DNV·GL

County of Santa Clara 2015 Municipal Operations Greenhouse Gas Emissions Inventory Report

March 2018

Acknowledgements

This 2015 Municipal Operations Greenhouse Gas Emissions Inventory Report was developed for the County of Santa Clara Facilities and Fleets Department. The municipal operations inventory was developed primarily using the Local Government Operations Protocol (LGOP). This inventory is intended to assist the County of Santa Clara in tracking progress towards the Board of Supervisors' Cool Counties Climate Stabilization Declaration of a 1% decrease in municipal operations emissions every five years.

Project Consultant: Ben Butterworth and Betty Seto (DNV GL)
County of Santa Clara Staff: Susana Mercado, Joanne Yee, Brad Vance

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1 INTRODUCTION

The County of Santa Clara (County) is pleased to present the 2015 municipal operations greenhouse gas (GHG) emissions inventory. Emissions inventories are developed to help government leaders understand how GHG emissions are generated from various activities associated with municipal operations. Emissions accounting standards and protocols are used to assist counties in compiling emissions data at the municipal operations scale.

Our 2009 *Climate Action Plan for Operations and Facilities* supported state legislation at the time of adoption (AB 32). The following are the goals noted within the document:

- Stop increasing the amount of emissions by 2010 (achieved)
- Decrease emissions by 10% every 5 years from 2010 – 2050
- Reach an 80% reduction by 2050

The County established a baseline municipal operations inventory for calendar year 2005 and a subsequent inventory for calendar year 2010. This 2015 inventory was developed to help the County track progress towards achieving the County Board of Supervisors' Cool Counties Climate Stabilization Declaration target of a 1% decrease in municipal operations emissions every five years.

The inventory primarily follows the Local Government Operations Protocol (LGOP) developed by the California Air Resources Board, California Climate Action Registry, ICLEI and the Climate Registry. Calendar year 2015 was chosen as the year for this inventory because it was the most recent calendar year with complete data available.

2 EXECUTIVE SUMMARY: 2015 EMISSIONS INVENTORY RESULTS

Our findings indicate that the County emitted municipal operations emissions of 112,952 MTCO2e in 2015 from the buildings, facilities, public lighting and utilities, employee commute, vehicle fleet, reimbursed employee miles, solid waste and closed landfills sectors. This represents a 3% increase from 2010 municipal operations emissions of 109,819 MTCO2e.

Figure 1 and Table 1 provide a comparison of 2010 and 2015 municipal operations emissions and trends by sector and subsector.

Figure 1: Municipal operations emissions by sector – 2010 vs. 2015

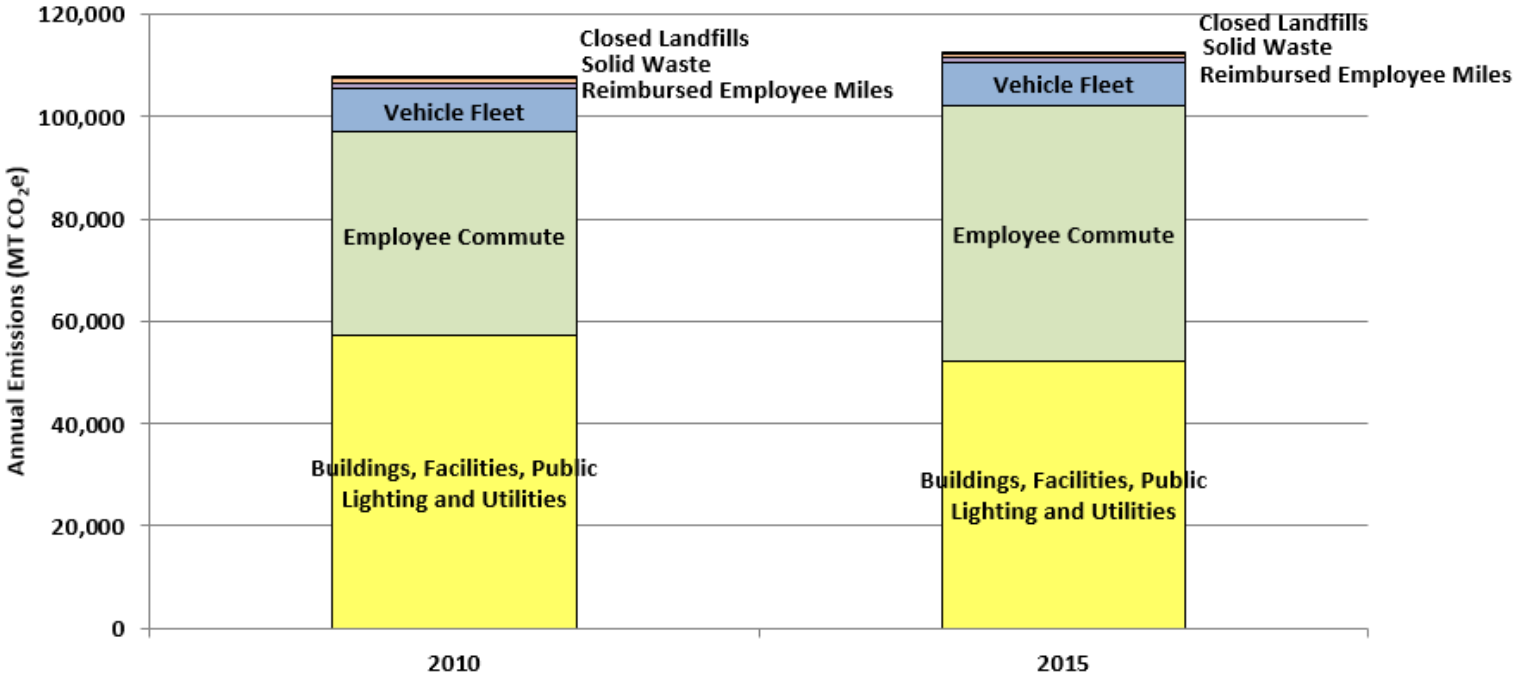


Table 1: Emissions by sector & subsector – 2010 vs. 2015

Sector/Subsector	2010 Emissions (MT CO_2e/yr)	2015 Emissions (MT CO_2e/yr)	Percent Change
Buildings, Facilities, Public Lighting and Utilities	57,140	52,340	-8%
Facilities Energy: Excluding Public Lighting	55,634	50,802	-9%
Public Lighting	613	571	-7%
Refrigerants	892	967	+8%
Employee Commute	39,774	49,892	+25%
Vehicle Fleet	8,596	8,428	-2%
Reimbursed Employee Miles	951	765	-20%
Solid Waste	2,892	1,372	-53%
Closed Landfills	466	155	-67%
Total	**109,819**	**112,952**	**+2.9%**

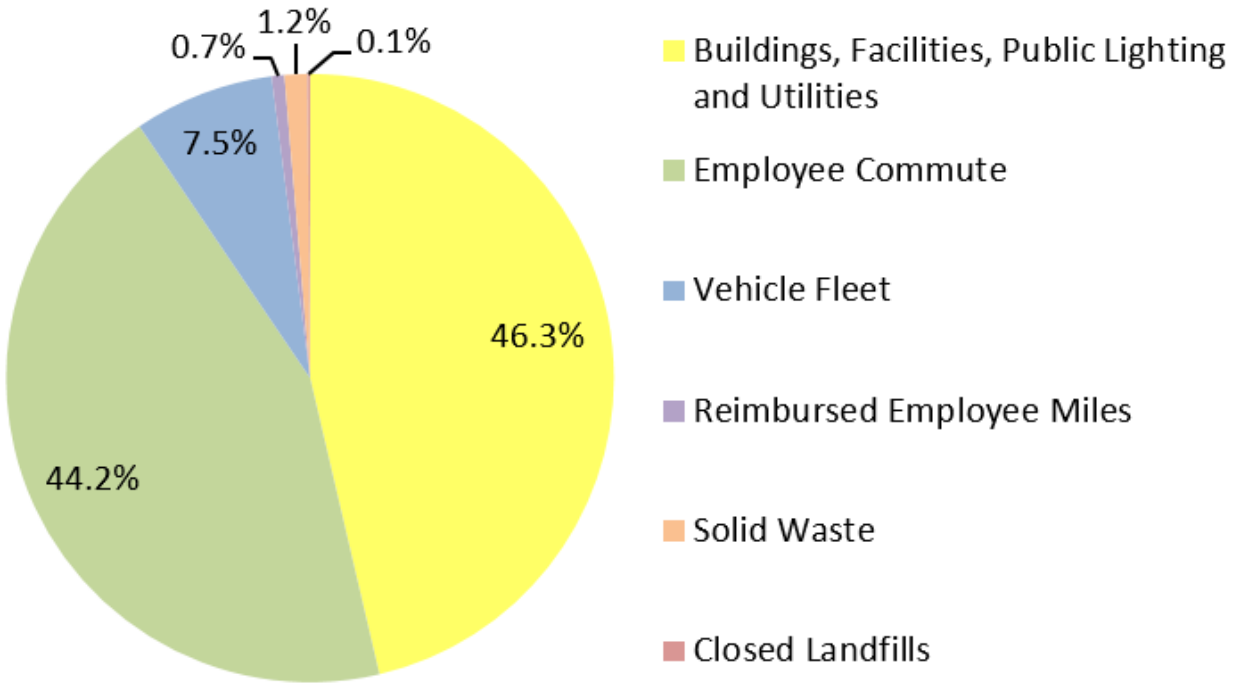
Table 2 provides a sector-by-sector analysis of key factors driving trends in municipal operations emissions from 2010-2015.

Table 2: Summary of key 2010-2015 emissions trends

Emissions Sector	Summary of 2010-2015 Trends
Buildings, Facilities, Public Lighting and Utilities	Buildings, facilities, public lighting and utilities emissions decreased 8% from 2010 to 2015. This trend in emissions was driven by a 17% decrease in electricity emissions.
Employee Commute	Employee commute emissions increased 25% from 2010 to 2015. This trend in emissions was driven by a 27% increase in County employees and a 59% increase in the total distance driven by employees commuting to work. The increase in distance driven was partially offset by a 21% increase in the efficiency of the vehicles employees drove to work.
Vehicle Fleet	Vehicle fleet emissions decreased 2% from 2010 to 2015. This trend in emissions was driven by a 5% decrease in the amount of gasoline consumed by the vehicle fleet.
Reimbursed Employee Miles	Reimbursed employee miles emissions decreased 20% from 2010 to 2015. This trend in emissions was driven by a 7% decrease in the reimbursed distance traveled by County employees and a 14% increase in the efficiency of the personal vehicles employees drive for work purposes.
Solid Waste	Solid waste emissions decreased 53% from 2010 to 2015. This trend in emissions was driven by a 53% decrease in solid waste landfilled, a result of an increase in recycling and compositing efforts.
Closed Landfills	Closed landfills emissions decreased 67% from 2010 to 2015. This trend in emissions was driven by a 67% decrease in landfill gas collected at closed landfills.

Figure 2 displays the relative contribution of each sector to overall 2015 municipal operations emissions.

Figure 2: 2015 emissions by sector



Buildings, facilities, public lighting and utilities (46.3%), employee commute (44.2%), and vehicle fleet (7.5%) continue to make up the vast majority of municipal operations emissions. Reimbursed employee miles (0.7%), solid waste (1.2%), and closed landfills (0.1%) make up the remaining municipal operations emissions.

Data and Methodology Inconsistencies in the 2005 Inventory:

Please note that throughout this report, the results of the 2005 municipal operations are only mentioned in relation to specific sectors. Because there were significant differences between the methodology used to complete the 2005 and 2015 inventories, it is difficult to compare the results of the two inventories in many sectors, particularly the employee commute, vehicle fleet and reimbursed miles sectors.

3 2015 EMISSIONS INVENTORY RESULTS BY SECTOR

3.1 Buildings, Facilities, Public Lighting and Utilities Sector

As summarized in Table 3 below, emissions in the buildings, facilities, public lighting and utilities sector decreased 7.4% from 2005-2015 and decreased 8.4% from 2010-2015. The buildings, facilities, public lighting and utilities sector made up 46% of the County's total municipal operations emissions in 2015.

Table 3: Buildings, facilities, public lighting and utilities sector consumption and emissions by subsector – 2005 -2015

Category	Year	Electricity Consumption (kWh)	Natural Gas Consumption (therms)	Refrigerant Consumption (lbs)	Emissions (MT CO2e)
Facilities Natural Gas	2005		4,886,454		26,006
	2010		5,633,742		29,899
	2015		5,551,286		29,461
	% Change: 2005 - 2015:		+14%		+13%
	% Change: 2010 - 2015:		-1%		-1%
Facilities Electricity Excluding Public Lighting	2005	133,458,863			29,719
	2010	127,496,601			25,735
	2015	130,516,210			21,341
	% Change: 2005 - 2015:	-2%			-28%
	% Change: 2010 - 2015:	+2%			-17%
Facilities Public Lighting Electricity	2005	3,369,724			749
	2010	3,038,519			613
	2015	3,113,830			571
	% Change: 2005 - 2015:	-8%			-24%
	% Change: 2010 - 2015:	2%			-7%
Facilities Refrigerants	2005			18	27
	2010			1,210	892
	2015			1,264	967
	% Change: 2005 - 2015:			+6924%	+3536%
	% Change: 2010 - 2015:			+4%	+8%
All Categories	**% Change: 2005 - 2015:**	**-2%**	**+14%**	**+6924%**	**-7.4%**
	% Change: 2010 - 2015:	**+2%**	**-1%**	**+4%**	**-8.4%**

The overall decrease in buildings, facilities, public lighting and utilities sector emissions between 2010 and 2015 was driven by a 17% decrease in electricity emissions, a 7% decrease in facilities public lighting electricity emissions, and a 1% decrease in natural gas emissions. Despite the increase in facilities and public lighting electricity consumption, emissions associated with this electricity consumption declined due to a lower emission factor for electricity.

Accounting for Fuel Cells in this Inventory:

In 2014, the County installed fuel cells at several facilities. These fuel cells convert natural gas to electricity through an electrochemical reaction. The ICLEI Local Government Operations Protocol (LGOP) is the industry standard for municipal operations GHG inventories and requires local governments to apply an emission factor to fossil fuel (e.g. natural gas) consumption. However, in the context of fuel cells, the methodology outlined by the LGOP differs from the California Public Utilities Commission (CPUC) findings and decisions on the emissions impacts of fuel cells in California. As a result, a combination of methodologies and data sources based on CPUC findings and decisions and input from County of Santa Clara were used to report emissions associated with the fuel cells.

The fuel cells were partially funded by the CPUC Self-Generation Incentive Program (SGIP). The SGIP provides incentives to support existing, new, and emerging distributed energy resources that are determined by the CPUC to have a net greenhouse gas emissions reduction in California. At the time the fuel cells were installed, the CPUC had determined that the SGIP should compare a threshold emission factor of 379 kg CO2/MWh (835.6 lbs CO2/MWh) against the low end emissions factor of a given technology to determine that technology's eligibility for incentives.[1] The model of Bloom Energy fuel cells installed at County facilities have a low end emissions factor of 735 lbs CO2/MWh, which qualified them for SGIP rebates.[2] The fuel cells produced 21,367.224 MWh of electricity in 2015. Table 4 below calculates the greenhouse gas emissions reduction impact of the County's fuel cells using the CPUC's SGIP methodology.

Table 4: Calculating Emissions Avoided from the County's Fuel Cells Using the CPUC SGIP Methodology

Description of Emission Factor Used	Emission Factor (lbs CO2/MWh)	Emission Factor (MT CO2/MWh)	2015 Electricity Generated (MWh)	2015 Emissions (MT CO2)
SGIP Eligibility Emission Factor	835.6	0.379	21,367.224	8,098.2
Fuel Cell Manufacturer's Low-end Emission Factor	735.0	0.333	21,367.224	7,123.6
Reduction in Emissions from Fuel Cells:				**-974.6**

The LGOP requires that a utility-specific grid average emission factor be applied to electricity purchased from that utility. Thus, if the electricity produced by the fuel cells in 2015 (21,367.224 MWh) was instead purchased from PG&E, the PG&E 2015 emission factor (404.51 lbs CO_2/MWh) would have been applied to that electricity consumption to calculate emissions associated with the electricity (3,920.5 MT CO2). Based on the CPUC finding that utilizing fuel

[1] See page 3 of CPUC "Decision Modifying the Self-Generation Incentive Program and Implementing Senate Bill 412" http://docs.cpuc.ca.gov/WORD_PDF/FINAL_DECISION/143459.PDF

[2] See Bloom Energy ES-5700 Energy Server Data Sheet http://www.bloomenergy.com/fuel-cell/es-5700-data-sheet/

cells has a net emissions reduction in California and input from County of Santa Clara, the reduction in emissions from fuel cells in 2015 from Table 4 above (-974.6 MT CO_2) was applied to the emissions that would have resulted if the electricity produced by the fuel cells was instead purchased from PG&E. See Table 5 below.

Table 5: Emissions Attributed to the County's Fuel Cells in this Inventory

Description of Emission Factor Used	Emission Factor (lbs CO2/MWh)	Emission Factor (MT CO2/MWh)	2015 Electricity Generated (MWh)	2015 Emissions (MT CO2)
PG&E Grid Average Emission Factor	404.51	0.183	21,367.224	3,920.5
Reduction in Emissions from Fuel Cells:				**-974.6**
Emissions Attributed to Fuel Cell in this Inventory:				**2,945.9**

3.2 Employee Commute Sector

As summarized in Table 6 below, emissions in the employee commute sector increased 25% from 2010 to 2015. The employee commute sector made up 44% of the County's total emissions in 2015.

Table 6: Employee commute sector consumption and emissions– 2010 - 2015

Year	Distance Driven (miles)	Diesel Consumption (gal)	Gasoline Consumption (gal)	E85 Consumption (gal)	Total Commute Emissions (MT CO2e)
2010	93,391,727	61,254	4,380,670	3,125	39,774
2015	148,159,643	124,531	5,364,157	6,959	49,892
% Change: 2010 -2015	**+59%**	**+103%**	**+22%**	**+123%**	**+25%**

The overall increase in employee commute emissions was driven by a 27% increase in County employees and a 59% increase in the total distance driven by employees commuting to work. The increase in distance driven was partially offset by a 21% increase in the efficiency of the vehicles employees drove to work.

3.3 Vehicle Fleet Sector

As summarized in Table 7 below, emissions in the vehicle fleet sector decreased 2% from 2010 to 2015. The vehicle fleet sector made up 7.5% of the County's total municipal operations emissions in 2015.

Table 7: Vehicle fleet sector consumption and emissions– 2010 - 2015

Year	Diesel Consumption (gal)	Gasoline Consumption (gal)	E85 Consumption (gal)	CNG Consumption (GGE)	Total Fleet Emissions (MT CO2e)
2010	107,518	833,694	0	219	8,596
2015	124,229	794,203	25	2,446	8,4428
% Change: 2010 -2015	**+16%**	**-5%**	**N/A**	**1016%**	**-2%**

The overall decrease in vehicle fleet sector emissions was driven by a 5% decrease in the amount of gasoline consumed by the vehicle fleet. Between 2010 and 2015, many gasoline powered vehicles were replaced with compressed natural gas (CNG) powered vehicles. This transition to CNG is partially responsible for the decrease in gasoline consumption.

3.4 Reimbursed Employee Miles Sector

As summarized in Table 8 below, emissions in the reimbursed employee miles sector decreased 52% from 2005 to 2015 and decreased 20% from 2010 to 2015. The reimbursed employee miles sector made up 0.7% of the County's total municipal operations emissions in 2015.

Table 8: Reimbursed employee miles sector consumption and emissions – 2005 - 2015

Year	Distance Travelled (miles)	Emissions (MT CO2e)
2005	3,187,166	1,596
2010	2,436,063	951
2015	2,271,773	765
% Change: 2005 -2015	**-29%**	**-52%**
% Change: 2010 -2015	**-7%**	**-20%**

The overall decrease in reimbursed employee miles sector emissions between 2010 and 2015 was driven by a 7% decrease in the reimbursed distance travelled by County employees and a 14% increase in the efficiency of the personal vehicles employees drive for work purposes.

3.5 Solid Waste Sector

As summarized in Table 9 below, emissions in the solid waste sector decreased 38% between 2005 and 2015 and decreased 53% between 2010 and 2015. The solid waste sector made up 1.2% of the County's total municipal operations emissions in 2015.

Table 9: Solid waste sector consumption and emissions – 2005-2015

Year	Waste Landfilled (Tons)	Emissions (MT CO2e)
2005	8,701	2,207
2010	5,844	2,892
2015	2,773	1,372
% Change: 2005 -2015	**-68%**	**-38%**
% Change: 2010 -2015	**-53%**	**-53%**

The 53% decrease in solid waste sector emissions between 2010 and 2015 is directly correlated with a 53% decrease in solid waste landfilled. The decrease in landfilled waste in 2015 was due to increased recycling and compositing efforts, a result of the Board of Supervisor's zero waste goals and program implementation.

3.6 Closed Landfills Sector

As summarized in Table 10 below, emissions in the closed landfills sector decreased 76% between 2005 and 2015 and decreased 67% between 2010 and 2015. The closed landfills sector made up 0.1% of the County's total municipal operations emissions in 2015.

Table 10: Closed landfills sector consumption and emissions – 2005-2015

Year	Landfill Gas Collected (cubic feet)	Emissions (MT CO2e)
2005	10,360,000	645
2010	5,365,2016	466
2015	1,778,700	155
% Change: 2005 -2015	**-83%**	**-76%**
% Change: 2010 -2015	**-67%**	**-67%**

The 67% decrease in closed landfill sector emissions between 2010 and 2015 is directly correlated with a 67% decrease in landfill gas collected at closed landfills.

4 RECOMMENDATIONS FOR HELPING FACILITIES AND FLEET DEPARTMENT PRIORITIZE FUTURE PROJECTS

Given the County's commitment to reducing emissions, it is important that the County of Santa Clara continue to implement projects that are focused on achieving this goal. The municipal operations inventory provides valuable information on how emissions in all sectors are trending and what percent of total municipal operations emissions these sectors represented in 2015. Below, potential emissions reduction strategies to be prioritized by FAF in key areas are highlighted.

4.1 Employee Commute

Employee commute emissions have increased 25% between 2010 and 2015 and made up 44% of total employee commute emissions in 2015. In 2017, Arup conducted a "Transportation Demand Management" study focused on the Santa Clara County Civic Center to better understand employee commute patterns and identify strategies to address employee commute emissions.

DNV GL recommends that FAF prioritize the "near-term" strategies outlined in the Arup study. The near-term measures can be implemented quickly and, thus, have an immediate positive impact on reducing employee commute emissions.

Table 11: Near-term transportation demand management (TDM) strategies from Arup study

Program Focus	Program Type	Program
Transit	Financial Incentive	Caltrain Go Pass/commuter checks
Carpool/Vanpool	Financial Incentive	Gas card for carpoolers
Carpool/Vanpool	Financial Incentive	Carpool incentives
Carpool/Vanpool	Financial Incentive	Free vanpools
Bike	Amenity	Elockers for bike commuters' clothes
Bike	Amenity	Increase bike & commuter lockers on site
Bike	Site Design	Bicycle parking
Bike	Financial Incentive	Bay Area Bike Share subsidy
Support	Financial Incentive	Parking pricing
Support	Financial Incentive	Parking cashout
Support	Financial Incentive	Subsidized carshare memberships
Support	Service	TDM manager/marketing
Support	Financial Incentive	Transportation allowance program
Support	Financial Incentive	Pre-tax commuter benefits

Since the Arup study has been completed, the County has taken the critical step of hiring a Transportation Demand Manager. Having a full-time staff member dedicated to implementing transportation demand management (TDM) measures is vital to the success efforts to reduce employee commute emissions.

Among the above programs, DNV GL would strongly recommend implementing the parking cashout program. Providing free parking to employees is a major barrier to shifting commute patterns away from single-occupancy vehicle (SOV) commuting. Parking cashout programs benefit employees because they allow employees to choose whether or not to continue driving alone. Cashout programs are often perceived as fair since they do not force employees to stop driving or give up free parking, but those who do are rewarded financially. The employee commute survey indicated that the percent of employees carpooling decreased slightly between 2010 (10%) and 2015 (9%). Additionally, the survey indicated that the percent of employees who use public transportation or active modes of transportation decreased between 2010 (9%) and 2015 (6%). Establishing a parking cashout would be an effective strategy to help reverse these trends. If a parking cashout program were implemented, the County could monitor the effectiveness of the program by administering an annual or bi-annual employee commute survey. Using the employee commute survey data, the County could compare the percent of SOV commuters before and after the implementation of the cashout program. The survey could also explicitly ask employees questions such as "Since the parking cashout program has been implemented, how many less times per week do you drive to work alone?"

The Arup study indicated that 24% of County employees live within a 30-minute bicycle commute to the Civic Center. Given the low percentage of employees using public transportation or active modes of transportation in 2015 (6%), there is significant room to improve on the number of employees that commute to work via bicycle. Another program that DNV GL would strongly recommend is increasing the amount of secure bicycle parking available at County facilities and updated bicycle lane infrastructure, such as protected bike lanes buffered by parked vehicles.

- **Bicycle parking.** One of the largest barriers to bicycle commuting is limited availability of parking locations and concern among riders that their bicycle will be subject to theft if left at an outdoor bike rack. Providing secured bike lockers or indoor bike parking could significantly reduce these major barriers to bicycle commuting.

- **Protected bike lanes.** In January 2018, City of Berkeley christened two protected bike lanes in key corridors in the City. The complete street projects features bus-boarding islands and piggy-backed on an existing paving project. DNV GL recommends the County continue its efforts to work with local cities to improve bike lane infrastructure, especially in key corridors to County facilities.

4.2 Electricity Supply

Despite a 27% decrease in the PG&E electricity emission factor from 2005 to 2015, electricity emissions continue to account for a significant portion of total municipal operations emissions. In 2015, electricity emissions made up 19.4% of total emissions. To date, the County has primarily relied on PG&E for the provision of electricity. However, with the recent emergence of community choice aggregators (CCAs) Silicon Valley Clean Energy (SVCE) and San José Clean Energy (SJCE), the County now has alternatives avenues for increasing the renewable content of purchased grid electricity. SVCE has already launched service and SJCE plans to launch service in spring of 2018. Based on 2015 data, almost all grid electricity purchases occur either in future SJCE territory (89.7%) or current SVCE territory (10.2%).

DNV GL strongly recommends procuring the highest content renewable grid electricity as quickly as feasible. SVCE is currently offering a GreenPrime 100% renewable energy supply option and SJCE also plans to offer a 100% renewable energy supply option. Additionally, PG&E's Solar Choice program also offers a 100% renewable energy supply option. By transitioning to 100% renewable energy through these electricity providers, the County has the potential to reduce total municipal operations emissions nearly 20% in a very short period of time.

4.3 Buildings and Facilities

The County has been a leader in reducing energy and emissions in its government buildings and facilities, including solar photovoltaic (PV) at 8 County facilities, energy efficiency audits and implementation of energy upgrades across its portfolio of buildings.

DNV GL recommends consideration of other innovative policies and initiatives to reduce emissions in buildings and facilities, including:

- **Setting a zero net energy policy for new County buildings.** While the County has been a green building leader, some jurisdictions are looking ahead to requiring new government buildings to achieve zero net energy performance (where all energy usage is offset by on-site emission-free renewable generation such as solar PV). Examples from other local governments include:
    - County of San Mateo now requires all new county buildings to be ZNE
    - County of San Diego requires all new county buildings to be ZNE
    - City of Hayward requires all new and existing municipal building stock to be ZNE by 2025
- **Electrification of building end uses.** As carbon-neutral electricity sources through community choice aggregation (CCA) and PG&E becomes increasing available, many jurisdictions are exploring opportunities to shift from natural gas usage to electricity. In

particular, DNV GL recommends the County explore opportunities for retrofitting with heat pump technologies when replacing water heaters, as well as heat pump capability on all new rooftop packaged HVAC systems.

- **Continue leadership on energy efficiency and retrofits.** DNV GL recommends that the County continue to implement energy efficiency upgrades in its buildings and facilities. High impact measures tend to include LED lighting, high efficiency HVAC retrofits, retrocommissioning and solar thermal for facilities with high hot water usage (e.g., hospitals, corrections facilities, swimming pools).

4.4 Solid Waste

In 2011, the County adopted a zero-waste event policy for county-sponsored events. DNV GL recommends evaluating how well the policy is working and awareness of the policy. A few additional ideas are provided below to further the County's waste reduction goals including:

- **Setting a zero waste goal for all County operations.** Many local jurisidictions are adopting zero waste targets including:
    - City of Palo Alto - Citywide zero waste goal of 90% diversion rate by 2021
    - City of Santa Monica - Adopted a zero waste goal of 95% diversion by 2030
- **Prohibit the sale or distribution of plastic water bottles for County operations.** DNV GL recommends a policy to ban providing disposable bottles of water as part of County operations, meetings and events. The County should encourage individuals to bring their own reusable canteens and nalgenes, by providing appropriate water bottle refilling stations at water fountains and large water jugs at public events.
    - City of Sunnyvale – bans the distribution and sale of single-use plastic water bottles at City permitted events and meetings.
    - City of San Francisco – prohibits the sale of plastic water bottles on city-owned properties.

5 CONCLUSION

The County has adopted ambitious GHG reduction targets to reduce emissions by 10% every 5 years from 2010 – 2050, with an overall reduction of 80% by 2050. This inventory report provides an important update that shows a slight increase in emissions, due to a significant increase in employee commuting. Recommendations are provided in the report on key areas to focus on and potential strategies for reducing emissions to meet the County's climate goals.

Appendix A INVENTORY METHODOLOGY

The 2015 municipal operations inventory primarily follows LGOP recommended methodologies and uses the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) 100-year without climate-carbon feedbacks global warming potentials (GWPs).[3]

A.1 Buildings, Facilities, Public Lighting and Utilities Sector

A.1.1 Building Energy

Activity Data:

2015 municipal operations natural gas and electricity consumption data was obtained through PG&E's Green Community website.[4] Data on electricity consumption at County owned facilities served by the City of Palo Alto Utilities and data on electricity generated by fuel cells and solar PV systems was provided by the County.[5]

Methodology:

Accounts associated with buildings and facilities were pulled from the PG&E Green Community data and the City of Palo Alto Utilities data and grouped into the building energy subsector. The full list of accounts was reviewed with County staff to determine that all accounts were both owned by the County and belonged in the buildings and facilities subsector.

Emission Factors:

This inventory uses The Climate Registry (TCR) natural gas emission factor of 0.00531 MT CO_2/therm[6], a PG&E-specific electricity emission factor of 0.000183 MT CO_2/kWh[7] and a City of Palo Alto Utilities-specific electricity emission factor of 0.0 MT CO_2/kWh[8]. See Section 3.1 of this report for a full description of the methodology used to calculate emissions associated with fuel cells.

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[3] Greenhouse Gas Protocol, "Global Warming Potentials"
www.ghgprotocol.org/sites/default/files/ghgp/Global-Warming-Potential-Values%20%28Feb%2016%202016%29_1.pdf

[4] PG&E Energy Watch Partnerships
www.pge.com/en_US/business/save-energy-money/contractors-and-programs/community-partnerships/community-partners.page

[5] Fuel cells and solar PV electricity generation data provided by the County of Santa Clara.

[6] The Climate Registry, Table 12.1 U.S. Default Factors for Calculating CO_2 Emissions from Fossil Fuel and Biomass Combustion
www.theclimateregistry.org/wp-content/uploads/2016/03/2015-TCR-Default-EFs.pdf

[7] 2015 PG&E The Climate Registry Electric Power Sector Report 1.2
www.theclimateregistry.org/tools-resources/reporting-protocols/general-reporting-protocol/

[8] City of Palo Alto, Electric Renewable Resources
http://www.cityofpaloalto.org/gov/depts/utl/residents/resources/pcm/default.asp

A.1.2 Refrigerants

Activity Data:

Data on stationary equipment refrigerant consumed and type of refrigerant was provided by the County.[9]

Methodology & Emission Factors:

Based on the way the refrigerant data is collected by the County, it was not possible to determine the exact amount of refrigerant consumption in calendar year 2015. However, it was possible to determine the total refrigerant consumed from January 2010 to April 2017 (7.2 years). This inventory assumes the refrigerant consumption in 2015 matched the average annual refrigerant consumption per year from January 2010 to April 2017. Emissions were calculated using the above consumption inputs and global warming potential of various refrigerants are from table E.2 of the LGOP.

A.1.3 Public Lighting

Activity Data:

2015 municipal operations electricity consumption data was obtained through PG&E's Green Community website.[10]

Methodology:

Accounts associated with public lighting were pulled from the PG&E Green Community data and grouped into the public lighting subsector. The full list of accounts was reviewed with County staff to determine that all accounts were both owned by the County and belonged in the public lighting subsector.

Emission Factors:

This inventory uses a PG&E-specific electricity emission factor of 0.000183 MT CO2/kWh and a City of Palo Alto Utilities emission factor of 0.0 MT CO2/kWh.

[9] Refrigerant data provided by Frank Lima, HVAC Mechanic, County of Santa Clara.

[10] PG&E Energy Watch Partnerships
www.pge.com/en_US/business/save-energy-money/contractors-and-programs/community-partnerships/community-partners.page

A.2 Employee Commute Sector

Activity Data:

An online survey was provided to County employees from Jun 15, 2017 to July 7, 2017 to collect data on County employee commute habits. Data on distance commuted to work and mode of transportation used to commute to work was collected. If applicable, data on vehicle make, model, fuel efficiency and fuel type was also collected. Employees were asked to provide information on how the commuted to work in the seven days that made up the prior week. Because an employee commute was not conducted in 2015 and it is too challenging to ask employees to recall how they commuted to work in a given week in 2015, the 2017 employee commute survey data was used as a proxy for 2015 employee commute data.

Methodology:

Some survey respondents did not provide data on vehicle make, model, fuel efficiency and fuel type. It was assumed that these survey respondents had, on average, the same mix of vehicles (fuel type, fuel efficiency) as those indicated by survey respondents who did provide this information. In order to remain consistent with the employee commute methodology used in the 2010 inventory, it was assumed the average employee travels round trip to work 219.2 times per year.

Emission Factors:

Emission factors for most fuels (biodiesel, compressed natural gas, diesel, ethanol and gasoline) used to calculate employee commute emissions are from the U.S. Energy Information Administration.[11] Gasoline and diesel CH4 and N2O emission factors used to calculate employee commute emissions are from the The Climate Registry.[12] The PG&E-specific electricity emission factor was used to calculate emissions associated with electric vehicles.

A.3 Vehicle Fleet Sector

Activity Data:

Data on individual vehicle fleet fueling events were provided by the County.[13]

[11] U.S. Energy Information Association, "Carbon Dioxide Coefficients" www.eia.gov/environment/emissions/co2_vol_mass.php

[12] The Climate Registry Genera Reporting Protocol, Version 2.0 https://www.scsglobalservices.com/files/tcr_grp_version_2.0_032913.pdf

[13] Data on vehicle fleet fueling events provided by Bernice Smith, Administrative Support Officer, County of Santa Clara

Methodology:

The vehicle fleet fueling event data was group into two categories, "assigned vehicles" and "Roads and Airports" vehicles. This inventory includes fueling events from both sets of data.

Emission Factors:

Emission factors for all fuels (diesel, compressed natural gas, ethanol and gasoline) used to calculate vehicle fleet emissions are from the U.S. Energy Information Administration.[14] Gasoline and diesel CH4 and N2O emission factors used to calculate employee commute emissions are from the The Climate Registry.[15]

A.4 Reimbursed Employee Miles Sector

Activity Data:

Data on individual transactions of reimbursement amounts received by employees for mileage in personal vehicles and the standard reimbursement rate of $0.575 per mile used by the County in 2015 was provided by the County.[16]

Methodology:

Reimbursement amounts ($) and the reimbursement rate ($/mile) were used to calculate the total employee reimbursed mileage in 2015. Because data on the fuel efficiencies and fuel types of vehicles used by employees during business travel were not available, it was assumed that the fuel efficiencies and fuel types of vehicles used for reimbursed business travel were the same as vehicles used by employees to commute to work. Thus, the fuel efficiency and fuel type data from the employee commute survey was applied to convert the total reimbursed mileage data into volumes of each fuel type consumed.

Emission Factors:

Emission factors for most fuels (biodiesel, compressed natural gas, diesel, ethanol and gasoline) used to calculate reimbursed mileage emissions are from the U.S. Energy Information Administration.[17] Gasoline and diesel CH4 and N2O emission factors used to calculate reimbursed mileage emissions are from the The Climate Registry.[18] The PG&E-specific electricity emission factor was used to calculate emissions associated with electric vehicles.

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[14] U.S. Energy Information Association, "Carbon Dioxide Coefficients" www.eia.gov/environment/emissions/co2_vol_mass.php

[15] The Climate Registry Genera Reporting Protocol, Version 2.0 https://www.scsglobalservices.com/files/tcr_grp_version_2.0_032913.pdf

[16] Data on employee mileage reimbursement amounts provided by Joanne Yee, Sustainability Analyst, County of Santa Clara

[17] U.S. Energy Information Association, "Carbon Dioxide Coefficients" www.eia.gov/environment/emissions/co2_vol_mass.php

[18] The Climate Registry Genera Reporting Protocol, Version 2.0

A.5 Solid Waste Sector

Activity Data:

Data on the type and volume or weight of waste collected was provided by the County.[19] In some cases, in order to convert volume of waste landfilled to weight of waste landfilled, a waste volume to weight conversion factor provided by waste haulers was used.[20] Data on waste composition is from CalRecycle's 2014 Disposal-Facility-Based Characterization of Solid Waste in California.[21]

Methodology & Emission Factors:

The LGOP recommends the use of the methane commitment method for estimating emissions from waste sent to landfills. The latest version of the LGOP was published in 2010 and recommends the use of ICLEI's methane commitment model contained within their Clean Air and Climate Protection (CACP) 2009 software. Because CACP is no longer in existence, this inventory relies on the methane commitment method detailed in the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC). The methane commitment method recommended by the LGOP and GPC is consistent in approach. The below explanation refers to equations from the GPC because the step-by-step process is fully spelled out in the GPC, whereas the LGOP relies on a model that is no longer used by cities.

Once the total mass of waste sent to landfill was determined, the methane commitment method for waste emissions was applied to the total landfilled waste to estimate emissions. Tonnages of disposed waste sent to landfills and waste composition were input into GPC equations 8.1, 8.3 and 8.4 to calculate CH4 emissions associated with disposed waste. For equation 8.1, the default carbon content values were used. For equation 8.3, the default fraction of methane recovered in landfill was used and an oxidation factor of 0.1 was selected because the landfills the County sends waste to are managed. For equation 8.4, default values for the fraction of degradable organic carbon degraded and the fraction of methane in landfill gas were used. A methane correction factor of 1.00 was used because the landfills the County sends waste to are actively managed.

https://www.scsglobalservices.com/files/tcr_grp_version_2.0_032913.pdf

[19] Solid waste data provided by Joanne Yee, Sustainability Analyst, County of Santa Clara

[20] CalRecycle Solid Waste Characterization Home
www2.calrecycle.ca.gov/WasteCharacterization/

[21] See Table ES-3 "Composition of California's Overall Disposed Waste Stream by Material Type".
www.calrecycle.ca.gov/publications/Documents/1546/20151546.pdf

A.6 Closed Landfills Sector

Activity Data:

Data on blower annual capture runtime (hours) and blower rate (cubic feet per minute) at Hellyer Landfill were provided by the County.[22]

Methodology & Emission Factors:

The methodology used to calculate closed landfill emissions in the 2010 inventory was from the Bay Area Air Quality Management District (BAAQMD) closed landfill emissions calculator tool. Because this methodology is generally consistent with Section 9.3.2 of the LGOP, it was also used to calculate closed landfill emissions in this inventory. Methane and nitrous oxide emission factors (lbs./MCF landfill gas collected) used in the BAAQMD methodology were provided directly by BAAQMD.

[22] Annual capture runtime and blower rate at Hellyer Landfill provided by Jason Gorman, Senior Park Maintenance Worker, County of Santa Clara

Appendix B ADJUSTMENTS TO 2010 INVENTORY

One of the inherent challenges with GHG inventories is that inventory protocols and methodologies are constantly evolving. Additionally, GWPs of CH4 and N2O are also changing with each new Assessment Report released by the IPCC. These two variables can make comparisons between past and current inventories challenging.

GWP is a relative measure of how much heat a greenhouse gas traps in the atmosphere. It compares the amount of heat trapped by a certain mass of the gas in question to the amount of heat trapped by a similar mass of CO2. The County's original 2010 municipal operations inventory used GWP values from the IPCC Second Assessment Report (SAR), GWP values that were commonly used when the 2010 inventory was completed. However, in 2014, AR5 was released. Between the SAR and AR5 the GWP of CH4 increased from 21 to 28 and the GWP of N2O decreased from 310 to 265. In order to make "apples-to-apples" comparisons between the 2010 and 2015 municipal operations inventories and accurately track the County's emissions reduction progress, it was necessary to revise the 2010 emissions to match the methodology and GWPs used in the 2015 inventory. Table 12 below compares the original 2010 and revised 2010 municipal operations inventories. Overall, the revised methodology decreased the total estimated 2010 municipal operations emissions from 111,166 MT CO2e to 109,819 MT CO2e.

Table 12: Municipal operations emissions – 2010 original vs. 2010 revised

Sector/Subsector	2010 Original Emissions (MT CO_2e/yr)	2010 Revised Emissions (MT CO_2e/yr)	Percent Change
Buildings, Facilities, Public Lighting and Utilities	57,740	57,140	-1.0%
Facilities Energy: Excluding Public Lighting	56,392	55,634	-1.3%
Public Lighting	456	613	+34.4%
Refrigerants	892	892	0.0%
Employee Commute	39,774	39,774	0.0%
Vehicle Fleet	9,466	8,596	-9.2%
Reimbursed Employee Miles	951	951	0.0%
Solid Waste	2,885	2,892	+0.2%
Closed Landfills	350	466	+33.2%
Total	**111,166**	**109,819**	**-1.2%**

Sector-by-sector adjustments to 2010 community-wide inventory

The buildings, facilities, public lighting and utilities sector, vehicle fleet sector, solid waste sector and closed landfills sector were adjusted in the revised 2010 municipal operations inventory. A summary of adjustments by sector is provided below:

- **Buildings, Facilities, Public Lighting and Utilities:** The original 2010 inventory relied heavily on energy data from a County data management platform called the Utility Data Management System (UDMS). The UDMS is no longer functional, so 2015 energy consumption data could not be pulled from this platform. In addition, data inconsistencies were observed when the 2010 UDMS data was compared to the 2015 PG&E Green Communities data. As a result, it was decided to rely on the PG&E Green Communities data for both the 2015 inventory and the revised 2010 inventory.

- **Vehicle Fleet:** The original 2010 inventory relied on a methodology that used the known vehicle fleet miles travelled and converted miles travelled to volume of fuel consumed by applying generic vehicle efficiencies provided by the EPA. This methodology was used because at the time the original 2010 inventory was completed, the County had not yet set up the system that automatically records individual fueling events. Data inconsistencies were observed when the 2010 vehicle fleet estimated fuel consumption data was compared to the 2015 vehicle fleet fuel consumption data. As a result, it was decided to rely on the County system that automatically records individual fueling events for both the 2015 inventory and the revised 2010 inventory. Because calendar year 2010 data was not available through the County's system, July 2010 – June 2011 fueling data was used as a proxy.

- **Solid Waste:** There are two generally acceptable methods for estimating waste emissions - the methane commitment method and the first order of decay (FOD) method. The methane commitment method allocates emissions based on the quantity of waste disposed during the inventory year, while the FOD method allocates emissions based on the quantity of waste disposed during the inventory year as well as existing waste in landfills. The original 2010 inventory used the FOD method to estimate waste emissions. However, after discussion with County staff, it was decided that the 2015 inventory should use the methane commitment method because emissions associated with the methane commitment method are more closely linked to current waste practices, rather than waste historically sent to landfills. As a result, the 2010 inventory was revised to estimate waste emissions using the methane commitment method. Additionally, 2010 waste emissions were adjusted to account for the updated AR5 GWP of CH_4, opposed to the SAR GWP originally used.

- **Closed Landfills:** 2010 closed landfills emissions were adjusted to account for the updated AR5 GWP of CH_4, opposed to the SAR GWP originally used.

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