the world. The City also recognizes that local governments play a strong role in reducing greenhouse gas emissions and mitigating the potential impacts of climate change.

The purpose of this Climate Action Plan (CAP) is to update the Belvedere Climate Action Plan 2011, report on existing actions, and recommend future potential strategies that the City take to address the local consequences of climate change. The CAP briefly defines climate change and its potential impacts. It focuses on policies and practices Belvedere can employ to reduce its greenhouse gas emissions and locally mitigate detrimental impacts of climate change. Through actions described in this Plan, the community can experience lower energy bills, improved air quality, reduced emissions, less risk of flooding, greater resiliency, and an enhanced quality of life. This updated plan acknowledges that climate action planning is an ongoing planning process that includes assessing, planning, mitigating, and adapting to climate change.

In 2021, the Intergovernmental Panel on Climate Change, a scientific body convened by the United Nations, released a major new report concluding that the world cannot avoid some devastating impacts of climate change, but there is still a narrow window to keep the devastation from getting even worse. There is broad scientific agreement that to stave off the worst effects of climate change, communities will need to reduce their greenhouse gas emissions 80% below 1990 levels by the year 2050. We are already seeing the effects of climate change locally and throughout the world with record-breaking heat, rising tides, more frequent catastrophic storms, and more unpredictable weather.

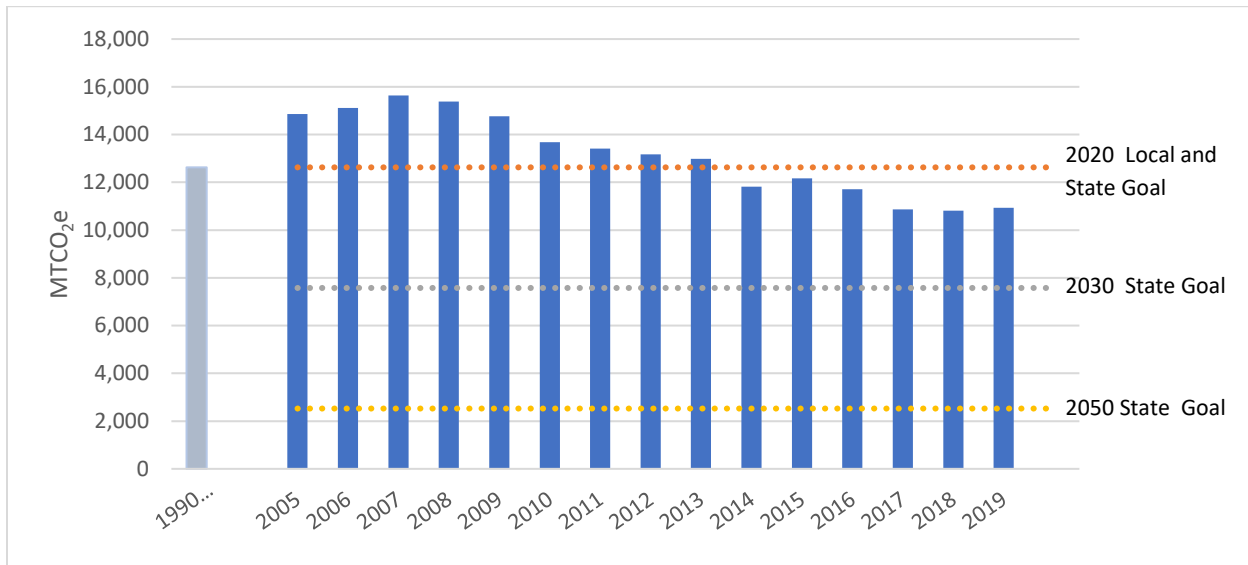
Since the City's initial preparation of the 2005 Greenhouse Gas Emissions Inventory and the 2011 Climate Action Plan, Belvedere has met its 2020 emissions reduction goal. Belvedere's emissions primarily come from residential use of energy and transportation, with approximately 1% coming from

government operations and facilities. In 2016, the State of California adopted an interim reduction target of 40% below 1990 levels by 2030 to stay on track. This updated plan sets out a road map to do just that.

Belvedere works with the Marin Climate & Energy Partnership (MCEP) to build upon best practices learned from other similar communities in the region. Belvedere publishes annual community greenhouse gas (GHG) emissions estimates through the MCEP. Annual inventories help the City to monitor its progress more closely in meeting its local goal to reduce community emissions 15% below 2005 emissions by 2020 and to meet the statewide goal to reduce emissions 40% below 1990 levels by 2030. In addition to the community inventories, MCEP periodically prepares inventories for government operations emissions.

This plan reviews emissions generated from the community from 2005 through 2019. The inventory shows that the Belvedere community has reduced emissions 26% since 2005, meeting its 2020 goal five years early, in 2015. Emissions dropped from about 14,855 metric tons carbon dioxide equivalents (MTCO₂e) in 2005 to 10,935 MTCO₂e in 2019. The community emissions trend and targets are shown in Figure 1. Belvedere needs to reduce emissions another 3,360 MTCO₂e to meet the State target for 2030 and another 8,410 MTCO₂e to meet the State target for 2050, which is 80% below 1990 levels.

FIGURE 1: BELVEDERE COMMUNITY EMISSIONS TREND, 2005-2019



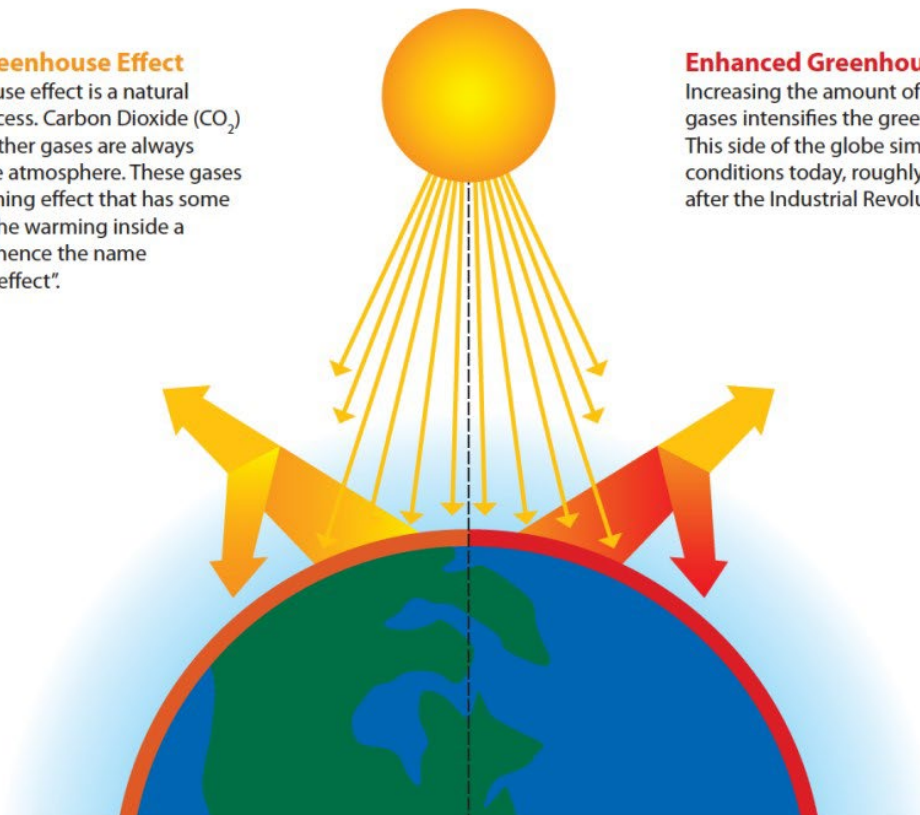
What are Greenhouse Gas Emissions and How Do They Contribute to Climate Change?

Greenhouse gases (GHGs) are gases in Earth's atmosphere that allow the sun's rays to enter our atmosphere and trap the resulting heat generated by the rays. These gases are naturally occurring and make Earth suitable for life. While we depend a certain level on these gases to keep our earth habitable, certain human activities have been shown to emit GHGs, increasing their concentration in the atmosphere to unsustainable levels and trapping more heat, resulting in an increase in Earth's average temperature (Figure 2). This intensification of the natural greenhouse effect affects local and global climate patterns, and which in turn amplifies many hazards including flooding, wildfire, drought, and storms.

FIGURE 1: THE GREENHOUSE EFFECT

Natural Greenhouse Effect

The greenhouse effect is a natural warming process. Carbon Dioxide (CO₂) and certain other gases are always present in the atmosphere. These gases create a warming effect that has some similarity to the warming inside a greenhouse, hence the name "greenhouse effect".



Enhanced Greenhouse Effect

Increasing the amount of greenhouse gases intensifies the greenhouse effect. This side of the globe simulates conditions today, roughly two centuries after the Industrial Revolution began.

Source: California Waterboard/Marion Koshland Science Museum Of The National Academy Of Sciences

These GHGs include carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride (Table 1)¹. Each one has a different degree of impact on climate change. To facilitate comparison across different emission sources with mixed and varied compositions of several GHGs, the term “carbon dioxide equivalent” or CO₂e is used across this CAP. One metric ton of CO₂e may consist of any combination of GHGs and has the equivalent Global Warming Potential (GWP) as one metric ton of carbon dioxide (CO₂). As gathering data and quantifying emissions can be quite difficult for some sources, community inventories at the local government level typically concentrate on the three primary GHGs: CO₂, CH₄, and N₂O.

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, wastewater, and livestock	28
Nitrous Oxide	N ₂ O	Combustion, wastewater treatment	265
Hydrofluorocarbons	Various	Leaked refrigerants, fire suppressants	4 to 12,400
Perfluorocarbons	Various	Aluminum production, semiconductor manufacturing, HVAC equipment manufacturing	6,630 to 11,100
Sulfur Hexafluoride	SF ₆	Transmission and distribution of power	23,500

Source: International Panel on Climate Change (IPCC) Fifth Assessment Report, 100-year values, 2014

According to the U.S. Environmental Protection Agency’s 2019 “Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2018,” the majority of GHG emissions comes from fossil fuel combustion which in turn is used for electricity, transportation, industry, heating, etc. The burning of fossil fuels occurs across nearly every sector of the global economy, in ways that have become foundational to the ways that most people move, eat, and live.

It is the charge of this plan to diminish our community’s dependence on fossil fuels and drastically decrease our associated GHG emissions.

¹ Water vapor is the most dominant greenhouse gas, but it is not measured as a part of a greenhouse gas inventory and for that reason is not included in this discussion.

How will Climate Change Impact California and Marin?

As described above, the Earth's climate is warming, mostly due to human activities such as changes in land cover and emissions of certain pollutants. GHGs are the major human-induced drivers of climate change. These gases warm the Earth's surface by trapping heat in the atmosphere.

California is already experiencing climate change impacts. Sea levels along the coast of southern and central California have risen about 6 inches over the past century and even moderate tides and storms are now producing extremely high sea levels.² Since 1950, the areas burned by wildfire each year has been increasing, as warming temperatures extend the fire season and low precipitation and snowpack create conditions for extreme, high severity wildfires to spread rapidly. Seventeen of the state's twenty largest fires have occurred since 2003, and the five largest fires have occurred since 2017.³ The megafires of 2020, sparked in many cases by lightning strikes, have so far burned over 3.75 million acres across California.

As temperatures continue to rise, California faces serious climate impacts, including:

- More intense and frequent heat waves
- More intense and frequent drought
- More severe and frequent wildfires
- More severe storms and extreme weather events
- Greater riverine flows
- Shrinking snowpack and less overall precipitation
- Accelerating sea level rise
- Ocean acidification, hypoxia, and warming
- Increase in vector-borne diseases and heat-related deaths and illnesses
- Increase in harmful impacts to vegetation and wildlife, including algal blooms in marine and freshwater environments, spread of disease-causing pathogens and insects in forests, and invasive agricultural pests.

² Louise Bedsworth, Dan Cayan, Guido Franco, Leah Fisher, Sonya Ziaja, "Statewide Summary Report," in California's Fourth Climate Change Assessment, publication number: SUMCCCA4-2018-013, 2018, p. 31.

³ Cal Fire, "Top 20 Largest Wildfires," 9/4/2020.

Overall temperatures are projected to rise substantially throughout this century. In Marin County, temperatures are expected to rise about 4°F by 2100 if global emissions peak around 2040 and then decline, the so-called “low emissions” scenario. If the world fails to act and we continue the path we are on, temperatures are projected to rise 10°F by the end of the century (the “high emissions” scenario).

As the climate changes, some of the more serious threats to public health will stem from more frequent and intense extreme heat days and longer heat waves. Extreme heat events are likely to increase the risk of heat-related illness, such as heat stroke and dehydration, and exacerbate existing chronic health conditions. Extreme heat days in Marin are expected to increase from 4 days to 9 days under the low emissions scenario and to as many as 25 days under the high emissions scenario.

Higher temperatures will make Marin more vulnerable to wildfire and sea level rise. By the end of the century, sea level is projected to rise 2.4 to 3.4 feet, and possibly as much as 10 feet. At 5 feet of sea level rise, flooding may inundate downtown San Rafael, Redwood High School in Larkspur, Town Center in Corte Madera, Mill Valley Middle School, the Cove Shopping Center in Tiburon, and thousands of homes and businesses located near Marin’s shorelines and creeks. Flooding will be even worse during storms, which are expected to increase in frequency and intensity.

What Role Does Government Play?

International, national, and statewide GHG reduction goals and policies affect the County’s own goals and policies. Whether trying to meet or exceed those goals, California and Marin are known for their environmental stewardship and willingness to be leaders on the international and national stage.

International	<ul style="list-style-type: none"> • The United Nations coordinates global commitments and targets to reduce emissions (such as the Paris Climate Accord) . • The United Nations also supports the advancement of climate science through the Intergovernmental Panel of Climate Change (IPCC). The IPCC coordinates the work of scientists across the world to continually update models and assess the science related to climate change. This work in turn informs the way that national, state, and local governments understand and address the human activities that contribute to climate change and the ways that climate change might impact earth’s environment.
National	<ul style="list-style-type: none"> • Currently, there is no federal legislation mandating comprehensive GHG emissions reporting or reduction in the United States.
State	<ul style="list-style-type: none"> • California first established statewide GHG emission reduction targets in 2005. • California has used its climate goals to develop regulations to reduce emissions across a variety of sectors, including: <ul style="list-style-type: none"> ○ Setting more strict fuel economy standards for vehicle manufacturers that would like to sell cars in the state. ○ Establishing zero-net energy building targets for new development. ○ Direct management of emissions from power plants and other stationary sources.

	<ul style="list-style-type: none"> California has also used SB 375, which was passed in 2008, to reduce emissions from cars and light trucks by promoting compact mixed-use, commercial, and residential development. SB 375 required local governments in California to consider GHG emissions, leading to successful proliferation of climate action plan development throughout the state.
Local	<ul style="list-style-type: none"> Looks at GHG emissions generated by their communities. Sets long term GHG emission reduction targets that align meet or exceed statewide goals through local Climate Action Plans. Develops policies and programs to achieve CAP GHG emission reduction goals.

Belvedere’s Actions to Date

Belvedere is a small city with a land area of 0.54 square miles and a population of 2,089. The city is in Marin County at the tip of the Tiburon Peninsula, surrounded by water on three sides. Most of its residents live on two former islands connected by two levees that enclose a residential lagoon. It is served by a single public bus stop and a ferry terminal in the adjacent town of Tiburon. Belvedere is primarily residential, with little commercial activity.

Belvedere city staff, agencies, government, and residents have been at the forefront of mitigation efforts such as renewable energy, low-carbon transportation, and water conservation. In 2010, Marin Clean Energy was adopted by the City of Belvedere and most electricity users went immediately to purchasing 50% carbon-free electricity for their homes and businesses. Belvedere was one of the first communities to participate in curbside recycling thanks to Mill Valley Refuse vendor agreements, moving to dual-stream recycling in 2019 at the insistence of the City Council. By 2019, Belvedere water users reduced their water consumption by an average of approximately 25% (based on Marin Municipal Water District district-wide data). And in 2017, Marin Municipal Water District began purchasing 100% renewable Deep Green electricity from MCE Clean Energy, which reduced Belvedere resident and businesses’ water-related greenhouse gas emissions dramatically. Most significantly, Belvedere obtained a 55%/45% matching grant in the amount of \$1.1 million from the California Department of Water Resources to study and design improvements to the two levees which provide all ingress and egress to most of the city, while housing nearly all utility infrastructure required by the community. The project is currently going through environmental review and a period of public engagement regarding funding possibilities.

Belvedere’s Current Emissions and Trend

Understanding the nature of harmful emissions, identifying their sources, and establishing local baseline measurement constitute the first step toward developing a climate action plan. Belvedere’s 2011 Climate Action Plan aptly recognized that this information can then inform the selection of a reduction target and action measures. Since then, staff has updated the City’s emission status to the City Council and public on a regular basis.

Residential emissions come primarily from the on-site combustion of natural gas and the off-site generation of electricity for heating, cooling, lighting, cooking, and the operation of appliances and

electrical devices. Transportation emissions result from the combustion of gasoline and diesel from trips generated from and to the city. Waste emissions come from the decomposition of organic waste generated within the city but subsequently located in landfills outside city limits.

In January 2022, the Marin Climate & Energy Partnership prepared an updated Greenhouse Gas Emissions Inventory for community emissions for the years 2005 through 2019. The inventory quantifies GHG emissions from a wide variety of sources, from the energy used to power, heat, and cool buildings, to the fuel used to move vehicles and power off-road equipment, to the decomposition of solid waste and treatment of wastewater. Emissions are quantified according to methodologies established by the U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions (v. 1.2). The inventory provides a detailed understanding of where the highest emissions are coming from, and, therefore, where the greatest opportunities for emissions reductions lie. The inventory also establishes a baseline emission inventory against which to measure future progress.

Community emissions are quantified according to these 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 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 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.

Community emissions totaled 14,855 metric tons of carbon dioxide equivalents (MTCO₂e) in 2005. By 2019, emissions had dropped to 10,935 MTCO₂e, a 26% reduction. This is well below the State target for Belvedere, which is 15% below baseline (2005) emissions by 2020. While emissions declined in almost all sectors, the largest reductions were due to reduction in the carbon intensity of electricity,

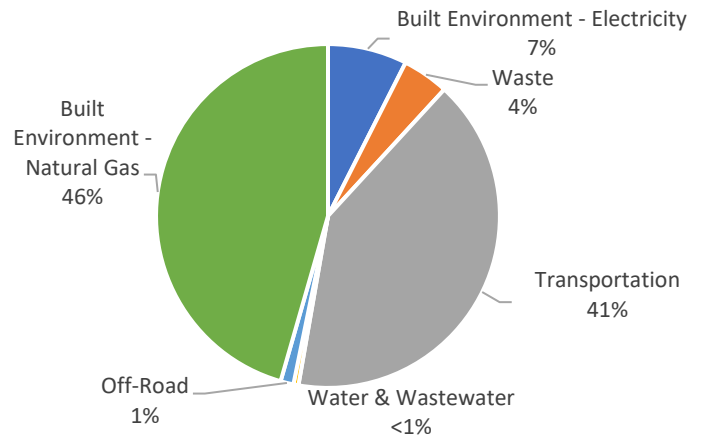
improvements in energy conservation and efficiency, and improvements to vehicle fuel efficiency. Emissions from City operations, which make up approximately 1% of community-wide emissions, fell 27% between 2005 and 2015. For more details, see the City’s most recent Greenhouse Gas Emissions Inventory (Appendix B).

TABLE 2: EMISSIONS SUMMARY BY SECTOR (MTCO_{2e})

Year	Built Environment - Electricity	Built Environment - Natural Gas	Transportation	Waste	Off-Road	Water	Wastewater	Total	% Change from 2005
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	5,186	420	154	38	70	13,416	-10%
2012	2,083	5,204	5,178	435	151	40	75	13,167	-11%
2013	2,012	5,161	5,095	441	148	47	77	12,981	-13%
2014	1,830	4,412	4,877	440	147	42	72	11,821	-20%
2015	1,776	4,614	5,068	461	145	33	71	12,168	-18%
2016	1,449	4,839	4,657	536	143	24	63	11,711	-21%
2017	649	4,824	4,630	559	140	7	59	10,868	-27%
2018	701	4,883	4,543	494	136	3	59	10,817	-27%
2019	817	4,987	4,480	469	131	3	48	10,935	-26%
Change from 2005	-1,696	-572	-1,226	-230	-80	-84	-31	-3,920	
% Change from 2005	-68%	-10%	-21%	-33%	-38%	-97%	-39%	-26%	

As shown in Figure 3, most emissions come from natural gas used in Belvedere homes and non-residential buildings and facilities. The second greatest source of emissions is from passenger vehicle trips generated by Belvedere residents, employees, and visitors.

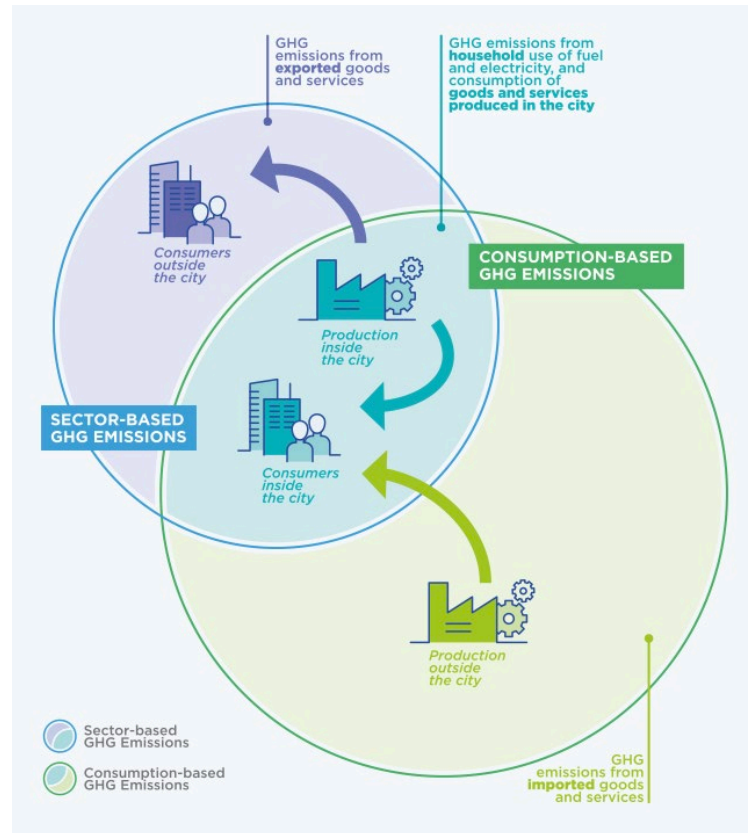
FIGURE 3: COMMUNITY EMISSIONS BY SOURCE, 2019



Consumption-Based Inventory

In addition to the sectors outlined above, which measures the emissions that are generated within the City’s borders, there are also emissions associated with the goods and services that residents in Marin consume. These are referred to as “consumption-based emissions” or “embodied emissions” (both terms are used interchangeably in this document). Rather than assessing emissions that are generated within a jurisdictional boundary, consumption-based inventories estimate the emissions based on the goods and services consumed within a place. This includes emissions from raw material extraction, manufacturing, distribution, retail, and disposal. Historically, local governments have only included emissions that occur within their boundaries, including emissions associated with goods that will eventually be exported. However, in communities like Marin County (as in many other communities in the United States) where goods are more often imported than exported, consumption emissions can be up to 800% higher than their sector-based emissions inventory. Consumption emissions are harder to track and have fewer defined pathways for policy intervention from local governments, so the City continues to follow ICLEI’s Community Protocol and focus on actionable programs and policies to address local emissions. This CAP, wherever possible, seeks to take into account the whole picture of

FIGURE 4: SECTOR-BASED VS. CONSUMPTION-BASED GHG EMISSIONS

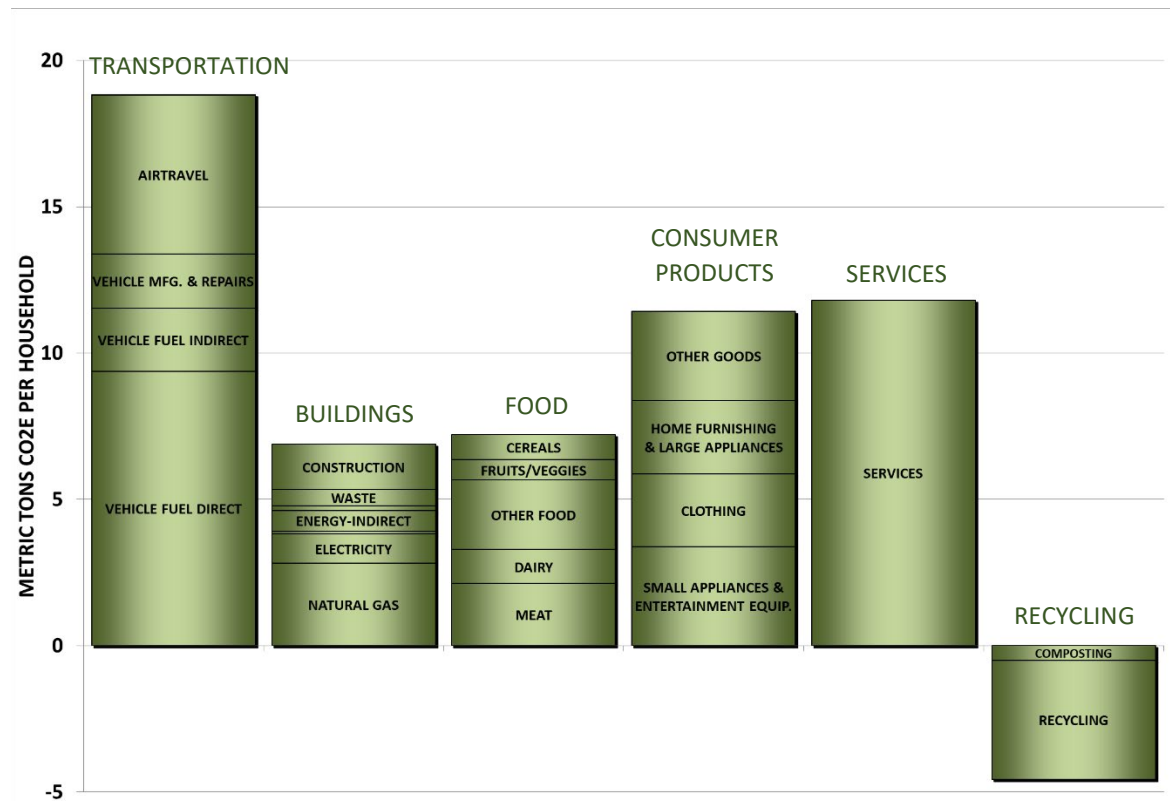


Source: C40 Cities, “Consumption-Based GHG Emissions of the C40 Cities”

local contributions to climate change and includes measures to address these emissions in the built environment.

In 2016, the Bay Area Air Quality Management District (BAAQMD) and U.C. Berkeley developed a [Consumption-Based Inventory](#) to better understand how purchasing habits contribute to global climate change. This consumption-based inventory includes emission sources that do not get counted in the typical “sector-based” GHG inventory, as well as other items that are difficult to quantify like airplane travel and upstream emissions from the production, transport and distribution of food and household goods. Figure 5 shows the results of the consumption-based inventory for Belvedere households. According to this inventory, the average Belvedere household generates 55.6 MTCO₂e per year. As a comparison, the City’s community-wide emissions of 10,935 MTCO₂e works out to about 11.9 MTCO₂e per household.

FIGURE 5: AVERAGE BELVEDERE HOUSEHOLD CARBON FOOTPRINT

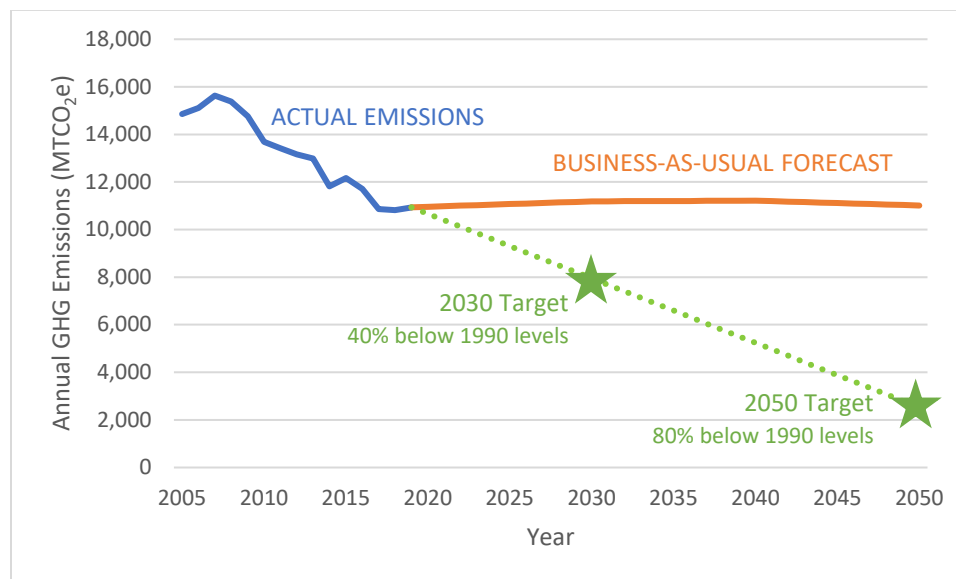


This graph shows the relative impact of all the sources of emissions that make up a household carbon footprint. *Source: CoolClimate Network*

Emissions Forecast and Reduction Targets

The Climate Action Plan includes a “business-as-usual” (BAU) forecast in which emissions are projected in the absence of any policies or actions that would occur beyond the base year to reduce emissions. The forecasts are derived by “growing” (increasing) 2019 emissions using forecasted changes in population, number of households, and jobs according to projections developed by the Association of Bay Area Governments. Transportation emissions are projected utilizing data provided by the Metropolitan Transportation Commission, which incorporate the vehicle miles traveled (VMT) reductions expected from the implementation of Plan Bay Area 2040. Emissions are expected to rise about 2.3% by 2030 and 0.3% by 2040. Because ABAG and MTC have not developed projections for 2050, the rate of population growth forecasted by the California Department of Finance for Marin County was used to project population, household, jobs, and VMT for 2050. The Department of Finance projects that Marin’s population will decrease 3.8% between 2040 and 2050. As a result, emissions would be approximately 11,011 MTCO_{2e} by 2050 under the BAU forecast, a decrease of 1.8% from 2019 levels. The Climate Action Plan establishes targets that meet the State’s goals to reduce emissions to 40% below 1990 levels by 2030 and 80% below 1990 levels by 2050. In Belvedere, that means emissions would need to drop to 7,576 MTCO_{2e} by 2030 and 2,525 MTCO_{2e} by 2050. The Plan lays out measures that will meet the 2030 target and put the City on a trajectory to meet the 2050 goal. The community emissions trend, forecast and targets are shown in Figure 6 below. While State actions will secure to meet a significant portion of reductions, continued reductions through community efforts are needed to meet these goals.

FIGURE 6: EMISSIONS TREND, FORECAST AND TARGETS

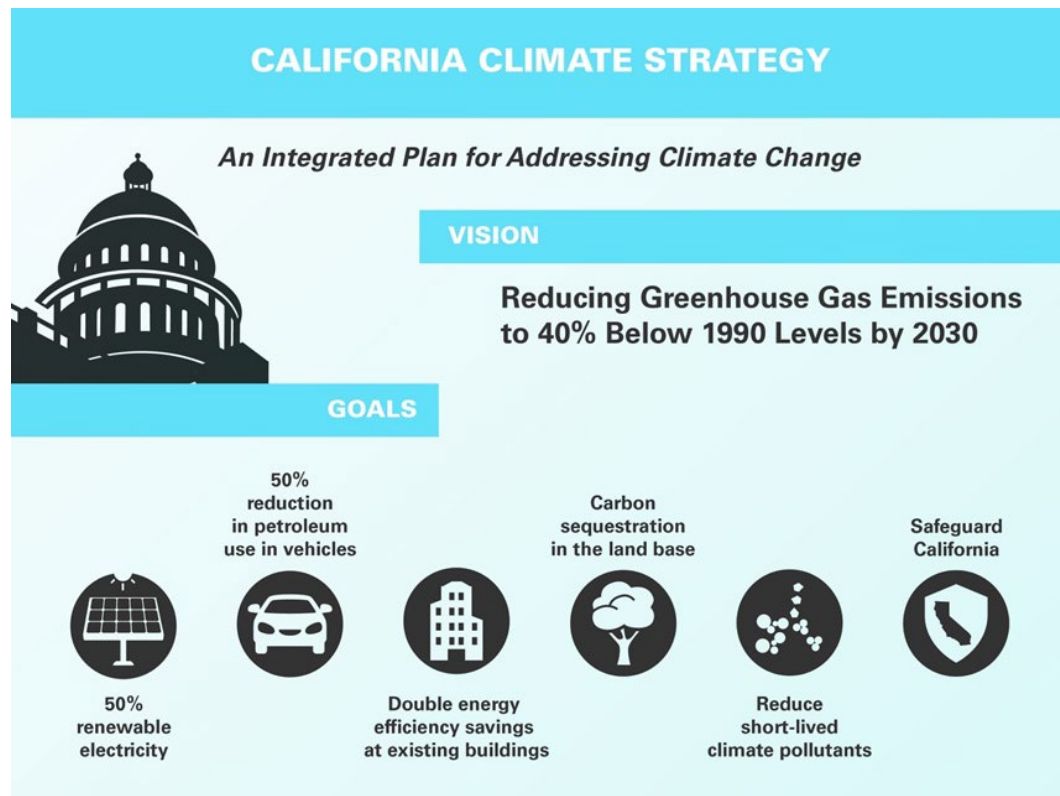


State Pillars

Belvedere does not exist in a vacuum, and we are leveraging or trying to combat regional, state-wide, national, and even international actions and trends, we also have the ability and responsibility to collaborate with other efforts and campaigns. Belvedere is already working collaboratively with other local agencies (through MCEP) and building upon best practices learned from other similar communities in the region.

To meet greenhouse gas reduction and climate change goals, the State of California established the [Six Pillars](#) framework in 2015 when Governor Jerry Brown was inaugurated for his second term as governor. These include (1) reducing today's petroleum use in cars and trucks by up to 50%; (2) increasing from one-third to 50% our electricity derived from renewable sources; (3) doubling the energy efficiency savings achieved at existing buildings and making heating fuels cleaner; (4) reducing the release of methane, black carbon, and other short-lived climate pollutants; (5) managing farm and rangelands, forests and wetlands so they can store carbon; and (6) periodically updating the state's climate adaptation strategy. The measures contained in this Climate Change Action Plan are designed to support and implement the Six Pillars and the goals of [California's 2017 Climate Change Scoping Plan](#) on a local level.

FIGURE 7: CALIFORNIA'S 6 PILLARS CLIMATE STRATEGY

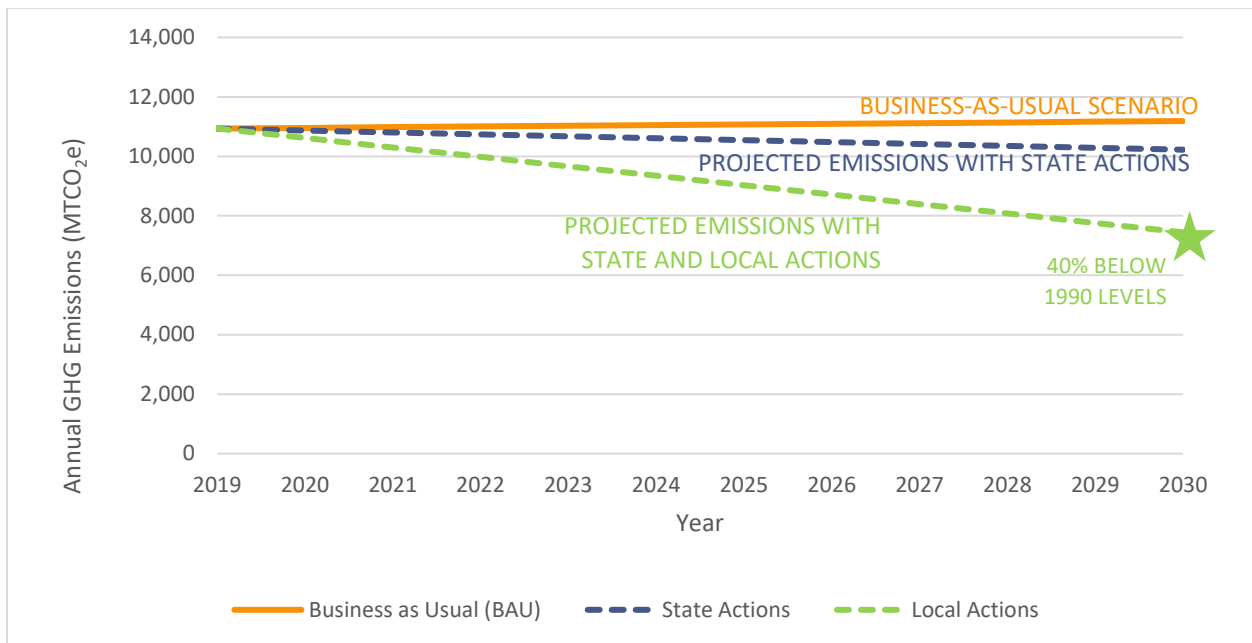


Actions to Reduce Greenhouse Gas Emissions

The Climate Action Plan includes a variety of regulatory, incentive-based, and voluntary strategies that are expected to reduce emissions from both existing and new development in Belvedere. Several of the strategies build on existing programs while others provide new opportunities to address climate change. State actions will have a substantial impact on future emissions. Local strategies will supplement these State actions and achieve additional GHG emissions reductions. Successful implementation will rely largely on the combined participation of Belvedere residents, city staff, and community leaders.

The following sections identify the State and local strategies included in the Climate Action Plan to reduce emissions in community and government operations. Emissions reductions are estimated for each strategy; combined, they show that the City could reduce emissions 41% below 1990 levels by 2030, which is enough to meet the State goal. Community emissions are projected to be 7,444 MTCO₂e in 2030 with all State and local actions implemented, while the reduction target is 7,576 MTCO₂e. As shown in Figure 8, State actions represent about 26% of the reduction expected through implementation of the Climate Action Plan while local actions represent about 74%.

FIGURE 8: CUMULATIVE IMPACT OF REDUCTION STRATEGIES



Summary of State Actions

The Climate Action Plan incorporates State reduction strategies that have been approved, programmed and/or adopted and will reduce local community emissions from 2019 levels. These programs require no local actions. As such, the State actions are first quantified and deducted from projected community

emissions to provide a better picture of what still needs to be reduced at the local level to get to the overall reduction targets. State actions and emissions reductions are shown in Table 3 and detailed in the appendix.

TABLE 3: EMISSIONS REDUCTIONS FROM STATE ACTIONS

State Action	Emissions Reductions by 2030 (MTO _{2e})
Light and Heavy-Duty Vehicle Regulations	699
Renewable Portfolio Standard	36
Title 24 Energy Efficiency Standards	228
Small Off-Road Equipment	58
Total	963

Note: Numbers may not total due to rounding.

Summary of Local Strategies

The local mitigation measures presented in the following sections, and as summarized in Table 4 below, achieve greenhouse gas emissions reductions in the community of approximately and 18,770 MTCO_{2e} by 2030.

TABLE 4: LOCAL EMISSIONS REDUCTION STRATEGIES

Strategy	GHG Reductions by 2030 (MTCO _{2e})	Percent of Reductions
Low Carbon Transportation	923	33%
Renewable Energy and Electrification	1,100	40%
Energy Efficiency	399	13%
Waste Reduction	359	13%
Water Conservation ⁴	>1	0%
Sequestration and Adaptation	n/a	-
Community Engagement	n/a	-
Implementation and Monitoring	n/a	-
Total	2,780	100%

Note: Percentages may not total 100% due to rounding.

⁴ Actions that reduce emissions from energy used to heat water are reflected in the Renewable Energy and Electrification and Energy Efficiency sections. See the Water Conservation section beginning on page 34 for more information.

These local strategies will be detailed in the following sections. Together, the projected reductions from State and local actions total 3,743 MTCO₂e by 2030. Community emissions are projected to be 7,444 MTCO₂e in 2030 with the full implementation of the CCAP. This is 41% below estimated 1990 levels and meets the reduction target set by the State.

Social Equity

Climate change and equity are interconnected. Often, the communities who have contributed the least to global warming, including low-income communities, communities of color, indigenous peoples, and developing nations, suffer first and most from climate change. The City acknowledges disadvantaged communities have existed and still exist in Marin County and seeks to design and implement solutions with them. This requires internal and external on-going work to normalize, organize, and internalize equity principles and approaches.

One definition of social equity is the “just and fair inclusion into a society in which all can participate, prosper, and reach their full potential.”⁵ Equity is the means to ensure equality for all. An example of how that might work with climate action measures is with energy efficiency. Giving rebates to homeowners to swap out natural gas appliances helps reduce GHG emissions by switching to low carbon electricity. But if financial incentives are only available to those with means to purchase new appliances it leaves out a section of the community without means. Programs that acknowledge this disparity might offer bigger discounts to low-income households. Additionally, the City acknowledges that appliance upgrades may not be a high priority for all residents. Part of the City’s on-going work is to build and nurture relationships with diverse community groups so that they can share what are their priorities and the City can attempt to integrate those priorities into its climate action efforts.

⁵ PolicyLink, “The Equity Manifesto.”

SECTION 2: MEASURES

Local Measures to Reduce Greenhouse Gas Emissions

Each of the following sections provide a summary table of local measures and associated GHG reductions, followed by a description of the specific actions the City of Belvedere will undertake to implement each measure. The methodologies and implementation targets used to calculate emissions reductions are described in the appendix. Sometimes, there is no direct or reliable way to estimate GHG savings for a particular measure or the savings are embedded in another measure. In this case, the GHG reduction is identified as “not applicable” or “n/a.” For example: Community Engagement is essential for success in many of the measures set forth throughout the Plan but counting savings in this section would then be double-counting savings from other measures such as those in Low Carbon Transportation or Energy Efficiency. People need to know about a program to take advantage of it, but the actual emissions reductions will come from participating in the program itself. Therefore, the savings are counted for that program.



LOW CARBON TRANSPORTATION

33% of potential reductions

Over 40% of Belvedere community emissions comes from transportation, and until the recent commercial success of electric vehicles, it has been hard to see how we were going to reduce transportation emissions. Improvements in fuel efficiency have driven emissions down – the passenger vehicle fleet in Marin County is about 14% more fuel-efficient than it was ten years ago. Miles traveled by passenger vehicle trips starting and/or ending in Belvedere have gone down 5% over the same period. Surveys show that “green” transportation rates have improved over the years, from about 33% to 40% of workers between 2010 and 2019, thanks in part to improvements in the bicycle and pedestrian network and public information campaigns to get people to carpool, bicycle, walk and take transit. But we will not reduce emissions significantly more at this rate.

All of that is now changing with the viability of zero emission vehicles (ZEVs), especially here in Belvedere where electricity is fairly clean and expected to get cleaner. ZEVs include all-battery as well as plug-in hybrid vehicles. Marin County is a leader in ZEV adoption rates – second only to Santa Clara County – and ZEVs already comprise about 4.7% of all registered light-duty vehicles in Marin and an estimated 8.3% in Belvedere. Our plan is to increase that rate to 35% by 2030 by building out the EV charging infrastructure and encouraging ZEV ownership through incentives, public education, and development requirements. This is an aggressive target, but one that complements the State’s goal to put 5 million ZEVs on the road by 2030. Improvements in battery and charging technology, expected cost reductions, and automakers’ commitments to significantly expand ZEV offerings point to an all-electric future.

That said, we cannot rely on ZEVs alone to meet our transportation reductions; reducing congestion, enhancing biking and walking opportunities, and incentivizing public transit carry co-benefits and can be enjoyed by all. To ensure Belvedere is a safe and walkable community for all ages, the City can prioritize sidewalk maintenance and mark crosswalks near bus stops and intersections.

The City will take the following actions to reduce emissions from transportation sources.

Things You Can Do

- #1 Drive an all-electric or plug-in hybrid vehicle.
- #2 Bike, walk or take transit whenever possible.
- #3 Shut your car off when you are sitting idle.
- #4 Walk or bike to school.
- #5 Use electric tools, including leaf blowers and lawn mowers, wherever possible.

TABLE 5: LOW CARBON TRANSPORTATION MEASURES

ID	Measure	GHG Reduction by 2030 (MTCO ₂ e)	Share of Reductions
LCT-1	Zero Emission Vehicles	837	91%
LCT-2	Bicycling and Micromobility	n/a	-
LCT-3	Walking	<1	<1%
LCT-4	Safe Routes to School	8	1%
LCT-5	Public Transit	3	0%
LCT-6	Employee Trip Reduction	30	3%
LCT-7	Vehicle Idling	n/a	-
LCT-8	Smart Growth Development	n/a*	-
LCT-9	Electric Landscape Equipment	8	1%
LCT-10	Zero and Low Emission City Vehicles	30	1%
LCT-11	Low Carbon Fuels for City Vehicles	3	<1%
LCT-12	City Employee Commute	4	<1%
TOTAL		923	100%

**Emissions reductions due to smart growth development are embedded in vehicle miles traveled projections utilized in the development of the emissions forecast. To avoid double-counting, they are not included here.*

LCT-1: Zero Emission Vehicles

Develop a Zero Emission Vehicle Plan that will result in at least 35% of passenger vehicles in Belvedere to be zero emission vehicles (ZEVs), including plug-in electric vehicles (EVs) and hydrogen fuel cell electric vehicles, by 2030. Incorporate the following actions in the plan as feasible:

- a. Work with MCE, PG&E and other entities to identify multifamily and workplace charging sites appropriate for available incentive programs.
- b. Participate in a countywide effort by MCE, PG&E, and others to provide rebates for new or used electric vehicles and/or charging stations.
- c. Pursue opportunities to expand the City’s EV charging network through innovative programs.
- d. Require new and remodeled commercial and multifamily projects to install a minimum number of electric vehicle chargers for use by employees and residents.
- e. Require new and remodeled single-family and multifamily projects to install electrical service, conduit and wiring for potential electric vehicle use, taking into consideration the cost to property owners.
- f. Participate in regional efforts and grant programs to encourage widespread availability of EV charging stations.
- g. Participate in programs to promote EV adoption, including media and outreach campaigns.
- h. Encourage or require, as practicable, ride hailing and delivery service companies to utilize zero emission vehicles.
- i. Promote adoption of electric bicycles, scooters, and motorcycles.

LCT-2: Bicycling and Micromobility

- a. Encourage bicycling and micromobility as an alternative to vehicular travel for recreational and non-recreational travel. Promote safe bicycling, including e-bikes, through outreach channels and partner agencies.
- b. Establish and maintain a system of bicycle facilities that are consistent with the Transportation and Circulation Element of the City's General Plan and Complete Streets policies.
- c. Encourage the local police force to use e-bikes where and when appropriate.
- d. Implement the policies and programs of the Transportation and Circulation Element of the City's General Plan that support and expand bicycling and micromobility.
- e. Update the Capital Improvement Program to maintain and improve the system of multiuse pathways and bicycling facilities that are consistent with the Transportation and Circulation Element of the City's General Plan.
- f. Support regional efforts to establish a bike and/or scooter share program.
- g. Create walking paths where feasible that are directed at destination points.

Micromobility

Micromobility refers to forms of transportation, human-powered or electric, that can occupy space alongside bicycles. It includes electric scooters and skateboards, docked and dockless shared bikes, and other forms of small, lightweight devices operating at speeds typically below 20 mph. Micromobility devices do not have an internal combustion engine.

LCT-3: Walking

Encourage walking as an alternative to vehicular travel through outreach channels and partner agencies.

- a. Establish and maintain a system of pedestrian facilities that are consistent with the Transportation and Circulation Element of the City's General Plan and Complete Streets policies to facilitate pedestrian access throughout the City and particularly to and from transportation facilities.
- b. Update and implement the Capital Improvement Program as necessary to construct and maintain this pedestrian system.
- c. Encourage pedestrian activity and reduction in auto use by further improving the public steps and lanes for safe pedestrian use. Protect and, when possible, expand the locations of lanes.

LCT-4: Safe Routes to School

Continue to support the Safe Routes to School Program and strive to increase bicycling, walking, carpooling, and taking public transit to school.

- a. Work with school districts, the Transportation Authority of Marin (TAM) and other organizations to promote school and student participation.
- b. Identify issues associated with unsafe bicycle and pedestrian facilities between neighborhoods and schools, apply for Safe Routes to School grants, and execute plans to improve pedestrian and bicycle facilities.

- c. Encourage residents to participate in the “Yellow School Bus” program and student use of regular transit to reduce school traffic.

LCT-5: Public Transit

Support and promote public transit by taking the following actions:

- a. Work with Marin Transit and Golden Gate Transit to maximize ridership through expansion and/or improvement of transit routes, schedules, and bus shelters.
- b. Work with TAM, employers, and others to provide first and last mile programs to maximize utilization of public transit.
- c. Provide safe routes to the ferry landing and other transit facilities that encourage bicycle and pedestrian connections.
- d. Encourage transit providers, including school buses, to use renewable diesel as a transition fuel and to purchase electric buses whenever replacing existing buses.

LCT-6: Employee and Construction Trip Reduction

Reduce vehicle miles traveled commuting to work through the following actions:

- a. Work with the Transportation Authority of Marin (TAM), the Metropolitan Transportation Commission (MTC), and the Bay Area Air Quality Management District (BAAQMD) to promote transportation demand programs to local employers, including rideshare matching programs, vanpool incentive programs, emergency ride home programs, telecommuting, transit use discounts and subsidies, showers and changing facilities, bicycle racks and lockers, and other incentives to use transportation other than single occupant vehicles.
- b. Work with MTC to identify and notify non-compliant businesses in Belvedere and encourage their participation in providing transportation demand management programs.
- c. Work with TAM on developing a countywide Transportation Demand Management Program to encourage trip reduction throughout County.
- d. Encourage large construction projects to provide off-site parking and vanpool incentives as part of the building process to reduce congestion on roadways.

LCT-8: Vehicle Idling

- a. Encourage drivers and autonomous vehicles to limit vehicle idling through public outreach and engagement campaigns.
- b. Investigate adopting policies for public employees to minimize idling.

LCT-9: Smart Growth Development

Promote land use and development policies that prioritize infill housing and mixed-use development near commercial services and transit facilities, as opposed to development in peripheral areas that require use of vehicles to access transit and services.

LCT-10: Electric Landscape Equipment. Encourage the use of electric landscape equipment instead of gasoline-powered equipment through engagement campaigns and strict enforcement of local ordinances. Advocate for a countywide ban on gas-powered equipment.

LCT-11: Zero and Low Emission City Vehicles

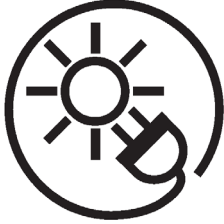
Purchase or lease zero-emission vehicles for the City fleet whenever feasible, and when not, the most fuel-efficient models available. Promote City adoption and procurement of zero-emission vehicles and electric vehicles charging infrastructure.

LCT-12: Low Carbon Fuels for City Vehicles

Use low-carbon fuel such as renewable diesel as a transition fuel in the City's fleet and encourage the City's service providers and joint powers agencies to do the same, until vehicles are replaced with zero-emissions vehicles.

LCT-13: City Employee Commute

Continue to provide City employees with incentives and/or reduce barriers to use alternatives to single occupant auto commuting, such as transit use discounts and subsidies, bicycle facilities, showers and changing facilities, ridesharing services, vanpools, emergency ride home service, flexible schedules, and remote working when practicable.



RENEWABLE ENERGY AND ELECTRIFICATION

40% of potential reductions

Energy that comes from renewable sources, including solar, wind, geothermal, and small hydroelectric, are the cleanest and most-environmentally friendly energy sources. Here in Belvedere, where there is an abundance of sunny days, solar energy is a particularly good energy source. According to [Project Sunroof](#), 82% of Belvedere buildings have roofs that are solar-viable⁶. These 800 roofs could generate over 14 million kWh per year, which is more than the total electricity usage in Belvedere in 2019. Our Climate Action Plan projects that we can get about 24% of our electricity from locally produced solar energy systems by 2030, up from about 7% currently, just by maintaining the current growth rate.

When transitioning to solar or when solar is not an option due to a shady roof or a reluctant landlord, residents and business owners can purchase 100% renewable electricity from MCE Clean Energy and PG&E. MCE and PG&E electricity have a high percentage of renewable and GHG-free content, which means it is some of the cleanest electricity in the country. MCE's goal is to provide a minimum 95% GHG-free electricity to all its customers by 2022. Considering that MCE currently carries about two-thirds of the total electricity load in Belvedere, that action will significantly reduce emissions.

Since Marin's electricity is very clean, and getting cleaner, swapping out appliances and heating and cooling systems that use natural gas for ones that use electricity is ultimately cleaner than relying on natural gas. Rebates are currently available from [Electrify Marin](#) and [BayREN and TECH Clean California](#). If you are constructing a new home or building, consider going all-electric. Battery prices are falling, and will soon be a cost-effective option, too. Eventually, we will need to replace the majority of natural gas appliances and equipment if we are going to hit our long-term goals. Utilities will need to expand grid capacity, develop electricity storage, and ensure system reliability. Fortunately, ongoing research and development of energy storage

Things You Can Do

- #1 Switch to MCE Deep Green or PG&E Solar Choice 100% renewable electricity option.
- #2 Install a solar energy system on your home or business and consider battery storage.
- #3 Replace appliances that use natural gas for ones that use electricity.
- #4 Investigate heat pump technology so you can swap out hot water and space heaters that use natural gas when it is time to replace them.

⁶ Project Sunroof data explorer (January 2022). Technical potential is based on electricity generation by the rooftop area suitable for solar panels assuming economics and grid integration are not a constraint. Every included panel receives at least 75% of the maximum annual sun in the county. Every included roof has a total potential installation size of at least 2kW. Only areas of the roof with enough space to install four adjacent solar panels are included.

systems are creating new business opportunities and making an all-electric, 100% renewable future possible.

The City will take the following actions to reduce emissions from energy use.

TABLE 6: RENEWABLE ENERGY AND ELECTRIFICATION MEASURES

ID	Measure	GHG Reduction by 2030 (MTCO ₂ e)	Share of Reductions
RE-1	Renewable Energy Generation and Storage	157	14%
RE-2	MCE Electricity	374	34%
RE-3	Building and Appliance Electrification	568	52%
RE-4	Innovative Technologies	n/a	n/a
RE-5	Solar Energy Systems for Municipal Buildings	n/a	n/a
RE-6	Deep Green Electricity	n/a	n/a
TOTAL		1,100	100%

Note: There are no GHG savings attributed to measures RE-5 and RE-6 because the City was purchasing 100% renewable electricity in 2019.

RE-1: Renewable Energy Generation and Storage

Accelerate installation of residential and commercial solar and energy storage systems.

- a. Provide permit streamlining and reduce or eliminate fees, as feasible.
- b. Update building codes, development codes, design guidelines, and zoning ordinances, as necessary, to further facilitate small, medium, and large-scale installations, where appropriate.
- c. Encourage installation of solar panels over parking areas on commercial projects and large-scale residential developments through ordinance, engagement campaigns, or agency incentives.
- d. Identify and promote financing and loan programs for residential and non-residential projects.
- e. Encourage battery storage in conjunction with renewable energy generation projects through engagement campaigns and partner agency incentives.

RE-2: GHG-Free Electricity

Encourage residents and businesses to switch to 100 percent renewable electricity (MCE Deep Green, MCE Local Sol, and PG&E Solar Choice) through engagement campaigns and partner agency incentives and work with MCE Clean Energy to assure that it reaches its goal to provide electricity that is 95 percent GHG-free by 2022.

RE-3: Building and Appliance Electrification

Accelerate electrification of building systems and appliances that currently use natural gas, including heating systems, hot water heaters, stoves, and clothes dryers.

- a. Promote available rebate programs such as Electrify Marin, BayRen, and TECH Clean California.
- b. Consider adopting an ordinance that requires homeowners to replace natural gas appliances, such as water heaters, stoves, cooktops, clothes dryers, and heating systems with high-efficiency electric appliances and heat pumps at time of replacement, where feasible.
- c. Prohibit the use of natural gas end uses in new residential, multifamily, and buildings in the City's green building ordinance that aligns with the 2022 California Building Standards code update. Extend the same prohibition to new nonresidential buildings in the 2025 code cycle, if not sooner.

RE-4: Innovative Technologies

Investigate and pursue innovative technologies such as micro-grids, battery storage, and demand-response programs that will improve the electric grid's resiliency and help to balance demand and renewable energy production.

RE-5: Solar Energy Systems for Municipal Buildings

Install solar energy systems at municipal buildings and facilities where feasible and investigate and pursue innovative technologies such as battery storage and demand response programs.

RE-6: Municipal Deep Green Electricity

Continue to purchase 100% renewable energy through programs such as MCE Deep Green.



ENERGY EFFICIENCY

14% of potential reductions

Increasing the efficiency of buildings is often the most cost-effective approach for reducing greenhouse gas emissions. Energy efficiency upgrades, such as adding insulation and sealing heating ducts, have demonstrated energy savings of up to 20 percent, while more aggressive “whole house” retrofits can result in even greater energy savings. Many “low-hanging fruit” improvements can be made inexpensively and without remodeling yet can be extremely cost-efficient, such as swapping out incandescent bulbs to LED bulbs, sealing air leaks, and installing a programmable thermostat. Energy Star-certified appliances and office equipment, high-efficiency heating and air conditioning systems, and high-efficiency windows not only save energy but reduce operating costs in the long run.

New construction techniques and building materials, known collectively as “green building,” can significantly reduce the use of resources and energy in homes and commercial buildings. Green construction methods can be integrated into buildings at any stage, from design and construction to renovation and deconstruction. The State of California requires green building energy-efficiency through the Title 24 Building codes. The State updates these codes approximately every three years, with increasing energy efficiency requirements since 2001. The State’s energy efficiency goals are to have all new residential and commercial construction to be zero net energy by 2030. Local governments can accelerate this target by adopting energy efficiency standards for new construction and remodels that exceed existing State mandates, or by providing incentives, technical assistance, and streamlined permit processes to enable quicker adoption.

The City will take the following actions to reduce emissions in the built environment.

Things You Can Do

- #1 Replace indoor and outdoor lights with LED bulbs and turn them off when not in use.
- #2 Have an energy assessment done for your home or business.
- #3 Upgrade insulation, seal leaks, and install a programmable thermostat.
- #4 Purchase Energy Star appliances and equipment.
- #5 Unplug electronic appliances when not in use and set the thermostat to use less heat and air conditioning.

TABLE 7: ENERGY EFFICIENCY MEASURES

ID	Measure	GHG Reduction by 2030 (MTCO ₂ e)	Share of Reductions
EE-1	Energy Efficiency Programs	382	96%
EE-2	Energy Audits	16	4%
EE-3	Green Building Reach Code	n/a	n/a
EE-4	Streamline Permit Process and Provide Technical Assistance	n/a	n/a
EE-5	Municipal Energy Efficiency Audit and Retrofits	n/a	n/a
EE-6	Municipal Energy Conservation	0.03	<1%
TOTAL		399	100%

Notes: Emissions reductions from a Green Building Reach Code are included in Measure RE-C3.

There are no GHG savings attributed to measures EE-5 and EE-6 reducing electricity consumption because the City was purchasing 100% renewable electricity in 2019.

EE-1: Energy Efficiency Programs

Promote and expand participation in residential and commercial energy efficiency programs.

- a. Work with organizations and agencies such as the Marin Energy Watch Partnership, the Bay Area Regional Network, Resilient Neighborhoods, and the Marin Climate & Energy Partnership to promote and implement energy efficiency programs and actions.
- b. Continue and expand participation in energy efficiency programs such as Energy Upgrade California, California Energy Youth Services, and Smart Lights.
- c. Promote utility, state, and federal rebate and incentive programs.
- d. Participate and promote financing and loan programs for residential and non-residential projects such as Property Assessed Clean Energy (PACE) programs, PG&E on-bill repayment, and California Hub for Energy Efficiency Financing (CHEEF) programs.

EE-2: Energy Audits

Investigate requiring energy audits for residential and commercial buildings prior to completion of sale, including identification of cost savings from energy efficiency measures and potential rebates and financing options.

EE-3: Green Building Reach Code

- a. Adopt green building requirements for new and remodeled commercial and residential projects above the State building code.
- b. Consider adopting low embodied-carbon concrete standards similar to those adopted by the County of Marin.

EE-4: Streamline Permit Process and Provide Technical Assistance

Analyze current green building permit and inspection process to eliminate barriers and provide technical assistance to ensure successful implementation of green building requirements. Coordinate with other

Marin County agencies to adopt consistent application requirements, where practicable. Work county-wide to identify incentives and make it easier for contractors and building counter staff to expedite.

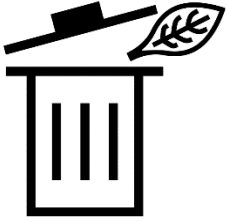
EE-5: Municipal Energy Efficiency Audit and Retrofits

Work with the Marin Energy Management Team to identify and implement energy efficiency projects in municipal buildings and facilities and electrification of existing building systems and equipment that use natural gas.

EE-6: Municipal Energy Conservation

Reduce energy consumption through behavioral and operational changes.

- a. Establish energy efficiency protocols for building custodial and cleaning services and other employees, including efficient use of facilities, such as turning off lights and computers, thermostat use, etc.
- b. Incorporate energy management software, electricity monitors, or other methods to monitor energy use in municipal buildings, where feasible.



WASTE REDUCTION

13% of potential reductions

The things we buy, consume, and throw away generate a lot of greenhouse gas emissions during manufacturing, transport, distribution, and disposal. The best way to reduce emissions is to purchase and consume less in the first place and attempt to gift or donate items to someone who can reuse whatever you no longer need before considering recycling or disposal.

Due to the way we account for community emissions, our Climate Change Action Plan does not take credit for reducing upstream emissions. Instead, our GHG accounting is directly concerned with emissions that are created from the anaerobic decomposition of organic waste in the landfill. The decomposition process creates methane, which is 28 times more potent as a greenhouse gas than carbon dioxide.⁷ Some landfills such as Redwood Landfill capture the methane use it to create biogas or electricity. However, about one-quarter of it escapes into the atmosphere.

Diverting organic material from the landfill is a clear and viable option for reducing these emissions. Paper and cardboard can be recycled. Food scraps, some paper (like napkins, paper towels, and greasy pizza boxes), and yard waste can be composted, either at home or by putting it in the green bin, which is then taken to a composting facility. Surplus food can be donated to non-profits that distribute it to those in need.

The measures below are designed to maximize diversion of organic waste from the landfill by 2025 and further conform with the letter and intent of SB 1383 discussed below. Such measures include encouraging residents and businesses to recycle and compost organic waste. To meet our diversion target, the City will favor trash collection practices that make recycling and composting cost-effective and efficient. The City will also work

Things You Can Do

- #1 Buy only as much as you need.
- #2 Buy locally grown food and eat less meat.
- #3 Put your food scraps in the green can and/or compost them at home.
- #4 Donate extra food and used clothing and housewares.
- #5 Consult the waste hauler's website to understand what to recycle and compost.
- #6 Conserve paper by implementing digital practices at home such as paperless billing, online banking, an online document storage and remove yourself from junk mailing lists.
- #7 Use refillable water bottles and coffee cups and take your reusable bags to the store.
- #8 Avoid single-use plastics, utensil, and straws and products that contain bioplastics.
- #9 Dispose of electronics at locations where they can be refurbished.

⁷ Environmental Protection Agency, <https://www.epa.gov/lmop/basic-information-about-landfill-gas>, accessed January 13, 2022.

with the local waste hauler to develop programs that incentivize residents and businesses about these practices.

These local measures also support state legislation to significantly reduce emissions from organic waste disposal. [Senate Bill \(SB\) 1383](#) establishes targets to achieve a 50% reduction statewide in organic waste disposal from the 2014 level by 2020 and a 75% reduction by 2025. The law also establishes a target for at least 20% of currently disposed edible food to be recovered for human consumption by 2025. In 2022, CalRecycle may begin to issue penalties for non-compliance. On January 1, 2024, the regulations may require local jurisdictions to impose penalties for non-compliance on regulated entities subject to their authority.

In addition, [Assembly Bill \(AB\) 1826](#) requires businesses to recycle their organic waste, depending on the amount of waste they generate per week. The law phases in mandatory recycling of commercial organics over time. As of January 2019, businesses that generate 4 or more cubic yards of commercial solid waste per week are required to arrange for organic waste recycling services. In 2020, the law was extended to cover businesses that generate 2 cubic yards or more of commercial solid waste.⁸

Belvedere supports the Waste Hierarchy, as set of practices that should be the basis of all waste management. Waste prevention through buying less is the most preferred method waste management and offers the greatest environmental benefits. This is followed by the reuse of products, which prolongs the life of the materials; donations are a great way to reuse products. Recycling and composting are next in the hierarchy as their processes turn waste material into new products, thereby conserving virgin resources. Safe disposal should be the last choice as it is typically landfilled or incinerate, releasing greenhouse gasses and harmful pollutants into the atmosphere.⁹

FIGURE 8 : THE WASTE HEIRARCHY



⁸ CalRecycle, <https://www.calrecycle.ca.gov/recycle/commercial/organics>, accessed January 13, 2022.

⁹ Environmental Protection Agency, <https://www.epa.gov/smm/sustainable-materials-management-non-hazardous-materials-and-waste-management-hierarchy>, accessed January 13, 2022.

Plastics are one of the materials that can often be recycled, but single use plastics such as such as straws and cutlery, end up in the landfill because their small size allows them to fall through the machinery openings. Many products are labeled as compostable, but also end up in the landfill because their materials contain bioplastics. Plastics are harmful to our marine life, fish, and birds, and they release greenhouse gas emissions during their manufacturing process. Belvedere supports Marin County’s proposed Reusable Foodware Ordinance for the local food service industry that prioritizes the use of reusables, prohibits the use of single use plastics, and encourages residents not to purchase single use plastics or products made with bioplastics.¹⁰

The City will take the following actions to reduce emissions from waste.

TABLE 8: WASTE REDUCTION MEASURES

ID	Measure	GHG Reduction by 2030 (MTCO ₂ e)	Share of Reductions
WR-1	Commercial Organic Waste	345	96%
WR-2	Residential Organic Waste		
WR-3	C&D Debris and Self-Haul Waste		
WR-5	Waste Hauler Agreement		
WR-6	Extended Producer Responsibility	n/a	n/a
WR-7	Inorganic Waste	n/a	n/a
WR-8	Waste from Public Containers and City Operations	14	4%
TOTAL		359	100%

WR-1: Commercial Organic Waste

Work with Zero Waste Marin, the local waste hauler, and non-profits such as Extra Food to divert commercial organic waste from the landfill through recycling, composting, and participation in waste-to-energy and food recovery programs.

- a. In compliance with SB 1383, adopt an ordinance requiring mandatory subscription to organics collection provided by the local waste hauler for all business, including multifamily residential dwellings, that produce 2 cubic yards or more of organic waste.
- b. Conduct outreach and education to businesses and private social clubs subject to State organic waste recycling mandates (AB 1826 and SB 1383) and encourage and enforce compliance with the law.
- c. Refer new and major remodel commercial and multi-family residential project proposals to the City's waste hauler for review and comment and require projects to provide adequate waste and recycling facilities and access as feasible.

¹⁰ County of Marin, <https://www.marincounty.org/depts/cd/divisions/environmental-health-services/reusable-foodware-ordinanc>, accessed January 13, 2022.

- d. Encourage and facilitate commercial and multi-family property owners to require responsible use of on-site recycling facilities in lease and rental agreements and to train and regularly evaluate janitorial, landscape, and other property management services.
- e. Assess capacity of existing food recovery programs, expand existing food recovery infrastructure if needed, monitor commercial generators for compliance, and conduct education and outreach.

WR-2: Residential Organic Waste

- a. Work with Zero Waste Marin, the local waste hauler, and other organizations to provide free educational resources that motivate residents to utilize curbside collection services (green bins) and home composting for food waste.

WR-3: Construction & Demolition Debris and Self-Haul Waste

- a. Require all loads of construction & demolition debris and self-haul waste to be processed for recovery of materials as feasible.
- b. Investigate creation of an ordinance requiring deconstruction of buildings proposed for demolition or remodeling to salvage materials of significant historical, cultural, aesthetic, functional or reuse value.
- c. Wherever feasible, keep soil on site and discourage “cut and fill.”

WR-4: Waste Hauler Services

- a. Review and revise the City’s franchise agreement with the waste hauler to ensure waste reduction and diversion targets are met.
- b. Ensure organic waste collection service (including green waste, food waste, fibers, and manure) that complies with SB 1383 regulations is provided to all residents and businesses.
- c. Conduct a feasibility study and encourage the waste hauler to consider investing in new solid waste processing infrastructure to remove recoverable materials (recycling and organics) from the waste stream and reduce contamination.
- d. Require regular residential and commercial waste audits and waste characterization studies to identify opportunities for increased diversion and to track progress in meeting targets.
- e. Embark on an education and social marketing campaign to increase waste reduction, reuse, recycling, and composting by residents and businesses.

WR-5: Extended Producer Responsibility

- a. Encourage the State to regulate the production and packaging of consumer goods and take-back programs.
- b. Encourage on-demand product and food delivery services to reduce packaging waste and investigate requirements and incentives for the same through ordinance and/or engagement campaigns.

WR-6: Inorganic Waste

- a. Promote reuse, repair, and recycling of inorganic materials, and encourage reduced use of packaging and single use items, including plastics and products with bioplastics, through engagement campaigns.
- b. Establish best practices to dispose of paint, electronics, and other hazardous waste materials in a socially responsible manner.
- c. Consider adopting a Reusable Foodware Ordinance for local businesses.

WR-7: Waste from Public Containers and City Operations

- a. Embark on an educational and social marketing-based campaign to increase waste reduction, reuse, recycling, and composting within municipal operations at public facilities.
- b. Conduct periodic waste audits of City facilities to understand where opportunities for increased diversion lie and to track progress.
- c. Provide attractively designed containers in public areas for food waste collection.



WATER CONSERVATION

<1% of potential reductions

Belvedere is no stranger to periodic droughts and the need to conserve water, and the community has responded by reducing per capita water use by about 25%, from 142 gallons per person per day (gpcd) in 2005 to 107 gpcd in 2019 (based on district-wide data). In addition to installing low-flow fixtures (showerheads, faucets, and toilets) and water-efficient appliances (clothes washers and dishwashers), residents and businesses are planting native, drought-tolerant species and even replacing lawns with attractive, low-water use gardens. Good thing, because as temperatures continue to rise, we will experience more droughts and more intense heat waves than before.

Our Greenhouse Gas Inventory counts emissions that are generated from the energy used to pump, treat, and convey water from the water source to Belvedere water users. Far more emissions are created from the energy that is used to heat water, but those emissions are counted in the Built Environment sectors. Therefore, the water sector comprises a much smaller share of community emissions than one might expect.

The water agencies that supply Belvedere's water are committed to using 100% renewable energy in their operations. Marin Municipal Water District (MMWD) began purchasing Deep Green electricity from MCE in 2017, and Sonoma County Water Agency, which provides 20-25% of MMWD's water, started purchasing 100% renewable electricity in 2015. As a result, emissions from the water sector are very small.

It is important to remember, however, that energy used to heat water contributes significantly to a household's carbon footprint, especially if the hot water heater uses natural gas. A hot water heater using natural gas generates approximately 1.5 MTCO₂e per year, or about one-quarter of the average household's energy emissions in Belvedere. Switching to an electric heat pump water heater can reduce emissions from heating water up to 90%.

In addition, water conservation reduces the amount of wastewater and the greenhouse gas emissions that are created from the wastewater treatment process.

The City will take the following actions to reduce emissions from water use.

Things You Can Do

- #1 Replace your lawn with a drought-tolerant garden.
- #2 Install a drip irrigation system and check it regularly for leaks.
- #3 Install low water flow faucets, showerheads, and toilets.
- #4 Buy water-efficient dishwashers and clothes washers when it is time to replace them.
- #5 Replace your natural gas hot water heater with an electric heat pump water heater.

TABLE 9: WATER CONSERVATION MEASURES

ID	Measure	GHG Reduction by 2030 (MTCO ₂ e)	Share of Reductions
WC-1	Community Water Use	0.3	100%
WC-2	Municipal Water Use	Included in WC-1	

WC-C1: Community Water Use

Reduce indoor and outdoor water use in residential and commercial buildings and landscaping.

- a. Work with Marin Municipal Water District (MMWD) and other organizations to promote water conservation programs and incentives.
- b. Educate residents and businesses about local and State laws requiring retrofit of non-compliant plumbing fixtures during remodeling and at resale.
- c. Ensure all projects requiring building permits, plan check, or design review use water-efficient landscaping in compliance with State and MMWD regulations.
- d. Encourage the installation of greywater and rainwater collection systems and the use of recycled water where available through ordinance or engagement campaigns.

WC-2: Municipal Water Use

Reduce indoor and outdoor water use in municipal facilities and operations.

- a. Replace high water use plants and inefficient irrigation systems with water-efficient landscaping.
- b. Replace inefficient plumbing fixtures with high-efficiency fixtures.
- c. Use recycled water as available and practicable for parks and outdoor landscaping.



SEQUESTRATION AND ADAPTATION

California is already experiencing the effects of climate change. Every year, it seems like the news gets grimmer: more wildfires, more heat waves, longer droughts, more intense storms, less snowpack, and less fresh water. Annual average air temperatures have already increased by about 1.8 °F in California, and that number will likely double even if the world can reduce emissions 80% by 2050. Belvedere needs to be prepared for the likely impacts of climate change, including flooding from more intense storms and sea level rise, health impacts from heat exposure and poor air quality, and safety risks from the increased likelihood of wildfires and landslides.

Sea level rise is a particular concern to Belvedere, where many homes, businesses, and industrial and recreational facilities are at risk for flooding. Sea level has already risen 8” in San Francisco Bay and is expected to rise another 10 inches by 2040. Within this short period, homes in the flat areas and around the lagoon could be flooded if levees are overtopped and would be vulnerable to worsening subsidence. Shoreline homes West Shore and Beach Roads would be vulnerable, especially during storms.

By the end of the century, sea level is projected to rise 2.4 to 3.4 feet, and possibly as much as 5 feet. At the higher end, 470 buildings, or 27% of all Belvedere’s buildings, could face some level of tidal flooding. A comprehensive assessment of Belvedere’s vulnerable assets was completed in 2017. For more information, see the [Marin Shoreline Sea Level Rise Assessment](#). While the Climate Action Plan contains some measures that address adaptation, a more complete set of goals, policies and programs are contained in the 2018 Marin County Multi-Jurisdictional Local Hazard Mitigation Plan.

In addition to adaptation strategies, this section contains measures to sequester carbon dioxide through planting and preservation of trees and other vegetation and the development of carbon-rich soils. Carbon offsets are often used to fund these types of carbon sequestration projects and can be purchased to offset emissions that are difficult to otherwise mitigate, such as airplane flights. We have not credited emission reductions for these actions because we do not count sequestered carbon in the community greenhouse gas inventory, but we recognize that sequestration is a critical component to meeting our carbon reduction goals.

The City will take the following actions to sequester carbon dioxide and adapt to climate change.

What You Can Do

#1 Plant trees appropriate to your situation.

#2 Add compost to your soil.

#3 Purchase carbon offsets for airplane flights and other emissions that are difficult to mitigate.

#4 Find out if your home or business is vulnerable to sea level rise at [Our Coast Our Future](#).

TABLE 10: SEQUESTRATION AND ADAPTATION MEASURES TO REDUCE COMMUNITY EMISSIONS

ID	Measure
SA-1	Urban Forest
SA-2	Carbon Sequestration
SA-3	Carbon Offsets
SA-4	Climate Change and Sea Level Rise Adaptation

SA-1: Urban Forest

Increase carbon sequestration and improve air quality and natural cooling through increasing tree cover in Belvedere. Preserving Belvedere’s vegetation is an essential adaptation to climate change, even as we balance these assets against the desire to protect view corridors, both public and private, which are important characteristics of the aesthetic life in Belvedere.

- a. Plant additional trees on City-owned land, including public parks and open space, where feasible.
- b. Review parking lot landscape standards to maximize tree cover, size, growth, and sequestration potential.
- c. Continue to regulate and minimize removal of large (heritage) trees and require planting of replacement trees and/or fees to support mitigation planting in Belvedere parks and open space areas.
- d. Require that the site planning, construction, and maintenance of new development preserve existing healthy trees and native vegetation on site to the maximum extent feasible. Replace trees and vegetation not able to be saved per subsection (c) above.
- e. Encourage community members to plant trees on private land.
- f. Permit reasonable maintenance of bees on private land.
- g. Require permeable pavement to capture surface run-off to support landscaping in all parks, open space, and common areas.
- h. Provide information to the public, including landscape companies, gardeners, and nurseries, on carbon sequestration rates, drought tolerance, and fire resistance of different tree species.
- i. Collaborate with fire agencies and Marin County Open Space District, Marin Municipal Water District, and private property owners, to manage fire-prone trees and invasive species in the open space for forest health and reduction of fuel load.
- j. Require new development, redevelopment, and infrastructure projects to implement best management practices, e.g., promoting low-impact construction and development techniques, avoiding non-pervious surfaces in landscape design, and integrating natural features into the project design, to naturally filter and biodegrade contaminants and to minimize surface runoff.
- k. Remove redwood trees from the City’s list of undesirable trees due to their extremely high sequestration rate.

SA-2: Carbon Sequestration

Increase carbon sequestration in the built environment, developed landscapes, and natural areas.

- a. Where appropriate, encourage the use of building materials that store carbon through agency partnerships and engagement campaigns.
- b. Encourage and support composting to develop healthy, carbon-rich soils.
- c. Manage parks and open spaces to steadily increase carbon in vegetation and soil.

SA-3: Carbon Offsets

Reduce the impact of greenhouse gas emissions through the purchase of carbon offsets.

- a. Encourage community members to purchase carbon offsets to reduce their carbon footprint through engagement campaigns.
- b. Consider partnering with a local non-profit organization to promote an effective carbon offset program.
- c. Educate community members as to means for offsetting emissions that are difficult to mitigate otherwise, such as airplane travel.

SA-4: Climate Change and Sea Level Rise Adaptation

Prepare for and adapt to a rising sea level.

- a. Support and integrate Climate Action Planning and implementation with the ongoing adaptation efforts of BayWAVE.
- b. Coordinate and integrate climate adaptation planning consistently throughout related City plans, including but not limited to the General Plan and its Safety Element, Local Hazard Mitigation Plan (LHMP), sea level rise adaptation plans, Community Wildfire Protection Plan, and emergency and capital improvement plans.
- c. Promote fair and robust inclusion of lower-income households, regardless of home ownership, in the planning and response to climate change impacts, including sea level rise, flood risk, fire, public health, and emergency preparedness.
- d. Collaborate with Marin cities and towns, the County of Marin, special districts, JPAs, and regional bodies to coordinate and integrate planning.



COMMUNITY ENGAGEMENT

The Climate Action Plan contains actions that the City can undertake to reduce its own emissions by about 51 MTCO₂e, bringing the emissions from municipal operations down to 50% below 2005 levels. However, since emissions from governmental operations make up only about 1% of community-wide emissions, that is just a drop in the bucket.

Our residents, businesses, workers, and visitors will have to do their part to ensure we meet our reduction targets. The City can compel some of these actions by adopting ordinances and building regulations, but much of the success of our plan will depend on informing our community members and encouraging them to act on their own. This section details the ways in which the City will seek public engagement and work with local businesses and community groups to achieve the emissions reductions identified for measures in other sections of the Plan.

The City promotes [Resilient Neighborhoods](#) to educate Belvedere residents on ways they can reduce their carbon footprint. The program organizes Climate Action Teams that meet five times over two months to learn about strategies and resources to improve home energy efficiency, shift to renewable energy, use low-carbon transportation, conserve water, reduce waste, and adapt to a changing climate. To start, participants calculate their household carbon footprint and then take actions to reduce their greenhouse gas emissions by at least 5,000 pounds or 25%. Studies show that Resilient Neighborhoods' graduates not only continue to fulfill pledges and further reduce household emissions after the program ends, they also inspire friends and families to take action.

Things You Can Do

- #1 Sign up for Resilient Neighborhoods and join a Climate Action Team.
- #2 Commit to reducing your carbon footprint by taking the actions identified in this Plan.
- #3. Spread the word - advocate to your neighbors, employees, co-workers, etc.

The City will take the following actions to engage the community to reduce emissions.

TABLE 11: COMMUNITY ENGAGEMENT MEASURES TO REDUCE COMMUNITY EMISSIONS

ID	Measure
CE-1	Community Education
CE-2	Community Engagement
CE-3	Advocacy
CE-4	Green Businesses

CE-1: Community Education

Work with community-based outreach organizations, such as Resilient Neighborhoods, to educate and motivate community members on ways to reduce greenhouse gas emissions in their homes, businesses, transportation modes, and other activities.

CE-2: Community Engagement

Implement a communitywide public outreach and behavior change campaign to engage residents, businesses, and consumers around the impacts of climate change and the ways individuals and organizations can reduce their GHG emissions and create a more sustainable, resilient, and healthier community. Create an overarching theme to articulate a long-term goal, motivate community members, and brand a comprehensive suite of GHG-reduction programs. Prioritize promotion of programs that have the greatest greenhouse gas reduction potential while utilizing the best practices for public outreach and education. Emphasize and encourage citizens' involvement in reaching the community's climate goals, including innovative means of tracking milestones and comparing Belvedere's performance with other communities and with state, national and global benchmarks.

- a. Conduct outreach to a wide variety of neighborhood, business, educational, faith, service, and social organizations.
- b. Inform the public about the benefits of installing energy and water-efficient appliances and fixtures, electrifying their homes and commercial buildings, installing solar energy systems, and purchasing 100% renewable electricity.
- c. Inform the public about the benefits of using carbon-free and low-carbon transportation modes, such as driving electric vehicles, walking, bicycling, taking public transportation, and ridesharing.
- d. Utilize and tailor existing marketing materials when available.
- e. Work with Marin County health and environmental services and other Marin agencies to promote the environmental (and health) benefits of a more plant-based diet, including growing food at home and purchasing locally produced food.
- f. Partner with MCE, PG&E, MMWD, Marin Sanitary Service, Transportation Authority of Marin, Marin Transit, Golden Gate Transit, SMART, and other entities to provide and promote equitable financing, audits, rebates, incentives, and services to the Belvedere community.
- g. Utilize the City's website, newsletters, social media, bill inserts, public service announcements and advertisements, recognition programs, and other forms of public outreach.
- h. Create stories and "shareable content" that can be used by residents, businesses, non-profits, in both the social media and the traditional media context.
- i. Use creative methods to engage the public, such as games, giveaways, prizes, contests, simple surveys, digital tools, and "pop-up" events.
- j. Develop pilot programs using community-based social marketing and other community outreach and incentive programs to encourage positive changes in local consumer habits.
- k. Participate in countywide outreach and education efforts.

CE-3: Advocacy

Advocate at the regional, state, and federal levels for policies and actions that support the rapid transition to GHG-free energy sources, electrification of buildings and the transportation fleet, and other impactful measures to rapidly reduce greenhouse gas emissions.

CE-4: Green Businesses

Encourage local businesses to participate in the Marin County Green Business Program through partnerships with the County, Chamber, and other business groups.



IMPLEMENTATION AND MONITORING

Plans are only effective if they are implemented, and results are carefully evaluated. The City will prepare an annual assessment of the progress it is making on implementing the measures contained in this Climate Action Plan and continue to quantify community and greenhouse gas emissions to determine if we are on track to meet our reduction targets.

The City will take the following actions to implement and monitor the Climate Action Plan.

Things You Can Do

#1 Get involved! Attend City Council meetings, Climate Action Plan implementation forums, and other public forums to voice your support for actions contained in this Plan.

TABLE 12: IMPLEMENTATION AND MONITORING MEASURES TO REDUCE COMMUNITY EMISSIONS

ID	Measure
IM-1	Annual Monitoring
IM-2	Update GHG Emissions Inventories
IM-3	Funding Sources
IM-4	Update the Climate Change Action Plan

IM-1: Annual Monitoring

Monitor and report on the City’s progress annually. Track and report on key metrics such as number of ZEV registrations, natural gas appliance conversions, and EV chargers installed. Create an annual priorities list for implementation.

IM-2: Update GHG Emissions Inventories

Update and report the greenhouse gas emissions inventory for community emissions annually and every five years for government operations.

IM-3: Funding Sources

Identify funding sources for recommended actions, and pursue local, regional, State, and federal grants as appropriate. Investigate creation of a local carbon fund or other permanent source of revenue to implement the Climate Action Plan.

IM-4: Update the Climate Action Plan

Update the Climate Action Plan regularly to incorporate new long-term reduction targets and strategies to meet those targets.

ACKNOWLEDGMENTS

City Council

Sally Wilkinson, Mayor
Steve Block, Vice Mayor
James Campbell
Nancy Kemnitzer
James Lynch

City Staff

Irene Borba, Director of Planning & Building
Rebecca Markwick, Senior Planner

Marin Climate & Energy Partnership

Christine O'Rourke, Sustainability Coordinator

Funded by the Marin Climate & Energy Partnership and the Marin Energy Watch Partnership.

Appendix A: Program Calculations

GHG EMISSIONS REDUCTION SUMMARY City of Belvedere		
	Measure	2030 GHG Emissions Reductions (MTCO₂e/yr)
<i>Local Actions</i>		
LCT-1	Zero Emission Vehicles	-837
LCT-3	Walking	-0.5
LCT-4	Safe Routes to School	-8
LCT-5	Public Transit	-3
LCT-6	Employee Trip Reduction	-30
LCT-10	Electric Landscape Equipment	-8
LCT-11	Zero and Low Emission City Vehicles	-30
LCT-12	Low Carbon Fuels for City Vehicles	-3
LCT-13	City Employee Commute	-4
RE-1	Renewable Energy Generation and Storage	-157
RE-2	MCE Electricity	-374
RE-3	Building and Appliance Electrification	-568
EE-1	Energy Efficiency Programs	-382
EE-2	Energy Audits	-16
EE-4	Municipal Energy Conservation	-0.3
WR 1-5	Waste Diversion Measures	-345
WR-8	Municipal Waste Diversion	-14
WC-1	Community Water Use	0
WC-2	Municipal Water Use	0
TOTAL - LOCAL ACTIONS		-2,780
<i>State Actions</i>		
RPS		-36
TITLE 24		-228
Light and Heavy-Duty Fleet Regulations		-699
Small Off-Road Equipment		-58
TOTAL - STATE ACTIONS		-963

<i>Projected Emissions</i>	
Projected BAU Community GHG Emissions	11,186
Emissions Reduction from Local and State Actions	-3,743
Projected Community Emissions with Local and State Actions Implemented	7,444
2030 GHG Target to Meet State Goals	7,576
<i>Reduction from 2005 Baseline Emissions</i>	
2005 Community GHG Emissions	14,855
Community Emissions with Local and State Actions Implemented	7,444
% Reduction from 2005 Emissions	50%
<i>Reduction from Estimated 1990 Emissions</i>	
Estimated 1990 GHG Level	12,627
% Below 1990 Levels	41%

ZERO EMISSION VEHICLES <i>LCT-1</i>	
Reductions (MTCO ₂ e) -837	2030
Targets	35% of passenger vehicles in Marin are ZEVs in 2030 (approximately 70,000 ZEVs). 21% annual growth rate of registered ZEVs in Marin.
Methodology and Assumptions	<p>Marin has approximately 1.5% of all ZEVs in California (DMV, 1-1-19) and 197,609 automobiles registered in the County (DMV, 2019). CARB's proposed strategy is to put 4.2 million ZEVs on the road by 2030, which is approximately 14% of light duty vehicles in California in 2030. In January 2018, Governor Jerry Brown issued Executive Order B-48-18 set a new goal of having a total of 5 million ZEVs in California in 2030. In September 2020, Governor Gavin Newsom issued Executive Order N-79-20 which sets a goal for 100 percent of in-state sales of new passenger cars and light trucks to be zero-emission by 2035.</p> <p>By the end of 2019, the CEC reports there were 5,362 battery EVs (BEV), 3,076 Plug-in hybrids (PHEV), and 60 fuel cell vehicles, for a total of 8,498 ZEVs. By the end of 2020, the CEC reports there were 6,377 BEVs, 3,280 PHEVs, and 52 fuel cell vehicles, for a total of 9,709 ZEVs. This represents an annual growth rate of 14.25%. We conservatively assume the same percentage of EVs in 2030 as in 2020: 66% battery EVs and 34% plug-in hybrids.</p> <p>74% of the distance PHEVs drive is electric (Smart et al, 2014).</p> <p>EV kWh/mile is 0.32 (US Dept of Energy).</p> <p>Assuming the same share of ZEV ownership in 2030 as in 2019 (1.5%) means there would be approximately 75,000 ZEVs registered in Marin by 2030, or approximately 37% of existing automobile registrations. We assume 69,699 ZEVs in Marin in 2030, or 35% of ZEVs registered in Marin. This would require an average annual growth rate of 21%. Electric vehicle sales in Marin grew by 26% in 2018 and 28% in 2019 (ICCT, 2018). This data suggests that an annual growth rate of 21% is reasonable, especially as the number of models expands and battery technology and charging improves.</p> <p>Passenger VMT is adjusted to reflect the fact that approximately 35% of countywide commute VMT originates in workers who live outside Marin County (TAM). Measure does not apply to VMT generated by Belvedere workers and visitors who do not live in Marin.</p> <p>According to the Department of Energy, towns (population 2,500 to 50,000) need 54 public EV plugs per 1,000 PEVs, which would equal about 3,549 public EV plugs countywide for 65,717 ZEVs. The analysis assumes 88% of EV charging is done at home.</p>

Sources	<p>California Air Resources Board, 2017 Scoping Plan.</p> <p>Smart, J., Bradley, T., and Salisbury, S., "Actual Versus Estimated Utility Factor of a Large Set of Privately Owned Chevrolet Volts," SAE Int. J. Alt. Power. 3(1):2014, doi:10.4271/2014-01-1803.</p> <p>U.S, Department of Energy, Alternative Fuels Data Center, https://www.afdc.energy.gov/vehicles/electric_emissions_sources.html. Sales weighted average of 2016 model year vehicles with sales in 2015: 2015 sales from "U.S. Plug-in Electric Vehicle Sales by Model" (https://www.afdc.energy.gov/data/vehicles.html); MPGs from 2016 Fuel Economy Guide (https://www.fueleconomy.gov/feg/)</p> <p>The International Council on Clean Transportation, "California's continued electric vehicle market development," May 2018, https://www.theicct.org/sites/default/files/publications/CA-cityEV-Briefing-20180507.pdf.</p> <p>US Department of Energy, "National Plug-In Electric Vehicle Infrastructure Analysis," September 2017. https://www.nrel.gov/docs/fy17osti/69031.pdf</p> <p>Bay Area Air Quality Management District, Vehicle Miles Dataportal, http://capvmt.us-west-2.elasticbeanstalk.com/, accessed 1/19/22.</p> <p>California Department of Transportation, "California County-Level Economic Forecast 2018-2050," September 2018.</p> <p>California Energy Commission, "Zero Emission Vehicle and Infrastructure Statistics," https://www.energy.ca.gov/data-reports/energy-insights/zero-emission-vehicle-and-charger-statistics, accessed January 19, 2022.</p> <p>Personal communication with Derek McGill, Planning Manager, Transportation Authority of Marin, dmcgill@tam.ca.gov, August 22, 2018.</p>
---------	---

Calculation

	2030
Number of registered Marin ZEVs by end of 2019	8,498
% of total light-duty vehicles in 2019	4.2%
Projected number of registered passenger vehicles in Marin in 2030	199,141
Percent of Marin ZEVs in target year	35%
Number of Marin ZEVs in target year	69,699
Percent of ZEVs in Marin assumed by EMFAC2021	8.2%
Increase in ZEVs	61,201
Additional ZEVs as a percent of Marin vehicles from this measure	26.8%
Belvedere passenger VMT	11,592,967 miles
VMT from non-Marin workers and visitors	1,099,191 miles
Belvedere passenger VMT from Marin-based vehicles	10,493,776 miles
VMT from additional ZEVs	2,815,062 miles
VMT driven with electricity	2,566,210 miles
Emissions without EV program	991 MTCO _{2e}

Tailpipe emissions reduction with EV program	903	MTCO ₂ e
Electricity used by ZEVs	821,187	kWh
Electricity emissions from ZEVs	66	MTCO ₂ e
Emissions reduction	837	MTCO ₂ e

WALKING <i>LCT-3</i>	
Reductions (MTCO _{2e}) 0.5	2030
Targets	2% reduction in VMT for vehicle trips that start and end in Belvedere by 2030
Methodology and Assumptions	Studies cited by CAPCOA show pedestrian network improvements can reduce VMT 1-2% (CAPCOA SDT-1). We apply this to passenger vehicle trips that start and end Belvedere and assume a 1% reduction for 2030.
Sources	California Air Pollution Control Officers Association, "Quantifying Greenhouse Gas Mitigation Measures: A Resource for Local Government to Assess Emission Reductions from Greenhouse Gas Mitigation Measures," August, 2010. Bay Area Air Quality Management District Vehicle Miles Traveled Data Portal, http://capvmt.us-west-2.elasticbeanstalk.com/data

Calculation

	2030
Passenger vehicle trips starting and ending in Belvedere	67,149 VMT
% decrease in VMT due to pedestrian improvements	2.0%
Annual decrease in VMT	1,343 VMT
GHG emissions reductions	0.5 MTCO _{2e}

SAFE ROUTES TO SCHOOL <i>LCT-4</i>	
Reductions (MTCO ₂ e) -8	2030
Targets	Reduce school trips in family vehicle by 29%, from an average of 45% to 32%.
Methodology and Assumptions	<p>To demonstrate the benefits of providing Safe Routes to Schools, the Marin County Bicycle Coalition recruited nine pilot schools in four different geographic locations. Initial surveys reported that 62% of the students were arriving by car, with only 14% walking, 7% biking to school, 11% carpool, and 6% arriving by bus. Every school in the pilot program held periodic Walk and Bike to School Days and participated in the Frequent Rider Miles contest, which rewarded children who came to school walking, biking, by carpool or bus.</p> <p>At the end of the pilot program, the participating schools experienced a 57% increase in the number of children walking and biking and a 29% decrease in the number of children arriving alone in a car.</p> <p>We assume an elementary school and middle school population (K-8) population of 301 with an average trip length of 1.7 mile, 180 school days, and an existing share of school trips completed in a family vehicle of 41% according to recent Safe Routes to School surveys taken at participating schools in Tiburon serving the Belvedere community.</p>
Sources	<p>US Census Bureau, American Community Survey 5-Year Estimates 2019, Table B14001.</p> <p>Safe Routes to School Marin County, http://www.saferoutestoschools.org/sr2s_reed_union.html</p> <p>Safe Routes to School Marin County, http://www.saferoutestoschools.org/history.html#success</p>

Calculation

	2030
School population miles travelled	191,485 miles
Percent of miles driven in a family vehicle	41%
Potential percent decrease in students driving to school	29 %
VMT avoided	22,768 VMT
Emissions reductions	8 MTCO ₂ e

PUBLIC TRANSIT
LCT-5

GHG Reductions (MTCO _{2e})	-3	2030
Targets	33% of Marin Transit and Golden Gate Transit buses will be electric by 2030 and the remaining use renewable diesel.	
Methodology and Assumptions	<p>Marin Transit reports 3,674,440 revenue miles in FY 2019 and 0.1% of those are within Belvedere for a total of 4,757 revenue miles attributed to Belvedere. Marin Transit's Draft Fixed Route Vehicle Replacement Plan indicates 33% of its fleet will be zero emission by 2030. In 2019, 72% of its buses were using renewable diesel and 3% of the fixed route buses were zero emission. Marin Transit has been using renewable diesel since 2016. We assume 33% will be driven by electric buses utilizing MCE electricity by 2030.</p> <p>CARB adopted the Innovative Clean Transit (ICT) Rule in December 2018. This rule outlines a transition of California transit agencies to a zero emission fleet by 2040. 100% of transit agencies' bus purchases must be zero emission beginning in 2029. Marin Transit's Draft Fixed Route Vehicle Replacement Plan (2019) identifies purchases that will achieve the ICT zero emission fleet mandate in 2040.</p>	
Sources	<p>Marin Transit Board of Directors Staff Report, April 1, 2019</p> <p>Personal communication with Keith Nunn, Director of Maintenance, Golden Gate Transit, Oct. 22, 2019.</p> <p>Personal communication with Anna Penoyar, Senior Capital Analyst, Marin Transit, Oct. 22, 2019.</p>	

Calculation

	2030
Belvedere's share of passenger revenue miles	4,757 miles
Emissions, BAU	6 MTCO _{2e}
Renewable diesel VMT	67%
Electric bus VMT	33%
Emissions	3 MTCO _{2e}
GHG emissions reductions	3 MTCO _{2e}

EMPLOYEE TRIP REDUCTION

LCT-6

Reductions (MTCO _{2e})	-30	2030
Targets	100% of covered employers provide an employee trip reduction program.	
Methodology and Assumptions	<p>CAPCOA TRT-1 indicates VMT reduction of 5.4% for suburban center location. Employer programs include: carpooling, ride matching, preferential carpool parking, flexible work schedules for carpools, a half-time transportation coordinator, vanpool assistance, bicycle parking, showers, and locker facilities. This measure assumes voluntary employee participation.</p> <p>BAAQMD Transportation Fund for Clean Air guidance indicates a reduction of 0.2% of commute VMT for Guaranteed Ride Home Programs.</p> <p>MTC identifies 11 unregistered businesses with 50 or more employees in Belvedere with a total of 474 employees. We assume all participate by 2030. We assume 240 workdays per year.</p>	
Sources	<p>California Air Pollution Control Officers Association, "Quantifying Greenhouse Gas Mitigation Measures: A Resource for Local Government to Assess Emission Reductions from Greenhouse Gas Mitigation Measures," August 2010.</p> <p>BAAQMD Transportation Fund for Clean Air Guidance FYE 2018.</p> <p>Personal communication with Corey Dodge, Program Coordinator, Bay Area Metro, cdodge@bayareametro.gov, 10/2/19.</p>	

Calculation

	2030
Number of unregistered employees working in companies with 50 or more employees	474
Number of employees targeted for program	474
Average daily VMT for Belvedere worker	13.3
Estimated annual VMT	1,513,527
VMT reduction	5.6%
Annual decrease in VMT	84,758
GHG emissions reductions	30

ELECTRIC LANDSCAPE EQUIPMENT	
<i>LCT-10</i>	
Reductions (MTCO _{2e})	-8 2030
Target	80% of landscape equipment is electric by 2030.
Methodology and Assumptions	<p>In October 2021, the state passed AB 1346, which states, “By July 1, 2022, the state board shall, consistent with federal law, adopt cost-effective and technologically feasible regulations to prohibit engine exhaust and evaporative emissions from new small off-road engines, as defined by the state board. Those regulations shall apply to engines produced on or after January 1, 2024.”</p> <p>In December 2021, CARB adopted small off-road engines (SORE) regulations that require most newly manufactured small off-road engines to be zero emission starting in 2024. SORE are spark-ignition engines rated at or below 19 kilowatts. Engines in this category are primarily used for lawn, garden, and other outdoor power equipment. An emissions reduction of 70% due to the implementation of AB 1346 is quantified separately as a State Action.</p> <p>For this action SORE subject to the 2024 ban includes lawn mowers, leaf blowers, trimmers, edgers, chainsaws <45 cc, riding mowers, and log splitters. This equipment consumed 1,171,773 gallons of gasoline in 2019 (OFFROAD 2021). Similar to the off-road emissions inventory, we assume 0.8% of emissions are attributable to Belvedere based on its share of countywide households in 2019. We assume an additional 10% reduction in emissions due to City action.</p>
Sources	OFFROAD2021 (v1.0.1) Emissions Inventory

Calculation

	2030
Portable landscape equipment gasoline consumption, BAU	9,375 gallons
Emissions from potable landscape equipment, BAU	83 MTCO _{2e}
Reduction due to City action	10%
Emissions reductions	8 MTCO _{2e}

ZERO AND LOW EMISSION CITY VEHICLES <i>LCT-11</i>	
Reductions (MTCO _{2e}) -30	2030
Targets	50% improvement in fuel efficiency of City vehicles that use gasoline by 2030.
Methodology and Assumptions	As vehicles are replaced, there will be opportunities to purchase/lease electric vehicles or improve vehicle fuel efficiency with similar models. For City electric vehicles, we assume EVs are replacing vehicles with an average 22 MPG, and .32 kWh/mile and that the City continues to purchase 100% GHG-free electricity for municipal operations.
Sources	City of Belvedere 2015 Greenhouse Gas Inventory for Government Operations

Calculation

	2030
City vehicle fleet tailpipe emissions, 2016 (gasoline)	60 MTCO _{2e}
Fuel efficiency improvement for fleet	50 %
Electricity for EVs	23,806 kWh
Electricity emissions	0 MTCO _{2e}
Emissions reductions	30 MTCO _{2e}

LOW CARBON FUELS FOR CITY VEHICLES <i>LCT-12</i>	
Reductions (MTCO _{2e})	-3 2030
Targets	100% of diesel use is replaced with renewable diesel by 2030.
Methodology and Assumptions	Emission factor for renewable diesel derived from data from Nexgen Fuel.
Sources	City of Belvedere 2015 Greenhouse Gas Emissions Inventory for Government Operations http://www.nexgenfuel.com/fleets-commercial-use/

Calculation

	2030
Diesel use, BAU	497 gallons
Renewable diesel percentage	100%
Emissions from diesel fuel	5 MTCO _{2e}
Emissions from renewable diesel fuel	2 MTCO _{2e}
Emissions reductions	3 MTCO _{2e}

CITY EMPLOYEE COMMUTE <i>LCT-13</i>	
Reductions (MTCO _{2e}) -4	2030
Targets	5.6% reduction in employee commute VMT by 2030.
Methodology and Assumptions	CAPCOA Measure TRT-1. VMT reduction is 5.4% for a suburban center location. BAAQMD Transportation Fund for Clean Air guidance indicates a reduction of 0.2% of commute VMT for Guaranteed Ride Home Programs.
Sources	California Air Pollution Control Officers Association, "Quantifying Greenhouse Gas Mitigation Measures: A Resource for Local Government to Assess Emission Reductions from Greenhouse Gas Mitigation Measures," August 2010. BAAQMD Transportation Fund for Clean Air Guidance FYE 2018.

Calculation

	2030
Employee commute VMT, BAU	191,309 VMT
Reduction in VMT	5.6%
VMT avoided	10,713 VMT
Emissions reduction	4 MTCO _{2e}

RENEWABLE ENERGY GENERATION AND STORAGE

RE-1

Reductions (MTCO ₂ e)	-157	2030
Targets	Solar energy installations continue to grow by an average of 108 KW DC each year through 2030.	
Methodology and Assumptions	<p>According to Project Sunroof, 82% of Belvedere buildings have roofs that are solar-viable. These 813 roofs have the capacity for 10.8 MW DC and could generate 14,800,000 kWh per year, which is more than the 10,121,000 kWh consumed in Belvedere in 2019. Project Sunroof estimates there are 92 existing solar installations in Belvedere.</p> <p>By 2019, approximately 550 KW of solar capacity had been installed in Belvedere, producing an estimated 797,000 kWh of electricity. 86 KW was installed in 2020 and 108 KW had been installed in 2021.</p> <p>The analysis assumes new distributed solar capacity will be added at annual rate of rate of 108 KW DC each year, similar to the amount installed in 2021.</p>	
Sources	<p>Project Sunroof, https://www.google.com/get/sunroof/data-explorer/place/ChIJRf47R3CahYARV2ndbPAFwMk/, accessed January 28, 2022.</p> <p>California Distributed Generation Statistics, "NEM Currently Interconnected Data Set," https://www.californiadgstats.ca.gov/downloads/, November 2021.</p>	

Calculation

	2030
Solar capacity added 2019 within City limits	550 KW DC
Estimated solar capacity added each year	108 KW DC
Additional solar through 2030	1,279 KW DC
kWh generated by 1 KW solar energy system	1,450 kWh
Additional electricity produced by distributed PV	1,854,889 kWh
GHG emissions reductions, inc. grid loss	157 MTCO ₂ e

MCE ELECTRICITY <i>RE-2</i>	
Reductions (MTCO _{2e}) -374	2030
Targets	MCE Light Green electricity is 95% GHG-free by 2030 and MCE continues to provide a Deep Green 100% GHG-free alternative.
Methodology and Assumptions	<p>The MCE Operational Integrated Resource Plan 2021-2030 states that MCE Light Green electricity is projected to be 95% GHG-free by 2022 and beyond. We have conservatively estimated a future GHG emission factor by assuming the remainder will be system power using the current emission factor set by CARB of 967.6 lbs CO₂/MWh (eGrid 2019).</p> <p>72.3% of the community electricity load was supplied with MCE Light Green electricity in 2019 and 2.72% with Deep Green electricity. The analysis assumes same percentage of Deep Green and Light Green electricity as in 2019.</p>
Sources	<p>MCE Operational Integrated Resource Plan 2021-2030 (October 5, 2020), p.21. https://www.mcecleanenergy.org/wp-content/uploads/2020/10/MCE-Operational-Integrated-Resource-Plan_2021.pdf</p> <p>Personal communication, Justin Kudo, MCE Manager of Account Services, jkudo@marinenergyauthority.org, July 14 and 15, 2016.</p>

Calculation

	2030
Electricity use, BAU	10,489,877 kWh
Electricity saved through State actions	197,973 kWh
Less electricity saved through energy efficiency and renewable energy actions	2,609,921 kWh
Net electricity use	7,681,983 kWh
Projected MCE Light Green electricity use (72.31% of total)	5,554,989 kWh
Projected MCE Deep Green electricity use (2.72% of total)	208,800 kWh
Electricity emissions w/MCE BAU	496 MTCO _{2e}
Electricity emissions w/MCE	122 MTCO _{2e}
GHG emission reductions	374 MTCO _{2e}

BUILDING AND APPLIANCE ELECTRIFICATION

RE-3.a

Reductions (MTCO ₂ e)	-19.5	2030
Targets	3 cooktops, 5 water heaters and 10 heating systems are replaced with electric versions by 2030 through a Building Decarbonization incentive program.	
Methodology and Assumptions	Potential number of appliance replacements is based on the County's Electrify Marin program which provides cash rebates for natural gas appliance swap-outs. During the first three years of the program (January 2019 - January 2022), the program has provided rebates for 39 stoves cooktops/ranges, 67 water heaters, and 141 heating systems. We assume 0.8% of the replacements will take place in Belvedere homes based on Belvedere's share of countywide households in 2019. With continued funding, outreach, and education, we assume a Building Decarbonization incentive program can produce these results on an annual basis. As of January 2022, no rebates had been issued to Belvedere residents.	
Sources	2019 California Residential Appliance Saturation Study, Volume 2. https://www.energy.ca.gov/data-reports/surveys/2019-residential-appliance-saturation-study Personal communication with Dana Armanino, County of Marin, January 31, 2022.	

Calculation

	2030
Estimated annual natural gas use for stoves and cooktops	25 therms
Estimated annual natural gas use for water heaters	278 therms
Estimated annual natural gas use for space heating and cooling	261 therms
Estimated annual electricity use for stoves and cooktops	71 kWh
Estimated annual electricity use for water heaters	1,794 kWh
Estimated annual electricity use for space heating and cooling	1,589 kWh
Number of cooktops/ranges replaced countywide, annually	39 units
Number of units water heaters replaced countywide, annually	67 units
Number of heating systems replaced countywide, annually	141 units
% share of county-wide replacements	0.8%
Number of cooktops/ranges replaced	2.8 units
Number of units water heaters replaced	4.8 units
Number of heating systems replaced	10.2 units
Natural gas savings	4,061 therms
Electricity consumption	24,985 kWh
GHG emissions reduction	19.5 MTCO ₂ e

BUILDING AND APPLIANCE ELECTRIFICATION	
<i>RE-3.b</i>	
Targets	24% of residential water heaters, 19% of residential cooktops, and 12% of residential dryers are replaced with high efficiency electric appliances.
Reductions (MTCO _{2e})	-312 2030
Methodology and Assumptions	We assume the ordinance applies to water heaters, stoves, cooktops, and clothes dryers in January 2025. We assume the high end of average life expectancies for these appliances. We further assume one-third of potential water heater replacements will be deemed infeasible due to interior location of the water heater.
Sources	2019 California Residential Appliance Saturation Study, Volume 2, Table 11 (single family for dryer) and Table 33 (single family for water heater, dryer, and range/oven). https://www.energy.ca.gov/data-reports/surveys/2019-residential-appliance-saturation-study California Department of Finance, E-5 Population and Housing Estimates for 2010-2020 with 2010 Census Benchmark

Calculation

	2030
Number of single-family homes in Belvedere in 2020	881 units
Estimated annual natural gas use for stove or cooktop	25 therms
Estimated annual electricity use for induction stove or cooktop	71 kWh
% stoves and cooktops replaced	19%
Estimated annual natural gas use for water heater	278 therms
Estimated annual electricity use for heat pump water heater	1,441 kWh
% water heaters replaced	24%
Estimated natural gas use for clothes dryer	12 therms
Estimated electricity use for clothes dryer	552 kWh
% clothes dryers replaced	12%
Natural gas use eliminated	64,707 therms
Additional electricity use	376,877 kWh
GHG emissions reductions	312 MTCO _{2e}

BUILDING AND APPLIANCE ELECTRIFICATION

RE-3.c

Action	Prohibit the use of natural gas end uses in new residential buildings in the City's green building ordinance that aligns with the 2022 California Building Standards code update. Extend the same prohibition to new nonresidential buildings in the 2025 code cycle.
Reductions (MTCO ₂ e) -237	2030
Methodology and Assumptions	<p>We assume adoption of an ordinance in that bans natural gas use in new residential buildings beginning in 2023 and new non-residential buildings in 2026.</p> <p>Replacing residential space heating systems in Climate Forecast Zone 2 that use natural gas with systems that use heat pumps and electricity reduces emissions by an average of approximately 91% (derived from CRASS). We assume the same emissions reduction for electrifying non-residential space heating systems.</p> <p>An estimated 91% of new homes use natural gas for ranges and ovens and 48% use natural gas for dryers (CRASS, Table 34). We assume the ordinance reduces these numbers 100%.</p> <p>We assume all new homes use natural gas for primary space heating and water heating. We assume the ordinance reduces these numbers by 100%. Electricity used to power these systems is regulated under Title 24, which requires solar energy to supply energy requirements.</p> <p>We assume a total of 112 new housing units between 2023 and 2030.</p>
Sources	<p>2019 California Residential Appliance Saturation Study, Volume 2, Table 11 (single family for dryer and range/oven), Table 15 (Forecast Zone 2 for water heating), Table 18 (Forecast Zone 2 for heat pump space conditioning), Table 33 (single family for water heater, dryer, and range/oven), and Table 37 (Forecast Zone 2 for primary heat and hot water heating). https://www.energy.ca.gov/data-reports/surveys/2019-residential-appliance-saturation-study</p> <p>California Energy Commission, California Commercial End-Use Survey (March 2006), https://ww2.energy.ca.gov/2006publications/CEC-400-2006-005/CEC-400-2006-005.PDF</p> <p>California Air Pollution Control Officers Association, "Quantifying Greenhouse Gas Mitigation Measures: A Resource for Local Government to Assess Emission Reductions from Greenhouse Gas Mitigation Measures," August 2010.</p>

Calculation

Residential	2030
New housing units, 2023-2030	158 units
Estimated natural gas use for space heating, per housing unit	261 therms
Estimated natural gas use for water heating, per housing unit	278 therms
Natural gas reduced beyond Title 24 requirements for heating systems	37,051 therms
Estimated annual natural gas use for range/oven	25 therms
Estimated natural gas use for clothes dryer	12 therms
Total natural gas reduced for appliances	4,505 therms
Estimated electricity use for range/oven	404 kWh
Estimated electricity use for clothes dryer	552 kWh
Total electricity used for electrified appliances	99,951 kWh
GHG emissions reductions	229 MTCO ₂ e

Commercial	2030
Natural gas reduced beyond Title 24 requirements	1,468 therms
GHG emissions reductions	7 MTCO ₂ e

ENERGY EFFICIENCY PROGRAMS	
<i>EE-1</i>	
Reductions (MTCO ₂ e)	-382 2030
Targets	Natural gas consumption is reduced an average of 0.7% per year between 2020 and 2030.
Methodology and Assumptions	<p>We are forecasting an annual natural gas savings of 0.7% based on the following:</p> <p>The National Action Plan for Energy Efficiency states among its key findings "consistently funded, well-designed programs are cutting annual savings for a given program year of 0.15 to 1 percent of energy sales."</p> <p>The American Council for an Energy-Efficiency Economy (ACEE) reports for states already operating substantial energy efficiency programs, energy efficiency goals of one percent, as a percentage of energy sales, is a reasonable level to target.</p> <p>Natural gas consumption in Belvedere declined an average of 0.7% per year between 2005 and 2019. Although electricity use declined an average of 0.3% per year in Belvedere between 2005 and 2019, this was offset by solar production. Therefore, there were no net electricity consumption savings, and no electricity reductions are forecasted.</p>
Sources	<p>National Action Plan for Energy Efficiency, July 2006, Section 6: Energy Efficiency Program Best Practices (pages 5-6).</p> <p>Energy Efficiency Resource Standards: Experience and Recommendations, Steve Nadel, March 2006 ACEEE Report E063 (pages 28-30).</p>

Calculation

	2030
Community natural gas use, 2019	933,420 therms
Natural gas savings	71,873 therms
GHG emissions reductions	382 MTCO ₂ e

ENERGY AUDITS

EE-C2

Reductions (MTCO ₂ e) -16	2030
Targets	9 housing units implement energy efficiency projects between 2025 and 2030 due to ordinance requiring energy audits at time of sale.
Methodology and Assumptions	Assumes program will be implemented in 2025 and program will require audits at time of sale but energy efficiency projects will be voluntary. Assumes 5% of audited housing units will implement energy efficiency upgrades based on findings from the City of Berkeley's Building Energy Saving Ordinance. Assume 31% Btu energy use reduction based on demonstrated Energy Upgrade California projects completed in Marin County between June 2010 and May 2012. 36 housing units sold annually, based on 2005-2020 average (Marin County Assessor).
Sources	Marin County Assessor, http://www.marincounty.org/depts/ar/divisions/assessor/sales City of Berkeley, "Building Energy Savings Ordinance (BESO) Findings through Nov. 2016," December 7, 2016, https://www.cityofberkeley.info/uploadedFiles/Planning_and_Development/Level_3_-_Energy_and_Sustainable_Development/Energy%20Commission%20Presentation%20Berkeley.pdf Marin County Energy Watch Partnership, Dana Armanino, Sustainability Planner, County of Marin, darmanino@marincounty.org

Calculation

	2030
Average household electricity use, 2019	9,037 kWh
Average household natural gas use, 2019	938 therms
Number of housing units sold annually	36 units
Number of housing units provided energy audits	180 units
Percent of participating housing units	5%
Number of housing units implementing energy efficiency projects	9 units
Electricity reduction	31%
Natural gas reduction	31%
Annual electricity savings	25,170 kWh
Natural gas savings	2,612 therms
Electricity emissions reduction, inc. grid loss	2 MTCO ₂ e
Natural gas emissions reduction	14 MTCO ₂ e
Total GHG emissions reduction	16 MTCO ₂ e

MUNICIPAL ENERGY CONSERVATION <i>EE-6</i>	
Reductions (MTCO ₂ e)	-0.3 2030
Targets	Reduce energy use in municipal buildings by 5%.
Methodology and Assumptions	Energy management software is proven to reduce energy consumption by 10% through identifying inefficiencies within operations. A 5% reduction in energy use for miscellaneous behavioral changes by staff and mechanical operations and upgrading to Energy Star equipment were assumed. There are no GHG savings attributed to electricity savings in this measure because the City was purchasing 100% renewable electricity in 2018.
Sources	Belvedere 2015 GHG Inventory for Government Operations

Calculation

	2030
Electricity consumption in municipal buildings	84,364 kWh
Electricity emissions from municipal buildings	0 MTCO ₂ e
Natural gas emissions from municipal buildings	7 MTCO ₂ e
Percent reduction in energy use	5%
Reduction in electricity consumption	4,218 kWh
GHG emissions reductions	0.3 MTCO ₂ e

WASTE DIVERSION MEASURES <i>WR-1 THROUGH 5</i>	
Reductions (MTCO ₂ e) -345	2030
Targets	A 75% reduction in organic waste from 2014 level by 2030
Methodology and Assumptions	<p>Passed in 2014, AB 1826 requires businesses to recycle their organic waste, depending on the amount of waste they generate per week. Organic waste means food waste, green waste, landscape and pruning waste, nonhazardous wood waste, and food-soiled paper waste that is mixed in with food waste. The law phases in mandatory recycling of commercial organics over time. In 2017, businesses that generate 4 cubic yards of organic waste per week were required to arrange for organic waste recycling services and divert all organic waste they produce. In 2019, the law extended to businesses that generate 4 cubic yards or more of commercial solid waste. The State law is intended to reduce statewide disposal of organic waste by 50% by 2020. If that target is not met, the law will be extended to cover businesses that generate 2 cubic yards or more of commercial solid waste.</p> <p>Passed in 2016, SB 1383 establishes targets to achieve a 50% reduction in the level of the statewide disposal of organic waste from the 2014 level by 2020 and a 75% reduction by 2025. The law grants CalRecycle the regulatory authority required to achieve the organic waste disposal reduction targets and establishes an additional target that not less than 20% of currently disposed edible food is recovered for human consumption by 2025. In 2022, CalRecycle may begin to issue penalties for non-compliance. On January 1, 2024, the regulations may require local jurisdictions to impose penalties for noncompliance on regulated entities subject to their authority.</p> <p>The State's Green Building Code (CALGreen) requires residential and non-residential development projects to recycle and/or salvage for reuse a minimum of 65% of the nonhazardous construction and demolition waste</p>
Sources	City of Belvedere 2019 Communitywide GHG Inventory

Calculation

	2030
Waste emissions less government operations, 2014	421.5 MTCO ₂ e
Reduction in waste emissions	75%
Targeted GHG emissions	105 MTCO ₂ e
Waste emissions less government operations, 2019	451 MTCO ₂ e
GHG emissions reduction	345 MTCO ₂ e

MUNICIPAL WASTE DIVERSION <i>WR-8</i>	
Reductions (MTCO ₂ e) -14	2030
Targets	A 75% reduction in organic waste from 2014 level by 2030
Methodology and Assumptions	<p>Passed in 2014, AB 1826 requires businesses to recycle their organic waste, depending on the amount of waste they generate per week. Organic waste means food waste, green waste, landscape and pruning waste, nonhazardous wood waste, and food-soiled paper waste that is mixed in with food waste. The law phases in mandatory recycling of commercial organics over time. In 2017, businesses that generate 4 cubic yards of organic waste per week were required to arrange for organic waste recycling services and divert all organic waste they produce. In 2019, the law extended to businesses that generate 4 cubic yards or more of commercial solid waste. The State law is intended to reduce statewide disposal of organic waste by 50% by 2020. If that target is not met, the law will be extended to cover businesses that generate 2 cubic yards or more of commercial solid waste.</p> <p>Passed in 2016, SB 1383 establishes targets to achieve a 50% reduction in the level of the statewide disposal of organic waste from the 2014 level by 2020 and a 75% reduction by 2025. The law grants CalRecycle the regulatory authority required to achieve the organic waste disposal reduction targets and establishes an additional target that not less than 20% of currently disposed edible food is recovered for human consumption by 2025. In 2022, CalRecycle may begin to issue penalties for non-compliance. On January 1, 2024, the regulations may require local jurisdictions to impose penalties for noncompliance on regulated entities subject to their authority.</p> <p>The State's Green Building Code (CALGreen) requires residential and non-residential development projects to recycle and/or salvage for reuse a minimum of 65% of the nonhazardous construction and demolition waste</p>
Sources	City of Belvedere 2015 Local Government Operations GHG Inventory

Calculation

	2030
Waste emissions, 2014	18.5 MTCO ₂ e
Reduction in waste emissions	75%
Targeted GHG emissions	5 MTCO ₂ e
Waste emissions, 2019	18 MTCO ₂ e
GHG emissions reduction	14 MTCO ₂ e

COMMUNITY WATER USE <i>WC-1</i>	
Reductions (MTCO ₂ e) 0	2030
Targets	1% annual water consumption reduction.
Methodology and Assumptions	<p>Water consumption in Belvedere fell 24% between 2005 and 2019, or approximately 1.7% per year. We conservatively assume water consumption will continue to fall an average of 1% per year based on the following legislation and water conservation programs:</p> <ul style="list-style-type: none"> -MMWD's regulations meet or exceed State law that requires single family homes and commercial and multi-family buildings to replace all non-compliant plumbing fixtures when remodeling and upon resale (resale requirement for commercial and multi-family buildings will be in effect on January 1, 2019). -MMWD provides rebates for water-efficient toilets, clothes washers, hot water recirculation systems, turf replacement, pool covers, mulch, graywater systems, and rain barrels. -MMWD provides residential and commercial building and landscape water audits and free-water saving devices (faucet aerators, showerheads, toilet leak test dye tablets, hose nozzles, etc.). -MMWD provides residential and commercial building and landscape water audits and free-water saving devices (faucet aerators, showerheads, toilet leak test dye tablets, hose nozzles, etc.). -MMWD has adopted a landscape water conservation ordinance which applies to all new construction and rehabilitated landscape projects requiring a building permit, plan check, or design review. Irrigation controllers are required under CALGreen. -New commercial and multi-family construction is required to meet CALGreen code. MMWD requires all plumbing installed, replaced, or moved on any new or existing service to have high efficiency fixtures and meet minimum requirements. -MMWD has adopted a Water Waste Ordinance and requires drinking water and linen washing upon request at restaurants and hotels. -MMWD requires applicants for new water service and applicants requesting an enlarged water service for substantial residential or commercial remodels to install a graywater recycling system to reuse the maximum practicable amount of graywater on site. -MMWD conducts outreach and provides water conservation information to water users on its website. -MMWD provides virtual water-friendly garden tours on its website.
	<p>GHG reduction calculations are based upon the following:</p> <ul style="list-style-type: none"> -The California Energy Commission estimates that it takes 3,500 kWh of electricity per million gallons to convey, treat and distribute water from the water source to the customer in northern California. -MMWD began purchasing 100% renewable electricity in 2017 and Sonoma County Water agency, which provides approximately 25% of water, began purchasing 100% renewable electricity in 2015. We assume the water agencies will continue this practice.
Sources	<p>Personal communication with Carrie Pollard, Sonoma Marin Water Saving Partnership</p> <p>The Climate Registry for Sonoma County Water Agency emission factors Refining Estimates of Water-Related Energy Use in California, California Energy Commission, Dec. 2006</p>

Calculation

	2030
Water consumption, BAU	85 MG
Annual water consumption reduction	1 %
Potential annual water savings	9 MG
GHG emissions reduction	0.3 MTCO ₂ e

LIGHT AND HEAVY DUTY FLEET REGULATIONS

State Action

Program Description	Current federal and State regulations and standards will reduce transportation emissions from the light and heavy duty fleet. Regulations and policies covered in EMFAC 2021 are identified in the EMFAC 2021 Technical Document.
Reductions (MTCO ₂ e) -699	2030
Methodology and Assumptions	Transportation emissions estimated using EMFAC 2021.
Sources	California Air Resources Board, EMFAC2021 v.1.0.1. California Air Resources Board, EMFAC2021 Volume III Technical Document v.1.0.1, April 2021. https://ww2.arb.ca.gov/sites/default/files/2021-08/emfac2021_technical_documentation_april2021.pdf

Calculation

	2030
Passenger VMT BAU	11,592,967 VMT
Passenger VMT, net reductions from other measures	8,658,324 VMT
Commercial VMT BAU	346,303 VMT
Emissions, BAU	3,457 MTCO ₂ e
Emissions with regulations	2,759 MTCO ₂ e
Reduction in emissions	699 MTCO ₂ e

RENEWABLE PORTFOLIO STANDARD

State Action

Program Description	Established in 2002 in Senate Bill 1078, the Renewable Portfolio Standard program requires electricity providers to increase the portion of energy that comes from eligible renewable sources, including solar, wind, small hydroelectric, geothermal, biomass and biowaste, to 20 percent by 2010 and to 33 percent by 2020. Senate Bill 350, passed in September of 2015, increases the renewable requirement to 50 percent by the end of 2030. Senate Bill 100, passed in September 2018, accelerated the RPS standard to 60 percent by 2030 and zero-carbon by 2045.
Reductions (MTCO ₂ e) -36	2030
Methodology and Assumptions	<p>This State Action assumes PG&E and Direct Access entities will meet the Renewable Portfolio Standard requirements and that these entities will carry the same share of the community's electricity load as in 2019. GHG reductions related to MCE's GHG reduction policies are quantified separately as a local action.</p> <p>California Public Utilities Code Section 454.52 requires each load-serving entity to procure at least 50 percent eligible renewable energy resources by 2030 and to meet the economywide reductions of 40% below 1990 levels by 2030.</p> <p>For 2030, the CPUC has set electric sector GHG reductions at a level that represents a 50% reduction from 2015 levels. We therefore apply a 50% reduction the DA 2015 CO₂ emission factor to forecast the 2030 emission factor. Since the PG&E 2019 emission factor was lower than the legislated threshold, we assume the 2019 emission factor for 2030. CH₄ and N₂O factors are kept constant at 2019 levels.</p>
Sources	<p>PG&E, "Greenhouse Gas Emission Factors: Guidance for PG&E Customers," November 2015, https://www.pge.com/includes/docs/pdfs/shared/environment/calculator/pge_ghg_emission_factor_info_sheet.pdf</p> <p>California Public Utilities Commission "CPUC Adopts Groundbreaking Path to Reduce Greenhouse Gases in Electric Sector," Press Release Docket #: R.16-02-007, Feb. 8, 2018.</p>

Calculation

	2030
Electricity use, BAU	10,489,877 kWh
Electricity saved through other State actions	197,973 kWh
Electricity saved through local actions	2,411,948 kWh
Net electricity use (PG&E)	1,519,647 kWh
Net electricity use (DA)	447,981 kWh
Electricity emissions, BAU	101 MTCO ₂ e
Electricity emissions w/RPS	65 MTCO ₂ e
GHG emission reductions	36 MTCO ₂ e

TITLE 24 ENERGY EFFICIENCY STANDARDS

State Action

Program Description	The California Energy Commission (CEC) promotes energy efficiency and conservation by setting the State's building efficiency standards. Title 24 of the California Code of Regulations consists of regulations that cover the structural, electrical, mechanical, and plumbing system of every building constructed or altered after 1978. The building energy efficiency standards are updated on an approximate three-year cycle, and each cycle imposes increasingly higher demands on energy efficiency and decarbonization.
Reductions (MTCO ₂ e) -228	2030
Methodology	<p>Estimated residential energy use assumes homes use natural gas for primary space heating and water heating. The analysis assumes all new homes install central air conditioning and outdoor lighting. Only end uses covered by Title 24 are included in the analysis. Housing development projections provided by Belvedere staff. New units include teardown/rebuilds and major remodels that trigger an equivalent new construction requirement.</p> <p>Estimated energy reductions for the 2019 building codes based on information provided by the California Energy Commission. CAPCOA Measure BE-1 used for estimating building energy savings. The analysis assumes all residential electricity use subject to Title 24 is offset by mandatory solar installation beginning with the 2019 building code.</p> <p>The 2022 Building Code increases establishes an energy budget based on efficient heat pumps or water heaters to encourage installation of heat pumps over gas-fueled HVAC units and requires homes to be electric-ready, with dedicated 240-volt outlets and space so electric appliances can eventually replace installed gas appliances. We assume the State Building Code will require net zero energy residential buildings beginning in 2026 and net zero energy non-residential beginning in 2029.</p>
Sources	<p>California Energy Commission, https://ww2.energy.ca.gov/title24/2019standards/documents/2018_Title_24_2019_Building_Standards_FAQ.pdf</p> <p>California Energy Commission, California Commercial End-Use Survey (March 2006), https://ww2.energy.ca.gov/2006publications/CEC-400-2006-005/CEC-400-2006-005.PDF</p> <p>2009 California Residential Appliance Saturation Study (CRASS), Volume 2. http://www.energy.ca.gov/2010publications/CEC-200-2010-004/CEC-200-2010-004-V2.PDF</p> <p>California Air Pollution Control Officers Association, "Quantifying Greenhouse Gas Mitigation Measures: A Resource for Local Government to Assess Emission Reductions from Greenhouse Gas Mitigation Measures," August, 2010.</p> <p>Personal communication with Rebecca Markwick, Senior Planner, City of Belvedere.</p>

Calculation

Reductions from Title 24 Upgrades	Energy Savings for 2019 Code (assumed for development 2020-2022)		Projected average reduction 2023-2030 from 2019 baseline	
	Electricity Savings	Natural Gas Savings	Electricity Savings	Natural Gas Savings
Residential New Construction	100.00%	7%	100%	50%
Non-residential New Construction	30%	30%	50%	50%

Projected Residential Development with Title 24 Energy Reductions

	2020- 2022	2023-2030	TOTAL through 2030	GHG Reductions through 2030
New Residential (units)	2	158	160	
Electricity Use BAU, subject to Title 24	1,902	1,427,892	1,429,794	
Electricity Use Savings	1,902	99,952	101,854	9
Natural Gas Use BAU	938	74,102	75,040	
Natural Gas Use Savings	66	37,051	37,117	197

Projected Non-Residential Development with Title 24 Energy Reductions

	2020- 2022	2023-2030	TOTAL through 2030	GHG Reductions through 2030
New/remodeled commercial sq. ft.	0	24,120	24,120	
Electricity Use BAU, subject to Title 24	0	192,236	192,236	
Electricity Use Savings	0	96,118	96,118	8
Natural Gas Use BAU	0	5,138	5,138	
Natural Gas Use Savings	0	2,569	2,569	14

SMALL OFF-ROAD EQUIPMENT <i>State Action</i>	
Reductions (MTCO ₂ e) -58	2030
Action	Implementation of AB 1346
Methodology and Assumptions	<p>In October 2021, the state passed AB 1346, which states, “By July 1, 2022, the state board shall, consistent with federal law, adopt cost-effective and technologically feasible regulations to prohibit engine exhaust and evaporative emissions from new small off-road engines, as defined by the state board. Those regulations shall apply to engines produced on or after January 1, 2024.”</p> <p>In December 2021, CARB adopted small off-road engines (SORE) regulations that require most newly manufactured small off-road engines to be zero emission starting in 2024. Portable generators, including those in recreational vehicles, and large pressure washers will be required to meet more stringent standards in 2024 and meet zero-emission standards starting in 2028.</p> <p>SORE are spark-ignition engines rated at or below 19 kilowatts. Engines in this category are primarily used for lawn, garden, and other outdoor power equipment. Engines that use diesel fuel and engines that are used in stationary equipment, including standby generators, are not subject to the SORE regulations. Federal law also preempts states from regulating new engines which are used in construction equipment or vehicles or used in farm equipment or vehicles, and which are smaller than 175 horsepower.</p> <p>For this action SORE subject to the 2024 ban includes lawn mowers, leaf blowers, trimmers, edgers, chainsaws <45 cc, riding mowers, and log splitters. This equipment consumed 1,171,773 gallons of gasoline in 2019 (OFFROAD 2021). Similar to the off-road emissions inventory, we assume 0.8% of emissions are attributable to Belvedere based on its share of countywide households in 2019. Generators and pressure washers are not included because they are not included in the City's GHG inventory. We assume an average lifespan of 10 years.</p>
Sources	OFFROAD 2021 (v1.0.1)

Calculation

	2030
Regulated SORE gasoline consumption subject to 2024 ban	9,375 gallons
Emissions from regulated SORE, BAU	83 MTCO ₂ e
Reduction (7 years at 10% each year)	70%
Emissions reductions	58 MTCO ₂ e

Appendix B: 2019 Greenhouse Gas Inventory Report for Communitywide Emissions

CITY OF BELVEDERE

COMMUNITY GREENHOUSE GAS EMISSIONS INVENTORY FOR THE YEAR 2019

January 2022

Prepared by the
Marin Climate & Energy Partnership

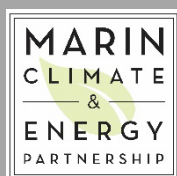


TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
INTRODUCTION	2
PURPOSE OF INVENTORY	2
GENERAL METHODOLOGY	2
COMMUNITY INVENTORY	4
COMMUNITY INVENTORY SUMMARY	4
PER CAPITA EMISSIONS	6
MAJOR SOURCES OF EMISSIONS	7
BUILT ENVIRONMENT - ELECTRICITY	7
BULT ENVIRONMENT - NATURAL GAS	8
TRANSPORTATION	9
WASTE DISPOSAL	9
WATER USE	10
APPENDIX	A-1

EXECUTIVE SUMMARY

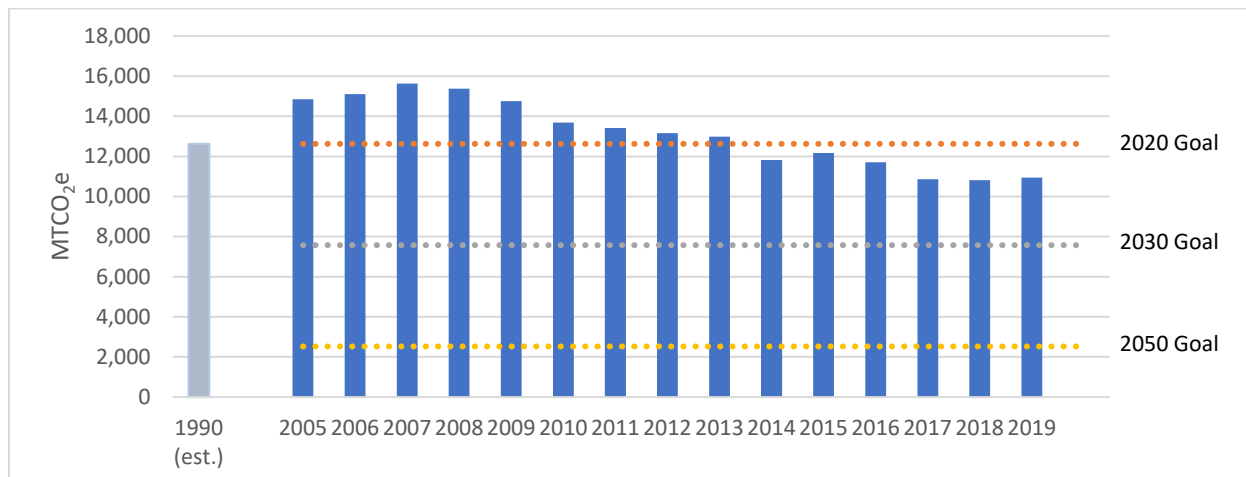
THE TAKEAWAY:

**COMMUNITY EMISSIONS ARE
DOWN 26% SINCE 2005**

Belvedere 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 goal to reduce community emissions. The City also publishes GHG emissions inventories for municipal operations approximately every five years. Municipal emissions accounted for approximately 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 2019, the most recent year data is available. The inventory shows that the Belvedere community has reduced emissions 26% since 2005. Emissions dropped from about 14,855 metric tons carbon dioxide equivalents (MTCO_{2e}) in 2005 to 10,935 MTCO_{2e} in 2019. The community emissions trend and targets are shown below. Belvedere has met its goal to reduce emissions 15% below 2005 levels by 2020. The community needs to reduce emissions another 3,360 MTCO_{2e} to meet the statewide target for 2030, which is 40% below 1990 levels, and another 8,410 MTCO_{2e} to meet the statewide target for 2050, which is 80% 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 2019. 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 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 CO₂e, 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 MTCO₂e.

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 ₂ O	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 CO₂e.¹ In 2019, those activities resulted in approximately 10,935 metric tons of CO₂e, a reduction of 26% from 2005 levels, which is equivalent to 13% 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 facilities².
- 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.

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.

² Previous inventories categorized emissions from electricity, natural gas, and propane in the built environment according to the Residential and Non-Residential sectors. Beginning with this inventory, we are categorizing emissions in the built environment as Electricity and Natural Gas in order to align and better track with the Climate Action Plan’s goals to electrify the built environment.

Figure 2 shows the relative contribution of emissions from these sectors in 2019. The use of natural gas and propane in the Built Environment represent the largest share of communitywide emissions (46%), while the Transportation sector accounts for 41% of emissions.

FIGURE 2: EMISSIONS BY SECTOR, 2019

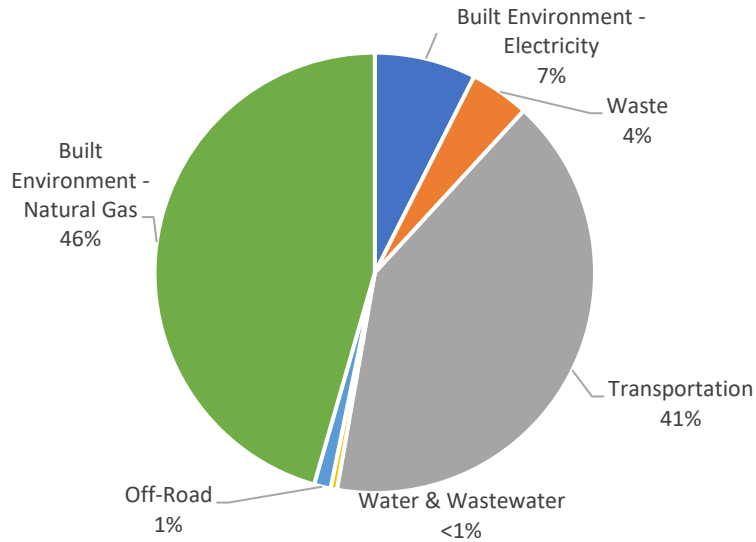


Table 2 shows how emissions in each sector have changed since 2005. The greatest reductions have occurred in the Built Environment – Electricity sector (1,696 MTCO₂e), followed by the Transportation sector (1,226 MTCO₂e) and the Built Environment – Natural Gas sector (572 MTCO₂e). The likely reasons for the largest emissions decreases are described in the remainder of this report.

TABLE 2: EMISSIONS SUMMARY BY SECTOR (MTCO₂E), 2005 THROUGH 2019

Year	Built Environment - Electricity	Built Environment - Natural Gas	Transportation	Waste	Off-Road	Water	Wastewater	Total	% Change from 2005
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	5,186	420	154	38	70	13,416	-10%
2012	2,083	5,204	5,178	435	151	40	75	13,167	-11%
2013	2,012	5,161	5,095	441	148	47	77	12,981	-13%
2014	1,830	4,412	4,877	440	147	42	72	11,821	-20%
2015	1,776	4,614	5,068	461	145	33	71	12,168	-18%
2016	1,449	4,839	4,657	536	143	24	63	11,711	-21%
2017	649	4,824	4,630	559	140	7	59	10,868	-27%
2018	701	4,883	4,543	494	136	3	59	10,817	-27%
2019	817	4,987	4,480	469	131	3	48	10,935	-26%
Change from 2005	-1,696	-572	-1,226	-230	-80	-84	-31	-3,920	
% Change from 2005	-68%	-10%	-21%	-33%	-38%	-97%	-39%	-26%	

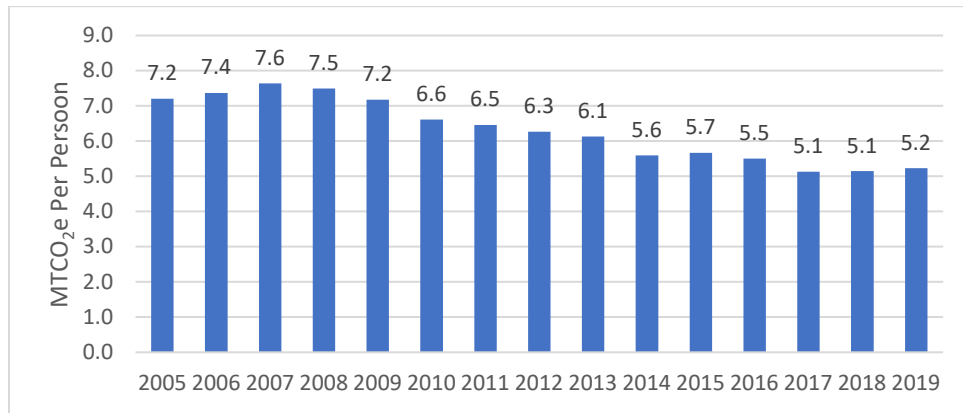
¹ Per California Air Resources Board guidance, 1990 levels are estimated at 15% below 2005 levels.

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 CO₂e per capita in 2005. Per capita emissions decreased 30% between 2005 and 2019, 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, etc.

FIGURE 3: EMISSIONS PER CAPITA



MAJOR SOURCES OF EMISSIONS

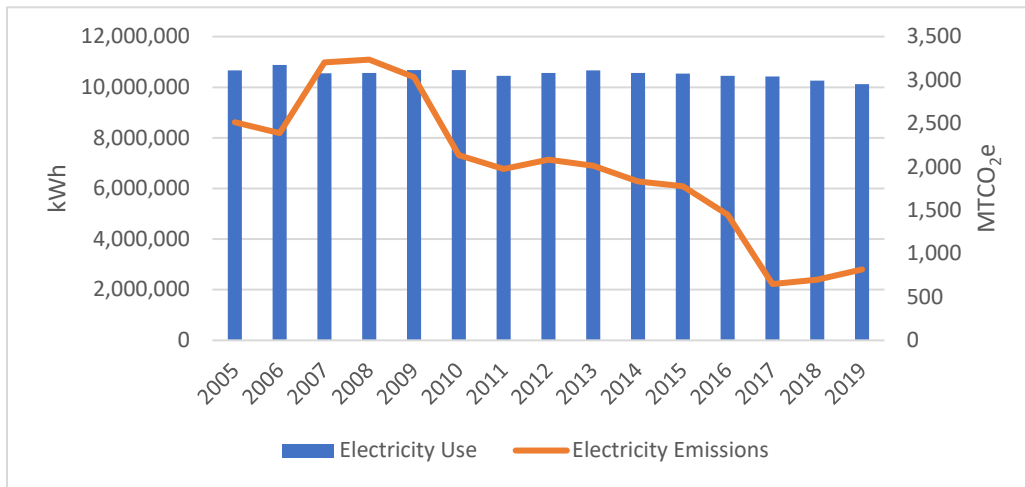
The following sections provide a year-by-year analysis of the changes in source GHG emissions in the Built Environment, Transportation, Waste and Water sectors. Whenever possible, each section discusses the change in emissions from previous years and the likely influence of state and local programs or policies and external factors on reducing emissions.

BUILT ENVIRONMENT - ELECTRICITY

Electricity use in homes and businesses in Belvedere decreased about 5% between 2005 and 2019. Greenhouse gas emissions from electricity consumption decreased 68% 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 2019, PG&E electricity came from a mix of renewable (29%), large hydroelectric (27%), and nuclear (44%) energy sources and was virtually GHG-free.³ The carbon intensity of MCE Light Green electricity was more carbon intensive in 2019 than the previous two years but was still below the 10-year average. In 2019, about 3.6% of MCE electricity purchased by Belvedere customers was 100% renewable Deep Green electricity, including electricity purchased by the City government.

³ PG&E, 2019 Power Mix, https://www.pge.com/pge_global/common/pdfs/your-account/your-bill/understand-your-bill/bill-inserts/2020/1220-PowerContent-ADA.pdf

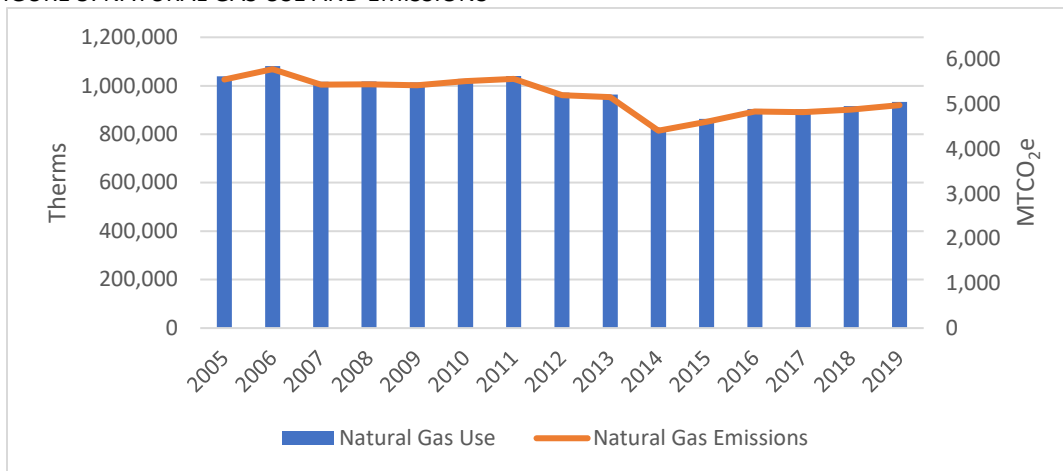
FIGURE 4: ELECTRICITY USE AND EMISSIONS



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. Estimated natural gas consumption rose 2% between 2018 and 2019 and was 10% below the 2005 level.

FIGURE 5: NATURAL GAS USE AND EMISSIONS



Reduction in energy use may be attributed to energy efficiency programs and rebates, local green building ordinances, and State building codes. California’s goal is to require all new residential and commercial buildings to be zero net energy by 2030.

TRANSPORTATION

Transportation activities accounted for approximately 41% of Belvedere’s emissions in 2019. Vehicle miles traveled (VMT) have decreased approximately 5% since 2005, and transportation emissions have decreased even more – by 21% – 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 91% of transportation emissions in 2019. Marin County continues to be a leader in zero emission vehicles (ZEVs) – second only to Santa Clara County – with 8,600 ZEVs in Marin at the end of 2019, or about 4% of registered automobiles. ZEVs include battery electric cars, plug-in hybrid electric cars, hydrogen fuel cell cars, and zero-emission motorcycles. Belvedere had over 140 ZEVs by the end of 2019, approximately one for every six households.

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: TRANSPORTATION VMT AND EMISSIONS

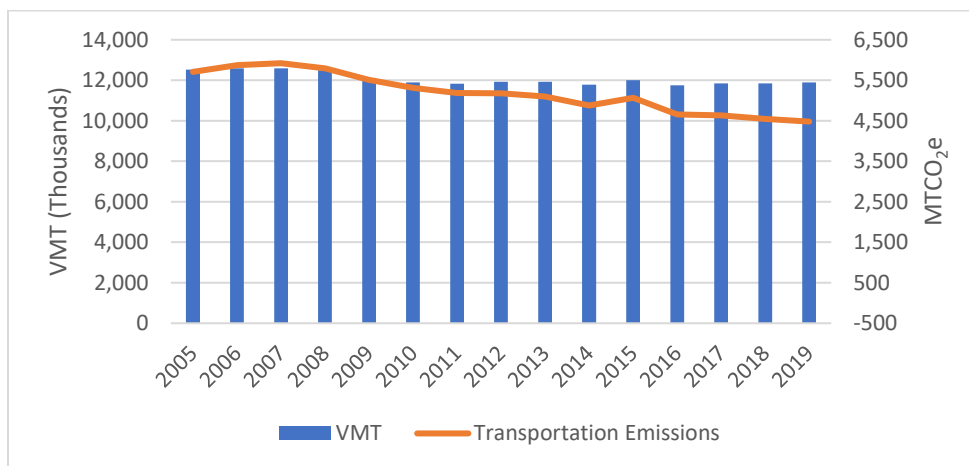
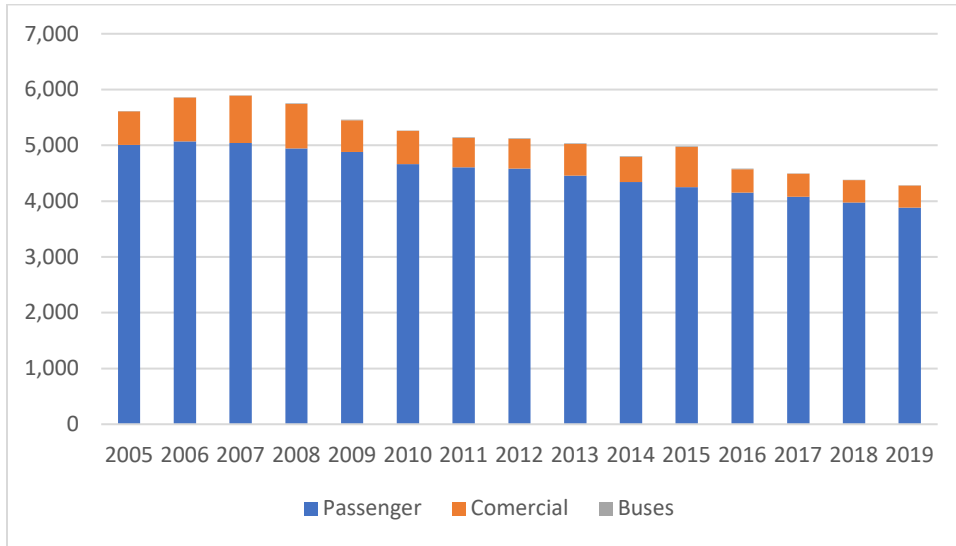


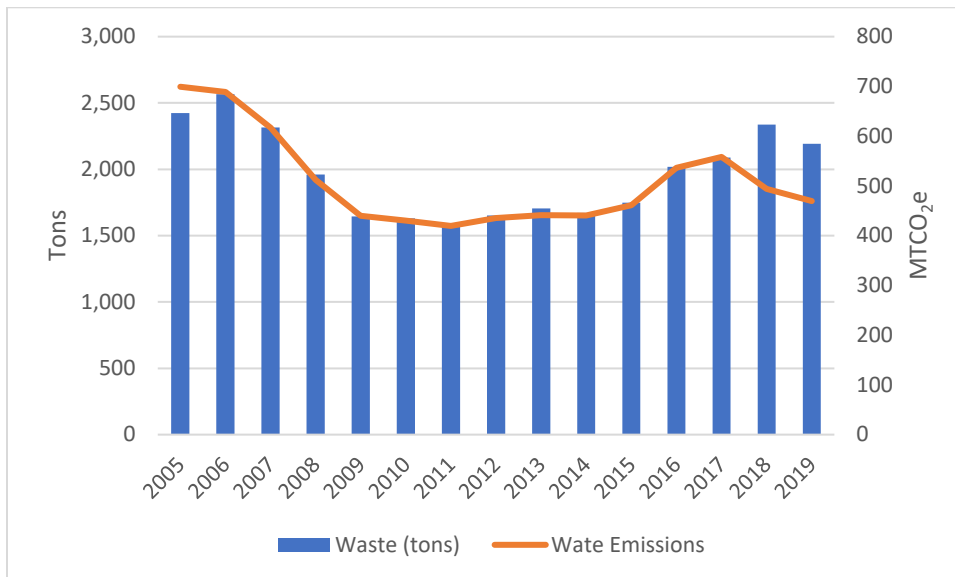
FIGURE 7: TRANSPORTATION EMISSIONS BY VEHICLE TYPE



WASTE DISPOSAL

Waste generated by the community hit a low in 2011 but has since increased as shown in Figure 8 (based on countywide disposal data). Total landfilled waste (including alternative daily cover)⁴ decreased 6% between 2018 and 2019 and was 10% below the 2005 baseline. Emissions from waste disposal decreased 33% due to the lower organic content of material used for alternative daily cover.

FIGURE 8: DISPOSED WASTE AND EMISSIONS



⁴ Alternative daily cover is cover 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.

WATER USE

District-wide, per capita water use declined 25% since 2005. 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 97% between 2005 and 2019. The reduction is primarily due to the lower carbon intensity of electricity. The Marin Municipal Water District (MMWD) began purchasing MCE Deep Green electricity in mid-2017. The Sonoma County Water Agency (SCWA), which supplies approximately 24% of MMWD’s water in 2019, 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: WATER CONSUMPTION AND EMISSIONS

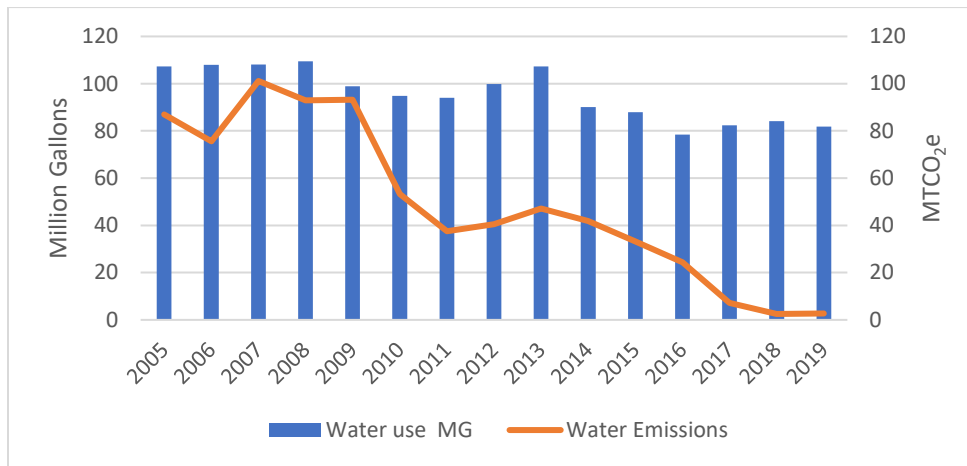
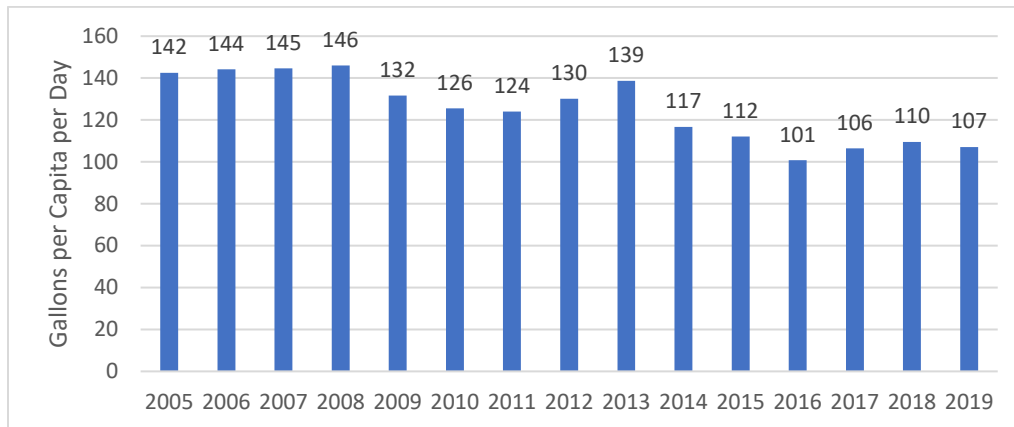


FIGURE 10: PER CAPITA WATER USE



Source: Marin Municipal Water District

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: 2,092 (CA Department of Finance, May 2021)

Number of Households: 919 (CA Department of Finance, May 2021)

Inventory Year: 2019

Date Prepared: January 18, 2022

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 ₂ e)
1.0	Built Environment						
1.1	Use of fuel in residential and commercial stationary combustion equipment	Both	•				4,987
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	817
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	•				4,062
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	•				413
2.5	On-road transit vehicles associated with community land uses	Activity		•			6
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	469
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	•				3
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	•				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.) 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 ₂ O)	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).	Default CO ₂ , CH ₄ & N ₂ O 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 ₂ O)	Known electricity use (meter readings by PG&E and MCE) and estimated direct access electricity consumption.	Verified utility-specific emission factors (PG&E and MCE) and eGrid subregion default emission factors. U.S. Community Protocol v. 1.1, Appendix C, Method BE.2.1.
	Electric Power Transmission and Distribution Losses (CO ₂ , CH ₄ & N ₂ O)	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, http://capvmt.us-west-2.elasticbeanstalk.com/data).	CO ₂ for on-road passenger vehicles quantified in the EMFAC2021 v.1.0.1 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 ₂ O)	Estimated vehicle miles traveled associated with origin and destination land uses (Metropolitan Transportation Commission, http://capvmt.us-west-2.elasticbeanstalk.com/data).	CH ₄ and N ₂ O for on-road passenger vehicles quantified in the EMFAC2017 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 the 2017 Regional Transportation Plan).	CO ₂ for on-road commercial vehicles quantified in the EMFAC2021 v.1.0.1 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 ₂ O)	Estimated commercial vehicle miles traveled within the boundary (Metropolitan Transportation Commission utilizing Plan Bay Area 2040 and the 2017 Regional Transportation Plan).	CH ₄ and N ₂ O for on-road commercial vehicles quantified in the EMFAC2017 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 (CH ₄ & N ₂ O)	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.

		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 categories. 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 ₂ O)	Estimated fuel use from OFFROAD 2021 v.1.0.1 for Lawn and Garden and from OFFROAD2017 for Construction equipment. All categories are allocated by share of countywide households.	CH ₄ and N ₂ O 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 and 2018) 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 ₂ O)	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 ₂ O)	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 ₂ O)	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).
--	---	---	--