APPENDIX B

County Operations
Greenhouse Gas Emissions Inventory and Projections

County of San Diego

PREPARED FOR

Planning & Development Services
County of San Diego
5510 Overland Avenue, Suite 310
San Diego, CA 92123

PREPARED AND COMPILED BY

Ascent Environmental, Inc.
600 B Street, Suite 300
San Diego, CA 92101

~~August~~December 2017

TABLE OF CONTENTS

List of Tables

List of Figures

1 INTRODUCTION

As a supplement to the Unincorporated County of San Diego 2014 Greenhouse Gas Emissions Inventory and Projections for the County of San Diego's Climate Action Plan (CAP), this document presents the GHG emissions related to County operations in 2014. 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. Projected emissions in 2020 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 for many years. The inventory reported in this document has primarily been compiled from information in the Climate Registry Information System (CRIS) database and supplemented by additional emissions quantification as detailed in the following sections. The community-wide inventory includes the emissions presented in the County 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. See Chapter 2 of the 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. The County operations greenhouse gas (GHG) inventory was developed using TCR's General Reporting Protocol (GRP) (Version 1.1 and associated updates and clarifications). The GRP requires general purpose local governments reporting to The Climate Registry to report in conformance with the Local Government Operations Protocol (LGOP) (ARB 2010). 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 2014 (baseline year). The methodology used to develop and compile the inventory is described in the following sections.

Note that despite the year associated with the emission factors taken from TCR's 2015 Default Emission Factors, these factors are considered representative of conditions in 2014 because the factors were published in April 2015.

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

The 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 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, perfluorocarbons, and sulfur hexafluoride. The County's reported inventory in CRIS includes fugitive hydrofluorocarbon emissions from refrigerant use in County facilities where data was available. However, emissions of the three additional GHGs, other than refrigerants, are not included in this inventory as data needed to quantify these gases is difficult to obtain. Total GHGs from these other sources would likely be minimal.

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 Second Assessment Report. The inventory presented in this document was updated using GWPs from the Fourth Assessment Report to be consistent with current methods and the community-wide inventory. 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
Methane (CH_4)	25
Nitrous oxide (N_2O)	298
HFC-134a	1,430
R-404A	3,922

Source: IPCC 2007

2.2 BASE YEAR

Assembly Bill (AB) 32, Senate Bill (SB) 32, and Executive Orders B-30-15 and S-3-05 use 1990 levels as a benchmark to identify statewide GHG reduction targets. ~~Because~~Data to develop the County's 1990 emissions level ~~were~~is not ~~estimated~~available; as such, proportional targets for the County's CAP were developed for 2014 that are consistent with CARB's ~~Draft 2030 Target~~*California's 2017 Climate Change Scoping Plan* and the state's 2014 GHG emissions inventory.

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.

2.3 OPERATIONAL CONTROL APPROACH

The organizational boundary of a GHG inventory is the boundary that defines which emission sources are included and which are excluded from the inventory. The LGOP strongly encourages local governments to utilize the operational control approach (as opposed to the financial control approach) to defining their organizational boundary because this control approach most accurately represents the emission sources that local governments can directly influence. Under the financial control approach, the economic relationship between the local government and the operation takes precedence over the legal ownership (e.g., 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 operational control approach is believed to most accurately represent the emission sources that local governments can influence. 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 (e.g., Clean Air Act Title V reporting). 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 municipality has operational control over a facility or operation if it has the full authority to introduce and implement its operating policies (e.g., it holds an operating lease for the facility, or has the ability to implement health and safety policies). The inventory reported in this document was prepared using the operational control approach.

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 Scope 2 emissions must be accounted for separately. The appropriate scopes for each inventory sector for the County are identified as follows.

This also applies to Scope 3 emissions, as one entity's Scope 3 emissions are also another entity's Scope 1 or Scope 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 was readily available, including government-generated solid waste and employee commute.

3 GHG INVENTORY RESULTS

In 2014, the total GHG emissions from County operations were estimated at 192,976 metric tons of CO_2e (MT CO_2e) emissions, distributed into 10 sectors as shown in Table 2. The inventory accounts of GHG emissions at County operations including County operations that occur in incorporated cities as these emissions exist as a result of 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.

Table 2 shows the County's operations GHG inventory for 2014. 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 above, all GHGs were converted to carbon dioxide equivalents using GWP factors from IPCC's Fourth Assessment Report.

Table 2 2014 Greenhouse Gas Inventory for County of San Diego Operations

Source[1]	Emissions (MT)					
	CO_2	CH_4	N_2O	HFC-134a	R-404A[2]	CO_2e
Airports						
Electricity Use[3]	286	0	0	-	-	286
Natural Gas	36	<0.01	<0.01	-	-	36
Subtotal[4]	*322*	*<0.01*	*<0.01*	-	-	*322*
Buildings & Other Facilities						
Electricity Use[3]	50,751	0	0	-	-	50,751
Natural Gas	12,367	1.17	0.02	-	-	12,403
Refrigerants	-	-	-	<0.01	0.07	277
Diesel Fuel[5]	130	0.02	<0.01	-	-	130
Propane	16	<0.01	<0.01	-	-	21
Subtotal[4]	*63,264*	*1.19*	*0.03*	*<0.01*	*0.07*	*63,583*
Employee Commute						
Vehicle Fuel Use	55,385	2.87	1.28	-	-	55,836
Landfills[6]						
Fugitive Emissions (including Viejas Landfill)[7]	-	1,667	-	-	-	41,675
Flared Gas[8]	-	0.89	0.18	-	-	75
Pilot Light	1.02	<0.01	<0.01	-	-	1
Subtotal[4]	*1.02*	*1,668*	*0.18*	-	-	*41,750*
Public Lighting (Streetlights and Traffic Signals)						
Electricity Use[3]	2,880	0	0	-	-	2,880
Solid Waste						
Employee Generated Solid Waste	-	85	-	-	-	2,126
Vehicle Fleet						
Fuel: Gasoline	21,731	1.16	1.02	-	-	22,063
Fuel: Diesel	4,000	0.21	0.19	-	-	4,061
Fuel: Compressed Natural Gas (CNG)	32	0.18	0.01	-	-	40
Subtotal[4]	*25,765*	*1.55*	*1.22*	-	-	*26,164*
Wastewater Facilities						
Process Emissions[9]	-	-	0.02	-	-	5
Water Pumping						
Electricity Use	280	0	0	-	-	280
Water Use at Facilities	29	0	0	-	-	29
Subtotal	309	0	0	-	-	309
TOTAL[4]	**147,923**	**1,759**	**2.7**	**0.00**	**0.07**	**192,976**

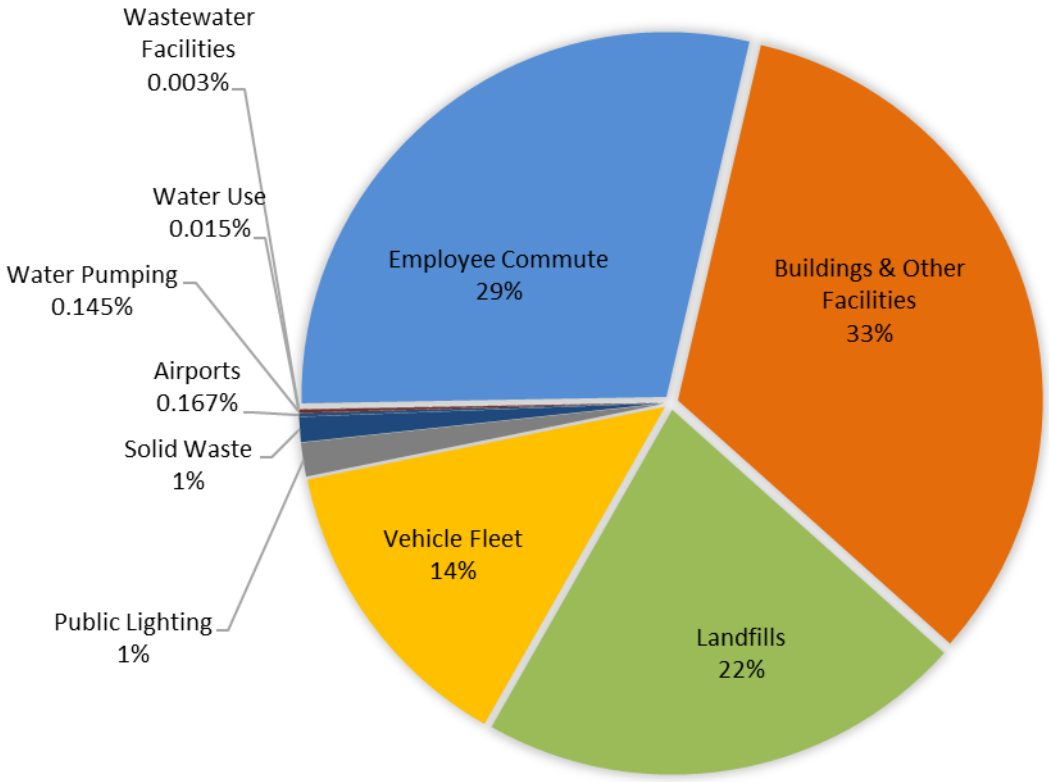
Notes: "-" = no emissions; CH_4 = methane; CNG = compressed natural gas; CO_2 = carbon dioxide; CO_2e = carbon dioxide equivalents; HFC = hydrofluorocarbon; MT = metric tons; N_2O = nitrous oxide; R-404A = Freon 404A (Refrigerant)

[1] All emissions data available from the Climate Registry Information System (CRIS) unless otherwise noted.
[2] R-404A is 44% HFC-125, 4% HFC-134a, and 52% HFC-143a.
[3] These emissions were adjusted from the CRIS inventory to reflect electricity emission factors for direct access electricity purchased by the County. These factors were available from the California Public Utilities Commission as MT CO_2e without a breakdown for CO_2, CH_4, and N_2O (CPUC 2014).
[4] Values may not equal totals due to rounding.
[5] Diesel used in emergency generators only.
[6] Landfill emissions exclude CO_2 emissions from flaring of landfill gases. These emissions are considered biogenic and are not included in the inventory.
[7] Emissions from Viejas Landfill were not included in the CRIS local government inventory. Emissions from Viejas Landfill were calculated separately.
[8] CO_2 emissions from flared landfill gas are considered to be biogenic and are not included.
[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 (ARB 2010). These emissions 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.

Source: County of San Diego 2014 Greenhouse Gas Inventory as reported in the CRIS database; data compiled and adjusted by Ascent Environmental in 2017.

Figure 1 shows the distribution of emissions across various end uses in the County's ~~local government~~ operations.

Figure 1: 2014 Greenhouse Gas Inventory for County of San Diego Operations



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

3.1 RELATIONSHIP TO THE SAN DIEGO COUNTY 2014 COMMUNITY 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-level inventory for activities within the unincorporated area. ~~about how each of the sectors between the community and County operations inventories and projections overlap.~~

Table 3 San Diego County 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 facilities except McClellan-Palomar and Gillespie Field are located in the unincorporated County.
Buildings & Other Facilities	Part	Only buildings located within the unincorporated County are included.
Employee Commute	Part	Only vehicle 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 facilities are located in the unincorporated County.
Solid Waste	None	A vast majority of solid waste generated at County facilities are located outside the unincorporated County (e.g., main offices)
Vehicle Fleet	All	Assumes majority of County fleet operation occur in part or fully within the unincorporated County.
Wastewater Facilities	All	All facilities are located in the unincorporated County.
Water Pumping	All	All facilities are located in the unincorporated County.
Water Use	Part	Some water usage that occurs at County facilities are located in the unincorporated County.

Source: Ascent Environmental in 2017.

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 2014 was available from electricity purchase records recorded in 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 2. To calculate GHG emissions associated with electricity generation, the total electricity consumption was multiplied by the electricity GHG emissions factor in the San Diego Gas & Electric (SDG&E) service territory, expressed in lb CO2e/MWh. In 2014, the County purchased its electricity through Direct Access (DA) agreements with SDG&E. The DA emissions factor used here is 0.379 MT CO2e/MWh (836 lb CO2e/MWh), a default value adopted in California Public Utilities Commission (CPUC) Decision D.14-12-037 (CPUC 2014). The breakdown of electricity use and related emissions by facility type is shown in Table 4.

Table 4 Electricity Usage and GHG Emissions by County Facility (2014)

Facility	kWh/year	MT CO_2e
Airports	755,238	286
Buildings & Other Facilities	133,836,900	50,751
Public Lighting	7,594,078	2,880
Water Pumping	738,955	280
Total	**142,925,170**	**54,198**

Notes: Totals may not sum due to rounding.

GHG = greenhouse gas; kWh = kilowatt-hours; MT CO_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. For airport operations and County-owned and operated buildings, electricity is used for typical building operations such as lights, cooling, computers, and other devices. For airports, additional 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.

4.2 NATURAL GAS

Natural gas consumption data for County facilities and operations in 2014 was available from natural gas purchase records recorded in the CRIS database. The CRIS database includes total therms of natural gas purchased for each facility, which was used to estimate associated GHG emissions, as shown in Table 2. To calculate GHG emissions associated with natural gas combustion, natural gas consumption was multiplied by its GHG emissions factor, expressed in million metric tons (MMT) CO_2e per million (MM) therms. The natural gas emissions factor was calculated based on the heat content of natural gas, fuel CO_2, CH_4, and N_2O emissions from the latest Statewide Greenhouse Gas Inventory in 2013 developed by ARB, and GWPs for CH_4 and N_2O from Table 1 (ARB 2015). This emission factor was the most recent available factor when the community-wide inventory was prepared in 2016. The natural gas emissions factor was 0.0055 MT CO_2e/therms. The breakdown of natural gas use and related emissions by facility type is shown in Table 5. As shown in Table 5, natural gas consumption in County facilities is primarily used in building furnaces, water heaters, and cooking activities.

Table 5 Natural Gas Usage and GHG Emissions by County Facility (2014)

Facility	therms/year	$MTCO_2e$
Airports	6,730	36
Buildings & Other Facilities	2,334,004	12,403
Total	**2,340,734**	**12,439**

Notes: Totals may not sum due to rounding.

GHG = greenhouse gas; MT CO_2e = metric tons carbon dioxide equivalent

Natural gas usage data as shown in the Climate Registry Information System (CRIS) database.

4.3 FACILITY REFRIGERANT USE

The total annual refrigerant usage in County Buildings and Facilities in 2014 was 0.07 metric tons (or 156 lb). The refrigerant usage data, were available, was directly recorded into CRIS through purchase records. Emissions from refrigerants were assumed to be equal to purchase amounts. The GWP factors for the two reported refrigerant types used in County operations are shown in Table 1.

4.4 FACILITY DIESEL USE

The total annual diesel fuel usage in the County's emergency generators at County Buildings and Facilities in 2014 was 286,082 gallons. Diesel usage data was available from diesel fuel purchase records recorded into CRIS. 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 2015: Table 12.1, Table 12.9).

4.5 FACILITY PROPANE USE

Similar to diesel usage, propane use at County Buildings and Facilities was recorded into CRIS from County purchase records and propane-specific emission factors were applied to the total amount of propane used in 2014. These purchase records only reflect propane usage in emergency generators. While facility propane usage represents a small portion of the County's emissions inventory, the County is working on setting up a system to allow collection of propane purchase data for County operations.

The total annual propane usage in the County's emergency generators at County Buildings and Facilities in 2014 was 2,821 gallons. 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: 5.71 kg CO_2/gal, 10 g CH_4/MMBTU, and 0.6 g N_2O/MMBTU (TCR 2015: Table 12.1, Table 12.9).

4.6 VEHICLE FLEET FUEL USE

The County's vehicle fleet operated on gasoline, diesel, and compressed natural gas (CNG) fuels in 2014. This included both on-road and off-road vehicle fleet and equipment, such as construction equipment and airport ground support equipment. Electricity use associated with electric vehicle charging is assumed to be captured within the electricity sector, under Section 4.1. 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 2014. CO_2 emission factors for all three fuel types are based on the volume of gasoline or diesel and the total energy content of purchased CNG fuel. CH_4 and N_2O emission factors were available on a per mile basis and varied by vehicle class (e.g., gasoline heavy-duty truck). Emission factors were available from Tables 13.1, 13.4, 13.6, and 13.7 in TCR's 2015 emission factors. These emission factors are summarized in Table 6.

Table 6 County Vehicle Fleet Emission Factors

Fuel Type	Vehicle Type	Technology	GHG	Emission Factor	Unit	Emission Factor Reference
Gasoline	All Gasoline	All	CO_2	8.78	kg/gal	TCR 2015 Default Emission Factors - Table #13.1
Gasoline	Gasoline Medium and Heavy-Duty Trucks and Buses	Low Emission Vehicles	CH_4	0.0303	g/mi	Precalculated[1]
Gasoline	Gasoline Medium and Heavy-Duty Trucks and Buses	Low Emission Vehicles	N_2O	0.032	g/mi	Precalculated[1]
Gasoline	Non-Highway	Construction/Mining Equipment/Other Small Utility	CH_4	0.5	g/gal	TCR 2015 Default Emission Factors - Table #13.7
Gasoline	Non-Highway	Construction/Mining Equipment/Other Small Utility	N_2O	0.22	g/gal	TCR 2015 Default Emission Factors - Table #13.7
Diesel	All Diesel	All	CO_2	10.21	kg/gal	TCR 2015 Default Emission Factors - Table #13.1
Diesel	Diesel Light Trucks	Moderate Control	CH_4	0.0009	g/mi	TCR 2015 Default Emission Factors - Table #13.4
Diesel	Diesel Light Trucks	Moderate Control	N_2O	0.0014	g/mi	TCR 2015 Default Emission Factors - Table #13.4
Diesel	Diesel Medium and Heavy-Duty Trucks and Buses	Moderate Control	CH_4	0.0051	g/mi	TCR 2015 Default Emission Factors - Table #13.4
Diesel	Diesel Medium and Heavy-Duty Trucks and Buses	Moderate Control	N_2O	0.0048	g/mi	TCR 2015 Default Emission Factors - Table #13.4
Diesel	Non-Highway	Construction/Mining Equipment/Other Large Utility	CH_4	0.58	g/gal	TCR 2015 Default Emission Factors - Table #13.7
Diesel	Non-Highway	Construction/Mining Equipment/Other Large Utility	N_2O	0.26	g/gal	TCR 2015 Default Emission Factors - Table #13.7
CNG	Light Duty Vehicles	Clean Natural Gas	CO_2	0.054	kg/scf	TCR 2015 Default Emission Factors - Table #13.1
CNG	Light Duty Vehicles	Clean Natural Gas	CH_4	0.737	g/mi	TCR 2015 Default Emission Factors - Table #13.6
CNG	Light Duty Vehicles	Clean Natural Gas	N_2O	0.05	g/mi	TCR 2015 Default Emission Factors - Table #13.6

Notes: CH_4 = methane; CNG = compressed natural gas; CO_2 = carbon dioxide; CRIS = Climate Registry Information System; g = grams; gal = gallons; GHG = greenhouse gas; kg = kilograms; mi = miles; MT = metric tons; N_2O = nitrous oxide; scf = standard cubic foot; TCR = The Climate Registry
[1] CRIS indicated the emission factors were pre-calculated; no further detail was provided in the database.

Source: County of San Diego 2014 Greenhouse Gas Inventory as reported in the CRIS database; TCR 2015

4.7 EMPLOYEE COMMUTE

Emissions from the County's employee commute activity were estimated based on a zip code database provided by the County, which included home and work zip codes for each employee anonymously, as well as indicated whether the employee was a full-time or part-time/temporary employee. The raw vehicle miles traveled (VMT) calculated from the zip code method was adjusted down by the VMT associated with alternative modes, such as biking, transit, carpooling, and vanpooling using data from the SANDAG's iCommute network trip logs for County employees in 2014. It was assumed that employees that drive would use a mixture of light duty auto and light duty trucks for commuting, based on a County-average vehicle mix from EMFAC 2014.

The one-way driving distance between two zip codes (home and work zip codes) was calculated through several steps. First, approximately 80 home and work zip code pairs were input into Google Maps to estimate actual driving distance. Second, the absolute distance between all home and work zip code pairs was calculated using the Haversine formula and the coordinates of each zip code, available from the U.S. Census Bureau (U.S. Census Bureau 2010). Third, a ratio of driving distance to absolute distance was calculated. This calculation resulted in 1.4 miles of driving distance for every absolute mile. Fourth, this ratio was then applied to the absolute distance for each home and work zip code pair to calculate the one-way driving distance for all employees.

For full-time employees, the calculations assumed that vehicle trips would occur twice per day, five times per week for 48 weeks per year, accounting for vacations and holidays. For part-time or temporary employees, vehicle trips were assumed to occur twice per day, 2.5 times per week for the same number of weeks. 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 2014 County Employee Commute Vehicle Trips

Employee Type	Number of Employees[1,2]	Raw Annual VMT[3]	SANDAG iCommute Adjustment	Adjusted Annual VMT[4]
Full-Time	16,623	143,519,332	71,262	143,448,070
Part-Time/Temporary	2,582	11,601,411	5,760	11,595,651
Total	19,205	155,120,743	77,023	155,043,720

Notes: VMT = vehicle miles traveled, SANDAG = San Diego Association of Governments

[1] 2015 employment figures are more conservative and used as a proxy for 2014 employment figures.
[2] The 2015 employment figures do not match the inventory in the *Comprehensive Annual Report for Fiscal Year Ending June 30, 2016* because the table includes a snapshot of the employee count, which fluctuates throughout the year.
[3] Based average driving distance between home and work zip codes.
[4] Adjusted for average organization-wide mode split (e.g., percent breakdown of employees biking, taking transit, carpool, driving alone from SANDAG's iCommute trip logs for County employees).

Source: Employee data provided by County of San Diego; U.S. Census Bureau 2010; data compiled by Ascent Environmental in 2016

Emission factors from EMFAC 2014 for gasoline and diesel light duty and light-heavy duty autos and trucks, medium duty vehicles, and motorcycles were applied to total VMT to estimate annual emissions from employee commute (shown in Table 8). For electric vehicles, San Diego Gas & Electric (SDG&E) emission factors from CRIS were applied to an average efficiency of 35 kWh per 100 miles, based on EPA's vehicle efficiency data for electric light duty passenger cars in 2014 (EPA 2015).

Table 8 2014 County Employee Commute Emission Factors from EMFAC 2014

Fuel Type	Percent Breakdown in San Diego County[3]	Emission Factor (g CO_2/mi)	Emission Factor (g CH_4/mi)	Emission Factor (g N_2O/mi)
Gasoline[1]	99%	358	0.019	0.008
Diesel[1]	1%	335	0.002	0.011
Electric[2]	0.4%	971	NA	NA

Note: CH_4 = methane; CO_2 = carbon dioxide; CRIS = Climate Registry Information System; g = grams; LDA = light duty auto; LDT1 = light duty truck; mi = miles; MT = metric tons; N_2O = nitrous oxide

[1] Based on San Diego County mix of LDA and LDT1 emission factors.
[2] Assumes an average efficiency of 35 kilowatt-hours (kWh) per 100 miles and San Diego Gas and Electric (SDG&E) emission factors.
[3] Values do not sum to 100% due to rounding

Source: Compiled by Ascent Environmental in 2017 using EMFAC 2014 v. 1.0.7

4.8 FACILITY WATER USE

Although the County's water pumping activity is captured in Section 4.1, those pumping facilities serve the unincorporated area. Several County facilities are located outside of the unincorporated area. To capture the emissions associated with water use not served by the County's own pumps, annual water usage data from facilities located outside the unincorporated area (183 million 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 outside the unincorporated County. This water energy intensity factor was based on the average local water energy intensity rate used to calculate the community-wide GHG inventory. See Table ~~28~~29 in the ~~*Unincorporated*~~ *County of San Diego 2014 Greenhouse Gas Emissions Inventory and Projections* for more details.

Total indirect electricity use from the water use in County facilities outside of unincorporated areas was 53 MWh per year in 2014. To calculate emissions from this indirect electricity use, a factor of 665 lb CO_2e/MWh was applied to the calculated electricity use, consistent with community-wide averages, for a total of ~~16~~29 $MTCO_2e$ in 2014 (see Section 4.2.2 of the ~~*Unincorporated*~~ *County of San Diego 2014 Greenhouse Gas Emissions Inventory and Projections).*

4.9 WASTEWATER FACILITIES

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.

Wastewater-related emissions from County facilities located outside the unincorporated County were calculated based on total indoor water use estimates provided by the County and emission factors for "Unspecified Wastewater Treatment Agencies" from Section 4.9.2.4 of the community-wide inventory and projections.

4.10 LANDFILL EMISSIONS

4.10.1 Fugitive

The landfill emissions only include landfills that are closed, as the County does not own or operate any active landfills. CRIS reported fugitive CH_4 emissions in 2014 for 10 out of 11 landfills that are closed and owned and/or operated by the County – Bell Junior High, Bonsall, Encinitas, Gillespie, Hillsborough, Jamacha, Palomar, Poway, San Marcos, and Valley Center Landfills. 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 (ARB 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. Based on a review of the CRIS database, it was found that fugitive emissions from the Bell Junior High Landfill were directly recorded into CRIS as CH_4 emissions. It was assumed that the reported emissions for Bell Junior High Landfill in CRIS accurately reflect the emissions from that landfill. 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 ARB's Landfill Emissions Tool (LET) (Version 1.3). 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 applied 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 alternative daily cover 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, LET estimates that the Viejas Landfill generated 24 metric tons of CH_4 in 2014. 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.

4.10.2 Pilot Light and Flared Gas

Pilot lights used to start flaring events at LFG capture sites require a minimal amount of fuel to stay lit. CRIS does not specify the type of fuel used to power the pilot lights; however, it is conservatively assumed that the emissions from combustion of fuel in pilot lights is not biogenic. CRIS uses the emission factor of 0.00382286 metric tons CO_2 per ignition and reports total calculated emissions of CO_2, although the number of ignitions was not reported.

Some LFG is flared on-site, resulting in GHG emissions. CO_2 emissions from combustion of LFG is considered biogenic due to its source in organic waste and is not included in these estimates. CH_4 and N_2O emissions from the combustion of LFG in flares are reported in CRIS and included in this inventory.

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 2014. 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 2017). County employee-generated solid waste calculations are summarized in Table 9.

Table 9 2014 County Employee-Generated Solid Waste Emissions

Employee-Generated Solid Waste	
Number of Full- and Part-Time County Employees (employees)[1]	19,205
Solid Waste Disposed Per Employee (Public Administration (tons/employee/year)[2]	0.30
Calculated Tons of Waste Generated by County Employees (tons/year)	5,762
Waste Generation Emissions Factor[3]	
Average Emissions Factor for Municipal Solid Waste ($MTCH_4$/ton)	0.06
Oxidation Rate (%)	10%
Minimum percent of landfills accepting waste from City of San Diego that have LFG Capture[4] (%)	99%
Landfill Gas Capture Rate (%)	75%
Average Emissions Factor for Municipal Solid Waste in the City of San Diego ($MTCH_4$/ton)	0.37
Emissions from Employee-Generated Solid Waste	
GHG Emissions from Employee-Generated Solid Waste ($MTCO_2e$/year)[5,6]	8,642

Notes: Manual calculations of using figures shown may not equal results due to rounding of individual figures.

CO_2e = carbon dioxide equivalents; MT = metric tons

[1] Number of employees provided by County of San Diego

[2] Solid waste generation rate from CalRecycle. Rate based on total employment (full and part time) for "Public Administration" business groups. Excludes recycled or composted waste.

[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 2017, EPA 2017)

[5] Based on a CH_4 global warming potential factor of 25.

[6] Part-time/temporary County employees only work half the amount of time, therefore, generating half the amount of waste as compared to a full-time County employee.

Source: CalRecycle 2011, CalRecycle 2017, ICLEI 2012, EPA 2017

Total waste generated by County employees was estimated by applying a solid waste generation rate (tons per employee per year) categorized under "Public Administration" to the total number of employees. The "Public Administration" solid waste generation rate was available from the California Department of Resources Recycling and Recovery CalRecycle (CalRecycle 2011). The emissions factor, 0.37 MT CO_2e per ton of solid waste generated, was calculated using Equation SW.4.1 from the US Community Protocol and the factors shown in Table 9 (ICLEI 2012). The percent of accepting landfills that have LFG capture was calculated by looking up Otay, Sycamore, and West Miramar Landfills in EPA's Landfill Methane Outreach Program (EPA 2017). These three landfills accepted over 99 percent of waste from the City of San Diego in 2014 and all operated LFG capture systems in 2014 (CalRecycle 2017, EPA 2017).

5 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 2020 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 2020, 2030, ~~2040,~~ and 2050. These projections account for the County's future population growth, County operation plans, and future emissions reductions pursuant to AB 32 and other legislation in California. These legislations include a variety of regulations and programs, including the Renewables Portfolio Standard (RPS), improving vehicle fuel economy standards due to Advanced Clean Cars, and other State and federal policies.

Table 10 shows the County's operations GHG inventory for the baseline year of 2014 and GHG projections for 2020 through 2050 at ten-year increments.

5.1 ELECTRICITY

Electricity use at County facilities in 2020 was projected based on capital projects identified in the County's Adopted Operational Plan Fiscal Years 2016-17 & 2017-18 and the County's Airport Capital Improvement Plan Fiscal Years 2017-2021 (ACIP) (County of San Diego 2016a, 2016b). For projections through 2050, it was assumed that the trends between 2014 and 2020 would continue into the future.

According to the County's plans, the County anticipates construction of several new facilities. With respect to airport facilities, the ACIP mostly anticipates new runway improvements and equipment that would have a minimal effect on overall municipal electricity usage, with the exception of a new aircraft rescue and firefighting facility (ARFF) at the McClellan-Palomar Airport. Electricity use associated with public lighting was projected based on projects identified in the County's Five Year Capital Improvement Plan Fiscal Years 2016/17 to 2020/21 (County of San Diego 2015a). Indirect electricity consumption associated with the County's water pumping facilities was scaled based on population growth in the unincorporated County from 2014 to 2020. Table 11 shows the anticipated facility projects and associated changes through 2021. The County currently does not have plans beyond 2021.

The estimated future electricity use in 2020 was based on the additional facilities shown in Table 11. CalEEMod version 2016.3.1. was used to estimate the additional electricity demand based on the types and size of the new or expanded facilities. CalEEMod modeling estimated that the additional facilities, if built by 2020, would require approximately 566 MWh more per year over 2014 conditions. Sixteen MWh per year of which are associated with the new airport facility. In addition, some facilities will require additional public lighting. Based on an assumption of three streetlights per acre and an average wattage of 150 watts per light operating eight hours per day, new public lighting needs would add approximately 285 MWh per year to current lighting electricity demands as of 2014. The additional employee estimates in Table 11 are used to project other resource areas, such as employee commute. Electricity from water use is anticipated to increase as the number of employees at the County increase.

Table 10 County of San Diego Operations Baseline GHG Inventory and Projections

Source	Emissions ($MTCO_2e$)			
	2014	2020	2030	2050
Airports				
Electricity Use	286	245	189	201
Natural Gas	36	38	40	44
Subtotal	*322*	*283*	*229*	*245*
Buildings & Other Facilities				
Electricity Use	50,751	42,656	32,050	32,485
Natural Gas	12,403	12,816	12,888	13,032
Refrigerants	277	~~279~~278	~~285~~280	~~299~~284
Diesel Fuel	130	131	132	~~135~~134
Propane	21	21	21	21
Subtotal	*63,583*	*55,902*	*45,371*	*45,956*
Employee Commute				
Vehicle Fuel Use	55,836	47,315	34,326	31,575
Landfill				
Fugitive Emissions (including Viejas Landfill)	41,675	36,956	30,275	20,276
Flared Gas	75	66	54	36
Pilot Light	1	1	1	1
Subtotal	41,750	37,023	30,331	20,313
Public Lighting (Streetlights and Traffic Signals)				
Electricity Use	2,880	2,501	1,979	2,204
Solid Waste				
Employee Generated Solid Waste	2,126	2,153	2,197	2,285
Vehicle Fleet				
Fuel: Gasoline	22,063	19,985	14,544	13,152
Fuel: Diesel	4,061	3,916	3,779	3,860
Fuel: Compressed Natural Gas (CNG)	40	41	42	43
Subtotal	*26,164*	23,942	18,365	17,055
Wastewater Facilities				
Process Emissions	5	5	6	6
Water Pumping				
Water Pumps	280	255	212	231
Water Use at Facilities	29	29	30	31
Subtotal	*309*	*284*	*242*	*262*
TOTAL	**192,976**	**169,348**	**133,045**	**119,902**
Percent Change from 2014 (%)	**0**	**-12**	**-31**	**-38**

Notes:
BAU = Business-as-usual; CNG = compressed natural gas; CO_2e = carbon dioxide equivalents; MT = metric tons;
Values may not equal totals due to rounding.

Source: Data compiled and adjusted by Ascent Environmental in 2017.

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. In 2014, the County's Direct Access contracts offered electricity based on a 25 percent renewable mix. The projections assume that electricity emission factors would decline in 2020 due to the 33 percent renewable mix by 2020 and 50 percent by 2030 through 2050. This is due to the renewable electricity requirements on the State's electricity providers, including the County's Direct Access contracts. Between 2014 and 2050, electricity emissions for County operations would decrease despite electricity use increasing through 2050 due to the RPS legislative reductions.

Table 11 Anticipated County Facility Changes between 2016 and 2021

Project	Type of Change	Original Square Footage	Additional Acres Requiring public lighting	Estimated New Employees
4S Ranch Library Expansion	Remodel and Expansion	3,000[1]	0	0
Aircraft Rescue and Fire Fighting Building at McClellan-Palomar Airport	New Airport Facility	3,000[1]	0	10
Alpine Active Recreation Park Acquisition	New Facility	1,000[1]	5	0
ARCC – East County Operations and Archive	Rebuilding and Expansion	14,980	0	15
Deerhorn Valley Fire Station 37	New Facility	2,000[1]	0	15
East Mesa Juvenile Detention Facility (EMJDF) Youth Development Center	New Facility	12,000	0	50
Emergency Vehicles Operation Course (EVOC)	New Facility	1,000[1]	30	15
Jacumba Fire Station	New Facility	15,000[1]	0	30
Miramar Training Facility Locker Room	New Facility	2,000	0	2
New Casa De Oro Branch Library	Rebuilding and Expansion	8,800	0	6
New Lakeside Branch Library	Rebuilding and Expansion	10,000	0	7
Otay Valley River Regional Park Active Recreation Site 3	New Facility	1,000[1]	46	5
Pine Valley Fire Station	New Facility	13,000	0	30
San Luis Rey River Park Land Acquisition and Improvements	New Facility	1,000[1]	25	3
San Pasqual Fire Station	New Facility	13,000[1]	0	30
Solana Beach Library Remodel	New Facility	4,000[1]	0	2
South County Animal Shelter (Bonita), Phase I	Rebuilding and Expansion	0	0	0
Tijuana River Valley Active Recreation Site	New Facility	1,000[1]	64	3
Tijuana River Valley Equestrian Facility	New Facility	3,000[1]	15	10
Total		108,780	185	233

Notes: Totals may not add due to rounding. This is not a comprehensive list of all the County's plans. This list reflects the major facility expansions and additions that may result in increased electricity use in the future.

[1] Exact square footages not provided. These are estimates based on the facility description.

Source: County of San Diego 2016a, 2016b

5.2 NATURAL GAS

Natural gas consumption was projected using similar methodologies as for electricity. Natural gas use at County facilities in 2020 was projected based on capital projects identified in the County's Adopted Operational Plan Fiscal Years 2016-17 & 2017-18 and the County's Airport Capital Improvement Plan Fiscal Years 2017-2021 (ACIP) (County of San Diego 2016a, 2016b). For projections through 2050, it was assumed that the trends between 2014 and 2020 would continue into the future.

The estimated future natural gas use in 2020 was based on the additional facilities shown in Table 11. CalEEMod version 2016.1.1. 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 2020, would require approximately an additional 8,139 therms per year over 2014 conditions, 224 therms of which are associated with the new airport facility.

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. Thus, between 2014 and 2050, natural gas emissions for County operations are projected to increase.

5.3 FACILITY REFRIGERANT USE

Refrigerant use in County facilities from 2014 through 2050 was scaled by change in Buildings and Facilities electricity use from 2014 to 2050. Emissions were estimated using the emission factors identified in Section 4.3. Emissions from annual refrigerant usage in County buildings and facilities is projected to slightly increase between 2014 and 2050.

5.4 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 2014 to 2020. Emissions were estimated using the 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 2014 and 2050.

5.5 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 2014 to 2050. Emissions were estimated using the emission factors identified in Section 4.5. Due to the small magnitude of this source, total annual propane emissions at County Buildings and Facilities are projected to remain unchanged from 2020 through 2050, even with scaling applied.

5.6 VEHICLE FLEET FUEL USE

The County's vehicle fleet operations include gasoline-, diesel-, and CNG-fueled on-road and off-road vehicles and equipment. Future vehicle fleet gasoline and diesel fuel use through 2050 is based off projected changes in community-wide vehicle fleet emission factors in EMFAC2014 for the vehicle categories specific to the County's vehicle fleet. Also, additional diesel usage due to new construction activities anticipated in Table 11 were added to 2020 projections, based on CalEEMod construction modeling results. CalEEMod estimated that an additional 380 $MTCO_2e$ would result from the construction of the new facilities shown in Table 11. Emissions from diesel and gasoline vehicles are anticipated to decline by 38 percent between 2014 and 2050 based on EMFAC2014 projections and assuming a vehicle turnover rate that is similar to the County's community-wide average.

With respect to fuel types other than diesel and gasoline, any electric vehicle (EV) usage is assumed to be captured within the electricity use sector, and the CNG-related emissions are assumed to remain unchanged due to the small number of existing CNG vehicles relative to the rest of the County's fleet.

5.7 EMPLOYEE COMMUTE

The 2014 employee commute VMT, already adjusted for alternative modes in Section 4.7, was scaled to 2050 using the anticipated employee growth through 2050, which was extrapolated from the anticipated trends between 2014 and 2020. Table 11 shows the additional employees that would be added to the County's 2014 roster of 19,205 part- and full-time employees, as documented in the County's Comprehensive Annual Financial Report for the Fiscal Year ended June 30, 2015 (County of San Diego 2015b). The employee commute emission factors were scaled based the change in EMFAC 2014 emission factors from 2014 to 2050 for passenger vehicles.

5.8 FACILITY WATER USE

Indirect emissions from water use in facilities in 2014, shown in Section 4.8, were scaled to 2050 using the anticipated employee growth through 2050, which was extrapolated from the anticipated trends between 2014 and 2020. Table 11 shows the additional employees ~~that would be added to the County's operations~~ that would be added to the County's 2014 roster of 19,205 part- and full-time employees, as documented in the County's Comprehensive Annual Financial Report for the Fiscal Year ended June 30, 2015 (County of San Diego 2015b). Based on this extrapolation, the Indirect emissions from water use are projected to increase slightly between 2014 and 2050. Because the contribution of this sector is less than 0.02 percent of the local government operations, this projection assumes that the emissions rates, or energy used to pump one gallon of water to the end user, would remain unchanged.

5.9 WASTEWATER FACILITIES

The wastewater facilities' emissions were scaled to the anticipated Unincorporated County population in 2020 through 2050. 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 2015a:87). 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 2014 levels.

5.10 LANDFILL EMISSIONS

5.10.1 Fugitive

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 ARB's LET 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 Jamacha, 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 11 percent less emissions by 2020 than in 2014 due to the decomposition of organic matter over time. The CH_4 emission factors for 2020 through 2050 were based on the decay rate, and emissions were calculated using the community inventory projections.

The actual emissions projections from LET were not used due to the inconsistency between LET's results and estimated emissions from CRIS for the baseline GHG emissions inventory. The inconsistency between the CRIS and LET emissions estimates is due to the difference between LET's theoretical approach based on historical waste tonnage and CRIS' empirical approach, using LFG collection rates available directly from the Jamacha, San Marcos, and Viejas landfills and Equation 9.1 from the LGOP. The fugitive landfill emissions are projected to decrease by 51 percent between 2014 and 2050.

5.10.2 Pilot Light and Flared Gas

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 in 2020 as this technology is not expected to advance in this timeframe. Emissions from flared LFG is assumed to decrease in proportion to the decay rate in the County's closed landfills.

5.11 SOLID WASTE

Employee-generated solid waste emissions in 2014, shown in Section 4.11, were scaled to 2050 using the anticipated employee growth through 2050, which was extrapolated from the anticipated trends between 2014 and 2020. Table 11 shows the additional employees that would be added to the County's 2014 roster of 19,205 part- and full-time employees, as documented in the County's Comprehensive Annual Financial Report for the Fiscal Year ended June 30, 2015 (County of San Diego 2015b). Based on this extrapolation, the employee-generated solid waste emissions are projected to increase between 2014 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.

6 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.

_____. 2015. *Documentation of California's Greenhouse Gas Inventory.* Fuel Combustion – Natural Gas. Available: http://www.arb.ca.gov/cc/inventory/doc/docs1/1a1ai_instategenerationutilityowned_fuelcombustion_naturalgas_ch4_2013.htm. Accessed February 9, 2017.

_____. 2017 (~~January). The~~November). *California's 2017 Climate Change Scoping Plan ~~Update. January 20,~~*. November 2017. Available: https://www.arb.ca.gov/cc/scopingplan/~~2030sp_pp_final~~scoping_plan_2017.pdf. Accessed January ~~25, 2017~~3, 2018.

California Department of Resources Recycling and Recovery. 2011 (June). Solid Waste Characterization Database: Waste Disposal Rates for Business Types. Available at http://www.calrecycle.ca.gov/wastechar/disprate.htm. Accessed March 29, 2016. Last Updated June 8, 2011.

_____. 2017. Jurisdiction Disposal By Facility. Disposal during 2014 for San Diego. Available: http://www.calrecycle.ca.gov/LGCentral/Reports/Viewer.aspx?P=ReportYear%3d2014%26ReportName%3dReportEDRSJurisDisposalByFacility%26OriginJurisdictionIDs%3d433. Accessed May 18, 2017,

CPUC. See California Public Utilities Commission.

California Public Utilities Commission. 2014. Decision 14-12-037, December 18, 2014 in Rulemaking 11-03-012 (Filed March 24, 2011). Available: http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M144/K130/144130487.pdf. Accessed February 10, 2017.

CalRecycle. See California Department of Resources Recycling and Recovery.

County of San Diego. *See* San Diego, County of.

EPA. See U.S. Environmental Protection Agency.

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

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

San Diego, County of. 2015a. *Five Year Capital Improvement Plan 2016/17 to 2020/21.* Available: http://www.sandiegocounty.gov/content/dam/sdc/dpw/ENGINEERING_SERVICES/engineerpdf/5yrplan.pdf. Accessed May 18, 2017.

_____. 2015b. *Comprehensive Annual Financial Report for the Fiscal Year ended June 30, 2015*. Available: http://www.sandiegocounty.gov/content/dam/sdc/auditor/annual_report15/pdf/cafr1415.pdf. Accessed February 10, 2017.

_____. 2016a. *Adopted Operational Plan Fiscal Years 2016-17 & 2017-18*. Available: http://www.sandiegocounty.gov/content/dam/sdc/auditor/pdf/adoptedplan_16-18.pdf. Accessed January 20, 2017.

_____. 2016b*. Airport Capital Improvement Plan Fiscal Years 2017-2021.*

TCR. See The Climate Registry

The Climate Registry. 2015 (April). Default Emission Factors. Available: https://www.theclimateregistry.org/wp-content/uploads/2015/04/2015-TCR-Default-EF-April-2015-FINAL.pdf. Accessed February 20, 2016.

U.S. Census Bureau. 2010. Zip Code Tabulation Areas. Available: https://www.census.gov/geo/maps-data/data/gazetteer2010.html. Accessed March 3, 2016.

U.S. Environmental Protection Agency. 2015. Fuel Economy Data. Available: https://catalog.data.gov/dataset/fuel-economy-data-c6a4c. Accessed March 23, 2015.

_____. 2017. Landfill Gas Energy Project Data and Landfill Technical Data. Available: https://www.epa.gov/lmop/landfill-gas-energy-project-data-and-landfill-technical-data#states. Accessed May 18, 2017.

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.