Memo

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Date: September 13, 2022

To: David Morrison and Deborah Elliott (County of Napa)

From: Honey Walters and Brenda Hom (Ascent Environmental, Inc.)

Subject: Draft Napa County Regional 2019 Community Greenhouse Gas Inventory Update Summary

INTRODUCTION

This document includes a 2019 communitywide greenhouse gas (GHG) inventory update for the Napa County region (region), including the 2019 GHG inventories for each of the six jurisdictions: American Canyon, Calistoga, the City of Napa, St. Helena, Yountville, and the unincorporated areas of Napa County (Unincorporated County). GHG emissions are attributed to each jurisdiction based on whether the emissions occur within, or originate from activities in, their jurisdictional boundary. The update year of 2019 was selected because this was the latest year in which data were most complete and excludes data anomalies due to the COVID-19 pandemic starting in 2020, such as reduced transportation emissions from increase telecommuting. The 2019 regional GHG inventory is an update to the 2005 regional inventory that was performed in the 2009 *Napa Countywide Community Climate Action Framework* (Napa County Transportation & Planning Agency [NCTPA] 2009). This effort differs from the draft Napa County Climate Action Plan (Napa County CAP) completed in 2018, which focuses on activities and emissions from the Unincorporated County only (County of Napa 2018). Quantification of the 2019 regional GHG inventory update is based on the International Council for Local Environmental Initiatives (ICLEI) methodologies, specifically, the *U.S. Community Protocol for Accounting and Reporting Greenhouse Gas Emissions* Version 1.2 (Community Protocol). In addition, to provide locally relevant emissions, additional protocols were used to refine certain sectors (e.g., agriculture, off-road equipment). Consistent with this protocol and past inventories, the community GHG inventories are divided into seven emissions sectors, or sources of emissions:

- Building Energy – Including electricity and natural gas consumption in residential and non-residential buildings.
- On-road transportation – Including on-road vehicles, such as passenger cars, trucks, and buses.
- Off-road equipment – Including off-road equipment, such as construction equipment, waterborne vessels, and lawn and garden equipment. Excludes agricultural equipment.
- Agriculture – Including livestock emission from enteric fermentation and manure management, off-road agricultural equipment, stationary diesel equipment (e.g., irrigation pumps), fertilizer and pesticide use, and residue burning.
- Solid waste – Including methane emissions from annual generation of solid waste and from waste accumulated in place at landfills inside the Napa region.
- Imported Water – Including water imported from outside of the Napa region.
- Wastewater – Including methane and nitrous oxide emissions from treatment of wastewater generated in the region.

The regional inventory update relies on the best available and most up-to-date data and calculation methodologies to provide a foundation upon which the County of Napa (County) can coordinate with the incorporated cities and town and other relevant stakeholders to plan and act to reduce regional GHG emissions. This approach differs somewhat from the approach used to develop the past inventories in the region. For example, the 2019 regional inventory includes water- and wastewater-related emissions, which were not included in the 2005 regional inventory. A comparison is provided for informational purposes only and uses an adjusted 2019 inventory, matching the basic assumptions and range of emissions sources of the 2005 inventory, to provide a direct comparison.

ORGANIZATION OF THIS MEMORANDUM

This memorandum consists of five parts:

- Section 1: Regional Inventory Boundary summarizes the scope of the inventory evaluated for the region.
- Section 2: Summary of Inventory Results by Sector summarizes the 2019 regional GHG emissions inventory and provides a comparison of 2019 emissions with past inventories from 2005 and 2014 by sector, including any differences in methodology and data.
- Section 3: Summary of Inventory Results by Jurisdiction summarizes the 2019 regional GHG emissions inventory by each jurisdiction, including insights into the reasons for any differences in methodology and data.
- Section 4: Comparison with the 2005 Regional Inventory compares the 2019 regional GHG emissions inventory to the 2005 regional inventory, adjusting for methodological differences.
- Section 5: Data, Methods, and Assumptions presents the methods and data used to develop the 2019 inventory. This includes details on what sources the inventory includes and excludes.

REGIONAL INVENTORY BOUNDARY

The inventory aims to estimate GHG emissions from sources within the six jurisdictions in the region, namely American Canyon, Calistoga, Napa, Saint Helena, Yountville, and Unincorporated. This inventory quantifies three main GHGs: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Other GHGs, such as hydrofluorocarbons and other short-lived climate pollutants, will be addressed in a separate memorandum. The region's inventory only includes emissions generated from sources and activities occurring within the boundaries of each jurisdiction; it does not account for GHG emissions generated from activities occurring outside of the respective jurisdiction, as a given jurisdiction does not have operational control of or authority over those sources.

Additionally, the regional inventory does not account for embedded or lifecycle GHG emissions. The regional inventory evaluates emissions using the production-based approach; therefore, the regional inventory does not consider the upstream emissions generated by the consumption of goods and services within the community.

The GHG emissions sectors and sources included and excluded in the region's 2019 community inventory are presented in Table 1 below. Table 1 identifies the protocol that provided the methodology for estimating GHG emissions from each emissions source. Emissions sources that identify multiple protocols used a combination of data and methods from those protocols. Fertilizer application and off-road vehicles and equipment calculations used methods consistent with Intergovernmental Panel on Climate Change (IPCC) and the Community Protocol but substituted locally specific data obtained from the California Air Resources Board (CARB). A detailed description of how each sector was quantified is discussed in Section 4.

Table 1 Summary of Sectors and Sources for the 2019 Napa County Regional GHG Inventory

Sector	Included	Excluded	Protocol(s)
Building Energy			
Electricity	Emissions associated with all electricity consumed within each jurisdiction		ICLEI
Natural Gas	Emissions from natural gas consumed within each jurisdiction	Emissions from propane and natural gas stationary source engines due to lack of readily variable data.	ICLEI
On-Road Transportation			
On-Road Transportation	Emissions from 100 percent of trips within each jurisdiction (internal-internal) and 50 percent of trips starting or ending outside each jurisdiction (internal-external and external-internal)	Emissions from 100 percent of pass-through trips starting and ending outside each jurisdiction (external-external)	ICLEI/ RTAC
Off-Road Equipment			
Off-Road Equipment	Emissions from off-road equipment within each jurisdiction	Emissions associated with aircraft operations were not included because they are outside of the control of the jurisdictions within the region. Entertainment equipment (e.g., filming equipment) were excluded due to its exclusion in CARB's OFFROAD2021 model, despite being included in the previous OFFROAD2007 model.	ICLEI/ CARB
Agriculture			
Livestock– Enteric Fermentation	Emissions from enteric fermentation from livestock within each jurisdiction		ICLEI
Livestock– Manure Management	Emissions associated with manure management practices within each jurisdiction		ICLEI
Fertilizer Application	Emissions associated with fertilizer use within each jurisdiction	Emissions associated with pesticide use within each jurisdiction.	CARB/ IPCC
Agricultural Off-Road Equipment	Emissions from agricultural off-road vehicles and equipment within each jurisdiction		ICLEI/ CARB
Agricultural Diesel Engines	Emissions from diesel fuel use for stationary engines (e.g., irrigation pumps) within each jurisdiction		CARB
Open Burning		No emissions from open burning of agricultural vegetative matter were reported for this year. Emissions from wildfires and prescribed forest fires are excluded as they occur apart from any jurisdictional control. This sector was not included in the 2005 inventory.[1]	
Carbon storage and sequestration		Emissions reductions or additions associated with changes to carbon sequestration or carbon storage rates in the region. These will be addressed in a separate memorandum.	

Sector	Included	Excluded	Protocol(s)
Solid Waste			
Community-Generated Solid Waste	Emissions from all waste generated by each jurisdiction	Emissions from waste generated outside of each jurisdiction but disposed of within the jurisdiction.	ICLEI
Waste-in-Place	Emissions from waste accumulated at landfills within each jurisdiction.		ICLEI
Wastewater Treatment			
Wastewater Treatment	Emissions associated with wastewater generated by each jurisdiction (including treatment in onsite septic systems and at centralized WWTPs)	Emissions from wastewater generated outside of each jurisdiction but treated within each jurisdiction (including treatment at centralized WWTPs)	ICLEI
Imported Water			
Imported Water	Emissions associated with imported water from outside the region	Disaggregated water usage-related emissions associated with each jurisdiction. These are assumed to be included in the building energy sector.	ICLEI

Notes: GHG = greenhouse gas; CARB = California Air Resources Board; ICLEI = ICLEI – Local Governments for Sustainability; VMT = vehicle miles traveled; RTAC = Regional Targets Advisory Committee; IPCC = Intergovernmental Panel on Climate Change; WWTP = wastewater treatment plant.

[1] Emissions from open burning are typically quantified using permit data obtained from the local air pollution control district (i.e., air quality management district), which specify the number of acres permitted for open burning operations. Bay Area Quality Management District (BAAQMD) only reported data for prescribed forest or open space burning. BAAQMD did not report any agricultural burning in Napa County in 2019.

Source: Ascent Environmental 2022.

SUMMARY OF INVENTORY RESULTS BY SECTOR

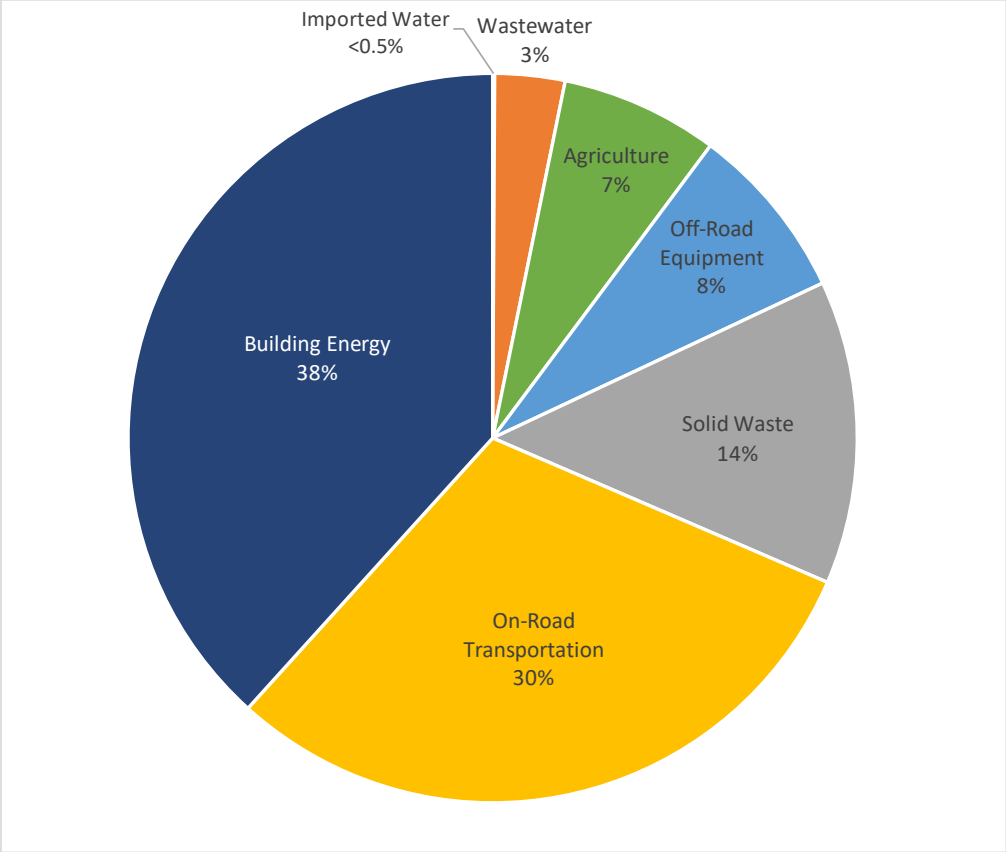
Based on the modeling conducted, the Napa County region generated approximately 1.5 million metric tons of carbon dioxide equivalents ($MTCO_2e$) in 2019. As shown in Figure 1, the top two emissions sectors in 2019 included building energy use (38 percent) and on-road transportation (30 percent), which together accounted for 68 percent of emissions in the region. Other sectors, include solid waste (14 percent), off-road equipment (8 percent), agriculture (7 percent), wastewater (3 percent), and imported water (0.04 percent). Emissions associated with water pumping within the region could not easily be disaggregated from 2019 electricity usage reports and thus, are included in the building energy sector. Table 2 details the emissions results from the 2019 GHG inventory update for the Napa County region. Attachment A presents the activity data used for each emissions sector. Emissions results by jurisdiction are addressed in Section 3. A comparison of emissions to the 2005 regional inventory is provided in Section 4. A detailed analysis of the background data and assumptions behind each individual sector is provided in Section 5.

Table 2 2019 Napa County Regional Greenhouse Gas Inventory by Sector ($MTCO_2e$/year)

Emissions Sector	2019 ($MTCO_2e$/year)	Percent of Total
Building Energy	564,336	38.1%
On-Road Transportation	446,673	30.2%
Solid Waste	198,862	13.4%
Off-Road Equipment	115,548	7.8%
Agriculture	103,381	7.0%
Wastewater	45,858	3.1%
Imported Water	5,943	0.40%
Total	1,480,602	100.0%

Notes: $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year.

Source: Prepared by Ascent Environmental in 2022.



Source: Prepared by Ascent Environmental in 2022.

Figure 1 2019 Napa County Regional Greenhouse Gas Emissions Inventory by Emissions Sector

SUMMARY OF INVENTORY RESULTS BY JURISDICTION

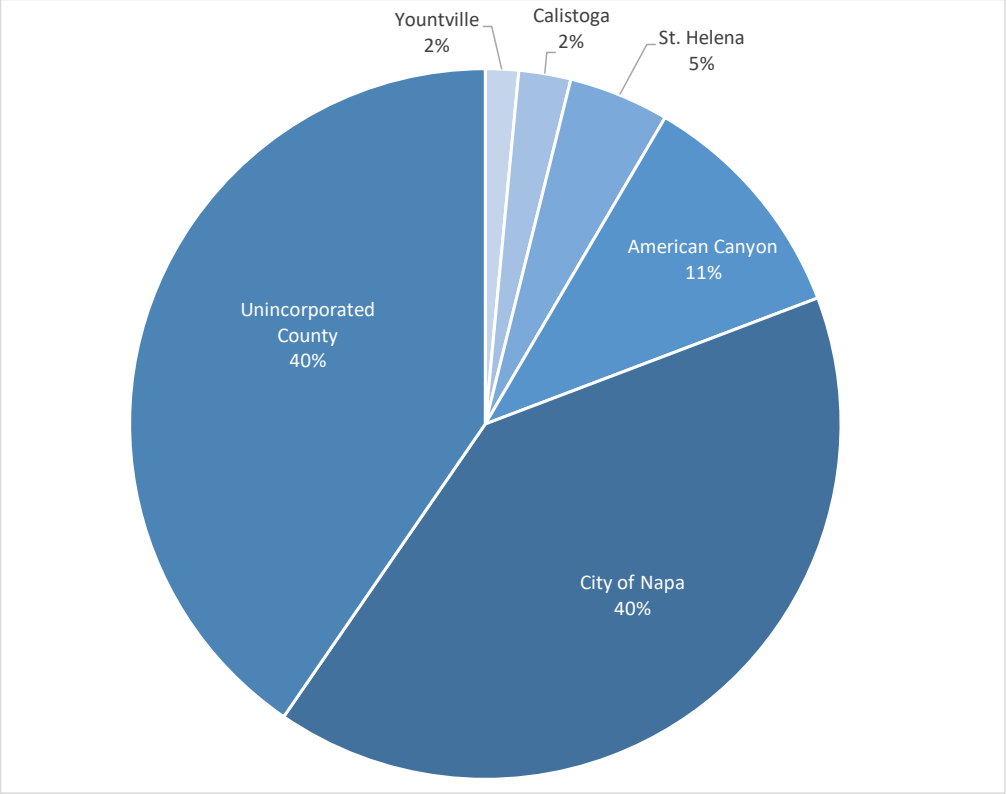
Across the six jurisdictions in the county, the Unincorporated County and City of Napa both accounted for 40 and 40 percent of emissions in the region, respectively, for a total of 80 percent. American Canyon contributed 11 percent of the region's emissions; and St. Helena, Calistoga, and Yountville accounted for the remaining 8 percent. These results are shown in Figure 2 and Table 3.

Table 3 2019 Napa County Regional Greenhouse Gas Inventory by Jurisdiction ($MTCO_2e$/year)

Emissions Sector	2019 ($MTCO_2e$/year)	Percent of Total
Unincorporated County	598,302	40.4%
City of Napa	597,610	40.4%
American Canyon	159,719	10.8%
St. Helena	67,657	4.6%
Calistoga	34,982	2.4%
Yountville	22,332	1.5%
Total	1,480,602	100.0%

Notes: $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year.

Source: Prepared by Ascent Environmental in 2022.



Source: Prepared by Ascent Environmental in 2022.

Figure 2 2019 Napa County Regional Greenhouse Gas Emissions Inventory by Jurisdiction

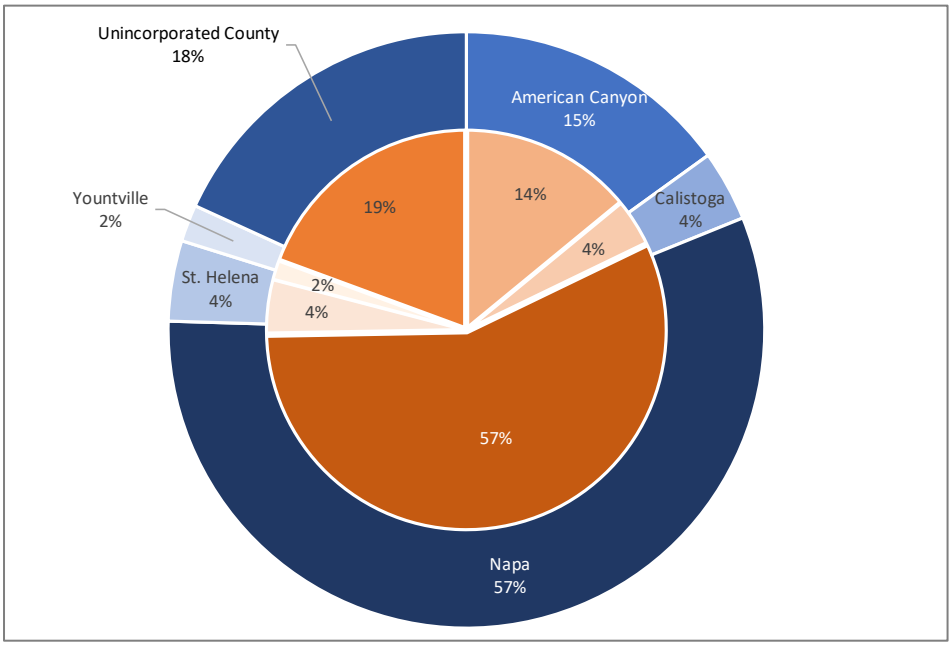
These results are consistent with the level of activity in each jurisdiction. Table 5 and Figures 4 and 6 show the breakdown of emissions by jurisdiction and emissions sector. Table 5 shows emissions normalized by population and employment. Figure 3 provides the population and employment by jurisdiction in 2019 to provide context.

Table 5 2019 Napa County Regional Greenhouse Gas Inventory by Jurisdiction and Sector ($MTCO_2e$/year)

Emissions Sector	American Canyon	Calistoga	Napa	St. Helena	Yountville	Unincorporated County	Total
Building Energy	29,168	8,431	216,505	21,599	5,551	284,313	565,567
On-Road Transportation	86,779	16,239	265,100	28,975	11,722	37,859	446,673
Solid Waste	25,938	4,981	34,236	5,676	2,601	125,429	198,862
Off-Road Equipment	8,998	2,880	47,238	4,502	1,328	50,602	115,548
Agriculture	154	274	1,086	4,415	75	97,378	103,381
Wastewater	7,822	1,994	29,542	2,270	1,040	3,191	45,858
Imported Water	983	229	4,383	285	65	-	5,943
Total	159,842	35,025	598,089	67,721	22,382	598,772	1,481,832
Emissions per capita	7.6	6.5	7.5	11.1	8.0	23.9	10.6
Emissions per SP	5.9	4.3	4.6	5.7	5.7	10.8	6.3
Transportation Emissions per capita	4.1	3.0	3.3	4.8	4.2	1.5	3.2

Notes: $MTCO_2e$/year = metric tons of carbon dioxide equivalent per year. SP = service population (population + jobs) (See Table 6).

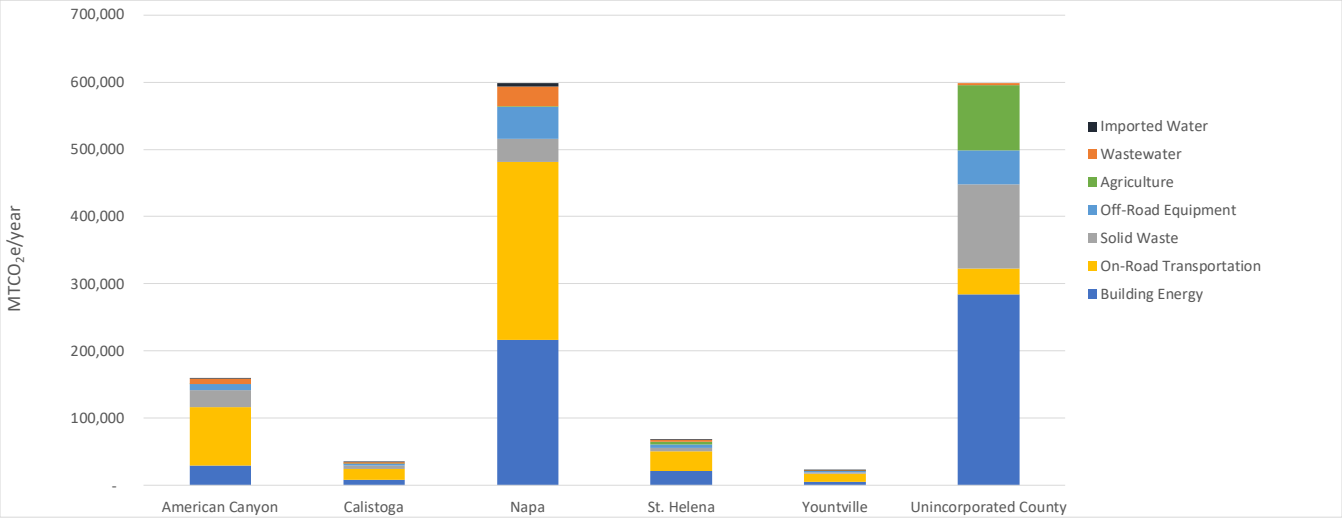
Source: Prepared by Ascent Environmental in 2022.



	American Canyon	Calistoga	Napa	St. Helena	Yountville	Unincorporated County	Total County
Jobs	10,000	2,700	40,500	3,100	1,100	13,800	71,200
Population	20,996	5,352	79,016	6,094	2,793	25,357	139,608

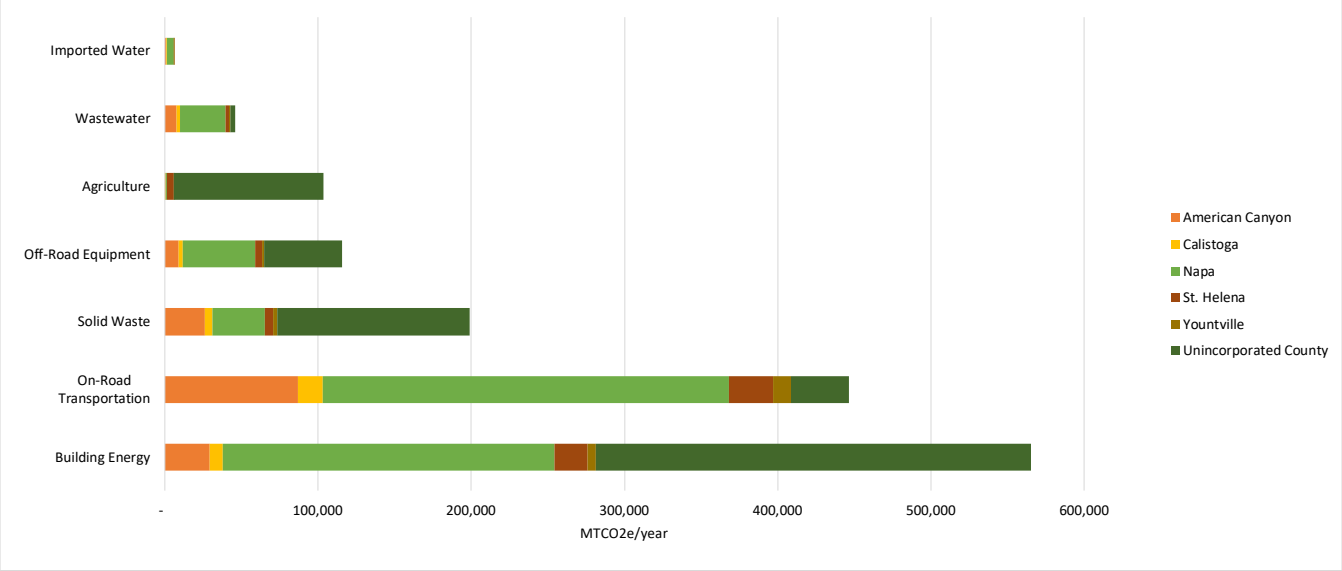
Source: Department of Finance (DOF) 2022, Employment Development Department (EDD) 2022.

Figure 3 2019 Napa County Regional Greenhouse Gas Emissions Inventory by Jurisdiction



Source: Prepared by Ascent Environmental in 2022.

Figure 4 2019 Napa County Regional Greenhouse Gas Emissions Inventory by Jurisdiction and Sector ($MTCO_2e$/year)



Source: Prepared by Ascent Environmental in 2022.

Figure 5 2019 Napa County Regional Greenhouse Gas Emissions Inventory by Sector and Jurisdiction ($MTCO_2e$/year)

As shown in Table 5 and Figure 4, emissions tend to be proportional to the level of economic activity in a jurisdiction (e.g., agricultural activity in the Unincorporated County, job and population centers in the City of Napa). For this reason, normalized emissions per capita and emissions per service population are also provided in Table 5, based on data available from Department of Finance (DOF) and the Employment Development Departments (EDD) and shown in Table 6. The region emitted 10.6 $MTCO_2e$ per capita per year in 2019. This is on-par with the state average emissions of 10.5 $MTCO_2e$ per capita in 2019 and may be slightly higher than estimated as the state's inventory includes additional smaller emission sectors (e.g., high-global warming potential gases, which account for 5 percent of the state's emissions) (CARB 2021a, 2021b). These normalized factors also show that Calistoga has the lowest GHG

emissions per capita and per service population in the region (6.5 $MTCO_2e$ per capita); and St. Helena has the highest GHG emissions per capita and service population (11.1 $MTCO_2e$ per capita) out of the incorporated jurisdictions. The Unincorporated County has the highest emissions per capita in the region (23.9 $MTCO_2e$ per capita), due mostly to the greater proportion of agricultural and industrial activity in that area against population.

HIGHLIGHTS BY JURISDICTION

Unincorporated County

The Unincorporated County emitted 598,802 $MTCO_2e$ in 2019 and has the highest emissions per capita (23.9 $MTCO_2e$/person/year) in the region. This is likely due two major reasons. First, winemaking and vineyard activities are prevalent throughout the Unincorporated County, as evidenced by the large proportion of building energy-related emissions attributable to the area (50 percent) despite having a smaller population (shown in Figure 5). Second, the agricultural and solid waste sectors are understandably high in the Unincorporated County due to the proportion of agricultural lands and location of landfills in the area. Building energy, agriculture, and solid waste accounted for 85 percent of the Unincorporated County's emissions in 2019. Emissions from building energy and agriculture overshadow emissions from on-road transportation, which only accounted for 6 percent of the area's emissions. Thus, the presence of solid waste landfills and high levels of agricultural activity contribute to the Unincorporated County's high emissions.

City of Napa

The City of Napa emitted nearly the same level of emissions as the Unincorporated County in 2019 (598,302 $MTCO_2e$/year) and has lower emissions-per-capita (7.5 $MTCO_2e$/person/year). As the largest city in the region, the City of Napa is a major job and population center in the region, accounting for 57 percent of the jobs and population in the region in 2019, as shown in Figure 3. The City of Napa, thus, understandably accounts for the majority of the building energy and on-road transportation emissions in the region as jobs and population both generate vehicle trips through commuting and commerce. The city is also a major tourist destination with a prominent hospitality industry, further contributing to higher transportation and building emissions. The City of Napa accounted for 38 percent of regional building energy emissions and 59 percent of regional on-road transportation emissions. These two emissions sectors are also the largest sectors with the city's own inventory; building energy and on-road transportation accounted for 39 and 42 percent of the city's total emissions, respectively, for a total of 81 percent of the city's emissions in 2019, when rounded. As the population center, the City of Napa is also the largest emitter of wastewater emissions, accounting for 64 percent of total wastewater emissions.

American Canyon

American Canyon was the next largest emitter in the region, emitting 159,719 $MTCO_2e$/year in 2019 and with a slightly higher emissions-per-capita (7.6 $MTCO_2e$/person/year). American Canyon is the second largest city in the region but is about a quarter of the size of the City of Napa. Even so, American Canyon makes up about 19 percent of total on-road transportation emissions in the region. On-road transportation is also the largest sector in the city, accounting for 54 percent of the city's emissions. This is possibly due to its location at the southern end of the county and subsequent proximity to other major job centers in the Bay Area, resulting in higher VMT associated with commuting.

St. Helena

St. Helena emitted 67,657 $MTCO_2e$/year in 2019, less than half of American Canyon's emissions in the same year. St. Helena accounted for 5 percent of the region's emissions. Despite this lower total emissions, St. Helena had the highest emissions-per-capita at 11.1 $MTCO_2e$/person/year. This could possibly be due to St. Helena's status as a major tourist destination. On-road transportation accounted for 43 percent of emissions generated by the city. As shown in

Table 5, St. Helena has the highest transportation-related emissions per capita in the region, over 40 percent higher than the City of Napa. St. Helena is also the third smallest city in the region, with a population of 3,100.

Calistoga

Calistoga emitted 34,982 $MTCO_2e$/year in 2019, nearly half of St. Helena's emission in the same year. Calistoga only accounted for 2 percent of the region's emissions. Calistoga also had relatively low emissions per capita at 6.5 $MTCO_2e$/person/year despite it being the second smallest city in the region with a population of 2,700. Its largest sectors were on-road transportation (46 percent) and building energy (24 percent), together accounting for 70 percent of the city's emissions.

Yountville

Yountville emitted 22,332 $MTCO_2e$/year in 2019 and only accounted for 2 percent of the region's emissions. Despite these low emissions, Yountville had the second highest emissions per capita at 7.5 $MTCO_2e$/person/year despite it being the smallest city in the region with a population of 1,100. Like St. Helena, Yountville is also a major tourist destination, and a high proportion of its emissions are from on-road transportation (52 percent), which are nearly double that of emissions from building energy (25 percent). Together, on-road transportation and building energy accounted for 77 percent of the city's emissions.

COMPARISON WITH THE 2005 REGIONAL INVENTORY

The 2019 regional inventory updates a previous regional inventory conducted for the year 2005. However, due to differences in methodology and data sources, the following assumptions and data were adjusted to allow for a proper comparison between the two inventories. These adjustments are only to be considered for purposes of comparison with the 2005 inventory only. The formal results for the updated 2019 GHG inventory are presented in the previous three sections.

- The 2019 values were adjusted to the global warming potential (GWP) factors from IPCC's Second Assessment Report (SAR), consistent with the methodology used in the 2005 inventory (NCTPA 2009). This approach was necessary because the 2005 inventory did not make CH_4 and nitrous oxide (N_2O) emissions available for adjustment with newer GWP factors from IPCC's Sixth Assessment Report (AR6) (IPCC 2021).
- 2019 on-road transportation activity was modified to use vehicle miles travelled (VMT) from the California Department of Transportation's (Caltrans) Highway Performance Monitoring System (HPMS), the same source used in the 2005 inventory (Caltrans 2020). In contrast, the main 2019 inventory update is based on the Regional Targets Advisory Committee (RTAC) method, which accounts for VMT generated by the jurisdiction and excludes pass-through trips. Caltrans roadway VMT estimates are generally much higher than the RTAC method. Regional VMT data by origin and destination were not readily available for 2005. (See Section 4).
- Only sectors that were present and verifiable in the 2005 inventory were included in the comparison.
    - The comparison excludes water and wastewater emissions sectors evaluated in the 2019 inventory, but which were not included in the 2005 inventory.
    - Additionally, agricultural emissions are excluded. Although both the 2005 and 2019 inventories include an agricultural sector, the 2005 inventory did not specify how the agricultural emissions were derived. Without knowing the specific sub-sectors that were incorporated in the 2005 agricultural sector, a proper comparison could not be made between the two years.
    - Off-road equipment were modeled in 2005 using a much less sophisticated model (OFFROAD2007) compared to the one used for the 2019 inventory (OFFROAD2021). The 2005 offroad inventory consisted of lawn and garden equipment, industrial, and commercial equipment. 2019 includes all offroad

equipment types in CARB's OFFROAD2021 model, except agriculture. It is possible that the 2005 inventory included fewer vehicle types and lower activity overall than the 2019 inventory, but that is uncertain. Thus, off-road equipment emissions were excluded from this comparison.

After accounting for these adjustments, Table 6 and Figure 6 show the 2005 baseline inventory alongside the 2019 inventory, for comparison purposes only. Between 2005 and 2019, countywide emissions decreased by 1 percent. This decrease in emissions between 2005 and 2014 is due to a combination of factors including, but not limited to:

- Increased population, jobs, and visitors affecting increased activity levels (e.g., building energy use, vehicle travel).
- Greater reductions in energy emission factors and building energy efficiency (e.g., less polluting vehicles, building renovations, more renewables in the electricity portfolio).
- Adjustments in calculation methodologies (e.g., models, equations, and emission factors).
- Differences in data sources between the two inventories.

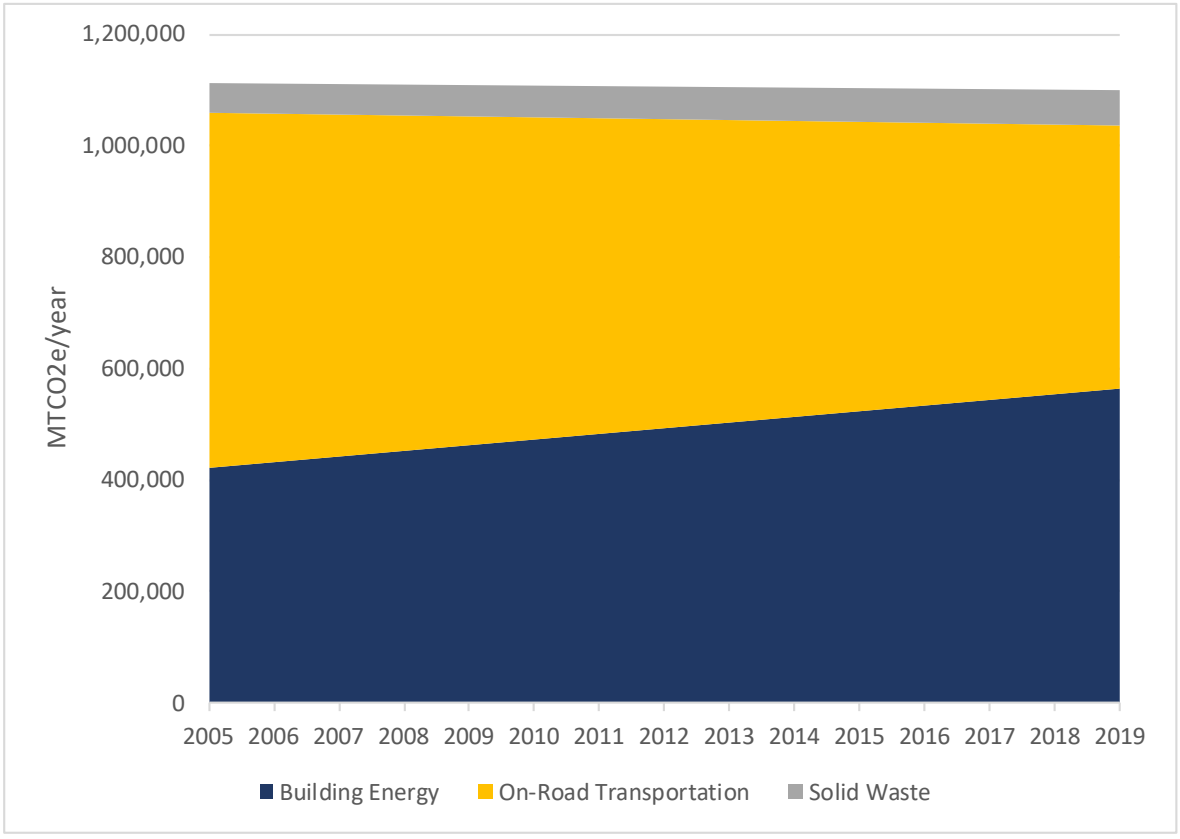
Table 6 Comparison of Napa County 2005 and 2019 Regional Greenhouse Gas Inventories by Sector (for comparison only) ($MTCO_2e$/year)

Emissions Sector	2005	2019	Percent Change	Primary Differences[1]
Building Energy	423,011	564,033	33%	Increased usage of both electric and natural gas. Decreased emission factors.
On-Road Transportation	636,724	471,256	-26%	Increases in regional VMT reported in Caltrans's HPMS data.
Solid Waste	54,209	63,409	17%	Increased accumulation of waste in landfills.
Total	1,113,944	1,098,698	-1%	

Notes: The 2005 inventory did not include water and wastewater sectors. Therefore, for comparison purposes, those sectors are excluded from this comparison table. CARB = California Air Resources Board, VMT = vehicle miles travelled, HPMS = Highway Performance Monitoring System, RTAC = Regional Targets Advisory Committee.

[1] After adjusting the 2019 inventory to use GWP factors from IPCC's Second Assessment Report and other calculation methods.

Source: Prepared by Ascent Environmental in 2022. NCTPA 2009.



Note: Graph based on 2005 and 2019 emissions inventories. Emissions based on GWP factors using IPCC's Second Assessment Report. Emissions between 2005 and 2019 are interpolated. Excludes offroad, agriculture, water, and wastewater emissions. GWP = global warming potential, IPCC = Intergovernmental Panel on Climate Change.

Source: Prepared by Ascent Environmental in 2022.

Figure 6 Napa County Regional Greenhouse Gas Emissions Inventory from 2005 to 2019 (for comparison only)

As shown in Table 6 and Figure 6, the decreases in emission in on-road transportation emissions outweigh the increase in emissions from building energy and solid waste . The building energy sector has surpassed on-road transportation as the largest emissions sector in the region. This could be attributed, in part to population and job growth in the county. To provide context, between 2005 and 2019, the region's population increased by 7 percent and jobs increased by 4 percent, according to the DOF and EDD (DOF 2012, 2021; EDD 2022). Although both population and emissions increased in the region, the average GHG emissions per capita and per service population also decreased by 8 percent with the contribution of the state's renewable portfolio goals and expanded clean vehicle standards.

DATA, METHODS, AND ASSUMPTIONS

The basic calculation for estimating GHG emissions involves two primary inputs: activity data and emissions factors. Activity data refers to the relevant measurement of a community's activity resulting in emissions, and emissions factors represent the amount of a GHG emitted on a per unit of activity basis. Emissions factors are applied to activity data (i.e., the two values are multiplied together) to estimate GHG emissions. For example, in the residential energy sector, activity data of annual community electricity consumption in megawatt-hours (MWh) is multiplied by an

emissions factor in pounds of GHG per MWh, which results in a pounds of GHG emissions value. This calculation-based methodology is used for estimating emissions from most sources in the region's inventory.

In addition to including new GHG emissions sectors and sources, the 2019 inventory update includes several changes to the data sources and emission factors used, along with changes in methods. These differences were necessary in cases where the original data sources used in the 2005 inventory were no longer available or have been updated. New methods that provide more accurate emissions estimates are available for sectors such as the on-road vehicles and solid waste sectors. The general approach used to estimate the region's 2019 GHG inventory is consistent with the latest guidance from the Community Protocol (ICLEI 2019). The calculations relied on activity data provided by each jurisdiction, sector-specific sources of information, and GWP factors from AR6 (IPCC 2021).

An overview of activity data and emissions factors for each emissions source, along with data sources, is shown in Table 8. Detailed methods are described in the following sections.

Table 8 2019 Napa County Regional GHG Inventory Summary of Activity Data and Emissions Factors

Sector/Source	Input Type	Description and Data Sources
Agriculture		
Livestock Management	Activity data	Livestock population data from the County of Napa Agricultural Commissioner's Office's 2019 Crop Report
	Emissions factor	Livestock-specific emissions factors from CARB, IPCC, and EPA
Fertilizer Application	Activity data	Fertilizer application data from CDFA's Fertilizer Tonnage Report 2019
	Emissions factor	Fertilizer emissions factors from IPCC 2006
Agricultural Equipment - Off-Road Equipment	Activity data	Off-road vehicles and equipment activity data and emissions factors from CARB's OFFROAD2021 model
	Emissions factor	
Agricultural Equipment – Diesel Engines	Activity data	Diesel-powered agricultural stationary engines (e.g., irrigation pumps) from BAAQMD permit data.
	Emissions factor	Napa County region-specific average emissions factor from CARB
On-Road Transportation		
On-Road Transportation	Activity data	VMT data from MTC's Regional Travel Demand Model via the VMT Data Portal.
	Emissions factor	Napa County-specific emissions factors from CARB's EMFAC2021 model.
Building Energy		
Electricity	Activity data	Electricity consumption data from PG&E and MCE
	Emissions factor	Utility-specific emissions factors from TCR, EPA's eGRID, CEC's Power Content Label.
Natural Gas	Activity data	Natural gas consumption data from PG&E
	Emissions factor	Average emissions factors from TCR
Solid Waste		
Community-Generated Solid Waste	Activity data	Waste and ADC disposal data from the California Department of Resources Recycling and Recovery
	Emissions factor	Mixed municipal solid waste emissions factor from EPA
Waste-in-Place	Emissions Data	Direct methane and nitrous oxide fugitive emissions reports from in-boundary landfills from EPA.

Sector/Source	Input Type	Description and Data Sources
Off-Road Vehicles and Equipment		
Off-Road Vehicles and Equipment	Emissions Data	County-level off-road vehicles and equipment emissions data from CARB's OFFROAD2021 model
Wastewater Treatment		
Wastewater Treatment	Activity data	Population data in the region and population served by septic tanks
	Emissions factor	Emissions factors based on population-based factors for centralized wastewater treatment and septic systems from ICLEI
Water Supply		
Water Supply	Activity data	Water consumption data by source from each jurisdiction
	Emissions factor	Energy intensity factors from 2015 CPUC Water/Energy Cost-Effectiveness Analysis.

Notes: MTC = Metropolitan Transportation Commission; CARB = California Air Resources Board; CEC = California Energy Commission; CPUC = California Public Utilities Commission; EPA = U.S. Environmental Protection Agency; ICLEI = ICLEI – Local Governments for Sustainability; IPCC = Intergovernmental Panel on Climate Change; District; PG&E = Pacific Gas and Electric Company; MCE = Marin Clean Energy; TCR = The Climate Registry; VMT = vehicle miles traveled; ADC = alternative daily cover; BAAQMD = Bay Area Air Quality Management District.

Source: Ascent Environmental 2022.

Additionally, demographic data related to population, jobs, and housing in the unincorporated County were obtained from DOF and EDD (DOF 2021, EDD 2022).

Global Warming Potentials

GHG emissions other than CO_2 generally have a stronger insulating effect and thus, a greater ability to warm the Earth's atmosphere through the greenhouse effect. This effect is measured in terms of a pollutant's GWP factor. CO_2 has a GWP factor of one while all other GHGs have GWP factors measured in multiples of one relative to the GWP of CO_2. This conversion of non-CO_2 gases to one unit enables the reporting of all emissions in terms of carbon dioxide equivalent (CO_2e), which allows for the consideration of all gases in comparable terms and makes it easier to communicate how various sources and types of GHG emissions contribute to climate change. The standard unit for reporting emissions is $MTCO_2e$.

Consistent with the best available science, these inventories use GWP factors published in the Sixth Assessment Report from IPCC, where CH_4 and nitrous oxide (N_2O) have GWP factors of 27.9 and 273, respectively (IPCC 2021). These values represent the GWP of GHG on a 100-year time horizon. This means that CH_4 is approximately 28 times stronger than CO_2 and N_2O is 273 times stronger than CO_2 in their potential to warm Earth's atmosphere over the course of 100 years. In comparison, the SAR, used in the development of the 2005 inventory, reported GWP's of 21 and 310 for CH_4 and N_2O, respectively. The use of 100-year GWP values is consistent with CARB methods and reflects the long-term planning horizon of the CAP.

BUILDING ENERGY SECTOR

Based on GHG emissions modeling conducted, residential and non-residential building energy use in 2019 resulted in 564,336 $MTCO_2e$ in 2019. This sector comprised approximately 38 percent of the region's emissions, resulting in the largest emissions sector in the inventory. These emissions were a result of electricity and natural gas energy use at buildings and facilities. The building energy sector consumed 927 megawatt-hours (MWh) of electricity and 103 million therms of natural gas. This estimate includes a negative credit for electricity consumption from electric vehicle charging to avoid double-counting with the on-road vehicle sector.

Marin Clean Energy (MCE), a community choice aggregation (CCA) program that offers additional renewable electricity options to northern Bay Area counties, began enrollment of customers in the region in 2015. Through automatic enrollment, customers are allowed to either increase their renewable mix for an additional fee or opt out of the program. Those opting out would have, by default, PG&E's resource mix (MCE 2015). In 2019, 85 percent of electricity use in the region was purchased from MCE, with 5 percent purchased from MCE's Deep Green option (Herrick, pers. comm., 2022). In this year, MCE customers had a 60 percent renewable mix and 90 percent GHG-free mix offered through their Light Green option and a 100 percent renewable mix through their Deep Green and Local Sol options (MCE 2022, MCE 2020). A GHG-free mix is the percent of electricity generated from sources that do not emit GHG emissions, including those that are not renewable (e.g., large hydroelectric, nuclear). The GHG-emitting portion of MCE's energy portfolio (e.g., the 39 percent of Light Green power that is not GHG-free) is assumed to be sourced from "unspecified sources of power," consistent with MCE's current Power Content Label (MCE 2020). The emission factors for the "unspecified sources of power" are assumed to be equal to the average emission factors for the state via eGRID for the CAMX region (455 lb CO_2e/MWh). This resulted in an average MCE emissions factor of 58 lb CO_2e/MWh for 2019.

In 2019, 15 percent of electricity use in the region was purchased from PG&E. PG&E supplied its customers electricity with a renewable mix of 28.5 percent, with 1.5 percent from geothermal sources (which generate some GHGs) (CEC 2020). 2019 was an anomalous year for PG&E in that the utility reported that the remaining 71.5 percent of electricity supplied in that year were from GHG-free sources, consisting of large hydroelectric and nuclear sources, for a total of 99 percent GHG-free sources for PG&E in 2019 (CEC 2020). For context, in 2018 and 2020, 15 to 16 percent of PG&E's electricity was generated from natural gas (CEC 2019, 2021). Based on the distribution of participation in MCE in the region in 2019, 99.5 percent of the region's electricity use was generated with GHG-free sources, resulting in a regional average emission factor of 21 lb CO_2e/MWh. This analysis is detailed in Table 9.

PG&E supplied all the natural gas used in the region in 2019. Due to the lower emissions from electricity consumption, GHG emissions from the use of natural gas accounted for approximately 99 percent of total emissions from the building energy sector. Approximately 30 percent of building natural gas emissions were from non-residential customers, contributing a total of 165,949 $MTCO_2e$ in 2019. Residential buildings generated 382,148 $MTCO_2e$, or approximately 70 percent of total building natural gas emissions.

Table 10 presents emission factors used to quantify emissions from electricity and natural gas use. Tables 11 and 12 presents building electricity and natural gas use and associated emissions by jurisdiction, respectively.

Table 9 2019 Napa County Regional Utility Participation (Percent of Electricity Use per Jurisdiction)

Jurisdiction	PG&E		MCE Light Green		MCE Deep Green	
	Electricity Use (MWh)	Percent of Electricity Use	Electricity Use (MWh)	Percent of Electricity Use	Electricity Use (MWh)	Percent of Electricity Use
American Canyon	26,616	25.6%	74,747	71.9%	2,582	2.5%
Calistoga	1,939	6.9%	25,980	92.7%	112	0.4%
Napa	64,494	17.4%	290,725	78.4%	15,462	4.2%
St. Helena	6,457	10.7%	39,121	65.1%	14,516	24.2%
Yountville	1,137	2.7%	30,644	74.0%	9,625	23.2%
Unincorporated County	37,411	11.6%	284,955	88.4%	138	0.0%
Total	138,054	14.9%	746,172	80.5%	42,435	4.6%

Notes: PG&E = Pacific Gas and Electric, MCE = Marin Clean Energy.

Source: Data provided by Ascent Environmental in 2022.

Table 10 2019 Napa County Regional GHG Inventory: Building Energy Emission Factors

Emission Factor	Unit	Source
Electricity – PG&E (99% GHG-Free)		
18.7	lb CO_2/MWh	TCR 2020
3.1	lb CH_4/GWh	eGrid 2019 (EPA 2021)
0.4	lb N_2O/GWh	eGrid 2019 (EPA 2021)
20.7	lb CO_2e/MWh	Calculated
Electricity – MCE Light Green (90% GHG-Free[1])		
44.0	lb CO_2/MWh	MCE 2022, TCR 2020
3.2	lb CH_4/GWh	MCE 2022, eGrid 2019 (EPA 2021), TCR 2020
0.4	lb N_2O/GWh	MCE 2022, eGrid 2019 (EPA 2021), TCR 2020
57.8	lb CO_2e/MWh	Calculated
Electricity – MCE Deep Green (100% GHG- Free)		
0.0	lb CO_2/MWh	MCE 2022
0.0	lb CH_4/GWh	MCE 2022
0.0	lb N_2O/GWh	MCE 2022
0.0	lb CO_2e/MWh	Calculated
Natural Gas		
5.31	kg CO_2/therm	TCR 2020
0.47	g CH_4/therm	TCR 2020
0.01	g N_2O/therm	TCR 2020
5.32	g CO_2e/therm	Calculated

Notes: CH_4 = CH_4; CO_2 = carbon dioxide; eGrid = Emissions & Generation Resource Integrated Database; EPA = U.S. Environmental Protection Agency; GHG = greenhouse gas; GWh = gigawatt-hours; kg = kilograms; lb = pounds; MT = metric tons; MWh = megawatt-hours; N_2O = nitrous oxide; PG&E = Pacific Gas and Electric; MCE= Marin Clean Energy; TCR = The Climate Registry.

Source: CEC 2020, MCE 2022, EPA 2021, TCR 2020; data compiled by Ascent Environmental 2022.

Table 11 2019 Napa County Regional GHG Inventory: Building Electricity Use and GHG Emissions by Jurisdiction

Jurisdiction	Electricity Use (MWh/yr)			GHG Emissions ($MTCO_2e$/yr)		
	Residential	Non-Residential	Total	Residential	Non-Residential	Total
American Canyon	35,398	68,547	103,945	661	1,085	1,747
Calistoga	12,053	15,979	28,032	225	314	539
Napa	159,409	211,272	370,681	2,974	3,454	6,428
St. Helena	18,667	41,427	60,094	332	512	844
Yountville	6,472	34,934	41,406	117	507	624
Unincorporated County	98,777	223,726	322,503	1,850	4,208	6,058
Total	330,776	595,885	926,661	6,160	10,079	16,240

Notes: Totals in columns may not add due to rounding. PG&E provided electricity use for 2019 by zip codes. These data were apportioned to each jurisdiction by the relative population in each zip code. MCE provided electricity use directly by jurisdiction.

MWh = megawatt-hours; MT = metric tons; CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; CO_2e = carbon dioxide equivalent; PG&E=Pacific Gas and Electric; MCE= Marin Clean Energy.

Source: Data provided by Ascent Environmental in 2022 based on data provided by MCE and PG&E.

Table 12 2019 Napa County Regional GHG Inventory: Building Natural Gas Use and GHG Emissions by Jurisdiction

Jurisdiction	Natural Gas Use (therms/yr)			GHG Emissions ($MTCO_2e$/yr)		
	Residential	Non-Residential	Total	Residential	Non-Residential	Total
American Canyon	5,040,518	89,005	5,129,523	26,825	474	27,299
Calistoga	1,443,578	31,352	1,474,929	7,682	167	7,849
Napa	24,511,805	14,872,674	39,384,478	130,448	79,150	209,598
St. Helena	2,156,533	1,731,322	3,887,855	11,477	9,214	20,691
Yountville	858,030	58,152	916,182	4,566	309	4,876
Unincorporated County	37,797,011	14,400,058	52,197,069	201,150	76,635	277,785
Total	71,807,474	31,182,562	102,990,036	382,148	165,949	548,097

Notes: Totals in columns may not add due to rounding. PG&E provided natural gas use for 2019 by zip code. These data were apportioned to each jurisdiction by the relative population in each zip code.

MT = metric tons; CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; CO_2e = carbon dioxide equivalent; PG&E=Pacific Gas and Electric.

Source: Data provided by Ascent Environmental in 2022 based on data provided by PG&E and TCR.

WASTEWATER GENERATION

Based on modeling conducted, wastewater generation in 2019 resulted in emissions of approximately 45,858 $MTCO_2e$, or 3 percent of total emissions, primarily from fugitive CH_4. All wastewater generated within each jurisdiction is treated in a number of methods: (1) conveyed to other wastewater treatment facilities in the region through sewer systems or (2) treated on-site via a septic tank system.

This sector accounts for the CH_4 and N_2O emissions from wastewater treatment processes. Wastewater treatment facilities are located wholly within the region and not exported outside of the area. Thus, the electricity use at those facilities is captured in the building energy sector and is excluded from the wastewater sector. These emissions are summarized in Table 13.

Table 13 2019 Napa County Regional Wastewater Methane Emissions by Source

Wastewater Treatment Process Emissions					
Wastewater Source	Population Served	$MTCO_2$/yr	$MTCH_4$/yr	MTN_2O/yr	$MTCO_2e$/yr
Septic	24,459	0	106	0	2,961
WWTP	230,299	0	1,533	0.461	42,897
Total	*254,757*	0	*1,639*	*0.461*	*45,858*

Notes: Totals may not add due to rounding. MG = million gallons; MT = metric tons; CH_4 = methane; CO_2e = carbon dioxide equivalent, MGD = million gallons per day.

Source: Data provided by Ascent Environmental in 2022.

Domestic Wastewater

Domestic wastewater CH_4 emissions were based on average population-generated wastewater rates from:

- equations WW.11 (alt) for septic systems and WW.6 (alt) and WW.8 for sewer systems from the Community Protocol;
- the County's estimate of the percent of the population that are serviced by sewer connections and septic connections; and
- the 2019 population estimates for each jurisdiction, available from the California Department of Finance.

Across all jurisdictions, it is estimated that approximately 90 percent of the region's population is served by centralized wastewater treatment facilities and while the other 10 is served by on-site septic tanks for wastewater treatment. Table WW.15.1 from the Community Protocol shows that California's average wastewater generation factor is 100 gallons per day per capita (ICLEI 2019). Using this factor, the region is estimated to have generated 9.3 billion gallons of wastewater in 2019.

IMPORTED WATER

Based on modeling conducted, water imports into the region accounted for 5,943 $MTCO_2e$ in 2019, less than one percent of the region's 2019 GHG inventory. These resulted from GHG emissions from electricity generation required to deliver and treat water outside the region. Water conveyance within the region is assumed to be accounted for under the electricity usage reports from MCE and PG&E. Each of the six jurisdictions in the region provided total water volume deliveries to their jurisdiction in 2019 broken out by water source and type of water (e.g., recycled, potable). Water conveyance and treatment energy rates per gallon vary by water source and type. These factors were available from a 2015 Water-Energy Cost Effectiveness Analysis released by the California Public Utilities Commission (CPUC) (CPUC 2015). Water conveyed from the State Water Project (SWP) in the San Francisco Bay water region requires 926 kWh per acre feet, which is between 2 and 90 times more energy than water sourced from local surface water, depending on the local source (e.g., groundwater, local deliveries) (CPUC 2015). Based on data collected, all the water imported to the region was sourced from the SWP and resulted in the usage of approximately 28.8 GWh outside of the region in 2019. Average eGRID CAMX emission factors were applied to this usage to get total emissions from imported water use. Results are shown below in Table 14 and 15 below.

Table 14 2019 Napa County Regional Imported Water and Energy Use by Jurisdiction

Jurisdiction	State Water Project (MG/year)	MWh/Year
American Canyon	661	4,759
Calistoga	154	1,109
Napa	2,948	21,224
St. Helena	191	1,378
Yountville	43	313
Unincorporated County	0	0
Total	3,998	28,783

Notes: MG = million gallons, MWh = megawatt hours

Source: Data compiled by Ascent Environmental in 2022.

SOLID WASTE

Based on modeling conducted, the solid waste sector was responsible for approximately 198,862 $MTCO_2e$, or 14 percent of the region's 2019 GHG inventory. The Community Protocol recommends that community GHG inventories include emissions from both solid waste facilities located in the community (i.e., "waste-in-place") and waste generated by the community. Waste-in-place CH_4 emissions from landfill gas (LFG) generated at solid waste facilities located within the region accounted for 114,619 $MTCO_2e$, or 57 percent of emissions from the solid waste sector. CH_4 emissions from decay of waste generated annually by residences and businesses in the region accounted for 84,243 $MTCO_2e$, or 42 percent of emissions from the solid waste sector. Table 15 summarizes emissions from the solid waste sector.

LFG is a mix of gases, primarily composed of CH_4, generated from decomposing organic waste and waste chemical reactions and evaporation in landfills. If a landfill has an impermeable membrane that covers a portion or all of the landfill (i.e., cover-and-capture), it can harvest the LFG and prevent CH_4 emissions from being released into the atmosphere. Once captured, a landfill can either convert the CH_4 to CO_2 through flaring or use it as a fuel for other energy-related applications. For the two landfills in the region, LFG generation and flaring rates for 2019 were available from EPA's Facility-Level Information on Greenhouse Gases (FLIGHT) database (EPA 2022). Any CO_2 emissions from flaring were not counted toward the region's inventory because the IPCC considers any CO_2 emissions from flaring or fugitive emissions to be of biogenic origin and not significant to overall solid waste emissions (IPCC 2006).

Table 15 2019 Napa County Regional GHG Inventory: Solid Waste Generation Emissions by Jurisdiction

Jurisdiction	Waste Generation			Waste-in-Place		$MTCO_2e$
	Annual Waste Tonnage	Annual ADC Tonnage	$MTCH_4$	$MTCH_4$	MTN_2O	
American Canyon	68,529	657	930	0	0	25,938
Calistoga	12,519	1,092	179	0	0	4,984
Napa	50,755	41,501	1,227	0	0	34,236
St. Helena	14,254	1,243	203	0	0	5,675
Yountville	6,533	570	93	0	0	2,601
Unincorporated County	28,105	761	4,495	4,108	<1	125,429
Total	180,695	45,824	7,127	4,108	<1	198,862

Notes: ADC = Alternative Daily Cover, $MTCH_4$ = metric tons of methane, MTN_2O = metric tons of nitrous oxide, $MTCO_2e$ = metric tons of carbon dioxide equivalent.

Source: Data provided by Ascent Environmental 2022 based on data from EPA 2022.

Waste in Place

The only landfills located within the region are the American Canyon Sanitary Landfill (ACSL) and the Clover Flat Landfill near Calistoga, both located in the Unincorporated County. While Clover Flat is open and currently accepting waste, ASCL closed in 1995 and currently has an active LFG collection system. According to FLIGHT, in 2019, the American Canyon landfill generated 2,574 $MTCH_4$ in fugitive CH_4 emissions from accumulated waste at the landfill in 2019 (EPA 2022). Clover Flat also has an active LFG collection system but does not anticipate closure of the landfill until 2053. In 2019, Clover Flat generated 1,534 $MTCH_4$ in fugitive CH_4 emissions (EPA 2022). CH_4 emissions from closed landfills generally decrease overtime due to the gradual reduction in organic decomposition.

Waste Generation

For emissions related to annual solid-waste generation from the community in the region, CH_4 emissions are also generated from organic decomposition. The release of CH_4 emissions from community-generated waste depends on which landfill the waste is disposed at as the LFG management systems differ.

ON-ROAD VEHICLES

Based on modeling conducted, on-road vehicle usage in the region resulted in 446,673 $MTCO_2e$ in 2019, or 30 percent of the County's inventory. On-road vehicle emissions are primarily the result of exhaust from the combustion of gasoline, diesel, and natural gas fuels, based on average 2019 fleet-wide emission factors for Napa County available from EMFAC2021. On-road passenger vehicle activity was based on the annual VMT associated with trips that begin or end in the region. Origin and destination-based daily VMT data by jurisdiction was obtained from average weekday VMT from MTC's VMT Data Portal and (MTC 2015, Brazil pers. comm., 2022). It was assumed that vehicle trips included 100 percent of vehicle trips that both originate from and end in the unincorporated area (i.e., fully internal trips), 50 percent of trips that either end in or depart from the unincorporated area (i.e., internal-external or external-internal trips), and zero percent of vehicle trips that are simply passing through the area (i.e., external-external, or "pass-through," trips). This passenger vehicle trip accounting method is consistent with the method recommended to CARB in 2010 by the RTAC (established through the Sustainable Communities and Climate Protection Act of 2008 [Senate Bill 375]).

MTC provided passenger vehicle VMT only. To estimate VMT from commercial vehicles (e.g., medium and heavy duty trucks), EMFAC2021 was used to calculate a ratio between passenger VMT and non-passenger VMT. Direct VMT and emissions from EMFAC are not typically used in GHG inventories as they are based on odometer data rather than the RTAC method. The calculated passenger-non-passenger ratio was then applied to the VMT from MTC to estimate non-passenger VMT.

Table 16 shows total annual VMT by vehicle fuel type and associated emissions estimates for the region.

Table 16 2019 Napa County Regional GHG Inventory: On-Road Vehicle Fleet Activity and Emissions by Jurisdiction

Jurisdiction	VMT/yr	$MTCO_2$/yr	$MTCH_4$/yr	MTN_2O/yr	$MTCO_2e$/yr
American Canyon	191,054,828	85,061	5	6	86,779
Calistoga	35,752,393	15,918	1	1	16,239
Napa	583,654,224	259,853	14	18	265,100
St. Helena	63,791,559	28,401	2	2	28,975
Yountville	25,806,950	11,490	1	1	11,722
Unincorporated County	83,352,463	37,110	2	3	37,859
Total	983,412,417	437,833	24	30	446,673

Notes: VMT = vehicle miles traveled; kWh = kilowatt-hour; MT = metric tons; CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; CO_2e = carbon dioxide equivalent.

Source: MTC 2022, Brazil, pers. comm., 2022; data compiled by Ascent Environmental 2022.

MTC provided vehicle travel information for the region based on their regional travel demand model under Plan Bay Area 2040. MTC provided average daily weekday VMT estimates in 2019. These were multiplied by annualization factors recommended by MTC (353.29 days per year for all jurisdictions except the City of Napa, which uses 340.84 days per year) to estimate annual VMT to account for lower VMT during weekends, holidays, and summer periods (Brazil, pers. comm., 2022). Emissions from electricity use in electric vehicles were assumed to be included in the building energy inventory.

OFF-ROAD VEHICLES

Based on modeling conducted, off-road vehicles operating in the region emitted approximately 115,548 $MTCO_2e$ in 2019, or 8 percent of the region's 2019 inventory. These emissions were the result of fuel combustion in off-road vehicles and equipment used in construction, industry, and recreation and were available from CARB's OFFROAD2021 model. Unfortunately, the OFFROAD2021 model only provides emissions detail at the State, air basin, or county level. Napa County emissions data from OFFROAD2021 were apportioned to each jurisdiction area using custom scaling factors depending on the off-road equipment type, as shown in Table 18. For example, due to the likely correlation between commercial activity and employment, each jurisdiction's portion of emissions from light commercial equipment in the County is assumed to be proportional to the number of jobs in the region as compared to the County as a whole. On the other hand, emissions from pleasure craft are assumed to occur entirely within the County because the majority of navigable waterways in the County are located in the unincorporated area. Further details on how OFFROAD emissions from each fleet type were scaled to the unincorporated area are discussed below. Note that, although reported by the OFFROAD model, emissions from agricultural equipment included separately in the agriculture sector and are excluded from the off-road vehicles sector.

Emissions from locomotives (e.g., Napa Valley Wine Train) are not included in the OFFROAD model and were also excluded from the regional inventory at this time. The estimated annual emissions and scaling factors were used to apportion the offroad emissions to each jurisdiction are presented in Table 17 below by fleet type.

Table 17 2019 Napa County Regional GHG Inventory: Off-Road Emissions by Fleet Type

Off-Road Fleet Type	$MTCO_2$/yr	$MTCH_4$/yr	MTN_2O/yr	$MTCO_2e$/yr	Percent	Jurisdiction: Countywide Scaling Method
Airport Ground Support	<1	<1	<1	<1	0%	All assumed to occur in the Unincorporated County
Commercial Harbor Craft	135	<1	<1	140	0%	Employment
Construction and Mining	12,250	1	<1	12,294	11%	Service Population
Industrial	5,366	2	<1	5,490	5%	Employment
Lawn and Garden Equipment	23,608	35	15	28,726	25%	Population
Light Commercial Equipment	23,132	6	4	24,282	21%	Employment
Pleasure Craft	26,792	19	6	28,896	25%	All assumed to occur in the Unincorporated County
Portable Equipment	9,721	3	1	10,088	9%	Employment
Railyard Operations	383	<1	0	383	0%	Employment
Recreational Equipment	1,904	5	2	2,687	2%	Population
Transport Refrigeration Units	2,551	<1	<1	2,561	2%	Service Population
Total	105,841	71	28	115,548	100%	

Notes: MT = metric tons; CO_2 = carbon dioxide; CH_4 = CH_4; N_2O = nitrous oxide; CO_2e = carbon dioxide equivalent; GHG = greenhouse gas.

Source: Data provided by Ascent Environmental in 2022, based on modeling from OFFROAD2021.

All commercial and industrial off-road emissions were scaled from countywide estimates by the unincorporated percentage of jobs in 2019. Emissions related to lawn and garden and recreational equipment were scaled by population. Countywide emissions from pleasure craft and airport ground support were assumed to entirely occur in the unincorporated areas.

AGRICULTURE

Based on modeling conducted, emissions from the agriculture sector accounted for approximately 103,381 $MTCO_2e$ from agricultural activity such as off-road equipment, diesel-powered agricultural engines (e.g., irrigation pumps), and stationary equipment, direct emissions from livestock, and fertilizer use. Fuel combustion in off-road farm equipment and fertilizer application made up 46 percent and 21 percent of total emissions from the sector, respectively. Other emissions estimated for this sector were from fertilizer use, lime application, and diesel-powered agricultural engines (e.g., irrigation pumps). These emissions are summarized in Table 18 below.

Table 18 2019 Napa County Regional GHG Inventory: Agriculture Emissions by Source

Source	$MTCO_2$/yr	$MTCH_4$/yr	MTN_2O/yr	$MTCO_2e$/yr	Percent
Agricultural Equipment	130	0	0	47,682	46%
Fertilizer Application	452	-	79	21,948	21%
Diesel Engines	15,417	-	-	15,417	15%
Livestock	-	650	1	18,334	18%
Total	15,999	650	80	103,381	100%

Notes: MT = metric tons; CO_2 = carbon dioxide; CH_4 = CH_4; N_2O = nitrous oxide; CO_2e = carbon dioxide equivalent; GHG = greenhouse gas.

[1] Pesticide application emissions were less than 0.5 MT.

Source: Data compiled by Ascent Environmental in 2022.

GHG emissions associated with farming equipment were obtained from CARB's OFFROAD2021 model. Farming equipment emissions reported for Napa County are assumed to occur entirely within the region. GHG emissions from fertilizers primarily result from their nitrogen content and the application of urea and lime. Data regarding tonnage of nitrogen and lime were obtained from CDFA's *2019 Fertilizer Tonnage Report* (CDFA 2020). Based on this report, 1,718 tons of nitrogen and 1,132 tons of lime were sold in Napa County in 2019. These amounts were used to estimate GHG emissions. These values include a small percentage of non-farm fertilizer sales which were included to allow for complete accounting of fertilizer use as an emissions source in the region. Emissions factors and quantification methods for GHG emissions associated with fertilizer application were obtained from IPCC (IPCC 2006). Using IPCC's methodologies, approximately 21,994 MT CO_2e were emitted from fertilizer application in 2019. A detailed breakdown of fertilizer emissions by type is shown in Table 19.

Table 19 2019 Agricultural Fertilizer Application Emissions in Napa County

Material	Material (Tons)	CO_2e Emissions (MT CO_2e/year)
Nitrogen	1,718	21,496
Liming Materials	1,132	498
Total	2,850	21,994

Notes: CO_2e = carbon dioxide equivalent. Non-farm fertilizer use was excluded. See the Attachment A for more details.

Source: CFDA 2019, Data modeled by Ascent Environmental in 2022.

According to BAAQMD, there were 131 diesel engines with valid permits in 2019 (Henderson, pers. comm., 2022). These engines are primarily remote irrigation or defrosting equipment which either pump or spray water for their respective purposes. To estimate their emissions, emission factors were quantified from a CARB diesel irrigation report, which estimated that, in 2006, there were 147 diesel irrigation pumps operating in Napa County which emitted an average of 28.4 tons of CO_2 per day, or 0.193 tons of CO_2 per day per pump (CARB 2006). Although this reference is 16 years old, CARB has not released more recent descriptions of their methodology in quantifying this sector. Applying this rate to the total number of permitted diesel engines in the county and multiplying it by 365 days per year resulted in an estimate of 15,417 $MTCO_2$ from the operation of diesel irrigation pumps in 2019.

With respect to livestock emissions, CH_4 and nitrous oxide emissions are released through enteric fermentation (a type of digestion process) and exposure of manure produced by these animals. The 2019 Napa County Crop Report provided estimates of total heads of cattle, calves, goats, and sheep and lambs in the county. All livestock-generated GHG emissions were estimated using population-based emission factors and quantification methods identical to those by CARB in the statewide 2019 GHG inventory.

With the exception of agricultural diesel engines, all sources of agricultural emissions were apportioned to each jurisdiction based on relative proportion of agricultural acres in the region. These acres are presented in Table 20. Agricultural diesel engines were scaled to each jurisdiction based on the engine permit location data provided by BAAQMD.

Table 20 Agricultural Acres by Jurisdiction

Jurisdiction	Agricultural Acres
American Canyon	95
Calistoga	168
Napa	392
St. Helena	1,100
Yountville	46
Unincorporated County	52,213
Total	54,014

Source: Malito, pers. comm., 2022.

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Attachment A

Table A-1 2019 Napa County Regional GHG Inventory – Base Activity Data

Emissions Sector	Sub-Sector	Unit	American Canyon	Calistoga	Napa	St. Helena	Yountville	Unincorporated County	Total
Building Energy	Residential	kWh	35,313,687	11,975,343	157,766,535	17,380,692	6,139,033	98,722,653	327,297,943
		therm	5,040,518	1,443,578	24,511,805	2,156,533	858,030	37,797,011	71,807,474
	Non-Residential	kWh	66,049,300	15,944,090	197,452,669	28,196,934	25,641,919	223,643,234	556,928,146
		therm	89,005	31,352	14,872,674	1,731,322	58,152	14,400,058	31,182,562
On-Road Transportation	Countywide	VMT	176,281,057	32,650,803	518,294,070	60,774,785	23,197,949	73,023,186	884,221,850
Solid Waste	Waste Generation	Tons of Waste	68,529	12,519	50,755	14,254	6,533	28,105	180,695
	Waste Generation	Tons of ADC	657	1,092	41,501	1,243	570	761	45,824
	Waste-in-Place (Clover Flat Landfill)	Reported Annual Methane ($MTCH_4$)	0	0	0	0	0	2,574	2,574
	Waste-in-Place (American Canyon Landfill)	Reported Annual Methane ($MTCH_4$)	0	0	0	0	0	1,534	1,534
Off-Road Equipment	See Note 1								
Agriculture	Agricultural Offroad	See Note 1							
	Fertilizer Application	tons of lime	2	4	8	23	1	1,094	1,132
		tons of nitrogen	3	5	12	35	1	1,661	1,718
	Diesel Engines	No. of engines	0	0	7	41	0	193	241
	Livestock	Calves	4	8	18	52	2	2,461	2,546
		Cattle	10	18	42	117	5	5,558	5,750
		Goats	0	1	1	4	0	193	200
		Sheep and Lambs	3	5	12	35	1	1,643	1,700
Wastewater	Centralized WWTP	Population Served	20,996	5,348	79,300	6,094	2,793	618	115,149
	Septic Tanks	Population Served	0	0	0	0	0	24,459	24,459
Imported Water	State Water Project	MG/year	661	154	2,948	191	43	0	3,998

Note: kWh = kilowatt hours, VMT = vehicle miles travelled, ADC = alternative daily cover, $MTCH_4$ = metric tons of methane, WWTP = wastewater treatment plant, MG = million gallons.

[1] Off-road emissions were directly obtained from CARB's OFFROAD 2021 model and apportioned to each jurisdiction.

Source: Ascent Environmental 2022.