SACRAMENTO COUNTY 2021 GHG INVENTORY

Community-wide and Government Operations

June 2023 Public Review Draft

SACRAMENTO COUNTY

Acknowledgements

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1 Introduction

Greenhouse Gas (GHG) Inventories are data-driven tools utilized to report and benchmark GHG emissions for a particular organization, facility, or in this case jurisdiction. They can be used to measure the progress of GHG emission reduction measures when conducted periodically over time. This GHG Inventory (Inventory) presents the Community-wide and Government Operations emissions for unincorporated Sacramento County for the calendar year 2021.

The Community-wide inventory represents all GHG emissions generated within unincorporated Sacramento County along with emissions associated with activities occurring within unincorporated Sacramento County areas, including emissions that occur elsewhere because of those activities. The Government Operations inventory represents emissions from only Sacramento County Government owned and controlled facilities and operations. This Inventory builds upon the County's 2015 GHG inventory (Baseline Inventory), to examine if Sacramento County is making progress, stagnating, or regressing in GHG emissions reductions. This report also serves to assist the public and decision makers in understanding the relative emissions contributions of the various Community-wide and Government Operations sectors and which of these may represent the best opportunities for further GHG reductions.

The 2021 Community-wide GHG emissions inventory was developed using the U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions (Community Protocol) version 1.2 (July 2019) developed by Local Governments for Sustainability (ICLEI). The 2021 Government Operations GHG emissions inventory was developed using the ICLEI Local Government Operations Protocol (LGO Protocol), version 1.1 (May 2010) developed by ICLEI.

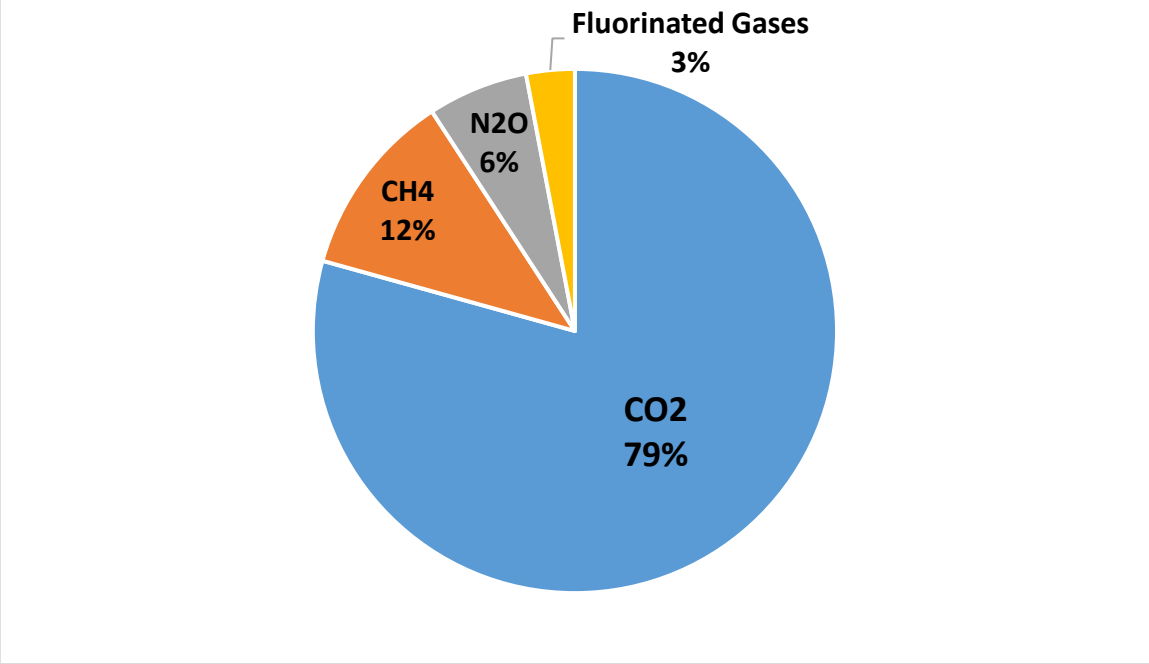
Like the Baseline Inventory, the Government Operations Inventory covers all Scope 1 and 2 emissions, and Scope 3 emissions where applicable and sufficient data exists. A definition of emission scopes can be found in the Glossary section, as well as all other terminology that will be used throughout this report. Emission Scopes are not classified for the Community-wide Inventory because, as noted by the Community Protocol, "the organization-related definitions of scopes do not translate to the community scale in a manner that is applicable, clear, and valuable" (ICLEI, 2019). Sacramento County is a member of ICLEI and utilized ICLEI's ClearPath GHG accounting software for conducting this Inventory.

1.1 Global Warming Potential

GHGs contribute to climate change by trapping heat in the atmosphere. Each GHG has a respective Global Warming Potential (GWP) based on its effectiveness at trapping heat. The three most prevalent GHGs that are released from human activities are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Fluorinated gases, such as chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs), have very high GWP but make up less than 3% of overall U.S. GHG emissions, and less than 8% of Sacramento County emissions (US EPA, 2022a).

The GWP of a gas is used to calculate its emissions value as a Carbon Dioxide Equivalent or CO_2e (US EPA, 2022b). CO_2 is used as the benchmark because it is the most prevalent GHG, as shown by Figure 1. Every other GHG is assigned a GWP based on its ability to absorb heat and how long it remains in the atmosphere equivalent to one unit of CO_2. The unit of measurement of CO_2e is frequently provided in metric tons (MT), as it is in this Inventory. GWPs can change over time as measurement accuracy increases and more data becomes available. Table 1 provides the GWPs used for this Inventory which are taken from the United Nations' Intergovernmental Panel on Climate Change (IPCC) 5th Assessment 100-year Values (Myhre et al, 2013).

Figure 1: Overview of U.S. GHG Emissions in 2021



Source: EPA. https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks

Table 1: IPCC 5th Assessment 100-year GWP Values for GHGs

GHG Name	Chemical Formula	GWP
Carbon Dioxide	CO_2	1
Methane	CH_4	28
Nitrous Oxide	N_2O	265

Note: GWPs for fluorinated gases are not listed in this table, as they are only used for one section of the inventory and are numerous. For the entire list of GWP values, see the IPCC website at https://www.ipcc.ch/.

2 Summary of Results

2.1 Community

GHG emissions in 2021 from unincorporated Sacramento County amounted to 4,026,910MTCO_2e. On-road vehicles were the largest emitter and accounted for 43% of all community GHG emissions. This mirrors statewide emissions data as vehicle miles traveled (VMT) are major contributors to GHG emissions. Building energy was the second leading emitter at 36%, also on-par with statewide data as shown in the California Air Resource Board's (CARB) 2020 California GHG Inventory (CARB, 2022), high-GWP gases at 8%, agriculture at 6% solid waste at 4%, off-road vehicles at 2.5%, and finally wastewater at just 0.5% of total County emissions. Figure 2 illustrates the comparison between sectors, and Table 2 expands the data further.

Community emissions decreased overall by 3.2% in comparison to the Baseline Inventory, but the rate of decrease, or in some instances increase, varied across sectors. This variance is due to different factors that may include actual emission reductions/increases or methodological differences. This will be discussed in this section and in more detail in Section 3.2.

Figure 3 and Table 3 illustrate the changes in emissions between the Baseline Inventory and this Inventory.

Figure 2: Community GHG Emissions

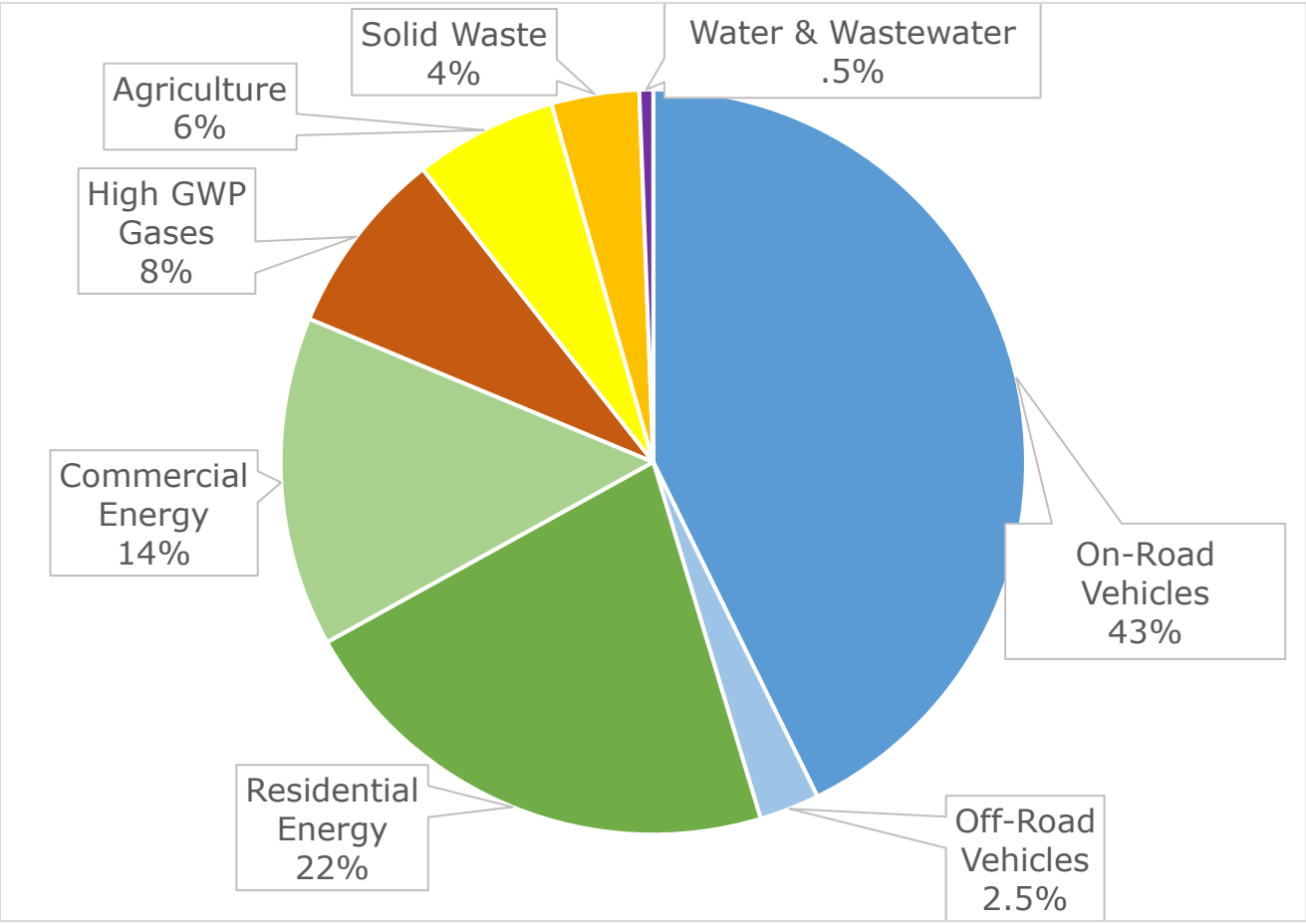


Table 2: 2021 Sacramento County Community GHG Inventory

Sectors	2021 (MTCO2e/year)	Percent of Total (%)
On-Road Vehicles	1,740,212	43
Off-Road Vehicles	107,174	2.5
Residential Building Energy	878,308	22
Commercial/Industrial Building Energy	555,596	14
High-GWP Gases	329,734	8
Agriculture	234,536	6
Solid Waste	156,422	4
Wastewater	24,928	0.5
Total	**4,026,910**	**100.0**

Figure 3: Community GHG Inventory Comparison ($MTCO_2e$)

Table 3: Comparison of Sacramento County Community GHG Inventories

Sectors	2015 Emissions ($MTCO_2e$)	2021 Emissions ($MTCO_2e$)	Difference 2015 to 2021 ($MTCO_2e$)	Percent (%) Change
On-Road Vehicles	1,671,596	1,740,212	68,616	4
Off-Road Vehicles	196,769	107,174	-89,595	-45.5
Residential Building Energy	967,253	878,308	-88,945	-9
Commercial/Industrial Building Energy	648,868	555,596	-93,272	-14
High-GWP Gases	251,085	329,734	78,649	31
Agriculture	254,710	234,536	-20,174	-8
Solid Waste	140,670	156,422	15,752	11
Wastewater	27,253	24,928	-2,325	-8.5
Total	**4,158,204**	**4,026,910**	**-131,294**	**-3.2**

As shown in Table 3, emission sectors in the Community Inventory varied from minimal reductions to large reductions, and steady increases. The building energy sector in its entirety recorded moderate reductions in emissions even though energy usage increased. This is possible due to the improved electricity emission factor. Emission factors and their effects on emissions will be discussed in Section 3.1.

Another sector that dropped in emissions, though more substantially, was off-road vehicles. This was most likely due to changes within the California Air Resources Board's (CARB) OFFROAD2021 model compared to the 2014 model which was used in the Baseline. Staff noted that fuel usage estimates reported by the 2014 model nearly matched the 2021 model, yet the emissions reported by the 2021 model were substantially lower.

Wastewater also recorded a measurable drop in emissions due to Regional San's participation in SMUD's SolarShares program and the introduction of a nutrient removal system, which is expanded on in Section 3.2.7.

There were three sectors that increased in emissions – on-road vehicles, high-GWP gases, and solid waste. On-road vehicles increased by 4%, which is generally consistent with the unincorporated County's population growth since 2015 of 6.2% (CA DOF, 2023). It should be noted that 2021 VMT were provided the Sacramento Area Council of Governments (SACOG) based on projected growth and not based on actual traffic counts during the pandemic downturn; the methodology is detailed further in Section 3.2.1 On-Road Vehicles. Solid Waste increased by 11%, in large part due to the increased amount of community generated waste sent to landfill.

High-GWP gases, which includes hydrofluorocarbons (HFCs) and other fluorocarbons, increased by 31%. This mirrors statewide data from the same period. According to CARB's 2022 Scoping Plan for Achieving Carbon Neutrality, "HFCs are the fastest growing source of GHG emissions, primarily driven by their use to replace ozone-depleting substances and an increased demand for cooling and refrigeration. Since 2005, statewide HFC emissions have more than doubled. While the rate of increase has slowed in recent years due to the state's measures, HFC emissions are still on the rise in California, and have grown by over 50 percent since 2010. Globally, as temperatures rise, adoption of cooling technologies (and refrigerants) is increasing rapidly. If no measures are taken, it is estimated that HFCs will account for 9 to 19 percent of the total global GHG emissions by 2050. (CARB, 2022a)."

2.2 Government Operations

Total GHG emissions in 2021 for Sacramento County Government Operations were 82,853 $MTCO_2e$. Figure 4 and Table 4 provide Sacramento County Government GHG emissions by sector. Employee commute and energy usage at County buildings & facilities (including airport buildings) generated the most GHG emissions, accounting for 36.5% and 37% respectively of total emissions. The County vehicle fleet was responsible for 19% of total emissions, and the two smallest emission sectors were water and streetlights & traffic signals, accounting for 6% and 1.5% of total emissions respectively.

Government Operations emissions declined by 39,979 $MTCO_2e$, or 32.5%, when compared to the Baseline Inventory. Emissions declined or stayed the same across almost all sectors, with the only exception being water, which increased slightly. This is consistent with the County's efforts to reduce GHG emissions since work began on a Climate Action Plan (CAP) in 2009. Figure 5 and Table 5 represent the $MTCO_2e$ difference from 2015 as well as the percentage change.

The greatest percentage and second largest measured emissions decrease was in the airport buildings & facilities sector at 64%. This was primarily due to a new 7.9-megawatt solar energy facility coming online in 2017 that provides power directly to the Sacramento International Airport (Sacramento County, 2017). This large decrease is without SMUD SolarShares participation, so the standard emission factor was used. SolarShares is a SMUD renewable energy program wherein a portion of the County's purchased electricity is derived directly from solar energy and therefore does not have any measurable GHG emissions (SMUD, 2023a). How this program affects emissions is discussed in more detail in Section 3.1.

The second biggest emission percentage reduction and largest measured was the County fleet, which decreased by 47%, or 14,035 $MTCO_2e$. According to County fleet services, they have "put a high priority and invested heavily on reducing emissions (R. Wirth, personal communication, January 19, 2023)". County Fleet emission reduction measures include conversion of Department of Waste Management and Recycling (DWMR) route and long-haul operations to 100% natural gas (mostly renewable), transition to renewable diesel (R99), increased number of hybrid vehicles, beginning the EV transition process, and managing/replacing vehicles on schedule to achieve the best possible fuel efficiency.

Figure 4: Government Operations GHG Emissions by Sector

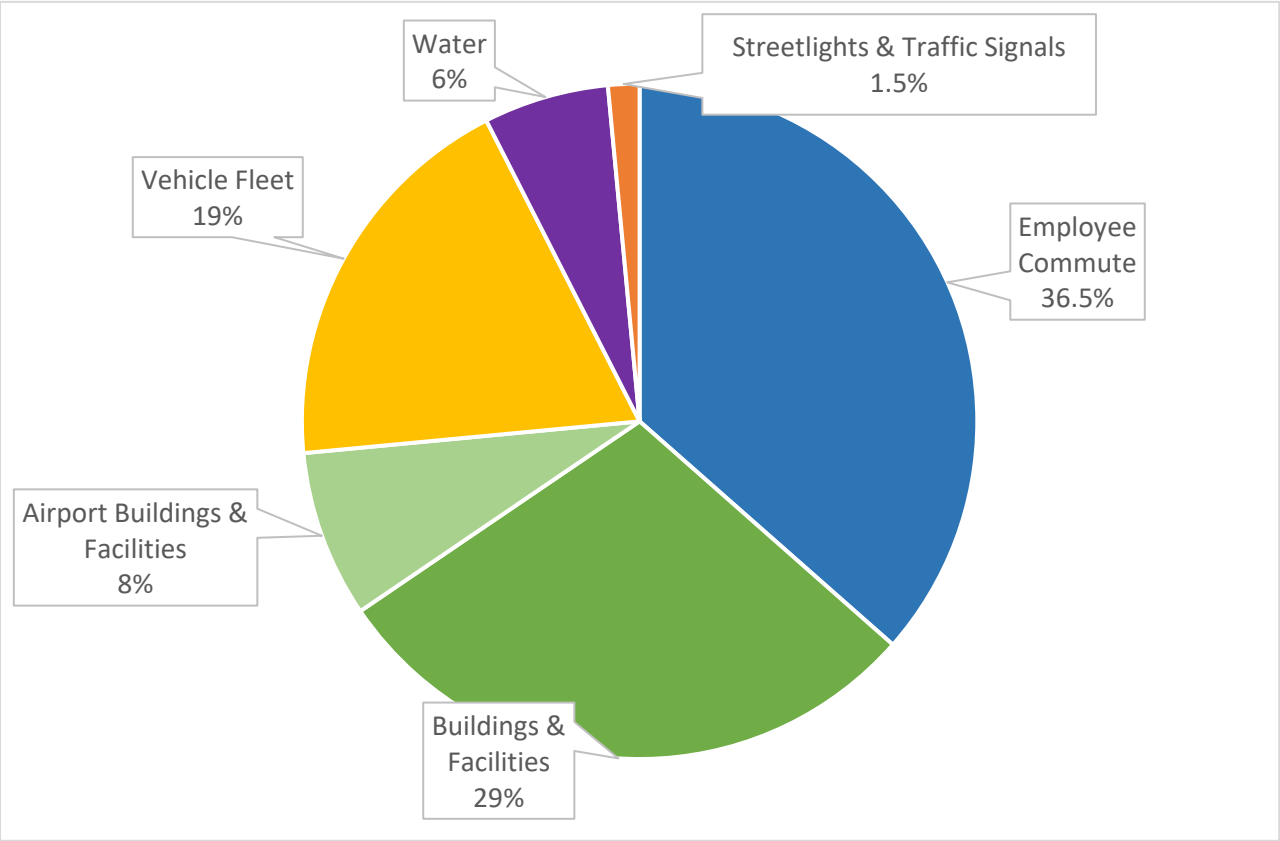


Table 4: 2021 Government Operations GHG Inventory

Sectors	2021 ($MTCO_2e$/year)	Percent of Total
Employee Commute	30,414	36.5
Buildings and Facilities	23,760	29
Airports (buildings and facilities)	6,671	8
Vehicle Fleet	15,556	19
Water	5,197	6
Streetlights and Traffic Signals	1,255	1.5
Total	**82,853**	**100**

Figure 5: Government Operations GHG Inventory Comparison ($MTCO_2e$)

Table 5: Comparison of Government Operations GHG Inventories

Sectors	2015 Emissions ($MTCO_2e$)	2021 Emissions ($MTCO_2e$)	Difference ($MTCO_2e$)	Change as a Percentage
Employee Commute	38,290	30,414	-7,876	-21%
Buildings and Facilities	28,247	23,760	-4,487	-16%
Airports (buildings and facilities)	18,310	6,671	-11,639	-64%
Vehicle Fleet	29,591	15,556	-14,035	-47%
Water	4,665	5,197	532	11%
Streetlights and Traffic Signals	3,729	1,255	-2,474	-66%
Total	**122,832**	**82,853**	**-39,979**	**-32.5%**

Streetlights and traffic signals represented the third largest percentage decrease at 66%. This is likely due to the Streetlight Improvement Plan that was enacted in 2015 by SACDOT to replace "7,500 old street light fixtures with newer, energy efficient models", as well as SolarShares participation by the County (Regan, 2015). Buildings & facilities emissions decreased by 16%, which was mostly due to the County's participation in SMUD's SolarShares program, as total energy usage increased slightly. Total energy usage for the County in 2021 was 89,677 gigawatt hours (GWh), compared to 89,101 GWh in 2015, yet the adjusted EF allows the County to show a reduction in emissions due to SolarShares participation.

Employee commute emissions declined from 38,290 MTCO2e in 2015 to 30,414 MTCO2e in 2021 and remains the largest emitter of GHGs within Government Operations. The decrease in emissions is likely related to methodological differences between the two Inventories and does not necessarily equate to a reduction in real GHG emissions. The difference in methodology will be discussed in detail in Section 3.3.1. Finally, water was the only sector that experienced increased emissions, rising by 11%. This could be attributed to either increased usage or more likely a change in reporting methodology from the Baseline Inventory.

3 Methodology

3.1 Utility Emission Factors

This section outlines the utility-provided emission factors (EFs) that are used to calculate GHG emissions throughout the Inventory anytime purchased electricity is involved. EFs are an integral part of calculating GHG emissions by helping form the connection between raw usage data and actual GHG emissions. Most EFs will stay constant over time, though some may fluctuate based on new data becoming available, from methodological changes in the way they are calculated, or by improvements in the carbon content of the energy portfolio.

EFs can be sourced directly from the IPCC emission factor database (EFDB) or locally when data is available and considered reliable. Local is generally better, as it will often give a more accurate representation of emissions. This Inventory strives to use the most up-to-date and local EFs whenever possible.

Table 6 illustrates the electricity EFs used for this Inventory compared with the Baseline. Electricity EFs are expressed in pounds of a given GHG per megawatt-hour delivered and are used to calculate emissions throughout the

Inventory, though they are primarily used in the buildings & facilities sectors.

Table 6: Electricity Emission Factors

2015	2021	2021 (Adjusted)	Unit
561.08	533.5	393.2	CO_2 lbs./MWh
31.12	32	32	CH_4 lbs./MWh
5.670	4	4	N_2O lbs./MWh

For 2015 and 2021, the CO_2 EF was provided through direct communication with Sacramento Municipal Utility District (SMUD). They are almost the sole electrical utility provider of electricity throughout unincorporated Sacramento County, so their EF was sufficient for calculating all electricity usage emissions throughout both inventories. The emission factor SMUD provided for 2021 decreased from 2015 in alignment with SMUD's goals to increase renewables in their energy mix. These goals are reflected in SMUD's 2030 Zero Carbon Plan, wherein SMUD has committed to reaching zero carbon emissions by 2030 (SMUD, 2021b). CH_4 and N_2O were derived from the 2020 eGRID – the EPA's emission factor database (US EPA, 2023). EPA had not yet updated the eGRID to 2021 at the time of the completion of this Inventory, but it is assumed that CH_4 and N_2O would not have significant changes, as they have remained constant over the last several eGRID updates.

The Inventory used 2021 EFs for all Community electricity, and 2021 (Adjusted) for Government Operations. Electricity EFs consider the total energy mix of power generation from a given utility. By purchasing SolarShares, the County is allocated a carbon-free amount of electricity equal to the amount purchased. The Adjusted EF accounts for the participation of the County in the SolarShares program, which in 2021 was 30,000 GWh. Of the County's total kWh usage of 114,604 GWh, SolarShares participation accounts for 26.3% of total energy usage. When that percentage is applied to the SMUD supplied emission factor, the adjusted emission factor becomes 393.2 lbs CO2/MWh.

Natural Gas EFs remained unchanged from 2015. The EF for CO_2 was provided by PG&E for 2021, who provides nearly all the natural gas to unincorporated Sacramento County. CH_4 and N_2O EFs were provided by ICLEI and already integrated into ClearPath for 2021.

Table 7: Natural Gas Emission Factors

2015	2021	Unit
11.7	11.7	CO_2 lbs./therm
.11	.11	CH_4 lbs./therm
.002	.002	N_2O lbs./therm

3.2 Community

3.2.1 On-Road Vehicles

The most important metric for calculating GHG emissions in the transportation sector is VMT, or the "amount of travel for all vehicles in a geographic region over a given period of time" (Williams et al, 2016). VMT is a useful measure for transportation GHG emission accounting because it "provides a measure of total travel" and shows "how travel changes over time" (Williams et al). The other deciding factor for determining GHG emissions is fuel type (gasoline, diesel, electric, etc.) and when combined with a respective vehicle type and an EF, the emissions can be calculated.

Every four years the Sacramento Area Council of Governments (SACOG) releases a Metropolitan Transportation Plan/Sustainable Communities Strategy (MTP/SCS) for the Sacramento region. For the 2016 MTP/SCS, SACOG used an "activity/tour" based travel demand model in accordance with California Air Resources Board (CARB) and Senate Bill (SB) 743 to calculate regional VMT. Their model is "designed to estimate individual's daily travel, accounting for land use, transportation, and demographics that influence peoples' travel behaviors" (SACOG, 2023). Using that model, SACOG was able to project 2021 VMT on a linear annual rate applied to the 2016 base year based on growth. Though the VMT used for this Inventory is projected from a non-pandemic to a pandemic-affected year, SACOG is confident that VMT trends have increased back to pre-pandemic level overall. By using this methodology, Sacramento County is presenting a more meaningful inventory and not attempting to take credit for any temporary trip reductions caused by the pandemic.

SACOG provided daily VMT totaling 12,118,018 for the unincorporated County. To calculate annual VMT, the same methodology as the Baseline Inventory was applied, in that "daily VMT was multiplied by 347 days per year […] to account for lower VMT during weekends, holidays, and summer periods" (Walters et al, 2016). Since SACOG's model is based on a typical non-holiday weekday, this method is consistent with CARB methodology for GHG emission accounting, and to promote continuity throughout the Inventory process, using the same method as the Baseline Inventory was

deemed appropriate. Annual VMT calculated in this way amounted to 4,204,952,246, which represents a 710 million VMT or 17% increase from 2015.

Once total VMT is found, it is then necessary to parse that data further by vehicle characterization and fuel type, as emissions will differ based on a combination of these variables. County-wide fuel and vehicle type were downloaded directly from EMFAC2021 and scaled to the unincorporated County based on the provided VMT from SACOG. The unincorporated VMT was found to be approximately 32.63% of County-wide VMT as sourced from EMFAC, so every vehicle/fuel type VMT combination was multiplied by 0.3263 to find the unincorporated VMT of each.

Vehicles come in many different types but are grouped into 4 main categories for calculating emissions: Passenger (P), Light Duty (LD) Trucks, Heavy Duty (HD) Trucks, and Motorcycles (M). For emissions purposes, the EPA designates LD as less than 8,500 lbs., and HD as over 8,500 lbs. (EPA, 2022e). These distinctions are important because each vehicle type, along with its associated fuel type, have respective EFs. The EFs used for the Inventory were derived from the EMFAC2021 model to best represent Sacramento County vehicle emissions. Table 8 provides a summary of on-road VMT by fuel and vehicle type.

Table 8: On-Road VMT by Fuel & Vehicle Type (in thousands)

VMT Category	Passenger	LD	HD	Motorcycle	Total Daily	Total Annual
Gas	5,781	4,794	367	46	10,988	3,813,904
Diesel	18	39	744	0	802	279,542
Natural Gas	0	0	27,509	0	28	9,545
Plug-in Hybrid	123	17	0	0	139	48,465
Electric	154	5	0	0	159	55,244
Total					**12,116**	**4,205,701**

Note: The totals calculated in this table differ by less than 1% from the SACOG provided totals due to rounding.

3.2.2 Off-Road Vehicles

Activity from off-road vehicles is not captured in SACOG's VMT and must be calculated separately. Fuel usage data based on vehicle category is obtained from CARB's OFFROAD2021 model for the entire County and scaled to the unincorporated area based on population. Sacramento County had a population of 1,580,624 in 2021, while the unincorporated population was

609,504 (Sacramento County, 2023b). The unincorporated County population represented 38.56% of the population, so that ratio was applied to the countywide data provided by the OFFROAD2021 model.

Off-road vehicles include but are not limited to recreational vehicles (watercraft, all-terrain vehicles, etc.), airline ground support vehicles, lawnmowers, and construction equipment. There are many potential categories to include, however, the eight most impactful and County relevant categories are included in this Inventory and listed in Table 9: Off-Road Fuel Consumption and Emissions by Equipment & Fuel Type. Emissions from off-road agriculture vehicles are included in the agriculture section so they are omitted from this section, as was done in the Baseline. For the fuel types listed in Table 9: Off-Road Fuel Consumption and Emissions by Equipment & Fuel Type, liquid fuels (gasoline and diesel) are shown in gallons and natural gas is in gallons gas equivalent (GGE).

Table 9: Off-Road Fuel Consumption and Emissions by Equipment & Fuel Type

Equipment Category	Gasoline (Gallons)	Diesel (Gallons)	Natural Gas (GGE)	2021 Emissions ($MTCO_2e$)	2015 Emissions ($MTCO_2e$)
Construction & Mining	119,537	3,385,448	0	35,913	96,063
Pleasure Craft	1,641,538	0	0	14,538	28,826
Transport Refrigeration Units	0	405,244	0	4,138	16,233
Lawn & Garden	1,619,716	30,430	0	14,649	12,145
Light Commercial	1,846,430	164,157	140,184	18,941	11,242
Industrial Equipment	316,611	138,881	572,243	7,990	10,627
Oil Drilling	0	151,023	0	1,555	9,781
Recreational	97,650	0	0	864	7,039
Airport Ground Support	775,304	110,126	91,272	8,586	4,633
Total	**6,416,787**	**4,385,308**	**803,698**	**107,174**	**196,589**

All categories shown in Table 9 were scaled based on population except for Airport Ground Support because the Sacramento International Airport is located entirely in the unincorporated area of the County, therefore the County-wide data is the same as the unincorporated. Finally, entertainment and railyard operations categories from the Baseline Inventory were omitted from this Inventory because their emissions relative to the entire off-road section were negligible and amounted to less than 200 $MTCO_2e$ combined.

3.2.3 Building Energy

GHG emissions from buildings and facilities throughout the unincorporated County are derived from purchased electricity and natural gas. While electricity does not produce emissions at the end-use location, it does generate off-site emissions from where it was generated, and the amount of emissions depends on the energy mix, as discussed previously. Almost all electricity in the County is served by SMUD, and almost all natural gas is delivered by PG&E. Data for this sector was provided by the respective utilities in kWh for electricity and therms for natural gas. The data in this section is broken down into residential, industrial, and commercial.

Table 10: Building Energy Use and Emissions by Source

Source	Quantity	GHG Emissions	Percent of Sector
Electricity	kWh/year	$MTCO_2e$/year	%
- Residential	1,982,264,551	481,450	54
- Commercial	1,392,983,289	338,326	38
- Industrial	290,216,671	70,488	8
Electricity Total	3,773,845,123	916,587	100
Natural Gas	therms/year		
- Residential	74,616,385	396,858	73
- Commercial	27,454,537	146,021	27
- Industrial	143,143	760	< 1
Natural Gas Total	102,214,065	543,639	100
Combined Totals			
Residential		878,308	61
Commercial		484,347	34
Industrial		71,248	5
Total		**1,433,903**	**100**

To parse the unincorporated consumers from the entire County, SMUD was provided a GIS shape file of the unincorporated area (PG&E has an automated data request system that parses the data automatically). Using the shape file, SMUD was able to generate a list of premises within the unincorporated area and pull the respective 2021 electricity usage data. Upon the County receiving the 2021 electricity usage data from SMUD, it was observed to be noticeably different from the 2015 data, not only in total usage but also how it was categorized into commercial and industrial usage.

To ensure consistency with the 2015 Inventory, electricity data from 2015 was then requested from SMUD to be compiled using the same methodology as the 2021 data. When this revised 2015 data was provided by SMUD, it was noted to be more consistent with what was reported for 2021 as far as characterization of commercial and industrial usage. The total usage in the new 2015 data was lower than what was reported for the 2015 inventory. The new 2015 data was used in this Inventory to be consistent with the methodology used in generating the 2021 electricity usage data. This results in a more accurate and transparent comparison of emissions between the years. In other words, instead of keeping the higher 2015 electricity usage and showing a larger reduction for 2021, an apples-to-

apples methodology was used that shows electricity usage slightly increased over 2015.

Data was entered directly into ClearPath along with the utility EFs. The SMUD-provided, non-adjusted EF was used for electricity. Electricity usage from the Sacramento Regional Wastewater Treatment Plant (SRWWTP) and wastewater pumping was subtracted from the Industrial total, as that data is included separately in the wastewater section. Agricultural data was provided by SMUD and combined into the commercial energy category because there was no separate agriculture data from PG&E, and per communication with PG&E, agricultural gas customers are usually assigned to the commercial sector.

3.2.4 High GWP Gases

Gases with particularly high GWP, namely hydrofluorocarbons, can be found locally in refrigerants, aerosols, foams, and fire suppressants. Refrigerants, such as those used in air conditioning systems, are the most prominent emissions source for these types of gases, especially in Sacramento County, due to the hot and dry climate. Local data wasn't available so statewide Inventory data was scaled based on the unincorporated County population. The California Inventory was from 2020 so population data from that year was used as well, taken from the U.S Census Bureau. County population was taken directly from the County website.

2020 California population: 39,538,245

2020 Unincorporated Sacramento County population: 610,442

Ratio of unincorporated to CA: .015

Using this data, the ratio was applied to each category of high GWP gases to find their respective County emissions as shown in Table 11.

Finally, fugitive emissions from natural gas distribution leakage were added in this Inventory based on recommendation by ICLEI. This calculation was done by inputting the total amount of natural gas used by the community in 2021 into ClearPath, which was 102,214,065 therms, and applying an ICLEI default leakage rate of .3%.

Table 11: High-GWP Gases Emissions Compared

Parameter	2021 Emissions	2015 Emissions
Refrigerants - Commercial	138,000	112,400
Refrigerants - Transportation	60,000	49,700
Refrigerants - Residential	58,500	28,900
Refrigerants - Industrial	30,000	24,900
Aerosols	9,000	14,800
Foams	13,500	18,400
Solvents & Fire Suppression	3,000	2,100
Natural Gas Distribution	17,734	N/A
Total	**329,734**	**251,200**

3.2.5 Agriculture

GHG emissions from agricultural activities in Sacramento County were found to be a result of enteric fermentation, fertilizer application, manure management, and vehicle engine combustion. Their respective calculation methods and emissions can be found in Table 12. The unincorporated County has virtually of all the agriculture activities of the entire County so the data that was provided for County-wide is assumed to be the same as the unincorporated County.

Table 12: Sacramento County Agriculture Emissions by Source

Emissions Category	Calculation Method	Emissions
Enteric Fermentation	Equation A.1	53,558
Fertilizer Application	Scaled from CA GHG Inventory	31,395
Manure Management	Scaled from CA GHG Inventory	116,000
Farm Equipment	OFFROAD2021	33,583
Total		**234,536**

According to Appendix G of the Community Protocol, "enteric fermentation is the process of microbial fermentation through which methane is produced during animal digestion" and "is one of the largest sources of methane." Digestion from ruminant animals (hoofed mammals

such as cows and goats) produce the highest levels of methane so they are accounted for. The number of cattle in Sacramento County in 2021 was 24,896 and was provided in the 2021 County Crop Report (Flores, 2022). To apply the correct emission factor, it was then necessary to divide the cattle based on their type – 45% beef and 55% dairy. This information was provided in communication with the County Agricultural Commissioner's office.

Using these percentages, it was determined that the beef cattle head count in 2021 was 11,203 and the dairy count was 13,693. Then the respective EFs were applied, which were retrieved from the IPCC Emission Factor Database (EFDB) and using equation A.1 in Appendix G of the Community Protocol the emissions were determined.

Equation A.1: Animal Population (head) x EF (kg CH_4/head/year) x (1/1000) x GWP = Emissions

In the equation above, 1/1000 represents the conversion from kg CH4 to MT CH4, and GWP is the CO_2e equivalent of CH4, which at the time of this Inventory was 25. Using the provided data and Equation A.1, the total emissions was solved for as shown below.

Beef: 11,203 x 47 x .001 x 25 = 13,164 $MTCO_2e$

Dairy: 13,693 x 118 x .001 x 25 = 40,394 $MTCO_2e$

Total: 53,558 $MTCO_2e$

There was not sufficient local data to calculate fertilizer application & manure management, so these values were scaled down from the statewide GHG Inventory. Manure management is based on production from livestock, of which there are local and statewide head counts available from the County Crop Report and USDA State Agriculture Overview for California, respectively. The number of cattle, beef and dairy combined, in the state of California for 2021 was 2,400,000 and for Sacramento County it was 24,896. The ratio of Sacramento County to the state of California was then found to be .01. This ratio was then applied to the statewide emissions from livestock manure management.

11,600,000 (statewide emissions) x .01 = **116,000 $MTCO_2e$**

Emissions from fertilizer are the result of micro-organisms in the soil producing "N_2O as a by-product of their metabolism" after fertilizer has been applied (Menegat, 2022). Fertilizer can either be synthetic or organic in nature, with the former resulting in far higher N_2O emissions. Since local data was not available for fertilizer application, emissions were scaled down

from statewide data. To find the ratio of Sacramento County farmland to statewide farmland, crops grown in the County were compared against the same crops for harvested acreage statewide. Crop acreage totals for the County were taken from the Crop Report, and from the USDA Agriculture Review for statewide data.

Table 13: Sacramento County & California Crops Harvested

Crop Type	County Acres Harvested	CA Acres Harvested
Grapes	37,888	829,000
Hay, Alfalfa	13,190	580,000
Hay, Other	4,158	330,000
Corn, Silage	8,764	345,000
Wheat	6,938	220,000
Rice	8,673	405,000
Pears	5,002	9,400
Tomatoes, Processed	4,310	228,000
Safflower	2,104	39,500
Almonds	1,752	1,320,000
Walnuts	2,163	390,000
Cherries	1,494	34,000
Total	**96,436**	**4,729,900**

Once the totals of each were calculated (1), the ratio was able to be determined and multiplied with the state emissions for fertilizer (2), as pulled from the CA 2020 GHG Inventory (California, 2022):

1. 96,546 / 4,729,900 = .02
2. 1,569,786 MTCO2e (statewide fertilizer emissions) x .02 = **31,395 $MTCO_2e$**

3.2.6 Solid Waste

The GHG emissions from solid waste are primarily a result of landfill gas (LFG), which comprises mostly methane, with a portion of biogenic CO_2 (which is not included in GHG emissions per either Protocol) and a negligible amount of N_2O and other gasses (US EPA, 2022d). Solid waste emissions for Sacramento County comprise three categories: community waste generation, LFG flaring, and LFG combustion (for energy purposes), as outlined in Table 14.

Table 14: Solid Waste Emissions

Emissions Category	Quantity	Emissions 2021 ($MTCO_2e$)	Emissions 2015 ($MTCO_2e$)
Waste Generation	546,072 tons	156,233	140,650
LFG Flaring	78,568,023 cubic feet (cf)/year	189	N/A
LFG Combustion	2,669,779,468 cf/year	322	20
Total		**156,422**	**140,670**

Community waste generation represents all solid waste that was generated by businesses and residents in the unincorporated County in 2021 and sent to landfill, which amounted to 546,072 tons. This data was sourced directly from the CalRecycle website, and the closest available year at the time of this Inventory was 2019 (CalRecycle, 2019).

The tonnage of waste was entered into ClearPath along with an LFG collection of 75% and oxidation percentage of 10%. LFG Collection is the amount of LFG that is collected by the landfill before it escapes into the atmosphere, and the percentage used is consistent with the Baseline Inventory and Appendix E of the Community Protocol. Oxidation percentage is the amount of LFG that is absorbed by the soil, of which the Community Protocol standard of 10% was used. Finally, California specific waste characterization was used. Waste characterization is the breakdown of types of waste by percentages, e.g. newspaper, food waste, textiles, construction, etc., and was also sourced directly from CalRecycle.

Once LFG is captured and treated by the landfill, it can be turned into energy via a combustion process or flared (burned off). Kiefer landfill flaring & combustion data for 2021 was provided by the Sacramento County Department of Waste Management and Recycling (DWMR). They were able to provide the total amount flared for 2021 along with the percentage of methane in the LFG (45.8%) and the destruction efficiency (99%). Destruction efficiency refers to the amount of methane that is destroyed during flaring, and subsequently converted to CO_2 (Plant et al, 2022). LFG is combusted at Kiefer and turned into energy via two on-site energy plants with a 15 MW capacity. Most of that electricity is sold to SMUD, while a fraction is used on-site to run the energy plant itself and the flare compound.

Waste-in-place emissions were omitted from the 2021 Inventory due to changes in the Community Protocol and to avoid double-counting. For this reason, they are not utilized in calculating the comparison table for 2015.

Kiefer landfill is responsible for their own mandatory GHG emission reporting which they report to CARB and the EPA annually. By making this change, the County is focusing on current behaviors and is more in line with the Community Protocol. This creates an Inventory that is more representative of emissions from activities from Sacramento County residents in 2021 and therefore better informs potential local actions to address these emissions.

3.2.7 Wastewater

Emissions from wastewater come from several different sources, though the most impactful is energy purchased from SMUD to operate the various treatment and pumping facilities. Regional San has a contract with SMUD for SolarShares, like the County, so their purchased electricity emissions were adjusted accordingly. Data was provided by Regional San for 2021, including the allotted amounts of SolarShares for each entry, as displayed in Table 15.

Table 15: Sacramento County Wastewater Emissions

Emission Source	Quantity	SolarShares Adjusted	Emissions ($MTCO_2e$)
Treatment Facility	102,962,388 kWh	76,991,093 kWh	18,700
Pumping & Collection	5,419,224 kWh	3,164,503 kWh	769
Effluent Discharge	1,888 kg N/day	N/A	1,434
Digester Gas Flaring	254,140 cf/day	N/A	317
Process N_2O	14 MT	N/A	3,710

Note: kg N = kilogram Nitrogen

These emissions represent the total energy used to power the SRWWTP located within the unincorporated County borders. Per Regional San, they allocate 25,971,295 kWh of purchased SolarShares to the treatment facility, bringing their total kWh usage for emission purposes to 76,991,093 kWh. As described earlier in this report, SolarShares represent 100% renewable energy purchased from SMUD and therefore have zero emissions, so a simple subtraction is made to calculate emissions. The unaltered SMUD EF was then applied to calculate emissions.

It should be noted that instead of changing the EF to represent the SolarShares purchases as was done in the County Inventory, here the bulk kWh is changed. This is done because of the way Regional San allocates their SolarShares. It is not a blanket application like at the County, so using a singular adjusted EF did not make sense, as there would have to be several different EFs for the different allocations. The same principal is

applied, and emissions are reduced by the amount of SolarShares purchased.

Data on wastewater pumping, collection, and conveyance was provided for the entire County and was scaled down based on the unincorporated population. Regional San provided a total service population of 1.6 million, the same population of the entire County, so the ratio of unincorporated population (609,504) to entire County population was applied. This ratio was found to be .3856. Similar to the treatment facility, SolarShares are allocated here as well. Total kWh usage was 14,054,004 minus a SolarShares allocation of 5,847,305, then an adjustment for the unincorporated area, resulted in the total kWh usage expressed in Table 15.

In normal operations, WWTPs discharge effluent, or treated wastewater, into nearby bodies of water. According to the Community Protocol, "Conventional WWTPs are not able to remove all of the nitrogen content in wastewater," and "when this nitrogen containing effluent reaches a natural watershed, indirect N_2O emissions occur". The SRWWTP has two rates of effluent discharge for 2021 due to the fact that in April they commissioned the EchoWater Nutrient Removal Project (BNR) which is a seven-stage nitrification and denitrification biological treatment process, effectively cutting their effluent ammonia releases by 99%. The averages of the two rates, pro-rated based on days in operation, were used to calculate the total discharge for the year.

The wastewater also undergoes a nitrification/denitrification process, in which ammonia is oxidized to nitrite, then to nitrate, and finally released as nitrogen gas (US EPA, 2007). This releases 14MT of N_2O emissions that, according to the Community Protocol, is calculated based on the population served by the WWTP.

Anaerobic digesters take in treated wastewater solids and turn them into biogas, which is then combusted or used as a renewable fuel. The SRWWTP uses flaring and boilers to burn off the portion of biogas that is not sent to SMUD. The amount burned in the boilers produces an insignificant amount of emissions, so just the amount combusted during flaring is represented in Table 15.

3.3 Government Operations

3.3.1 Employee Commute

Much like the Community transportation sector, when determining employee commute emissions, the most important dataset is VMT. Though

technically a Scope 3 emission, employee commute is included in the Inventory because of its impact on emissions. For this Inventory, VMT was calculated using an origin-destination model. Home zip codes for all County employees were compiled as well as their respective work addresses. VMT to work locations was calculated by using either the post office as the origin, or in cases with no post office present, the centroid point of the zip code.

To account for vacation and work-from-home days, it was assumed that every other week employees either work from home or take a day off for vacation or illness, in addition to County holidays. Beginning with 365 days out of the year, then subtracting 104 for weekends, 14 for County holidays, and an additional 25 for vacation/work from home, it was determined that the average County employee commuted to work 222 days in 2021. This is consistent with what was used in the Baseline Inventory, and for all intents and purposes may be an overestimation due to the increase of employees working from home since the onset of the pandemic. However, for the sake of consistency, the ability to compare data across inventories, and gradual return to regular work schedules, this methodology was used.

When determining mode split with alternative means of transportation such as bicycle, public transit, or carpool, several factors were considered. Based on data from the US Census Bureau, local observations, employee interviews, and the County Department of Personnel Services, it was determined that 6.5% of County employees commute to work by some other means than a personal vehicle.

Using this methodology, it was determined that total annual VMT for County employees in 2021 was 81,877,233. This represents a 26 million VMT decrease from the Baseline Inventory. When computing VMT for this Inventory, there were a handful of outliers that were removed due to their reported home zip codes being hundreds, often thousands of miles away from their listed work location. Since it is not feasible for these employees to commute this distance, these entries were not included in VMT calculations for this Inventory. These entries represented only 31 of 12,209 employees but a substantial amount of false VMT.

3.3.2 Building Energy

Emissions from County buildings & facilities are classified as a Scope 2 emission, meaning that they are indirect and from the result of purchased electricity and natural gas. Like the Community, the County purchases its natural gas from PG&E and electricity from SMUD. The difference here being the EF is adjusted for County purchased SolarShares, as described

previously in Section 3.1. See Table 16 for a breakdown of electricity and natural usage expressed in kWh and therms, respectively.

Table 16: Government Operations Building Energy Usage

Sector	Electricity (kWh)	Natural Gas (therms)	Emissions ($MTCO_2e$)
Buildings & Facilities	89,472,931	1,452,005	23,760
Airport Buildings & Facilities	24,369,000	437,124	6,671
Total	**113,841,931**	**1,889,129**	**30,431**

Buildings & facilities, as well as the airport, includes all buildings & facilities that are owned, operated, and leased by the County. Energy usage data was provided by the County Energy Program Manager in the form of an Excel spreadsheet, which included all County energy usage and was referenced throughout the Government Operations section of the Inventory. From this spreadsheet airport data was parsed out separately.

Airport energy usage and emissions are shown separately for two reasons. The first of which is that they have an energy program separate from the County. Secondly, for sake of continuity with the Baseline Inventory, as the airport data was broken out separately there. In addition to airport data being removed from the building energy data, there was some duplicate water-related data as well. To avoid double-counting, 206,479 kWh of stormwater pumping data was removed because it already appears in the water section of the Inventory.

3.3.3 Vehicle Fleet

This Scope 1 emission sector of the Inventory represents direct emissions from combustion and includes vehicles owned and operated by the County, both off-road and on-road. The miles driven with a particular fuel, along with an EF, is used to calculate emissions associated with that fuel type. For certain fuel types that include mostly off-road vehicles, namely propane and diesel, vehicles are stationary and operate based on hours, not miles. VMT are not required for these emissions calculations and are therefore not included in the data. For the fuel types listed in Table 17, liquid fuels (unleaded, diesel, and propane) are shown in gallons and natural gas is in gallons gas equivalent (GGE).

Table 17: County Fleet (Non-Airport)

Fuel Type	Fuel Usage (gal or GGE)	VMT	GHG Emissions ($MTCO_2e$)	Biogenic CO_2 Emissions
Unleaded	1,406,894	15,575,483	12,353	N/A
Diesel	13,926	N/A	144	N/A
R99 Diesel	725,140	669,661	28	6,784
CNG	2,791	N/A	18	N/A
RNG	1,344,379	2,166,025	0	7,848
Propane	12,800	N/A	72	N/A
Total	N/A	N/A	**12,615**	**14,632**

As shown in Table 17, emissions from unleaded fuel represents by far the largest emitter of CO_2e. R99 Diesel and renewable natural gas (RNG), which the County sources from California's renewable natural gas procurement program, represent rather large amounts of fuel usage and VMT, but because of their renewable properties they emit biogenic CO_2, as opposed to fossil CO_2 that is extracted from underground. These renewable fuels are made from biological processes that occur upstream, re-using carbon that is already in the carbon cycle, and are therefore carbon neutral and not counted in County GHG emissions. Biogenic CO2 is shown in the table only for accounting purposes. This reporting methodology is consistent with the LGO Protocol.

As with building energy, the Airport manages their fleet separately from the rest of the County. Emissions from aircraft and airline-owned ground support equipment were not included in the airport emissions because these are not part of County Government Operations and therefore do not fall under any of the reportable emission Scopes. They are owned by private entities such as the airline companies themselves and should be accounted for in their inventories. The Airport uses just three types of fuels for its fleet, shown in Table 18.

Table 18: 2021 County Airport Fleet Usage Data

Fuel Type	Fuel Usage (gal or GGE)	VMT	Emissions ($MTCO_2e$)
Unleaded	79,858	806,536	701
Diesel	3,558	37,331	61
Natural Gas	260,662	1,091,778	1,645
Total			**2,407**

3.3.4 Water

Emissions from water-related activities in this Inventory are classified as a Scope 2 emission, as they are calculated from the amount of purchased energy from SMUD to operate the treatment & delivery of potable water to residents within the unincorporated County by Sacramento County Department of Water Resources (SCWR) and the pumping of storm water. This methodology is consistent with the LGO Protocol for emissions from water delivery and pumping facilities. SCWR provided an excel spreadsheet of total energy usage for 2021 within its own facilities operations and Zone 41, which was 28,838,061 kWh. Zone 41, per the SCWR website, includes all "water production, treatment, storage, and distribution facilities, pursuant to permits issued by the California Department of Health Services."

There was a handful of water-related entries on the building energy spreadsheet that were combined with the SCWR file. They amounted to only 157,113 kWh (minus duplicates totaling 47,566 kWh) and when added to the SCWR data, the final water energy total amounted to 28,995,174 kWh. Then to calculate emissions, the Adjusted EF was applied and entered into ClearPath.

Wastewater emissions were not included in the Government Operations Inventory due to its minimal impact on County emissions and its inclusion in detail in the Community Inventory.

3.3.5 Streetlights & Traffic Signals

Streetlights & Traffic Signals represent another Scope 2 emission, as their emissions originate from purchased electricity. Electricity usage for this sector was parsed out of the provided SMUD energy data using TS (Traffic Signal) and SL (Street Light) indicators, the same as it was done for the

Baseline. As mentioned earlier, there has been a large reduction in electricity usage due to the implementation of the streetlights improvement plan, resulting in the decreased kWh for 2021. When calculating emissions, the Adjusted EF was used, further adding to the decrease in emissions.

Table 19: Streetlights & Traffic Signals Emissions

Inventory	Total Usage (kWh)	Emissions ($MTCO_2e$)
2015	14,979,246	3,729
2021	7,002,921	1,255

4 Conclusion

4.1 Projections

Based on the data from 2015 and 2021, a simple linear regression analysis was done to project emissions to the years 2030 and 2045. It is assumed that Sacramento County will continue to grow at the same rate it did from 2015-2021 which is supported by data from SACOG in their Sacramento Region Draft Growth Projections Technical Memo (SACOG, 2021). 2030 was chosen as the first projected date, and 2045 was also selected as that is the State of California's carbon neutrality goal set forth in Executive Order B-55-18.

As previously noted, SMUD plays an integral role in the emissions associated with building energy, as they are the primary supplier of purchased electricity throughout the County. The emission projections in Table 20 for residential and commercial/industrial energy as well as County buildings and facilities include projecting the reduced SMUD emission factor from 2015 to 2021 out to 2030 and 2045; however, they do not include the reductions associated with SMUD's energy production reaching carbon neutral, as they have laid out in their 2030 Zero Carbon Plan. As SMUD progress towards carbon zero, building energy emissions will decline further to the point where there are only GHG emissions associated with purchased natural gas.

Table 20: Sacramento County GHG Emissions Forecast

Sector	2015 ($MTCO_2e$)	2021 ($MTCO_2e$)	2030 ($MTCO_2e$)	2045 ($MTCO_2e$)
Community				
On-Road Vehicles	1,671,596	1,740,212	1,843,136	2,014,676
Off-Road Vehicles	196,769	107,174	0	0
Residential Building Energy	967,253	878,308	744,891	522,528
Commercial/Industrial Building Energy	648,868	555,596	415,688	182,508
High-GWP Gases	251,085	329,734	447,708	644,330
Agriculture	254,710	234,536	204,275	153,840
Solid Waste	140,670	156,422	180,050	219,430
Wastewater	27,253	24,928	21,441	15,628
Total	**4,158,204**	**4,026,910**	**3,857,188**	**3,752,940**
Internal Operations				
Employee Commute	38,290	30,414	18,600	0
Buildings and Facilities	28,247	23,760	17,030	5,812
Airports (buildings and facilities)	18,310	6,671	0	0
Vehicle Fleet	29,591	15,556	0	0
Water	4,665	5,197	5,995	7,325
Streetlights and Traffic Signals	3,729	1,255	0	0
Total	**122,832**	**82,853**	**41,625**	**13,137**

5 Glossary

ClearPath – GHG accounting software developed by ICLEI that was used to conduct this Inventory.

Community Protocol - U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions. The standard by which Community GHG Inventories are conducted in the U.S. and the Inventory handbook used for this Inventory.

eGRID – Emissions & Generation Resource Integrated Database. Database of nationwide electricity emissions data.

Emission Scopes – Classification system for GHG Emissions when conducing a government or other entity-driven GHG Inventory. Not generally used for Community Inventories.

Scope 1 – Direct emissions from controlled sources such as internal combustion engines or methane from a landfill.

Scope 2 – Indirect emissions, generally from purchased electricity and natural gas.

Scope 3 – Indirect *adjacent* emissions that are not from owned and operated facilities, such as from purchased goods that were manufactured elsewhere.

GGE – Gasoline Gallon Equivalent. Measure of a particular fuel converted to gallons of gasoline for accounting and comparability purposes.

GHG – Greenhouse Gas. Gases, that when present in the atmosphere, reflect heat back to the Earth's surface. Three primary GHGs are:

CO_2 – Carbon Dioxide. Most common GHG emitted.

N_2O – Nitrous Oxide. More potent than CO2, but less so than Methane.

CH_4 – Methane. High GWP gas.

GWP – Global Warming Potential. Unit of measure for the warming potential of a GHG.

kWh – Kilowatt-hour. Standard unit of measurement for electricity usage. Equivalent to one kilowatt of power per hour.

LGO Protocol - Shorthand for "Local Government Operations Protocol: for the quantification and reporting of greenhouse gas emissions", which is the standard by which Government GHG Inventories are conducted in the United States.

MPG – Miles per Gallon. A measurement of how many miles a vehicle travels on one gallon of fuel.

Natural Gas – fossil fuel that emits GHGs into the atmosphere when burned, primarily methane.

LNG – Liquefied Natural Gas.

CNG – Compressed Natural Gas.

RNG – Renewable Natural Gas.

Therms – Standard measurement for natural gas usage

R99 Diesel – Diesel fuel containing at least 99% renewable diesel (CARB, 2023). Renewable Diesel is "a fuel made from fats and oils, such as soybean oil or canola oil, and is processed to be chemically the same as petroleum diesel (US DOE, n.d.)."

VMT – Vehicle Miles Traveled. A measure of total miles traveled by a given vehicle, or number of vehicles.

CARB – California Air Resources Board. California State agency in charge of air quality. Responsible for conducting statewide GHG Inventories.

ICLEI – Local Governments for Sustainability. "Global network of local and regional governments committed to sustainable urban development (About, 2023)." Authors of the Community and LGO Protocols and ClearPath software.

IPCC – International Panel on Climate Change. United Nations body that sets standards for GHG emission reporting.

EPA - Environmental Protection Agency. Federal agency responsible for nation-wide environmental regulation and policy.

PG&E – Pacific Gas & Electric Company. Investor-owned utility that provides natural gas services to Sacramento County.

SACOG – Sacramento Area Council of Governments. Metropolitan Planning Organization for the greater Sacramento region.

SMUD – Sacramento Municipal Utility District. Community-owned Utility that supplies electricity to Sacramento County.

DGS – Department of General Services.

SCWA – Sacramento County Water Agency.

DWMR – Department of Waste Management & Recycling.

Regional San – Owner and operator of the regional wastewater conveyance system and the Sacramento Regional Wastewater Treatment Plant.

6 References

"About Us". *ICLEI.* (2023). Retrieved on January 10, 2023 from https://iclei.org/about_iclei_2/#:~:text=ICLEI%20%E2%80%93%20Local%20Governments%20for%20Sustainability,equitable%2C%20resilient%20and%20circular%20development.

CalRecycle. (2019). "California Solid Waste Statistics". Retrieved on December 15, 2022 from https://www2.calrecycle.ca.gov/LGCentral/DisposalReporting/

California Air Resources Board (CARB). (October 26, 2022). *California Greenhouse Gas Emissions for 2000 to 2020: Trends of Emissions and Other Indicators.*

CARB. (November 2022a). *2022 Scoping Plan for Achieving Carbon Neutrality. Retrieved from https://ww2.arb.ca.gov/sites/default/files/2022-12/2022-sp_1.pdf*

CARB. (February 2023). "CHC Factsheet: Renewable Diesel (R100 or R99)." California Code of Regulations, Title 17, Section 93118.5

California (CA) Department of Finance (DOF). (2023). "January Population and Housing Estimates." Retrieved on May 26, 2023 from https://dof.ca.gov/forecasting/demographics/estimates/

Flores, Chrisandra J. (2022). *Sacramento County 2021 Crop and Livestock Report.* Sacramento County Department of Agriculture, Weights & Measures

ICLEI. (2019). U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions. Local Governments for Sustainability USA. Version 1.2

Myhre, G., D. Shindell, F.-M. Bréon, W. Collins, J. Fuglestvedt, J. Huang, D. Koch, J.-F. Lamarque, D. Lee, B. Mendoza, T. Nakajima, A. Robock, G. Stephens, T. Takemura and H. Zhang, 2013: Anthropogenic and Natural Radiative Forcing. In: *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Plant, G., Kort, E., Brandt, A., Chen, Y., Fordice, G., Smith, M. (September 2022). *Inefficent and unlit natural gas flares both emit large quantitites of methane.* Science; Vol. 377, Issue 6614, pp. 1566-1571

Regan, Dan. (February 2015). *Doubling Energy Efficient Street Lights.* SACCOUNTY NEWS. Sacramento County. Retrieved from https://www.saccounty.gov/news/latest-news/Pages/Doubling-Energy-Efficient-Street-Lights.aspx

SACOG. (2021). "Sacramento Region Draft Growth Projections." Retrieved on May 26, 2023 from https://www.sacog.org/sites/main/files/file-attachments/attachment_a._growth_projections_technical_memo.pdf?1640645575

Sacramento County. (December 2017). "Airport Celebrates New Solar Facility That Will Provide More Than 30% of Electricity". Retrieved from https://sacramento.aero/scas/about/news-and-events/airport-celebrates-new-solar-facility-that-will-provide-more-than-30-of-ele

"Senate Bill 743". SACOG. Retrieved on January 19, 2023 from https://sb743-sacog.opendata.arcgis.com/

SMUD. (2023a). "Commercial SolarShares." Retrieved on January 12, 2023 from https://www.smud.org/en/Going-Green/Commercial-SolarShares

SMUD. (2023b). *2030 Zero Carbon Plan.* Retrieved on May 24, 2023 from https://www.smud.org/-/media/Documents/Corporate/Environmental-Leadership/ZeroCarbon/2030-Zero-Carbon-Plan-Executive-Summary.ashx

US Department of Energy (DOE). (n.d.). Retrieved on May 25, 2023 from https://afdc.energy.gov/fuels/renewable_diesel.html

US EPA. (January 2023). "Emission & Generation Resource Integrated Database (eGRID)". Retrieved from https://www.epa.gov/egrid

US EPA. (May 2022a). "Overview of Greenhouse Gases". Retrieved from https://www.epa.gov/ghgemissions/overview-greenhouse-gases

US EPA. (May 2022b). "Understanding Global Warming Potentials". Retrieved from https://www.epa.gov/ghgemissions/understanding-global-warming-potentials

US EPA. (April 2022d). "Frequent Questions about Landfill Gas." Retrieved from https://www.epa.gov/lmop/frequent-questions-about-landfill-gas#:~:text=Combusting%20the%20LFG%20also%20destroys,and%20other%20less%20volatile%20compounds.

US EPA. (August 2022e) "How does MOVES Define Light Duty Trucks?" (August 2022). Retrieved from https://www.epa.gov/moves/how-does-moves-define-light-duty-trucks

US EPA. (September 2007). "Wastewater Management Fact Sheet". Retrieved from https://www.epa.gov/sites/default/files/2019-08/documents/denitrifying_filters_fact_sheet_p100il79.pdf

Walters, H.; de Kok, E.; Antoniou, D. (November 2016). *Task 1 Technical Memorandum: 2015 Greenhouse Gas Emissions Inventory & Forecasts*. Ascent Environmental

Williams, T.; Chigoy, B.; Borowiec, J.; Glover, B. (July 2016). *Methodologies Used to Estimate and Forecast Vehicle Miles Traveled (VMT).* Texas A&M Transportation Institute. Transportation Policy Research Center. Retrieved from https://static.tti.tamu.edu/tti.tamu.edu/documents/PRC-2016-2.pdf