Appendix 04

County of San Diego Local Government Operations Greenhouse Gas 2019 Inventory and Projections

Technical Report

for the

County of San Diego Local Government Operations Greenhouse Gas 2019 Inventory and Projections

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October 2023

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ACRONYMS AND ABBREVIATIONS

ACIP	Airport Capital Improvement Plan
ADC	alternative daily cover
AB	Assembly Bill
CARB	California Air Resources Board
CCAR	California Climate Action Registry
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CAP	Climate Action Plan
IPCC	Climate Change
CRIS	Climate Registry Information System
eGRID	Emissions & Generation Resource Integrated Database
EU ETS	European Union Emission Trading System
Gal	gallon
GRP	General Reporting Protocol
GWh	gigawatt-hours
GWP	global warming potential
G	grams
GHG	greenhouse gas
GSE	ground support equipment
Kg	kilograms
kWh	kilowatt-hours
LFG	landfill gas
LGT	Landfill Gas Tool
LGOP	Local Government Operations
ICLEI	Local Governments for Sustainability
CH_4	methane
$MTCO_2e$	metric tons of CO_2e
MMBTU	million British Thermal Units
N_2O	nitrous oxide
SB	Senate Bill
TCR	The Climate Registry
WBCSD	World Business Council for Sustainable Development
UNFCCC	United Nations Framework Convention on Climate Change

USEPA	United States Environmental Protection Agency
WECC	Western Electricity Coordinating Council
WRI	World Resources Institute
VMT	vehicle miles traveled

1 INTRODUCTION

As a supplement to the *Unincorporated County of San Diego 2019 Greenhouse Gas Emissions Inventory and Projections for the County of San Diego's Climate Action Plan (CAP)*, this document presents the greenhouse gas (GHG) emissions related to County of San Diego (County) operations in 2019. County operations refer to all facilities and operations owned and operated by the County. The purpose of the GHG emissions inventory is to identify source types, distribution, and overall magnitude of GHG emissions. Emissions projections for 2030 through 2050 are also provided.

The County is a member of The Climate Registry (TCR) and has reported its County operational emissions to the TCR since 2010. The inventory reported in this document has primarily been compiled from information in the Climate Registry Information System (CRIS) database, TCR's GHG emissions reporting platform, and supplemented by additional emissions quantification as detailed in the following sections. The community-wide inventory includes the emissions presented in the County operations inventory, with some sectors overlapping. For example, the portion of employee commute-related emissions that occur, at least in part, in the unincorporated county are already included in the overall on-road transportation estimates in the community-wide inventory. However, commute trips that might occur entirely outside of the unincorporated county are unique to County operations and are added into the community-wide inventory separately. Additionally, some County facilities and operations are located within incorporated cities; nonetheless, the emissions from these facilities are being accounted for within this inventory as these facilities are owned and/or operated by the County.

Refer to the Unincorporated County of *San Diego 2019 Greenhouse Gas Emissions Inventory and Projections for the County of San Diego's Climate Action Plan (CAP)* for a discussion of how County operations are included in the community-wide inventory.

2 GHG INVENTORY METHODOLOGY

The purpose of the GHG emissions inventory is to identify source types, distribution, and overall magnitude of GHG emissions resulting from operations of the County government. The County operations GHG inventory was developed using TCR's General Reporting Protocol (GRP) (Version 3). The GRP requires general purpose local governments reporting to The Climate Registry to report in conformance with the Local Government Operations Protocol (LGOP). The LGOP was developed by the California Air Resources Board (CARB), the California Climate Action Registry (CCAR), and Local Governments for Sustainability (ICLEI), in collaboration with TCR. The LGOP is designed to provide a standardized set of guidelines to assist local governments with quantifying and reporting GHG emissions associated with their operations. The County operations GHG inventory was developed for the year 2019 (baseline year) using latest version (Version 1.1) of the LGOP (TCR 2010). The methodology used to develop and compile the inventory is described in the following sections.

2.1 OVERVIEW

An emissions "sector" is a distinct subset of a market, society, industry, or economy, whose components share similar characteristics. The County's operations GHG inventory was compiled for the following emissions sectors, as per the LGOP:

- Airports
- Buildings & Other Facilities
- Employee Commute
- Landfills
- Public Lighting
- Solid Waste
- Vehicle Fleet
- Wastewater Facilities
- Water Pumping
- Water Use

This inventory focuses on the three GHGs most relevant to local government policymaking: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). These gases comprise a large majority of GHG emissions from the County's government operations. The LGOP and most other GHG reporting protocols also include consideration of three additional GHGs: hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). The County's reported inventory in CRIS includes R-401A, R-404A, R-410A, and R-438A which are fugitive HFC emissions from refrigerant use in County facilities, where data were available. Emissions of PFCs (byproducts of aluminum and semiconductor manufacturing) and SF6 (used electrical transmission and distribution equipment, electronic and semiconductor manufacturing, and magnesium production) as well as HFCs from sources other than refrigerants (e.g., insulating foams, aerosol propellants), are not included in the County's inventory because data needed to quantify these gases are prohibitively difficult to obtain and the primary sources of these emissions are not within the scope of County operations.

All emissions are converted to carbon dioxide equivalent (CO_2e) so that GHGs can be compared using a common metric. Non-CO_2 gases are converted to CO_2e using internationally recognized 100-year global warming potential (GWP) factors. GWPs are developed by the Intergovernmental Panel on Climate Change (IPCC) to represent the heat-trapping ability of each GHG relative to that of CO_2. For example, the GWP of CH_4 is 25 because one metric ton of CH_4 has 25 times more capacity to trap heat in the atmosphere than one metric ton of CO_2. The County's CRIS database inventory used GWPs from IPCC's Fifth Assessment Report. The inventory presented in this document uses GWPs from the Fourth Assessment Report to be consistent with the approach used by the California Air Resources Board (CARB) in the 2000–2020 statewide GHG inventory and Unincorporated County of San Diego 2019 Greenhouse Gas Emissions Inventory and Projections. The GWPs factors used in this report are shown in Table 1.

Table 1 Global Warming Potentials used in Baseline Inventory and Projections

Greenhouse Gas	Global Warming Potential (GWP)
Carbon dioxide (CO_2) [1]	1
Methane (CH_4) [1]	25
Nitrous oxide (N_2O) [1]	298
R-404A[2]	3,922
R-401A	1182
R-438A	2265
R-410A	2088

Source: [1]IPCC 2007, [2]CARB 2023.

2.2 BASE YEAR

The LGOP recommends that a local government's emissions inventory include all GHG emissions occurring during a selected calendar year. Reporting GHG inventories on a calendar year basis is considered an international standard. The United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol, The European Union Emission Trading System (EU ETS), TCR, and the State of California's mandatory reporting regulation under Assembly Bill (AB) 32, all require GHG inventories to be tracked and reported on a calendar year basis. The County's inventory was prepared and compiled for the year 2019, to be consistent with the communitywide GHG inventory developed for the CAP.

2.3 OPERATIONAL CONTROL APPROACH

The County's local government operations inventory was prepared using the operational control approach. The LGOP strongly encourages local governments to utilize the operational control approach to define their organizational boundary because this control approach most accurately represents the emission sources that local governments can directly influence. The organizational boundary of a GHG inventory is the boundary that defines which emission sources are included and which are excluded from the inventory.

Under the operational control approach, a local government accounts for 100 percent of the GHG emissions from operations over which it has operational control, including both wholly owned and partially owned facilities. A local government has operational control over a facility or operation if it has the full authority to introduce and implement its operating policies (for example, it holds an operating lease for the facility, or has the ability to implement health and safety policies). Operational control is the consolidation approach required under AB 32's mandatory reporting program and is consistent with the requirements of many other types of environmental and air quality reporting (for example, Clean Air Act Title V reporting).

The LGOP also references a financial control approach for defining a local government's organizational boundary. Under the financial control approach, the economic relationship between the local government and the operation takes precedence over the legal ownership (for example, the local government may have financial control over the operation even if it has less than 50 percent interest in that operation). Therefore, an inventory prepared under the financial control approach may include emissions that the local government cannot directly influence. The financial approach was not used in this inventory.

2.4 GHG EMISSION SCOPES

To separately account for direct and indirect emissions, to increase transparency, and to provide usefulness for different types of climate policies and goals, the LGOP follows the World Resources Institute and the World Business Council for Sustainable Development (WRI/WBCSD) GHG Protocol Corporate Standard in categorizing direct and indirect emissions into "scopes" as follows, assuming the use of the operational control approach to the organizational boundary:

Scope 1: All direct GHG emissions (with the exception of direct CO_2 emissions from biogenic sources) from sources controlled by the reporting entity.

Scope 2: Indirect GHG emissions associated with the consumption of purchased or acquired electricity, steam, heating, or cooling, at facilities controlled by the reporting entity.

Scope 3: All other indirect emissions not covered in Scope 2, such as emissions resulting from the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity (e.g., employee commuting and business travel), outsourced activities, waste disposal, etc.

GHG accounting programs recognize that the Scope 2 emissions reported by one entity may also be reported as Scope 1 emissions by another entity. For example, the Scope 2 emissions from electricity use reported by a local government may also be reported as Scope 1 emissions by the regionally serving utility that produced the electricity. This dual reporting does not constitute double counting of emissions as the entities report the emissions associated with the electricity production and use in different scopes (Scope 1 for the regionally serving utility and Scope 2 for the local government). Emissions can only be aggregated meaningfully within a scope, not across scopes. By definition, Scope 2 emissions will always be accounted for by another entity as Scope 1 emissions. Therefore, Scope 1 and 2 emissions must be accounted for separately. The appropriate scopes for each inventory sector for the County are identified in Section 3.

This also applies to Scope 3 emissions, as one entity's Scope 3 emissions are also another entity's Scope 1 or 2 emissions. Thus, all scopes should be accounted for separately. Reporting both Scope 1 and Scope 2 emissions helps ensure that local governments create a comprehensive emissions profile that reflects the decisions and activities of their operations. Reporting of Scope 3 emissions is encouraged but considered optional by the WRI/WBCSD and the LGOP. A large majority of Scope 3 emissions are typically associated with life-cycle processes, which can be speculative and difficult to quantify. The County's inventory includes Scope 3 emissions for sectors where data were readily available, including government-generated solid waste, and employee commute.

3 GHG INVENTORY RESULTS

In 2019, the total GHG emissions from County operations were estimated at 130,591 metric tons of CO_2e ($MTCO_2e$), distributed into 9 sectors as shown in Table 2 and Figure 1. The inventory accounts for GHG emissions from County operations, including County operations that occur in incorporated cities, because these emissions are caused by County operations. The GHG inventory was primarily generated from information in the CRIS database. Emissions sectors extracted from the CRIS database include electricity consumption, natural gas consumption and other fuel consumption at County-owned and operated buildings, airports, and public facilities; public and street lighting; landfills; fuel consumption in County fleet; water use in buildings and facilities; wastewater treatment facilities; and water pumps. The CRIS inventory was supplemented with estimated emissions from employee commute and employee-generated solid waste.

Methods used to develop the inventory are described in the following sections. Emissions associated with electricity consumption are classified as Scope 2 emissions while emissions associated with employee commute and employee-generated solid waste are Scope 3 emissions. All other reported emissions represent Scope 1 emissions. As stated in Section 2.1, all GHGs were converted to carbon dioxide equivalents using GWP factors from IPCC's Fourth Assessment Report.

Table 2 2019 Greenhouse Gas Inventory for County of San Diego Operations

Serial Number	Source[1]	Emissions (MT)							
		CO_2	CH_4	N_2O	R-401A	R-404A	R-410A	R-438A	CO_2e
1	**Airports[2]**								
a.	Electricity Use[3]	200	0.01	0.00	-	-	-	-	200
b.	Natural Gas	24	0.00	0.00	-	-	-	-	24
c.	Diesel Fuel[4]	0.96	0.00	0.00	-	-	-	-	0.96
d.	Propane[4]	0.22	0.00	0.00	-	-	-	-	0.22
	Subtotal[5]	**224**	**0**	**0**	**-**	**-**	**-**	**-**	**225**
2	**Buildings & Other Facilities**								
a.	Electricity Use[3]	23,926	1.64	0.19	-			-	24,025
b.	Natural Gas	13,563	1.20	0.03	-			-	13,601
c.	Refrigerants	-	-	-	0.00	0.08	0.04	0.03	462
d.	Diesel Fuel[6]	95	0.01	0.00	-	-	-	-	95
e.	Propane	27	0.00	0.00	-	-	-	-	27
	Subtotal[5]	***37,611***	***2.86***	***0.22***	***0.00***	***0.08***	***0.04***	***0.03***	***38,210***
3	**Employee Commute**								
a.	Vehicle Fuel Use	-	-	-	-	-	-	-	38,803
4	**Vehicle Fleet**								
a.	Fuel: Electricity	12	0.00	0.00	-	-	-	-	12
b.	Fuel: Gasoline	21,843	0.58	0.66	-	-	-	-	22,055
c.	Fuel: Diesel	38	0.06	0.07	-	-	-	-	61
d.	Fuel: Renewable Diesel	4,484	-	-	-	-	-	-	4,484
	Subtotal[5]	**26,376**	**0.64**	**0.74**	**-**	**-**	**-**	**-**	**26,612**

5	**Landfills[7]**								
a.	Fugitive Emissions (including Viejas Landfill)[8]	-	957	-	-	-	-	-	23,918
b.	Pilot Light	2			-	-	-	-	2
c.	Purchased Electricity[3]	80	0.01	0.00	-	-	-	-	81
d.	Natural Gas	86	0.01	0.00	-	-	-	-	87
e.	Flared Gas	-	0.62	0.12	-	-	-	-	52
	Subtotal[5]	**168**	**957.35**	**0.12**	**-**	**-**	**-**	**-**	**24,139**
6	**Public Lighting**								
a.	Purchased Electricity[3]	1,258	0.09	0.01	-	-	-	-	1,263
7	**Wastewater Facilities**								
a.	Electricity Use[3]	27	0.00	0.00	-	-	-	-	27
b.	Process Emissions[9]	-	-	0.01	-	-	-	-	3
	Subtotal[5]	***27***	***0.00***	***0.01***	**-**	**-**	**-**	**-**	***30***
8	**Water**								
a.	Water Pumps	129	0.01	0.00	-	-	-	-	130
b.	Water Use at Facilities[10]	34	-	-	-	-	-	-	34
	Subtotal[5]	**163**	**0.01**	**0.00**	**-**	**-**	**-**	**-**	**163**
9	**Solid Waste**								
a.	Employee-Generated Solid Waste	-	113	-	-	-	-	-	2,812
	TOTAL	**65,827**	**1,073**	**1**	**0.00**	**0.08**	**0.04**	**0.03**	**132,257**

Notes:
"-" = no emissions; CH_4=methane; CO_2 = carbon dioxide; CO_2e = carbon dioxide equivalents; MT = metric tons; N_2O=nitrous oxide; R-401A= Freon MP39 (R-401A) refrigerant; R-404A = Freon 404A (R-404A) refrigerant; R-410A = Freon 410A (R-410A) refrigerant; R-438A = Freon M099 (R-438A) refrigerant.

[1] All emissions data available from the Climate Registry Information System (CRIS) unless otherwise noted.

[2] Airports emissions exclude emissions generated by fuel consumption from aircraft not owned or operated by the County. This is consistent with LGOP's operational control approach (see Section 2.3 for details).

[3] Purchased electricity emissions estimated using emission factors from CRIS inventory.

[4] Data for diesel and propane use in Airport Ground Support Equipment was provided separately by the County.

[5] Values may not equal totals due to rounding.

[6] Diesel used in emergency generators only.

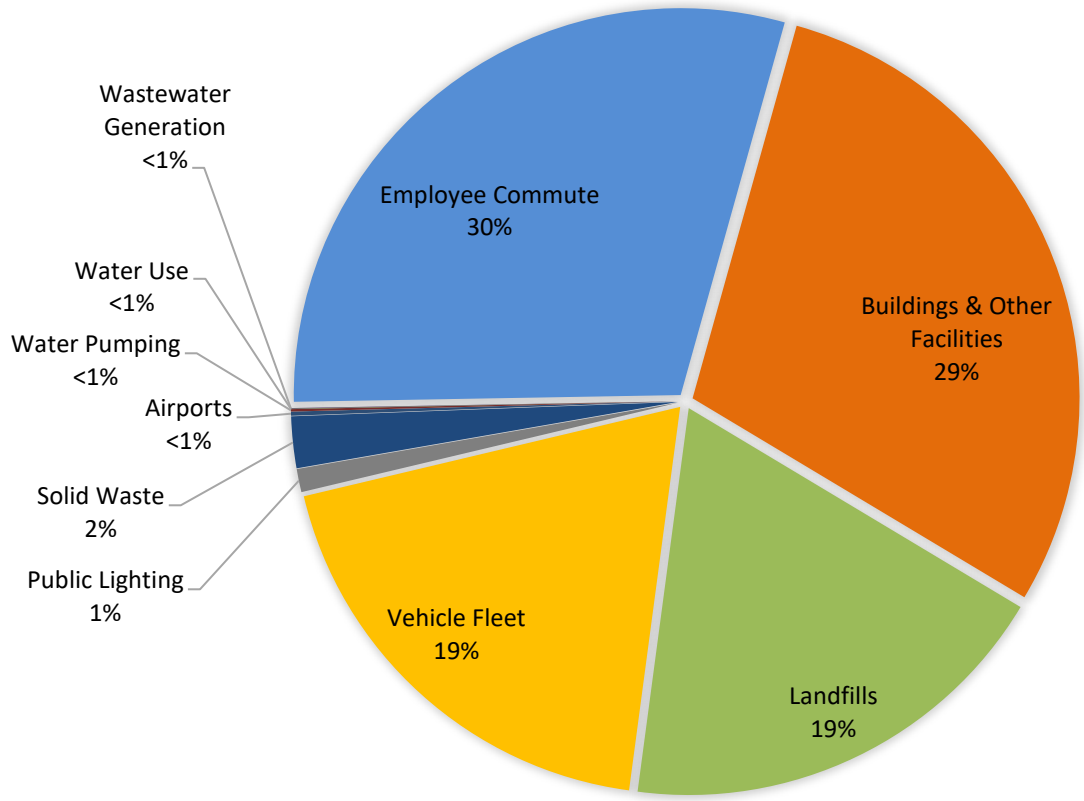
[7] Landfill emissions exclude CO_2 emissions from flaring of landfill gases because this carbon would have normally been released as biogenic CO_2 from natural decomposition completing the photosynthesis/respiration cycle (USEPA, 2010). These emissions are not included in the inventory.

[8] Emissions from Viejas Landfill were not included in the CRIS local government inventory. Emissions from Viejas Landfill were calculated separately.

[9] All wastewater treatment facilities owned and operated by the County have aerobic operations and, thus, do not emit measurable CH_4 emissions according to Box 10.2 of the Local Government Operations Protocol (CARB 2010). These include emissions from wastewater facilities within the unincorporated county and owned and operated by the County plus wastewater generated by County facilities located outside of the unincorporated county.

[10] Emissions from water used at County facilities are from energy used to supply and convey, treat, and distribute water. The emission factors used for estimating water emissions are the same as the purchased electricity emission factors used in the CRIS inventory.

Source: County of San Diego 2019 Greenhouse Gas Inventory as reported in the CRIS database; data compiled by Ascent in 2023.



Note: Due to rounding, the percentages do not add, or percentages exceed 100 percent

Figure 1 2019 Greenhouse Gas Inventory for County of San Diego Local Government Operations

3.1 RELATIONSHIP TO THE UNINCORPORATED SAN DIEGO COUNTY 2019 GREENHOUSE GAS EMISSIONS INVENTORY AND PROJECTIONS

GHG emissions from County operations overlap with the community-wide inventory and projections. All emissions physically occurring within the unincorporated county are assumed to be included in the community-wide inventory as the methodology is based on physical boundaries rather than consumers. In addition, vehicles trips occurring in part or in whole within the unincorporated county are also included in the community-wide inventory. Table 3 shows additional detail on which County operation emissions are already included within the community-wide inventory for activities within the unincorporated area.

Table 3 County of San Diego Operation Emissions included in the Unincorporated Area Inventory

County Operations Sector	Portion of County Operations Emissions included in the Unincorporated Area Inventory	Reason
Airports	Part	All County airports except McClellan-Palomar and Gillespie Field are located in the unincorporated county.
Buildings & Other Facilities	Part	Only County government buildings and facilities located within the unincorporated county are included.
Employee Commute	Part	Only County employee commute trips that end and/or begin in the unincorporated county are included.
Landfills	Part	Four out of the 11 closed landfills operated by the County are located in the unincorporated county.
Public Lighting (Streetlights and Traffic Signals)	All	All County streetlights and traffic signals are located in the unincorporated county.
Solid Waste	None	A vast majority of County government buildings and facilities generating solid waste are located outside the unincorporated county (e.g., main offices)
Vehicle Fleet	All	Assumes vast majority of County government vehicle fleet operations occur in part or fully within the unincorporated county.
Wastewater Facilities	All	All County wastewater facilities are located in the unincorporated county.
Water Pumping	All	All County water pumping facilities are located in the unincorporated county.
Water Use	Part	Some County facilities using water are located in the unincorporated county.

Source: Ascent in 2023.

4 INVENTORY METHODS

The following sections outline the methodologies used in estimating GHG emissions for each source or fuel type applicable to the County's operational inventory.

4.1 ELECTRICITY

Electricity consumption data for County facilities and operations in 2019 were available from electricity purchase records input into the CRIS database. The CRIS database includes total annual kilowatt-hours (kWh) for each facility, which was used to estimate associated GHG emissions, as shown in Table 4. In 2019, County facilities used 113 gigawatt-hours (GWh) of electricity. To calculate GHG emissions associated with electricity generation, the United States Environmental Protection Agency's (USEPA's) 2010 Emissions & Generation Resource Integrated Database (eGRID) electricity emission factors for CO_2, CH_4, and N_2O for the Western Electricity Coordinating Council (WECC) region (which includes California) were applied to consumption data. These emission factors are as follows: 496.5 pounds CO_2 per megawatt-hours (lb CO_2/MWh), 34 lb CH_4/gigawatt-hours (GWh), and 4 lb N_2O/GWh (TCR 2020: Table 3.1). The breakdown of electricity use and related emissions by facility type or use is shown in Table 4.

Table 4 Electricity Usage and GHG Emissions by County Facility or Use (2019)

Facility/Use	kWh/year	$MTCO_2e$
Airports	886, 860	200
Buildings & Other Facilities	106,240,927	24,025
Public Lighting	5,584,777	1,263
Water Pumping	573,705	130
Total	**113,285,269**	**25,618**

Notes: Totals may not sum due to rounding.
GHG = greenhouse gas; kWh = kilowatt-hours; $MTCO_2e$ = metric tons carbon dioxide equivalent
Electricity usage data as shown in the Climate Registry Information System (CRIS) database

As shown in Table 4, the electricity consumption in County facilities varies by facility type or use. For airport[1] operations and County-owned and operated buildings[2], electricity is used for building operations such as lights, cooling, computers, and other devices. For airports, electricity is required to power runway lights, tower lights, and other airport-specific operations. For public lighting operations, electricity is needed to power streetlights, traffic signals, and other public lighting fixtures. For water pumping, electricity is used to power the pumps used to distribute water, convey wastewater to treatment plants, and redistribute storm water during the rainy season. Emissions from electricity use at airports and buildings and facilities are shown in rows 1a and 2a, respectively in Table 2. Emissions from electricity use for water pumping are shown in row 8a in Table 2.

4.2 NATURAL GAS

Natural gas consumption data for County facilities and operations in 2019 were available from natural gas purchase records inputted into the CRIS database. The CRIS database includes total therms of natural gas purchased for each facility which was used to generate GHG emissions shown in Table 5. In 2019, the County used 2,461,283 therms. To calculate GHG emissions associated with natural gas combustion, natural gas therms were converted to million British Thermal Units (MMBTU) and CO_2, CH_4, and N_2O natural gas emission factors (in grams per MMBTU) available from TCR's 2020 default emission factors were applied in CRIS. These emission factors are as follows: 53.06 kilograms (kg) CO_2/MMBTU, 4.7 grams (g) CH_4/MMBTU, and 0.1 g N_2O/MMBTU (TCR 2020: Table 1.1 and Table 1.10). Natural gas consumption in County facilities is primarily used in building furnaces, water heaters, and cooking activities. Natural gas consumption for County landfills is addressed in Section 4.10.2. Emissions from natural gas use at airports and buildings and facilities are shown in rows 1b and 2b, respectively in Table 2.

Table 5 Natural Gas Usage and GHG Emissions by County Facility (2019)

Facility	therms/year	$MTCO_2e$
Airports	4,447	24
Buildings & Other Facilities	2,456,836	13,601
Total	**2,461,283**	**13,624**

Notes: Totals may not sum due to rounding.
GHG = greenhouse gas; $MTCO_2e$ = metric tons carbon dioxide equivalent
Natural gas usage data as shown in the Climate Registry Information System (CRIS) database.

[1] Emissions from airports are generated by energy used in all airport operations (required to power runway lights, tower lights, and other airport-specific operations).
[2] Emissions from Buildings & Other Facilities are generated by energy used for building operations such as lighting, heating/cooling, computers, and other appliances.

4.3 FACILITY REFRIGERANT USE

Total annual refrigerant usage in County operations in 2019 was available for R-401A, R-404A, R-410A, and R-438A. These data were directly input into CRIS through purchase records. Emissions from refrigerants were assumed to be equal to purchase amounts. These refrigerants are blends of GHGs recognized by the IPCC. For example, R-401A is a blend of HCFC-22, HFC-152a, and HCFC-124 for which IPCC assigns GWP values of 1,810, 124, and 609, respectively, which results in a GWP factor of 1,182. Table 6 shows the quantity of each compound in 2019, the respective weighted GWP values, and metric tons of carbon dioxide equivalent emissions. The GWP factors for the four refrigerant types used by the County are from IPCC's Fourth Assessment Report (IPCC, 2007), obtained from CARB, which calculates the GWP factors based on the refrigerant blends (CARB 2023a). These factors were used to convert the refrigerant emissions to $MTCO_2e$. Emissions from refrigerants at buildings and facilities are shown in row 2c in Table 2.

Table 6 County Operations Refrigerant Use and GHG Emissions

Refrigerant	Gas Quantity (MT)[2]	GWP Factor[1]	$MTCO_2e$
R-401A	0.000454	1,182	0.5
R-404A	0.078921	3,922	307.8
R-410A	0.043633	2,088	91.1
R-438A	0.027758	2,265	62.9
Total			**462.3**

Notes:
[1] Source: IPCC Fourth Assessment Report (IPCC, 2007).
[2] Source: CRIS inventory.

4.4 FACILITY DIESEL USE

The total annual diesel fuel usage in the County's emergency generators at County buildings and facilities in 2019 was 9,298 gallons. Diesel usage data for diesel consumption in building facilities (except airport ground support equipment (GSE) were available from diesel fuel purchase records recorded in CRIS. Airport GSE consumed 94 gallons of diesel. This data was provided by the County Airport team. Diesel combustion emission factors (in kg per gallon [gal] and g per MMBTU) were applied to the total volume of purchased fuel and fuel energy content for Distillate Fuel Oil No. 2 from the TCR's default emission factors. These emission factors are as follows: 10.21 kg CO_2/gal, 10 g CH_4/MMBTU, and 0.6 g N_2O/MMBTU (TCR 2020: Table 1.1, Table 1.10). Emissions from diesel use at airports and buildings and facilities are shown in rows 1c and 2d respectively in Table 2.

4.5 FACILITY PROPANE USE

Similar to diesel usage, propane use at County buildings and facilities (except airport GSE) was recorded in CRIS from County purchase records, and airport GSE propane consumption data were provided by the County airport team. Propane-specific emission factors were applied to the total amount of propane used in 2019.

The total annual propane usage was 4,682 gallons in the County's emergency generators at County buildings and facilities and 38 gallons for airport GSE in 2019. Propane combustion emission factors (in kg per gallon and g per MMBTU) were applied to the total volume of purchased fuel and fuel energy content for liquid propane from the TCR's default emission factors. These emission factors are as follows: 5.72 kg CO_2/gal, 10.02 g CH_4/MMBTU, and 0.6 g N_2O/MMBTU (TCR 2020: Table 1.1, Table 1.10). Emissions from propane use at airports and buildings and facilities are shown in rows 1d and 2e respectively in Table 2.

4.6 VEHICLE FLEET FUEL USE

The County's vehicle fleet operated on gasoline, diesel, renewable diesel, and electricity in 2019. This included both on-road and off-road vehicle fleets and equipment, such as construction equipment. Airport GSE data were separately provided by the County airports team. Fuel use and mileage by vehicle type was recorded into CRIS from County records and fuel-specific or vehicle-specific emission factors from TCR were applied to estimate vehicle fleet emissions in 2019. These emissions are shown in rows 4a through 4d in Table 2. In 2019, the County fleet used 2,476,087 gallons of gasoline, 3,702 gallons of diesel, 439,135 gallons of renewable diesel, and 53,889 kWh of electricity. Emissions from the County fleet were recorded in the CRIS inventory.

4.7 EMPLOYEE COMMUTE

Emissions from the County's employee commute activity were estimated based on a zip code database provided by the County that provided the home and work zip codes for each employee anonymously, as well as indicated whether the employee was regularly or temporarily employed. It was assumed that employees would use a mix of light duty auto and light duty trucks for commuting, based on a County-average vehicle mix from EMFAC 2021. The one-way driving distance between two zip codes was calculated through multiple steps. First, the zip code pairs were geocoded using Google Maps by plotting addresses to estimate the Euclidean distance between zip code pairs. The distance between each pair reflects the one-way driving distance between the home and work address of each employee.

The calculations assume that vehicle trips would occur twice per day for net working days[3] in 2019 (one trip from home to work, and one trip from work to home). The analysis assumes that the number of working days for temporary (or part-time) employees is half of the total working days for regular (or full-time) employees. For the purposes of this inventory, full-time employees are assumed to have 23 days off work per year (eleven holidays, two floating holidays, and ten days of vacation), while part-time employees are assumed to have 11 days off in a year. The net working days for the full-time and part-time employees was calculated based on the total number of working days in 2019 and the assumed amount of time off work. The net working days in 2019 was the commute trip frequency for employees. The calculated commute trip frequencies combined with the individual one-way trip lengths allowed for the calculation of total employee commute vehicle miles traveled (VMT). County employee commute vehicle trips are summarized in Table 7.

Table 7 2019 County Employee Commute Vehicle Trips

Employee Type	Number of Employees[1]	Annual VMT[2]
Full-Time/Regular	16,033	92,925,297
Part-Time/Temporary	2,793	8,650,378
Total	18,826	101,575,675

Notes: VMT = vehicle miles traveled

[1] The 2019 employment figures were provided by the County.

[2] Based average driving distance between home and work zip codes.

Emission factors from EMFAC 2021 for gasoline, diesel, and plug-in hybrid for light duty autos and trucks were applied to total VMT to estimate annual emissions from employee commute (shown in Table 8). It is assumed that EVs are not charged exclusively at County facilities and are also charged at employee's residences, hence countywide electricity emissions factors are used for calculating emissions for EVs from home-based charging. Emissions from County employee commute are shown in row 3 in Table 2 and Table 8 shows emission factors used for estimating emissions from employee commute.

[3] Net working days indicates the total working days in a year minus number of days off for holidays, vacation, and/or sick leave.

Table 8 2019 Employee Commute Emission Factors from EMFAC 2021

Fuel Type	Percent Breakdown for LDA and LDT Vehicle Types in San Diego County	Emission Factor (g CO_2/mi)	Emission Factor (g CH_4/mi)	Emission Factor (g N_2O/mi)	Emission Factor (lb/CO_2e)
Diesel	0.67%	367.62	0.002	0.058	
Electricity[1]	1.01%	--	--	--	645
Gasoline	97.28%	382.19	0.021	0.014	
Plug-in Hybrid	1.04%	169.57	0.004	0.003	

Note: CH_4=methane; CO_2 = carbon dioxide; CRIS= Climate Registry Information System; g = grams; GHG = greenhouse gas; LDA= light duty auto; LDT = light duty truck; MDV = medium duty vehicle; mi = miles; MT = metric tons; N_2O=nitrous oxide

[1] Assumes county wide electricity emission factors. Electric load from EVs is accounted in electricity sector (Section 4.1).

Note: Based on San Diego County mix of LDA, LDT, MDV and motorcycle vehicle classes.

Source: EMFAC 2021.

4.8 WATER

Emissions from the County's water pumping facilities are reported in the CRIS inventory and are shown in row 8b in Table 2. Emissions from water used at County facilities are not reported in the CRIS inventory and are calculated separately. To capture the emissions associated with water use not served by the County's own pumps, annual water usage data from facilities located in the unincorporated areas and non-unincorporated area (394,890,322 gallons per year) was multiplied by a water energy intensity factor (292 kWh per million gallon) to get annual electricity usage required for facility water use. This water energy intensity factor was based on the average of City of San Diego's three Water Treatment Plants.

Total indirect electricity use from the water use in County facilities was 115 MWh per year in 2019. To calculate emissions from this indirect electricity use, a factor of 645 lb CO_2e/MWh was applied to the calculated electricity use, consistent with community-wide averages, for a total of 34 $MTCO_2e$ in 2019 (see Section 4.2.2 of the *County of San Diego 2019 Greenhouse Gas Emissions Inventory and Projections)*.

4.9 WASTEWATER FACILITIES

Emissions from wastewater facilities are from two sources: nitrification-denitrification process (shown in row 7b in Table 2) and electricity use (shown in row 7a in Table 2) at facilities. Emissions from electricity use at wastewater facilities in 2019 were available from electricity purchase records input into the CRIS database. CRIS reported N_2O emissions from nitrification-denitrification in County-owned and operated wastewater treatment facilities using Equations 10.7 and 10.8 from the LGOP. These equations are based on total population served by the wastewater treatment facility and whether the treatment facility has a nitrification-denitrification process or not. Wastewater facilities that are owned and/or operated by the County are Heise Park Plant, Julian Plant, Pine Valley Plant, Rancho Del Campo Plant, and San Pasqual Plant. These facilities treat wastewater aerobically and, therefore, do not emit CH_4 emissions.

4.10 LANDFILL EMISSIONS

4.10.1 Purchased Electricity

Emissions from electricity use at landfill facilities in 2019 were available from electricity purchase records input into the CRIS database. The CRIS database includes total annual kWh for each facility, which was used to estimate associated GHG emissions (shown in row 5c in Table 2). To calculate GHG emissions associated with electricity generation, the USEPA's eGRID electricity emission factors for CO_2, CH_4, and N_2O for the WECC California region were applied to consumption data. These emission factors are as follows: 496.5 lb CO_2/MWh, 34 lb CH_4/GWh, and 4 lb N_2O/GWh (TCR 2020: Table 3.1). Emissions from electricity use at landfills are shown in row 5c in Table 2.

4.10.2 Natural Gas

Natural gas consumption data for landfill facilities in 2019 were available from natural gas purchase records input into the CRIS database. The CRIS database includes total therms of natural gas purchased for each facility which was used to generate GHG emissions (shown in row 5d in Table 2). To calculate GHG emissions associated with natural gas combustion, emission factors from TCR's 2020 default emission factors were applied in CRIS. These emission factors are as follows: 53.06 kg CO_2/MMBTU, 4.7 g CH_4/MMBTU, and 0.1 g N_2O/MMBTU (TCR 2020: Table 1.1 and Table 1.10). Emissions from natural gas use at landfills are shown in row 5d in Table 2.

4.10.3 Fugitive Emissions

The landfill emissions only include landfills that are closed, as the County does not own or operate any active landfills. Bell Junior High, Encinitas, Gillespie, Hillsborough, Palomar, Poway, San Marcos landfills are located in incorporated cities, while Valley Center, Jamacha, Bonsall, and Viejas landfills are located in the unincorporated area.

CRIS reported fugitive CH_4 emissions in 2019 from 10 out of 11 landfills owned and operated by the County. Emissions from Viejas Landfill were calculated separately. For all landfills, except the Viejas Landfill, fugitive CH_4 emissions were calculated using Equation 9.1 from the LGOP (CARB 2010). This equation is specific to landfills with comprehensive landfill gas (LFG) collection systems and calculates emissions based on annual LFG collected, destruction efficiency, and assumed percent of CH_4 in the LFG. The GWP factor for CH_4 was applied to the total estimated CH_4 emissions from County-owned and operated landfills to calculate the CO_2 equivalent emissions.

Fugitive landfill CH_4 emissions from the Viejas Landfill were calculated using CARB's Landfill Gas Tool (LGT) (updated September 24, 2021) (CARB, 2021). The default values for the percent of anaerobically degradable carbon (ANDOC) in California were used in the LGT. This model calculates CH_4 from a landfill for a given year based on rainfall, opening year, closure year, tons of annual waste disposed, and tons of alternative daily cover (ADC). The landfill is located in San Diego County, which has an average rainfall of less than 20 inches per year (Western Regional Climate Center 2009). Also, the Viejas Landfill is assumed not to have had applied any ADC during its operation (Forga, pers. comm., 2016). A 2014 facility emissions report, which did not report CH_4 emissions, from the San Diego Air Pollution Control District noted that the Viejas Landfill opened in 1971, closed in 1979, and has a final landfill size of 46,000 tons (San Diego Air Pollution Control District 2014). Assuming that the landfill was closed due to maxed capacity and that waste was disposed at the landfill at equal rates during each year of operation, LGT estimates that the Viejas Landfill generated 22 metric tons of CH_4 in 2019. In addition, no landfill gas capture or flaring systems are currently installed at Viejas Landfill; therefore, this landfill generated no flaring or pilot light-related emissions. Fugitive emissions from landfills are shown in row 5a in Table 2.

4.10.4 Pilot Light

Pilot lights used to start flaring events at LFG capture sites require a minimal amount of fuel to stay lit. CO_2 emissions from each landfill were precalculated and entered into CRIS. Emissions from pilot lights at landfills are shown in row 5b in Table 2.

4.10.5 Flared Gas Emissions

Some LFG is flared onsite, resulting in GHG emissions. CRIS does not report CO_2 emissions from combustion of LFG. CH_4 and N_2O emissions from the combustion of LFG in flares are reported in CRIS and included in this inventory. Flared gas emissions at landfills are shown in row 5e in Table 2.

4.11 SOLID WASTE

To quantify emissions from employee-generated solid waste, a solid waste emissions factor was calculated for waste generated from the City of San Diego in 2019. This approach, as opposed to one calculated specifically for the unincorporated county, was chosen because most of the County's offices are in the City of San Diego.

According to CalRecycle, waste generated by the residents and businesses of City of San Diego mostly ended up in landfills located outside of the unincorporated county, with the exception of Otay Landfill, which received 24 percent of the waste generated by the City of San Diego (CalRecycle 2022). County employee-generated solid waste calculations are summarized in Table 9.

Total waste generated by County employees in 2018 was available from the County's Internal Operations Waste Diversion Phased Implementation Plan 2019. Waste generated by employees in 2019 was estimated by applying the employee growth factor from 2018 to 2019 to the total waste generated in 2018. The emissions factor, 0.221 MTCO2e per ton of solid waste generated, was calculated using Equation SW.4.1 from the U.S. Community Protocol and the factors shown in Table 9 (ICLEI 2012). The percentage of accepting landfills that have LFG capture was calculated by looking up Otay, Sycamore, and West Miramar Landfills in USEPA's Landfill Methane Outreach Program (USEPA 2023). These three landfills accepted over 99 percent of waste from the City of San Diego in 2019 and all operated LFG capture systems in 2019 (USEPA 2023). Solid waste emissions from County facilities are shown in row 9 in Table 2.

Table 9 2019 County Employee-Generated Solid Waste Emissions

Employee-Generated Solid Waste	
Tons of Landfilled Solid Waste generated by County facilities in 2018[1]	12,529
Full-time Equivalent County Government Employees in 2018[2]	16,938
Full-time Equivalent County Government Employees in 2019[2]	17,172
Tons of solid waste generated per employee	0.74
Tons of Landfilled Solid Waste generated by County facilities in 2019	12,702
Waste Generation Emissions Factor[3]	
Average Emissions Factor for Municipal Solid Waste ($MTCH_4$/ton)	0.06
Oxidation Rate (%)	1%
Minimum percent of landfills accepting waste from City of San Diego that have LFG Capture[4] (%)	99%
Landfill Gas Capture Rate (%)[5]	85%
Calculated Average Emissions Factor for Municipal Solid Waste in the City of San Diego ($MTCH_4$/ton)	0.221
Emissions from Employee-Generated Solid Waste	
GHG Emissions from Employee-Generated Solid Waste ($MTCO_2e$/year)[6]	2,812

Notes: Manual calculations of using figures shown may not equal results due to rounding of individual figures.
CH_4 = methane; CO_2e = carbon dioxide equivalents; MT = metric tons
[1] County of San Diego Internal Operations Waste Diversion Phased Implementation Plan 2019
[2] County of San Diego, Annual Comprehensive Financial Report for Fiscal Year ended June 30, 2022 (San Diego County, 2022b).
[3] Based on methodology recommended in the U.S. Community Protocol (ICELI 2012: Table SW.5).
[4] Based on the existence of LFG capture systems at Otay, Sycamore, and West Miramar Landfills that serve the majority of the City of San Diego. (CalRecycle 2022, USEPA 2023)
[5] San Diego County Air Pollution Control District (n.d.)
[6] Based on a CH_4 global warming potential factor of 25.
Source: CalRecycle 2022, ICLEI 2012, USEPA 2023, San Diego County, 2022c.

5 COMPARISON OF COUNTY OPERATIONS INVENTORIES FOR 2014 AND 2019

The 2019 County Operations Inventory shows that annual GHG emissions from County operations decreased by approximately 31 percent relative to annual GHG emissions from County operations in 2014 due, in part, to policies and programs designed to reduce GHG emissions, such as 2018 CAP measures that reduce emissions from County operations. Table 10 compares annual GHG emissions in 2014 and 2019 for each source included in the County operations inventory.

Table 10 Percent Change in County of San Diego Operation Emissions in 2019 relative to 2014

Source	2014 County Operations GHG Inventory ($MTCO_2e$)	2019 County Operations GHG Inventory ($MTCO_2e$)	Percent Change from 2014
Airports	322	225	-30%
Buildings & Other Facilities	63,583	38,210	-40%
Employee Commute	55,836	38,803	-31%
Vehicle Fleet	26,164	26,612	2%
Landfills	41,750	24,139	-42%
Public Lighting	2,880	1,263	-56%
Wastewater Facilities[1]	5	30	514%
Water	309	163	-47%
Solid Waste	2,126	2,812	32%
Total	192,976	132,257	-31%

Changes in energy consumption (e.g., electricity, natural gas, gasoline, diesel) and activities (e.g., miles of vehicle travel, water use, and solid waste generation) account for some of the differences in annual GHG emissions between the 2014 and 2019 County operations inventories. Table 11 compares activity data inputs used in the 2014 and 2019 inventories.

Table 11 Change in County Operations Energy and Activity Data by Facility Type in 2019 from 2014

Facility Type/ Source Type	2014 Energy/Activity Data	2019 Energy/Activity Data	Units	% Change, 2014-2019
Airports				
Electricity Use	755,238	885,860	kwh	17%
Natural Gas	6,730	4,447	therm	-34%
Diesel	N/A	94	gal	N/A
Propane	N/A	38	gal	N/A
Buildings & Other Facilities				
Electricity Use	133,836,900	106,240,927	kwh	-21%
Natural Gas	2,334,004	2,456,836	therm	5%
Refrigerants	N/A			
Diesel	10,052	9,298	gal	-8%
Propane	2,821	4,682	gal	66%
Employee Commute	155,043,720	101,575,675	VMT	-34%
Vehicle Fleet				
Fuel: Electricity[1]	N/A	53,889	MWh	N/A
Fuel: Gasoline	2,475,012	2,476,087	gal	0%
Fuel: Diesel	391,738	3,702	gal	-99%

Fuel: Renewable Diesel[1]	N/A	439,135	gal	N/A
Fuel: CNG	6,132	N/A	therm	N/A
Landfills				
Fugitive Emissions (including Viejas Landfill)	N/A			
Pilot Light	N/A			
Purchased Electricity	N/A	356,123	kwh	N/A
Natural Gas	N/A	16,262	therm	N/A
Flared Gas	N/A			N/A
Public Lighting				
Electricity Use	7,594,078	5,584,777	kWh	-26%
Wastewater Facilities				
Electricity Use	N/A	118,535	kWh	N/A
Process Emissions	N/A			N/A
Water				
Water Pumps	738,955	573,705	kWh	-22%
Water Use at Facilities	326,849,163	394,890,322	gal	21%
Solid Waste				
Employee Generated Solid Waste[2]	5,227	12,702	tons	143%

Notes: N/A indicates that no fuel quantity was reported for this source.
[1] County's vehicle fleet did not operate on this fuel in 2014
[2] Significant increases in 2019 emissions due to change in methodology

6 GREENHOUSE GAS EMISSIONS PROJECTIONS

The following sections outline the methodologies used in projecting GHG emissions for each source applicable to the County's inventory for 2030 through 2050. Methods used to project emissions vary by source as detailed in the following sections.

Emissions projections were prepared for legislative-adjusted business-as-usual scenarios for 2030, 2035, 2040, 2045, and 2050. These projections account for the County's future population growth, County operation plans, and future emissions reductions pursuant to State and federal laws, regulations, and other actions to reduce GHG emissions, including the Renewables Portfolio Standard (RPS), improving vehicle fuel economy standards due to Advanced Clean Cars II, and other State and federal policies. Table 12 shows the County's operations GHG inventory for the baseline year of 2019 and GHG projections for 2030 through 2050 at five-year increments.

Table 12 County of San Diego Operations Baseline and GHG Projections

Serial Number	Source[1]	Emissions ($MTCO_2e$)					
		2019	2030	2035	2040	2045	2050
1	Airports						
a.	Electricity Use	200	-	-	-	-	-
b.	Natural Gas	24	32	35	39	43	46
c.	Diesel Fuel	0.96	1.0	1.1	1.1	1.1	1.2
d.	Propane	0.2	0.2	0.2	0.2	0.3	0.3
	Subtotal	225	33	37	40	44	48

2	Buildings & Other Facilities						
a.	Electricity Use	24,025	-	-	-	-	-
b.	Natural Gas	13,601	13,860	14,218	14,576	14,934	15,293
c.	Refrigerants	462	496	511	526	541	556
d.	Diesel Fuel	95	102	106	109	112	115
e.	Propane	27	29	30	31	32	32
	Subtotal	38,210	14,487	14,864	15,242	15,619	15,996
3	Employee Commute						
a.	Vehicle Miles Travelled	38,803	31,743	22,372	13,159	13,603	14,064
4	Vehicle Fleet						
a.	Fuel: Electricity	12	4	1	0	-	-
b.	Fuel: Gasoline	22,055	16,873	11,574	7,134	6,891	6,593
c.	Fuel: Diesel	61	62	61	61	62	64
d.	Fuel: Renewable Diesel	4,484	6,574	6,808	7,087	7,462	7,985
	Subtotal	26,612	23,512	18,443	14,283	14,416	4,642
5	Landfills						
a.	Fugitive Emissions (including Viejas Landfill)	23,918	19,198	17,371	15,724	14,224	2,868
b.	Pilot Light	2	2	2	2	2	2
c.	Purchased Electricity	81	-	-	-	-	-
d.	Natural Gas	87	97	101	104	107	110
e.	Flared Gas	52	42	38	34	31	28
	Subtotal	24,139	19,339	17,511	15,864	14,364	13,008
6	Public Lighting						
a.	Electricity Use	1,263	-	-	-	-	-
7	Wastewater Facilities						
a.	Electricity Use	27	-	-	-	-	-
b.	Process Emissions	3	3	3	3	3	4
	Subtotal	30	3	3	3	3	4
8	Water						
a.	Water Pumps	130	-	-	-	-	-
b.	Water Use at Facilities	34	10	2	1	-	-
	Subtotal	163	10	2	1	-	-
9	Solid Waste						
a.	Employee Generated Solid Waste	2,812	2,471	2,583	2,681	2,775	2,873
	TOTAL	132,259	91,600	75,817	61,274	60,826	60,636
	Percent Change from 2019 (%)	0%	-31%	-43%	-54%	-54%	-54%

Notes:
"-" means zero emissions.
CO2e = carbon dioxide equivalents; MT = metric tons.
Values may not equal totals due to rounding.

Source: Data compiled and adjusted by Ascent in 2023

6.1 ELECTRICITY

Electricity use at County facilities in 2030 was projected based on capital projects identified in the County's *Adopted Operational Plan Fiscal Years 2022-23 & 2023-24* (County of San Diego 2022a). For projections beyond 2030 and through 2050, it was assumed that the trends between 2019 and 2030 would continue into the future at the same growth rate.

According to the County's plans, the County anticipates construction of several new facilities. With respect to airport facilities, the Airport Capital Improvement Plan (ACIP) includes the construction of an aircraft rescue and firefighting building (anticipated in fiscal year 2026). The project is located at McClellan-Palomar Airport and is anticipated to be approximately 4,700 square feet. Electricity use associated with public lighting was projected based on projects identified in the County's *Five-Year Capital Improvement Plan Fiscal Years 2022-23 & 2023-24* (County of San Diego 2022). Indirect electricity consumption associated with the County's water facilities was scaled based on population growth in unincorporated county from 2019 through 2050. Table 13 shows the anticipated facility projects and associated changes through 2030. The County plans used to prepare this analysis do not extend beyond 2030.

Table 13 Anticipated County Facility Changes between 2019 and 2030

Project	Type of Change	Size				Completion Year
		New SF	New Acres	New Miles	New Linear feet	
Casa De Oro Library	New Facility	13,000	--	--	--	2024
Youth Transition Campus	New Facility	147,575	--	--	--	2024
East Otay Mesa Fire Station #38	New Facility	14,000	--	--	--	2023
San Diego County Animal Shelter	New Facility	25,000	--	--	--	2024
Third Avenue Mental Health Inpatient Facility (Central Regional Hub)	New Facility	206,000	--	--	--	2025
Julian Library Community Room	New Facility	2,900	--	--	--	2022
Ramona Sheriff Station	New Facility	18,000	--	--	--	2025
East Otay Mesa Sheriff Station	New Facility	25,000	--	--	--	2027
Santee Library	New Facility	25,000	--	--	--	2030
San Marcos Library	New Facility	20,000	--	--	--	2030
Jacumba Fire Station #43	New Facility	5,500	--	--	--	2030
Campo Library Community Room	Expansion	1,000	--	--	--	2027
I-15 and SR-76 Sheriff Station	New Facility	25,000	--	--	--	2030
Santee Public Safety Center	New Facility	25,000	--	--	--	2030
North Coastal Sheriff Station	New Facility	37,000	--	--	--	2030
South County Animal Shelter (San Diego County)	New Facility	20,000	--	--	--	2024
Dye Road Extension	Expansion	--	--	1.2	--	2025
Ramona Street Extension - Road Extension	Expansion	--	--	--	1,700	2024
McClellan-Palomar Airport - Aircraft rescue and firefighting building	New Facility	4,700	--	--	--	2030

The estimated future electricity use in 2030 was based on the additional facilities and improvements shown in Table 13. CalEEMod Version 2022.1 was used to estimate the additional electricity demand based on the types and sizes of the new or expanded facilities. CalEEMod modeling estimated that the additional facilities and improvements, if built by 2030, would require approximately 78 MWh more per year over 2019 conditions. In addition, some roadway construction and extensions will require additional public lighting. Based on San Diego County's street design manual (San Diego County, 2016), on road extensions in neighborhoods, the streetlights are spaced 300 feet apart.

Assuming an average wattage of 150 watts per LED streetlight operating eight hours per day, new public lighting needs would add approximately 12 MWh per year to current lighting electricity demands as of 2019. The additional employee estimates are used to project other emissions sources, such as employee commutes. Electricity from water use is anticipated to increase as the number of County employees increases.

Emissions from future electricity use were estimated by multiplying anticipated electricity use with the projected emission factors. Emission factors are based on the electric power mix. The projections assume that electricity emission factors would decline in 2030 because in 2030, the County will purchase 100 percent renewable electricity, 90 percent of which would come from Direct Access and 10 percent would come from San Diego Community Power (Kelly, pers. comm., 2021). Between 2019 and 2050, electricity emissions for County operations would decrease despite electricity use increasing through 2050 because of the increased use of electricity generated from renewable or zero emission sources. Emission projections from electricity use at airports and buildings and facilities are shown in rows 1a and 2a respectively in Table 12. Emission projections from electricity use for water pumping are shown in row 8a in Table 12.

6.2 NATURAL GAS

Natural gas consumption was projected using similar methodologies as used for electricity. Natural gas use at County facilities in 2030 was projected based on capital projects identified in the County's *Adopted Operational Plan Fiscal Years 2022-23 & 2023-248* (County of San Diego 2022a) and the County's *Airport Capital Improvement Plan Fiscal Years 2020-2021* (ACIP) (County of San Diego, 2020). For projections through 2050, it was assumed that the trends between 2019 and 2030 would continue into the future.

The estimated future natural gas use in 2030 was based on the additional facilities and improvements shown in Table 13. CalEEMod version 2022.1 was used to estimate the additional natural gas demand based on the types and size of the new or expanded facilities. CalEEMod modeling estimated that the additional facilities, if built by 2030, would require approximately an additional 1,505 therms per year over 2019 conditions.

Emissions from future natural gas use were estimated by multiplying projected natural gas use with the natural gas emission factor identified in Section 4.2. Between 2019 and 2050, natural gas emissions in the County are projected to increase. Emission projections from natural gas use at airports and buildings and facilities are shown in row 1b and 2b respectively in Table 12.

6.3 FACILITY REFRIGERANT USE

Refrigerant use in buildings and facilities is associated with heating, ventilation, and air conditioning (HVAC) systems and refrigeration needs. These uses can be correlated with electricity use in buildings and facilities. Therefore, refrigerant use in County facilities through 2050 was scaled by change in building and facility electricity use from 2019 through 2050. Refrigerant emissions would be expected to increase with growth in buildings and facilities and are best captured using electricity use forecast. Emissions were estimated using the emission factors identified in Section 4.3. Emissions from annual refrigerant usage in County buildings and facilities are projected to slightly increase between 2019 and 2050 and shown in row 2c in Table 12.

6.4 FACILITY DIESEL USE

Diesel fuel use in the County's emergency generators at County buildings and facilities was scaled by change in buildings and facilities electricity use from 2019 to 2050. Emissions were estimated using emission factors identified in Section 4.4. Emissions associated with annual diesel fuel usage in the County's emergency generators at County buildings and facilities are projected to increase slightly between 2019 and 2050. Emission projections from diesel use at airports and buildings and facilities are shown in row 1c and 2d respectively in Table 12.

6.5 FACILITY PROPANE USE

Similar to refrigerant and diesel emissions, propane use at County buildings and facilities was projected by scaling to the change in the County buildings and facilities electricity use from 2019 to 2050. Emissions were estimated using emission factors identified in Section 4.5. Emissions associated with annual propane fuel usage at County buildings and facilities are projected to increase slightly between 2019 and 2050. Emission projections from propane use at airports and buildings and facilities are shown in row 1d and 2e respectively in Table 12.

6.6 VEHICLE FLEET FUEL USE

The County's vehicle fleet operations include gasoline, diesel, renewable diesel, and electricity-fueled on-road and off-road vehicles and equipment. Future electric vehicle fleet fuel use through 2050 is based off projected changes in community-wide electricity emission factors, assuming that electric vehicles are not exclusively charged at County facilities and are also charged at public charging stations in the county. Future vehicle fleet gasoline and diesel fuel use through 2050 is based on projected changes in community-wide vehicle fleet emission factors in EMFAC 2021 for the vehicle categories specific to the County's vehicle fleet.

Additional renewable diesel usage due to new construction activities anticipated in Table 13 was added to 2030 projections, based on CalEEMod construction modeling results. CalEEMod estimated that an additional 2,090 $MTCO_2e$ would result from the construction of the new facilities. EMFAC 2021 does not account for Advanced Clean Cars II (ACCII) regulations, which were incorporated separately. Reduction in passenger vehicle emissions due to ACCII were applied using the ACCII impact factor data for passenger vehicles provided by the CARB EMFAC team. The methodology is consistent with the community-wide inventory and more details can be found in section 6.1.1.2 in the Unincorporated County of San Diego 2019 Greenhouse Gas Emissions Inventory and Projections report. Emissions from passenger vehicles are anticipated to decline by 70 percent between 2019 and 2050 based on EMFAC2021 projections, ACCII regulations, and assuming a vehicle turnover rate that is similar to the County's community-wide average. These emission projections are shown in row 4 in Table 12.

6.7 EMPLOYEE COMMUTE

The 2019 employee commute VMT was scaled to 2050 using the anticipated employee growth through 2050 using government job forecast from SANDAG Series 14 Regional Growth Forecast (SANDAG, 2021). Percentage of fuel use from EMFAC 2021 was applied to the total VMT to determine VMT for diesel, gasoline, electric, and plug-in hybrid fueled vehicles. The employee commute emission factors were scaled based on the change in EMFAC 2021 emission factors from 2019 to 2050 for passenger vehicles. The additional electric load from new Zero Emission Vehicles (ZEVs) from EMFAC2021 is also included in the employee commute forecast. EMFAC 2021 does not account for ACCII regulations, which were incorporated separately. Reduction in passenger vehicle emissions due to ACCII were applied using the ACCII impact factor data for passenger vehicles provided by the CARB EMFAC team. Only light-duty vehicles are subject to ACCII, so the emissions benefits from ACCII were applied only to light-duty vehicles in the county. The additional electric load due to the new ZEVs from ACCII was not estimated due to lack of electricity load data. However, in 2045 when the electricity supply is mandated to be zero-emissions, any ZEV will have zero impact on electricity emissions. The methodology is consistent with the community-wide inventory and more details can be found in section 6.1. 2 in the 2019 Unincorporated County of San Diego 2019 Inventory and Projections report. Emission projections from County employee commute are shown in row 3 in Table 12.

6.8 FACILITY WATER USE

Indirect emissions from water use in facilities in 2019, shown in Section 4.8, were scaled to 2050 using government job forecast from SANDAG Series 14 Regional Growth Forecast (SANDAG, 2021). Based on this extrapolation, the indirect emissions from water use are projected to increase slightly between 2019 and 2050. Emission projections from facility water use are shown in row 8b in Table 12.

6.9 WASTEWATER FACILITIES

The wastewater facilities' emissions were scaled to the anticipated growth in unincorporated county population through 2050 provided by SANDAG. Although changes in wastewater treatment technology could affect the N_2O emission factors and the County's five-year plan allots funding to upgrades at wastewater treatment plant, the plan does not specify the type of improvements that may occur (County of San Diego 2020). Thus, wastewater emissions factors are assumed to remain constant in the future on a per-gallon basis of wastewater generated. Also, due to the small magnitude of emissions in this sector, emissions are not anticipated to measurably change from 2019 levels. Emission projections from wastewater facilities are shown in row 7b in Table 12.

6.10 LANDFILL EMISSIONS

6.10.1 Purchased Electricity

Electricity use at landfills was scaled to the anticipated County employee growth in 2030 through 2050 using government job forecast from SANDAG Series 14 Regional Growth Forecast (SANDAG, 2021). Emissions were estimated by multiplying anticipated electricity use with the projected electricity emission factors.

The projections assume that electricity emission factors would decline in the future because beginning in 2030, the County will purchase 100 percent renewable electricity, 90 percent of which would come from Direct Access and 10 percent would come from San Diego Community Power. Emission projections from electricity use at landfills are shown in row 5c in Table 12.

6.10.2 Natural Gas

Natural gas use at landfills was projected based on growth in County employees by 2030 through 2050 using government job forecast from SANDAG Series 14 Regional Growth Forecast (SANDAG, 2021). Emissions were estimated by multiplying anticipated natural gas use with the projected natural gas emission factors. Between 2019 and 2050, natural gas emissions from landfills are projected to increase. Emission projections from natural gas use at landfills are shown in row 5d in Table 12.

6.10.3 Fugitive Emissions

Over time, CH_4 emissions produced by closed landfills decrease as the finite organic matter within the landfills is slowly converted to CH_4 through decomposition via a growth pattern similar to a bell-shaped curve. The CARB's LGT models the decay in organic matter, rate of conversion to CH_4, and subsequent reduction in CH_4 emissions before and after closure of a landfill. To calculate emissions, this model requires historical annual tonnage data. Historical tonnage data were readily available for the Encinitas, Palomar, San Marcos, and Viejas Landfills, but not for the other landfills under the County's jurisdiction. The rates of decay for these landfills were used to project emissions from the other closed landfills owned and/or operated by the County. Based on these results, emissions from currently closed landfills would generate approximately 46 percent less emissions by 2050 than in 2019 due to the decomposition of organic matter over time. The CH_4 emission factors for 2030 through 2050 were based on the decay rate, and emissions were calculated using the Unincorporated County of San Diego 2019 Greenhouse Gas Emissions Inventory and Projections.

The actual emissions projections from LGT were not used due to the inconsistency between LGT's results and estimated emissions from CRIS for the baseline GHG emissions inventory. The inconsistency between the CRIS and LGT emissions estimates is due to the difference between LGT's theoretical approach based on historical waste tonnage and CRIS' empirical approach, using LFG collection rates available directly from the Encinitas, Palomar, San Marcos, and Viejas landfills and Equation 9.1 from the LGOP. Fugitive emission projections from landfills are shown in row 5a in Table 12.

6.10.4 Pilot Light

Pilot lights used to start flaring events at LFG capture sites require a minimal amount of fuel to stay lit. The emissions associated with the pilot light are not anticipated to change between 2019 and 2050 as this technology is not expected to advance in this timeframe. Emission projections from pilot lights in landfills are shown in row 5b in Table 12.

6.10.5 Flared Gas

Flared gas emissions from County landfills were projected based on change in fugitive CH_4 emissions from municipal landfills with landfill gas capture. The flared gas emissions decreased from 52 $MTCO_2e$ in 2019 to 28 $MTCO_2e$ in 2050. Flared gas emission projections in landfills are shown in row 5e in Table 12.

6.11 SOLID WASTE

Employee-generated solid waste emissions in 2019, shown in Section 4.11, were projected based on growth in County employees in 2030 through 2050 using government job forecast from SANDAG Series 14 Regional Growth Forecast (SANDAG, 2021). As a result, the employee-generated solid waste emissions are projected to increase between 2019 and 2050. This projection assumes that the emissions rates, based on the off gassing of methane from the top layer of the landfill, per-ton of generated waste would remain unchanged. Solid waste emission projections from County facilities are shown in row 9 in Table 12.

7 REFERENCES

ARB. See California Air Resources Board.

California Air Resources Board. 2010. Local Government Operations Protocol. Version 1.1. Available: http://www.arb.ca.gov/cc/protocols/localgov/pubs/lgo_protocol_v1_1_2010-05-03.pdf. Accessed February 20, 2016.

California Air Resources Board. 2021. CARB's Landfill Gas Tool. Available: https://ww2.arb.ca.gov/resources/documents/carbs-landfill-gas-tool . Accessed April 9 2023.

California Air Resources Board. 2022a. 2022 Scoping Plan For Achieving Carbon Neutrality. November 16, 2022. Available: https://ww2.arb.ca.gov/sites/default/files/2022-12/2022-sp.pdf. Accessed April 9 2023.

California Air Resources Board. 2022b. Current California GHG Emission Inventory Data. Available: https://ww2.arb.ca.gov/ghg-inventory-data . Accessed April 9 2023.

California Air Resources Board. 2023. Current California GHG Inventory Data Query Tool. Available: https://ww2.arb.ca.gov/applications/greenhouse-gas-emission-inventory-0. Accessed May 4 2023.

California Public Utilities Commission. 2022. Decision 21-09-037. Available: https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M479/K826/479826194.PDF. Accessed April 6, 2023.

CalRecycle. See California Department of Resources Recycling and Recovery.

EMFAC, 2021. Emissions Inventory. Available: https://arb.ca.gov/emfac/emissions-inventory/57133217f06fd634deb35bc4895e48dae772fd71. Accessed April 9 2023.

Forga, Jason. Landfill Management. Department of Public Works. County of San Diego. San Diego, CA. January 29, 2016. – email to Poonam Boparai regarding alternative daily cover at Viejas Landfill.

ICLEI. 2012 (October). U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions.

Intergovernmental Panel on Climate Change. 2007. *The Physical Science Basis*. https://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_wg1_report_the_physical_science_basis.htm

Kelly, Meghan. Sustainability Division. Planning and Development Services. County of San Diego. San Diego, CA. September 24, 2021. – email exchange between Brenda Hom regarding County Operations Electric Utility

San Diego, County of. 2016. Street Design Manual – Lighting Update 2016. Available: https://www.sandiego.gov/sites/default/files/street_design_manual_-_lighting_update_2016_2.pdf Accessed April 9 2023.San Diego Air Pollution Control District. 2019. Facility Emissions 2019 Emissions Inventory Report. Facility ID: 88189A

San Diego Air Pollution Control District. 2014. Facility Emissions 2014 Emissions Inventory Report. Facility ID: 88189A

San Diego County Air Pollution Control District (n.d.). Emissions Inventory Request Instructions. Landfill Operations. Available: https://www.sdapcd.org/content/dam/sdapcd/documents/permits/emissions-calculation/instructions/Landfill-Operations.pdf . Accessed April 12 2023.

San Diego, County of. 2020. 5 Year Capital Improvement Plan. Fiscal Years 2020/21 to 2024/25.

San Diego, County of. 2022a. Operational Plan and Budget Information. County of San Diego Adopted Operational Plan. Available: https://www.sandiegocounty.gov/content/sdc/auditor/opplan/adoptedlist.html. Accessed April 5, 2023.

San Diego, County of. 2022b. Comprehensive Annual Financial Report for the Fiscal Year ended June 30, 2022. Available: https://www.sandiegocounty.gov/content/dam/sdc/auditor/annual_report22/ACFR2022.pdf Accessed April 6, 2023.

SANDAG, 2021. Series 14 Regional Growth Forecast. San Diego Region. Available: https://datasurfer.sandag.org/download/sandag_forecast_14_region_san-diego.pdf . Accessed April 5, 2023.

TCR. 2010. Local Government Operations Protocol. For the quantification and reporting of greenhouse gas emissions inventories. Version 1.1. Available: https://theclimateregistry.org/wp-content/uploads/2022/11/2010-05-06-LGO-1.1.pdf . Accessed April 9, 2023.

The Climate Registry. 2020 (April). Default Emission Factors. Available: https://www.theclimateregistry.org/wp-content/uploads/2020/04/The-Climate-Registry-2020-Default-Emission-Factor-Document.pdf. Accessed July 2, 2021.

U.S. Environmental Protection Agency. 2010. Landfill Carbon Storage in EPA's Waste Reduction Model. Available: https://www.epa.gov/sites/default/files/2016-03/documents/landfill-carbon-storage-in-warm10-28-10.pdf#:~:text=Although,position. Accessed: April 12, 2023.

U.S. Environmental Protection Agency. 2023. Landfill Methane Outreach Program (LMOP). Landfill Technical Data. Available: https://www.epa.gov/lmop/landfill-technical-data. Accessed April 9, 2023.

Western Regional Climate Center. 2009. Climatological Summary of the San Diego International Airport Station. Available: http://www.wrcc.dri.edu/summary/san.ca.html. Accessed February 5, 2016.