City of Oakley

2010 Community-Wide & Local Government Operations Greenhouse Gas Emissions Inventory Update

Photo Credit: City of Oakley

Final Report

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Credits and Acknowledgements

Oakley

Bryan Montgomery, City Manager
Ken Strelo, Senior Planner, Planning Division
Paul Abelson, Finance Director, Finance Department
Jeff Billeci, Assistant to Chief of Police, Police Department
Keith Coggins, Engineering Development Manager, Engineering Department
Len Morrow, Park & Landscape Manager, Public Works Department
Christine Keller, Administrative Assistant

Quantum Energy Services and Technologies, Inc.

Elena Olmedo, Sustainability Specialist
Tim Bankroff, Program Manager

Pacific Gas and Electric Company (PG&E)

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ICLEI-Local Governments for Sustainability USA

Amruta Sudhalkar, Program Officer
J.R. Killigrew, Program Associate
Brian Holland, Climate Program Director

This report was prepared by Elena Olmedo, Sustainability Specialist at Quantum Energy Services and Technologies, Inc. (QUEST). The author would like to thank Oakley staff for providing much of the insight and local information necessary for the completion of this report.

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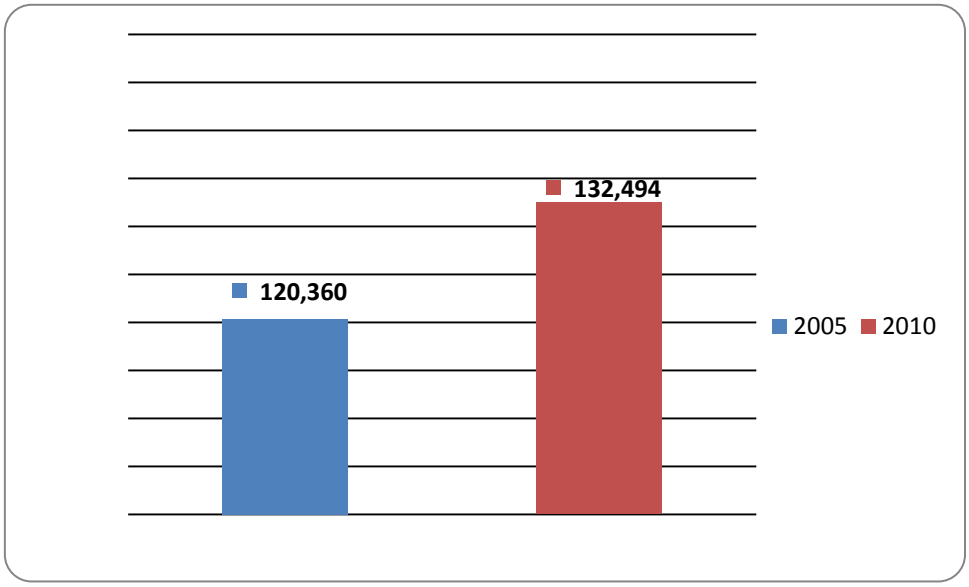
Executive Summary

The City of Oakley recognizes that greenhouse gas (GHG) emissions from human activity are catalyzing profound climate change, the consequences of which pose substantial risks to the future health, well-being, and prosperity of our community. Furthermore, the City of Oakley has multiple opportunities to benefit from quick action to reduce community GHG emissions. The City of Oakley, with the assistance of PG&E, ICLEI, and ABAG produced a baseline community and local government operations inventory for 2005. The baseline inventory was conducted to assess greenhouse gas emissions from Oakley's local government operations and community wide activity.

This inventory report provides an update of baseline emissions for the community and the local government using 2010 as the inventory year. The inventory update is important because it provides a metric of progress illustrating how emissions have changed since the 2005 baseline. It is also useful in identifying areas where local action can have a significant impact, and shows where the City is in terms of meeting its reduction goal. This report will compare the 2005 baseline inventory to the 2010 update inventory in two sections: the community-wide inventory results and the local government operations inventory results; with the local government operations inventory as a subset of the community inventory. The 2005 local government operations inventory concluded that Oakley's local government was responsible for 764 metric tons of CO_2e. The 2005 community inventory reported that Oakley as a whole city caused 120,360 metric tons of CO_2e. This report found that the total emissions attributed to the community for 2010 were 132,494 metric tons of CO_2e and 752 metric tons of CO_2e for the local government. While the community emissions figure appears to have increased from the baseline emissions, further analysis is needed to compare both inventories equally.

Figure 1: Oakley Community GHG Emissions Comparison

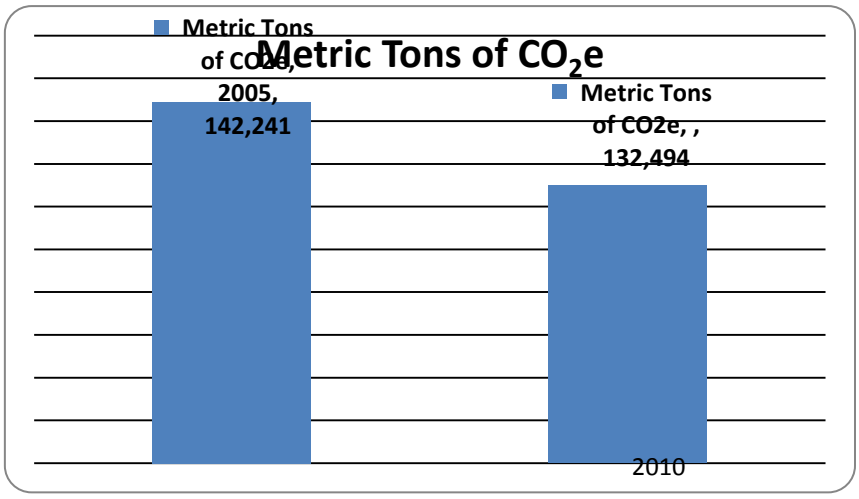


Key Findings

At first glance, it appears community emissions have increased by 10 percent between 2005 and 2010 (120,360 against 132,494 metric tons respectively). However, given a couple variations in methodology, this figure represents the inventories equivocally. For instance, the Transportation Sector originally showed an increase in emissions (63,637 against 75,377). This can be explained by the fact that off-road vehicles[1] (which accounted for 22,517 metric tons of CO_2e in 2010) were not included as a subsector within the Transportation Sector in the 2005 community inventory. As a result, transportation emissions appear to have increased by 18%. However, if we compare subsectors equally, they actually decreased by 14 percent. Another difference between the inventories is that emissions from wastewater treatment, which accounted for 151 metric tons of CO_2e in 2010, were not included in the baseline (2005) inventory. In order to analyze how emissions have changed between inventory years, it is necessary to include the same sectors and subsectors in the comparison. If adjustments are made to the 2005 inventory to include emissions from off road vehicles in the Transportation Sector (based on the 2010 emissions figure), and emissions from wastewater treatment (based on the 2010 emissions figure) as shown in Figure 2, overall emissions in Oakley actually decreased by 7 percent.

There was a reasonable increase in emissions from electricity and natural gas use in the residential sector between 2005 and 2010 (38,011 against 42,707 metric tons of CO_2e)[2] given the population growth. The Commercial/Industrial Sector noticed a larger increase in emissions from electricity and natural gas use (7,933 against 11,061 metric tons of CO_2e)[3]. Although emissions from wastewater treatment were not analyzed in the baseline inventory (2005), they have been added to the 2005 inventory for the purpose of comparing both inventories equally. The Solid Waste Sector saw the biggest downward trend proportionally between 2005 and 2010, with a decrease of 68%.

Figure 2: Oakley Community-Wide GHG Emissions Comparison with Adjustments



[1] Off-road vehicles refer to equipment used by the community such as agricultural equipment. A full list of equipment included in this subsector can be found in Appendix D.
[2] Emissions from the 2005 residential sector have been updated to reflect 2005 CO2e emissions data provided by PG&E. Previously, PG&E provided aggregate electricity data in terms of kWh & a coefficient was applied to calculate emissions.
[3] Emissions from the 2005 commercial sector have been updated to reflect 2005 CO2e emissions data provided by PG&E. Previously, PG&E provided aggregate electricity data in terms of kWh & a coefficient was applied to calculate emissions.

Climate Change Background

Naturally occurring gases dispersed in the atmosphere influence the Earth's climate by trapping solar radiation. This phenomenon is known as the greenhouse effect. Overwhelming evidence shows that human activities are increasing the concentration of greenhouse gases and changing the global climate. The most significant contributor is the burning of fossil fuels for transportation, electricity generation and other purposes, which introduces large amounts of carbon dioxide and other greenhouse gases into the atmosphere. Collectively, these gases intensify the natural greenhouse effect, causing global average surface and lower atmospheric temperatures to rise.

Evidence of Human-Caused Climate Change

There is overwhelming scientific consensus that the global climate is changing, and that human actions, primarily the burning of fossil fuels, are the main cause of those changes. The Intergovernmental Panel on Climate Change (IPCC) is the scientific body charged with bringing together the work of thousands of climate scientists. The IPCC's Fourth Assessment Report states that "warming of the climate system is unequivocal."[4] Furthermore, the report finds that "most of the observed increase in global average temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic GHG concentrations."

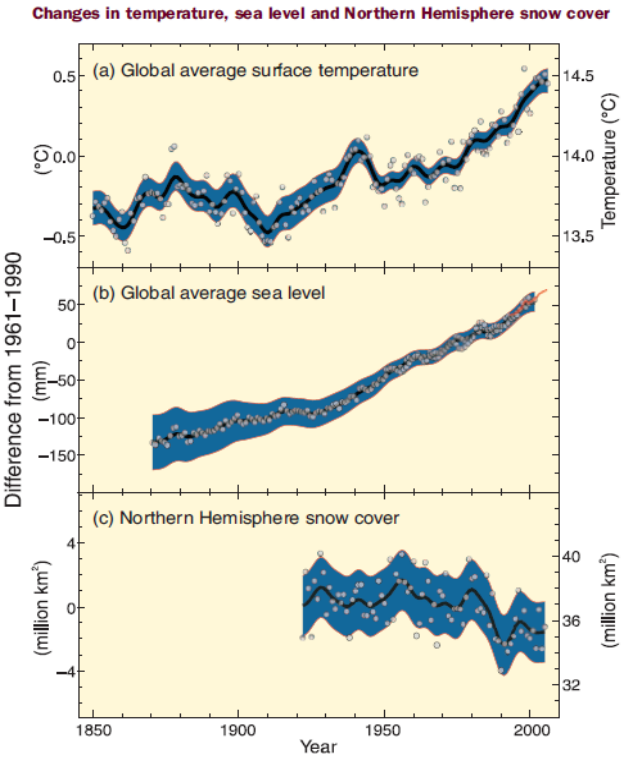


Figure 3: Observed changes in global temperature, sea level and snow cover.

Analysis released in January 2011 by NASA's Goddard Institute for Space Studies shows that global average surface temperatures in 2010 "tied" 2010 as the warmest on record (the difference is smaller than the uncertainty in comparing the temperatures of recent years).[5] The next hottest years, also with very close average temperatures, are 1998, 2002, 2003, 2006, 2007, and 2009. The period from January 2000 to December 2009 is the warmest decade on record, followed by the 1990's, then the 1980's respectively. The steady uptick in average temperatures is significant and expected to continue if action is not taken to greatly reduce greenhouse gas emissions.

[4] IPCC, 2007: Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland, 104 pp.

[5] Goddard Institute for Space Studies, "Research Finds 2010 Tied for Warmest Year on Record," 2011, 18 Jan. 2011, <http://www.nasa.gov/topics/earth/features/2010-warmest-year.html>.

Pacific Gas and Electric Company Supported Inventory Project

With the administrative support of Pacific Gas and Electric Company (PG&E) and funding from California utility customers under the auspices of the California Public Utilities Commission, QuEST was contracted to work with PG&E to assist in the quantification of greenhouse gas emissions in Oakley and the following other participating communities: Antioch, Brentwood, Moraga, Lafayette, Orinda, Pittsburg, and Pleasant Hill. With training resources and technical assistance provided by ICLEI, a nonprofit association of local governments, QuEST has prepared a full baseline community-wide and local government operations report for the City of Oakley.

ICLEI Local Governments for Sustainability Climate Mitigation Program

In response to the problem of climate change, many communities in the United States are taking responsibility for addressing emissions at the local level. Since many of the major sources of greenhouse gas emissions are directly or indirectly controlled through local policies, local governments have a strong role to play in reducing greenhouse gas emissions within their boundaries. Through proactive measures around land use patterns, transportation demand management, energy efficiency, green building, waste diversion, and more, local governments can dramatically reduce emissions in their communities. In addition, local governments are primarily responsible for the provision of emergency services and the mitigation of natural disaster impacts.

ICLEI – Local Governments for Sustainability (herewith known as "ICLEI") is an association for local governments to share knowledge and successful strategies toward increasing local sustainability.[6]

ICLEI provides a framework and methodology for local governments to identify and reduce greenhouse gas emissions, organized along Five Milestones:

1. Conduct an inventory and forecast of local greenhouse gas emissions;
2. Establish a greenhouse gas emissions reduction target;
3. Develop a climate action plan for achieving the emissions reduction target;
4. Implement the climate action plan; and,
5. Monitor and report on progress.

Sustainability & Climate Change Mitigation Activities in Oakley

The City of Oakley has already begun to address energy efficiency and other greenhouse gas reduction issues. The following climate change mitigation measures have been taken or are in process in the City of Oakley:

- The City implemented a recycling program throughout the community in conjunction with Oakley Disposal to facilitate disposal of recyclable such as green waste, plastic, glass, cardboard, and paper.

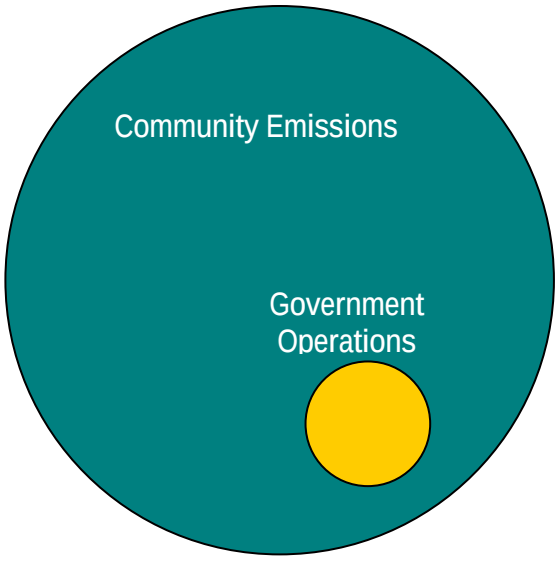
[6] ICLEI was formerly known as the International Council for Local Environmental Initiatives, but the name has been changed to ICLEI – Local Governments for Sustainability. http://www.iclei.org & http://www.icleiusa.org

- The City conducts a series of workshops on composting to educate the public about recycling organic materials and also provides discounted compost bins to the public.
- The City gives priority to and expedites Solar Photovoltaic Permit Submittals at no extra charge.
- The City has reduced Permit Fees by 50% for Energy Conserving Permits such as more efficient water heaters, skylights, dual pane window installations and HVAC change outs.
- The City installed energy-efficient LED streetlights for energy conservation
- The City completed a baseline 2005 community and local government operations greenhouse gas emissions inventory

Inventory Methodology

Understanding a Greenhouse Gas Emissions Inventory

The first step toward achieving tangible greenhouse gas emission reductions requires identifying baseline levels and sources of emissions in the community. As local governments have continued to join the climate protection movement, the need for a standardized approach to quantify GHG emissions has proven essential. Standard processes of accounting for emissions have been developed to which our inventory adheres. Oakley staff used the International Local Government GHG Emissions Analysis Protocol (IEAP) to inventory the City's community-wide emissions. In addition, methods from the Local Government Operations Protocol were used as appropriate for specific sectors.



Oakley has previously completed an inventory of emissions from government operations. The government operations inventory is a subset of the community inventory; for example, data on commercial energy use by the community includes energy consumed by local government buildings, and community vehicle-miles-traveled estimates include miles driven by local government fleet vehicles. The government operations inventory is in this way a subset of the community-scale inventory.

Community Emissions Protocol

The IEAP, developed by ICLEI, provides guidelines for local governments in quantifying greenhouse gas emissions from the community within their geopolitical boundaries. Staff used this protocol to inventory Oakley's community emissions. ICLEI began development of the IEAP with the inception of its Cities for Climate Protection Campaign in 1993, and through this work has established a common GHG emissions inventory protocol for all local governments worldwide.[7] In October 2012, ICLEI USA released the U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, a national standard designed to guide local governments in accounting for and reporting on greenhouse gases emissions within their community. This report however relies on the guidelines established in the IEAP and the LGOP, since the 2012 community protocol had not yet been finalized.

[7] International Local Government Greenhouse Gas Emissions Analysis Protocol (IEAP). ICLEI. http://www.iclei.org/index.php?id=ghgprotocol

Local Government Operations Protocol

In 2008, ICLEI, the California Air Resources Board (CARB), and the California Climate Action Registry (CCAR) released the LGO Protocol to serve as a national appendix to the IEAP.[8] The LGO Protocol serves as the national standard for quantifying and reporting greenhouse emissions from local government operations. The purpose of the LGO Protocol is to provide the principles, approach, methodology, and procedures needed to develop a local government operations greenhouse gas emissions inventory. The LGO Protocols also informs some methods used for community inventories.

Quantifying Greenhouse Gas Emissions

Emission Types

The IEAP and LGOP recommend assessing emissions from the six internationally recognized greenhouse gases regulated under the Kyoto Protocol as listed in Table 1, however, calculating emissions beyond the three main greenhouse gas emissions--carbon dioxide, methane, and nitrous oxide--can be difficult. Emissions of hydrofluorocarbons, perfluorocarbons, and sulfur hexaflouride are not included in this inventory because of the difficulty of obtaining data on these emissions at a community scale**.** Greenhouse gas emissions are commonly aggregated and reported in terms of equivalent carbon dioxide units, or CO_2e. This standard is based on the Global Warming Potential (GWP) of each gas, which is a measure of the amount of warming a greenhouse gas may cause, measured against the amount of warming caused by carbon dioxide. Converting all emissions to equivalent carbon dioxide units allows for the consideration of different greenhouse gases in comparable terms. For example, methane is twenty-one times more powerful than carbon dioxide in its warming effect, so one metric ton of methane emission is equal to 21 metric tons of carbon dioxide equivalents. See Table 1 for the GWPs of the commonly occurring greenhouse gases.

Table 1: Greenhouse Gases and Global Warming Potential

Greenhouse Gas	Chemical Formula	Global Warming Potential
Carbon Dioxide	CO2	1
Methane	CH4	21
Nitrous Oxide	N2O	310
Hydroflurocarbons	Various	3-11,700
Perfluorocarbons	Various	6,500-9,000
Sulfur Hexafluoride	SF6	23,900

[8] Local Government Operations Protocol (LGOP). http://www.icleiusa.org/programs/climate/ghg-protocol/ghg-protocol

Quantification Methods

Greenhouse gas emissions can be quantified in two ways:

- Measurement-based methodologies refer to the direct measurement of greenhouse gas emissions (from a monitoring system) emitted from a flue of a power plant, wastewater treatment plant, landfill, or industrial facility.[9]
- Calculation-based methodologies calculate emissions using activity data and emission factors. To calculate emissions accordingly, the basic equation below is used: *Activity Data x Emission Factor = Emissions*

All emissions sources in this inventory are quantified using calculation based methodologies. Activity data refers to the relevant measurement of energy use or other greenhouse gas-generating processes such as fuel consumption by fuel type, metered annual electricity consumption, and annual vehicle miles traveled. Please see appendices for a detailed listing of the activity data used in composing this inventory.

Known emission factors are used to convert energy usage or other activity data into associated quantities of emissions. Emissions factors are usually expressed in terms of emissions per unit of activity data (e.g. lbs CO_2/kWh of electricity). Please see appendices for details on the emissions factors used in this inventory.

CACP 2009 Software

To facilitate community efforts to measure greenhouse gas emissions as a first step towards reducing them, ICLEI developed the Clean Air and Climate Protection 2009 (CACP 2009) software package in partnership with the National Association of Clean Air Agencies (NACAA) and the U.S. Environmental Protection Agency (EPA). CACP 2009 is designed for compatibility with the LGO Protocol and determines emissions by combining activity data (energy consumption, waste generation, etc.) with verified emission factors.

The CACP software has been and continues to be used by over 600 U.S. local governments to measure their greenhouse gas emissions. However, it is worth noting that, although the software provides governments with a sophisticated and useful tool, calculating emissions from activity data with precision is difficult. The model depends upon numerous assumptions, and it is limited by the quantity and quality of available data. With this in mind, it is useful to think of any specific number generated by the model as an approximation of reality, rather than an exact value.

[9] Oakley's community inventory includes emissions data provided by the PG&E that was gathered through direct measurement and calculation.

Evaluating Emissions

There are several important concepts involved in the analysis of emissions arising from many different sources and chemical/mechanical processes throughout the community. Those not touched on already are explored below.

Emissions by Scope

For both community and government operations, emissions sources are categorized relative to the geopolitical boundary of the community or the operational boundaries of the government. Emissions sources are categorized as Scope 1, Scope 2, or Scope 3, as described below. The scopes framework is used to prevent double counting of emissions for major categories such as electricity use and waste disposal.

The Scopes framework identifies three emissions scopes for community emissions:

- **Scope 1:** All direct emissions from sources located within the geopolitical boundary of the local government.
- **Scope 2:** Indirect emissions associated with the consumption of purchased or acquired electricity, steam, heating, and cooling. Scope 2 emissions occur as a result of activities that take place within the geopolitical boundary of the local government, but that rely upon emissions-producing processes located outside of the government's jurisdiction.
- **Scope 3:** All other indirect or embodied emissions not covered in Scope 2 that occur as a result of activity within the geopolitical boundary.

Scope 1 and Scope 2 sources are the most essential components of a community greenhouse gas analysis as these sources are typically the most significant in scale, and are most easily affected by local policy making. In addition to the categories in the Scopes framework, emission sources may also fall in a fourth category called Information Items.

Emissions by Sector

This inventory classifies emissions based on sector. Our findings are based on how emissions from individual sectors have changed between the baseline inventory (2005) and the update (2010). Detailed information on community and local government operations inventory methodologies can be found in the Appendices.

Community Emissions Inventory Results

Emissions by Sector

In order to effectively demonstrate the differences between inventory years, this inventory update focuses on emissions by sector and subsectors rather than scope. Comparing both inventories by sector, subsector and corresponding emissions allows for a closer look and analysis of emission changes.

Table 2: Oakley Community CO_2e Emissions by Sector

	2005	2010	
Sector	**metric tons CO2e**	**metric tons CO2e**	**% change**
Residential	37,995	42,707	↑12%
Community/Industrial	8,736	11,061	↑27%
Transportation	63,637	75,377	↑18%
Wastewater Treatment	Not Included	151	
Solid Waste Generation	9,991	3,197	↓68%
Totals	**120,360**	**132,494**	**↑10%**

Table 2 shows changes in CO_2e emissions between 2005 and 2010 using the originally reported data. None of the sectors above have been modified. The table also shows that emissions from wastewater treatment were not included in the 2005 baseline inventory. The overall increase in emissions from the 2005 to 2010 was 10%. However, as mentioned previously, there were differences in the methodology and subsectors included in both inventories that significantly affect the resulting emissions. Due to the inconsistencies in methodology and subsectors included within each sector, simply comparing the total emission figures would result in an incomplete and inaccurate comparison.

In order to compare sectors equally, Table 3 below shows the differences in CO_2e emissions from 2005 to 2010 with adjustments made to individual sectors. Sectors with an asterisk denote that modifications were made to the particular sector. For instance, the Transportation Sector in the 2005 inventory was modified to include emissions from off-road vehicles (based on the 2010 emissions figure) and the baseline Wastewater Sector was modified to include emissions from wastewater treatment (based on 2010 figures). All other sectors remain unchanged.

Table 3: Oakley Community GHG Emissions by Sector with Adjustments

	2005	2010	
Sector	**metric tons CO2e**	**metric tons CO2e**	**% change**
Residential*	38,011	42,707	↑12%
Community/Industrial*	7,933	11,061	↑39%
Transportation*	86,154	75,377	↓14%
Wastewater Treatment*	151	151	No Change
Solid Waste Generation	9,991	3,197	↓68%
Totals	**142,241**	**132,494**	**↓7%**

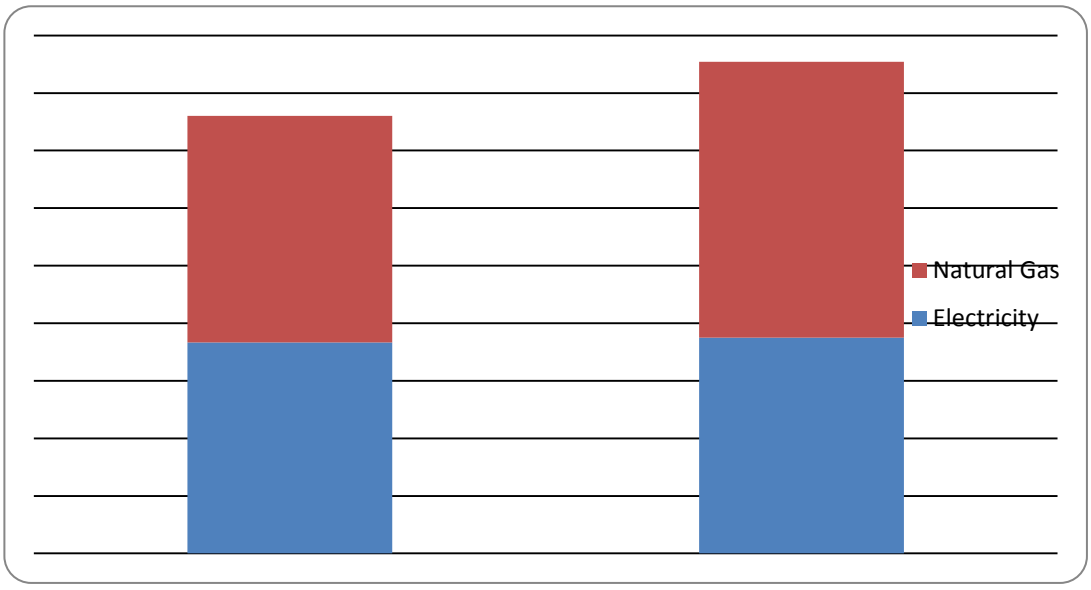
*Emission figures have been adjusted to allow for an equal comparison.

Residential

The Residential Sector shows a 12% increase in emissions between 2005 and 2010. Table 3 shows Oakley's Residential Sector generated an estimated 42,707 metric tons in 2010 compared to 38,011 metric tons of CO_2e in 2005[10]. Emissions for this sector were calculated using 2010 electricity and natural gas consumption data provided by PG&E. Interestingly, most of these emissions are the result of an increase in natural gas consumption by the Residential Sector. Figure 4 below shows emissions from natural gas consumption increased by more than 4 thousand metric tons of CO_2e. Emissions from electricity remained relatively stable between 2005 and 2010 (18,328 against 18,755 metric tons of CO_2e).

GHG emissions associated with residential transportation and residential waste generation are included separately in the Transportation and Waste Sector emissions totals.

Figure 4: Residential Emissions Comparison by Subsector



[10] Emissions from the 2005 residential sector have been updated to reflect 2005 CO2e emissions data provided by PG&E. Previously, PG&E provided aggregate electricity data in terms of kWh & a coefficient was applied to calculate emissions

Per household emissions can be a useful metric for measuring progress in reducing greenhouse gases and for comparing one's emissions with neighboring cities and against regional and national averages. Table 4 provides information on residential emissions on a per household basis. The information provided on population trends in comparison to the total GHG residential emissions provides insight into potential reasons for the increase. Between 2005 and 2010, Oakley's household population grew by 21% which corresponds with the rising trend in residential emissions. However emissions actually decreased from an individual household perspective. Oakley households generated slightly less than 3.98 metric tons of CO_2e, a conservative decrease from the 4.28 metric tons of CO_2e generated per household in 2005.[11]

Table 4: Emissions per Household Comparison

Household Emissions	2005	2010	% change
Number of Occupied Housing Units	8,864	10,727	21% ↑
Total Residential GHG Emissions (metric tons CO_2e)	38,011	42,707	12%↑
Residential GHG Emissions/Household (metric tons CO_2e)	4.28	3.98	7%↓

Commercial / Industrial

The Commercial/Industrial Sector also experienced an upward trend in emissions between 2005 and 2010. In 2010 Oakley's businesses and industries generated nearly 11,061 metric tons of CO_2e compared with 7,933 metric tons of CO_2e in 2005[12]. Similar to the Residential Sector, the Commercial/Industrial Sector also experienced a notable shift toward more natural gas consumption. As shown in Table 5, emissions from natural gas consumption saw a 53% increase between 2005 and 2010. Emissions from electricity use—while still positive —were less significant.

Table 5: Commercial/Industrial Electricity and Natural Gas Comparison

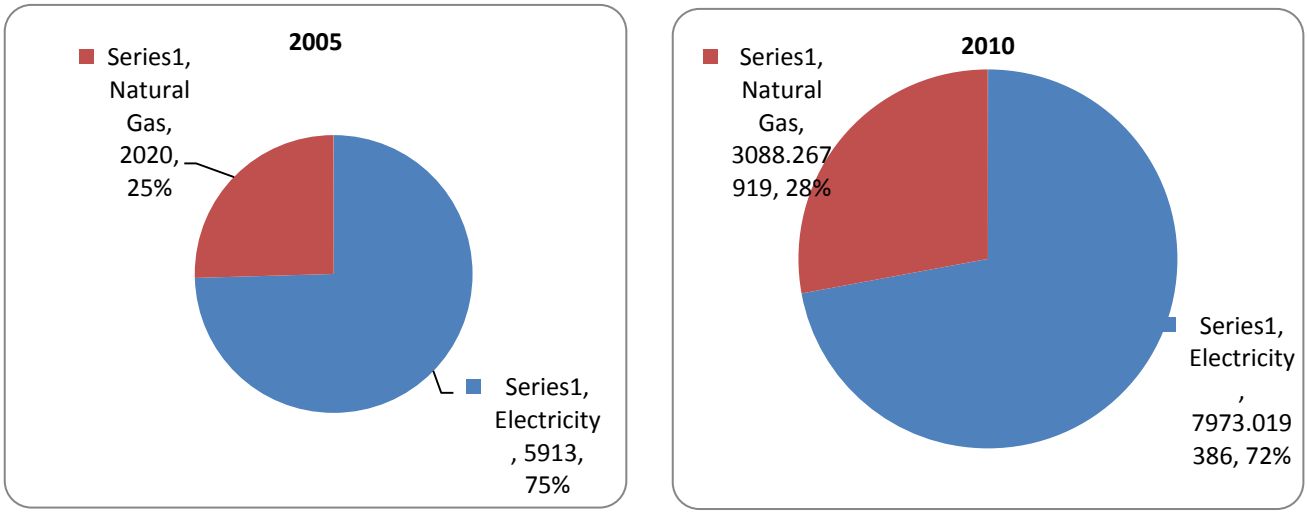
Commercial/Industrial	2005	2010	% change
Electricity (metric tons)	5,913	7,973	35% ↑
Natural Gas (metric tons)	2,020	3,088	53% ↑

The proportional representation of natural gas to electricity is shown in Figure 5 below. In 2005, approximately 75% of emissions were generated from electricity use while only 25 percent were caused by natural gas consumption. In 2010, the proportion of natural gas use to electricity increased. As a result 72 % (or 7,973 metric tons) of CO_2e were generated from electricity use while 28 percent (or 3,088 metric tons) were caused by natural gas consumption.

[11] 2005 and 2010 household population figures obtained from the U.S. Department of Commerce, U.S. Census Bureau, State & County Quick Facts, http://quickfacts.census.gov/qfd/states/06/0653070.html

[12] Emissions from the 2005 commercial sector have been updated to reflect 2005 CO2e emissions data provided by PG&E. Previously, PG&E provided aggregate electricity data in terms of kWh & a coefficient was applied to calculate CO2e emissions.

Figure 5: Commercial/Industrial Subsectors Comparison



Transportation

In 2010, transportation emissions caused 75,377 metric tons of CO_2e. Emissions from the Transportation sector are a result of vehicle miles travelled on State highway and local roads located within the City's jurisdiction, and emissions from off-road equipment. This sector saw an overall decrease in emissions by 10,777 metric tons of CO2e. Table 6 shows that when off-road equipment is included in the 2005 Transportation Sector, total emissions resulted in 86,154 metric tons of CO_2e as opposed to the previously reported figure (63,637 metric tons). Emissions from Local Roads within Oakley remained fairly consistent between 2005 and 2010. After factoring in off-road emissions, which accounted for 22,517 metric tons of CO2e in 2010, in the baseline inventory, we can see that the decrease in transportation emissions comes from a reduction in State highway emissions as detailed in the chart below.

Table 6: Transportation Emissions by Subsector

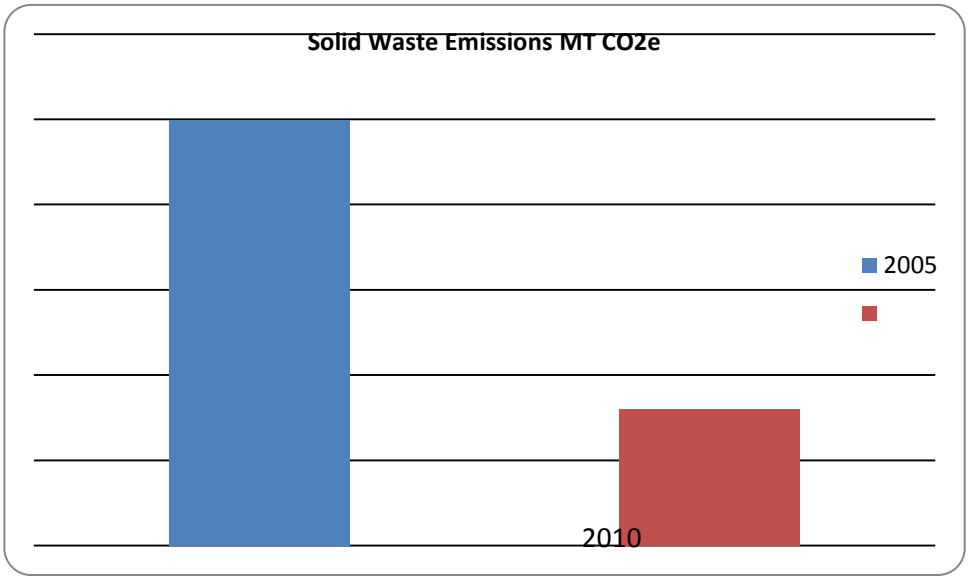
Sector	Local Roads	State highways	Off Road Equipment	Total
Metric tons (2005)	30,288	33,349	Not included	63,637
Metric tons (adjusted 2005 figure)	30,288	33,349	22,517	86,154
Metric tons (2010)	33,736	19,124	22,517	75,377

Waste

The Waste Sector saw the largest decrease in emissions for the community inventory. Between 2005 and 2010, waste emissions were reduced by 212 % (9,991 metric tons against 3,197metric tons respectively). This significant decrease can be explained by the difference in tonnage being land filled. In 2005, the community sent approximately 30,000 metric tons of waste to landfill, a significantly larger number compared with the 18,154 metric tons sent in 2010. Another potential explanation for the decrease in waste emissions involves increased levels of recycling in California cities and more stringent recycling requirements at the State and/or County level. It should be noted that in the 2010 inventory, a

75% methane recovery factor was used, as opposed to the 60% used in the 2005 inventory, which may also contribute to the overall decrease in waste emissions. In addition, the 2008 Waste Characterization Study conducted by the California Integrated Waste Management Board (CIWMB) was used to characterize the waste as opposed to the 2004 Waste Characterization Study used for 2005.

Figure 6: Solid Waste Emissions Comparison



Wastewater Treatment Emissions

Although not included in the 2005 baseline inventory, emissions from Wastewater Treatment caused an estimated 151 metric tons of CO_2e. Most Oakley residents are served by the Ironhouse Sanitary District (ISD), a wastewater treatment facility located within Oakley's jurisdiction but operated by a special district. Resulting emissions were based on the Oakley population served by this facility.

Local Government Operations Inventory Results

Key Findings

This report also provides a detailed update comparing the 2005 and 2010 inventory emissions for local government operations. Emissions from Oakley's local government operations are included as a subset within overall community emissions as shown in Figure 7 below. In 2010, Oakley's greenhouse gas emissions from local government operations totaled 752 metric tons of CO_2e, less than 1 percent of total community emissions. The 2005 baseline inventory reported 764 metric tons of CO_2e for local government operations. Between 2005 and 2010, there was certainly a decrease in emissions from local government operations. However, similarly to the community inventory, adjustments were made to certain sectors in order to compare both inventories equally and determine the actual emissions change.

There were differences in the subsectors included between the baseline inventory and the update that impacted that the final emissions figure. In order to compare the inventories equally, the following adjustments were made to the baseline inventory: employee commute emissions were adjusted to reflect 2010 emission figure, and PG&E owned streetlights (LS-1) were added and classified as Scope 3 (previously classified as Information Items and not counted toward total emissions).

After factoring in for the differences between subsectors, this report determined that emissions from local government operations actually decreased by 19 percent. The most apparent decrease occurred in the Vehicle Fleet Sector, in which emissions were reduced by half. The Public Lighting Sector and Buildings and Facilities Sector experienced an increase in emissions.

Figure 7: Oakley Local Government Operations Sector as a Subset of Community Emissions

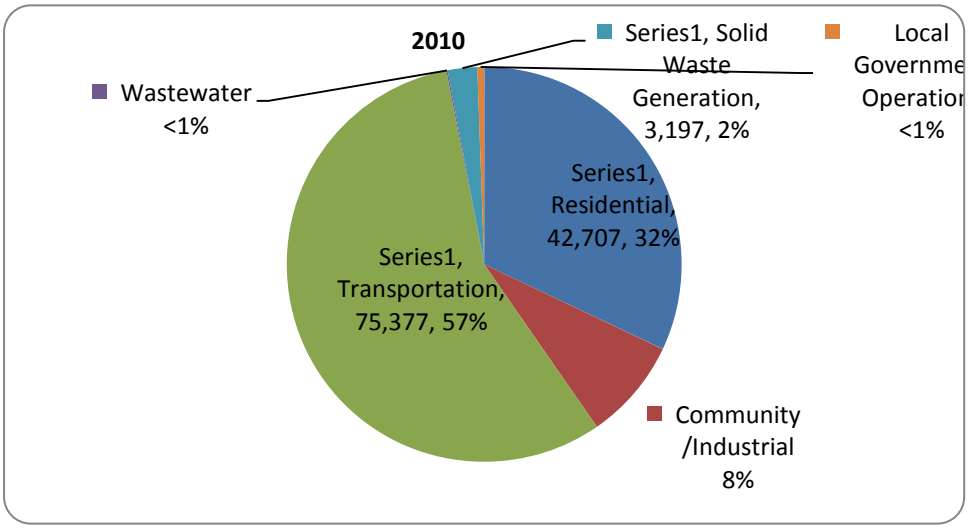


Table 7: CO_2e Local Government Operations Inventory Comparison (as originally reported)

	2005	2010
Sector	**metric tons CO2e**	**metric tons CO2e**
Buildings and Facilities	52	100
Public Lighting	4	143
Water Delivery	1	21
Vehicle Fleet	403	201
Employee Commute	241	266
Employee Business Travel	24	13
Government Solid Waste	37	7
Total	**764**	**752**

*Emission totals have been rounded to the nearest whole number and may not reflect the exact sum of subsectors

Table 8: CO_2e Local Government Operations Inventory Comparison with Adjustments

	2005	2010	
Sector	**metric tons CO2e**	**metric tons CO2e**	**% change**
Buildings and Facilities	52	100	92%↑
*Public Lighting[13]	147	143	3% ↓
Water Delivery	1	21	2000% ↑
Vehicle Fleet	403	201	50% ↓
*Employee Commute[14]	266	266	no change
Employee Business Travel	24	13	45% ↓
Government Solid Waste	37	7	81 % ↓
Total[15]	**930**	**752**	**19% ↓**

*Adjustments have been made to this sector in order to compare equally

Buildings and Other Facilities

The Buildings and Other Facilities sector saw a 92 % increase in emissions between 2005 and 2010. Most of these emissions can be attributed to the increased electricity and natural gas use at the City Hall. In 2010 the Oakley City Hall generated 82 metric tons of CO_2e emissions compared to 40 metric tons in 2005. In 2008, Oakley's City Hall was renovated. This project consisted of the addition of the Council Chambers, and new office space adding 11,000 square

[13] Emissions from this sector have been modified to include similar subsectors . In order to compare inventories equally, emissions from LS-1 lights have been included in the 2005 figure. The original baseline emissions from this sector reported 4 MT of CO2e based on the exclusion of emissions from LS-1 lights.

[14] Emissions from the original baseline inventory reported 241 metric tons of CO2e from Employee Commute. These emissions have been modified to match the 2010 figure since there was no actual change in the employee commute data but instead on a methodological difference in quantifying the data.

[15] The 2005 figure has been modified to accommodate the changes made to the Public Lighting and Employee Commute Sectors. The 2005 baseline inventory originally reported total local government operations emissions as 764 MT CO2e.

feet to the building. Oakley's public parks also saw a significant increase in emissions. In 2005, the City of Oakley two PG&E accounts associated with its parks: Laurel Ball Fields, and Crockett Park. In 2010, the City had increased its number of accounts to include Holly Park, Creekside Park, Marsh Creek Glen, Nutmeg Park, and Simoni Ranch.

Table 8: Buildings and Facilities Comparison

	2005	2010
Sector	metric tons CO2e	metric tons CO2e
City Hall	40	82
Parks	7	14
Other buildings	5	3
Totals	**52**	**100**

Streetlights, Traffic Signals, and Other Public Lighting

Like most local governments, Oakley operates a range of public lighting including streetlights, traffic signals/controllers, and park lighting. In 2010 emissions from Public Lighting caused approximately 143 metric tons of CO2e. This included emissions from all public lighting subsectors mentioned above and emissions from PG&E owned streetlights. PG&E owned streetlights are accounts that are owned, operated and maintained by PG&E. Although the City does not have operational or financial control over this subsector, their operation results in the release of a large portion of emissions.

Table 9: Public Lighting Emissions by Subsector

Subsector (Light Type)	metric tons CO2e	% of Sector Emissions	Electricity Use (kWh)	Cost ($)
Traffic Signals / Controllers	24	17%	118,758	$18,897
Streetlights	79	56%	389,438	$48,653
PG&E Owned Streetlights	38	27%	187,542	$46,206
Park Lighting	<1	1%	4,771	$868
Totals	**143**	**100%**	**700,509**	**$114,624**

*Due to rounding, the total may not equal the sum of its components

Table 10 below shows a wide gap in emissions between 2005 and 2010, a 3566% increase. However, this difference can be explained by a discrepancy in methodology. Although PG&E streetlights caused 142.5 metric tons of CO_2e in 2005, they were not included in the total community emissions. This resulted in a large underestimation of emissions from Public Lighting. After factoring in emissions from PG&E owned streetlights into the baseline inventory (see Table 10) in order to compare subsectors equally, we see a 2.6% decrease in emissions.

Table 10: Public Lighting Emissions

Public Lighting CO2e	2005	2010	% change
Metric tons (CO2e)	4	143	3566%↑
With PG&E streetlights (LS-1)	147	143	2.6%↓
% of total emissions	less than 1% (exc. LS-1)	19%.	

Water Delivery Facilities

This sector saw an overall increase in emissions from water delivery between 2005 and 2010 (1 metric ton against 21 metric tons). This can be expalined by the increase in equipment systems to distribute and transport water to Oakley residents. In 2005, Oakley had 40 PG&E accounts associated with sprinklers and irrigation controllers at various locations throughout the City. By 2010, the City had 78 accounts for irrigation controllers and sprinkler systems, storm management, and other water delivery infrastructure. Overall electricity use for this sector increased by about 92,000 kWh. (see Table 11)

Table 11: Water Delivery Facilties Comparison

	2005	2010
Subsector Equipment Type	metric tons CO2e	metric tons CO2e
Irrigation / Sprinkler Systems	1	18
Storm Water Management	0	2
Other Water Delivery Infrastructure	0	1
	1	21

Vehicle Fleet and Mobile Equipment

This sector saw the largest decrease in emissions between 2005 and 2010 (403 against 201 metric tons of CO2e). This is explained due to the decrease in vehicle miles traveled and gallons consumed. Although the City had a larger vehicle fleet size in 2010, with 32 compared to 30 vehicles in 2005, there was a significant reduction in vehicle miles travelled. Accordingly, there was also a large reduction in fuel consumption and associated fuel cost. Fuel purchased by the City of Oakley was reduced by 23,374 gallons between 2005 and 2010. The average cost of gasoline in 2010 was $3.138 per gallon[16]. This significant reduction in fuel consumption resulted in $69,154 in lower fuel expenses in 2010.

The vehicles and mobile equipment used in Oakley's daily operations consist of code enforcement vehicles, trucks used for parks and recreation, police cruisers, and off road equipment. All of these vehicles burn gasoline, or diesel, which results in greenhouse gas emissions. In addition, vehicles with air conditioning or refrigeration equipment use refrigerants that can leak from the vehicle.

[16] U.S. Energy Information Administration, Petroleum and Other Liquids. http://www.eia.gov/petroleum/gasdiesel/

Table 12: Vehicle Fleet Emissions by Source

Vehicle Fleet Emissions	2005	2010	Difference
metric tons CO2e	403	201	202
Consumption (gallons)	44,580	21,206	23,374
Cost ($)	$135,699	$66,545	$69,154

Government-Generated Solid Waste

Like the community Waste Sector, Oakley's local government operations Waste Sector also saw a decrease in waste sent to the landfill between 2005 and 2010 (37 against 7 metric tons) Solid waste was collected from the City's Parks, City buildings and public trash cans. According to Oakley's local waste hauler, Oakley Disposal, only 69% of the waste collected from the local government was sent to landfill as part of a diversion measure as opposed to 100% in 2005.

Table 13: Government Generated Solid Waste Comparison

Solid Waste	2005	2010
Subsector	metric tons CO2e	metric tons CO2e
City Buildings	6.4	2.5
Parks	13.8	1.7
Public trash cans	16.8	2.9
Totals	**37.0**	**7.1**

Employee Commute

Emissions in the Employee Commute Sector are due to combustion of fuels in vehicles used by city employees for commuting to and from work in their personal vehicles. A survey was administered in 2011 and used for the 2005 baseline inventory since no previous data was available. The results of the 2011 survey have also been used to determine emissions for the employee commute sector for this inventory. Therefore emissions from this sector remained the same. It should be noted that there was a difference in methodology employed for calculating emissions from this sector between 2005 and 2010. This resulted in a 25 metric ton increase in 2010 (241 against 266). However, this difference should not be counted toward the total local government operations emissions comparison since these emissions did not result from any changes in employee commute data.

Local Government Operations Data Sources

Buildings and Other Facilities

Electricity and natural gas consumption for 2010 was provided in terms of kWh and therms by Pacific Gas & Electric Company (PG&E). In order to produce electricity, PG&E relies on a fuel mix consisting of fuel sources such as hydropower, nuclear, and wind. In order to calculate emissions from generated electricity, a PG&E verified emissions factor[17] was used. The following emission factors were used to calculate emissions from electricity use for 2010: 445 lbs/MWh for CO_2, .010 lbs/MWh for N_2O and .030 lbs/MWh for CH_4. These emission factors were entered into CACP 2009 to calculate emissions. In order to calculate emissions resulting from natural gas production a U.S. default emission factor was used since emissions for natural gas production are based on national averages.

In 2010, the City of Oakley had 3 PG&E accounts associated with its buildings (City Hall, the Community building and the Recreational building). In addition the City also had electricity accounts for a number of parks throughout the City.

Refrigerants in Oakley were used in refrigeration (e.g., domestic refrigeration, medium and large refrigeration, and industrial refrigeration), chillers, and HVAC systems. Leaked refrigerants are an expected result in fugitive emissions such as HFC-134a. Data on refrigerants from 2005 was not available; therefore 2010 was used as a proxy year. Data collected for the baseline inventory has also been used for this update, therefore emissions from refrigerants remain unchanged. Specific data on annually purchased refrigerants was not available; therefore default emission rates have been used. In order to estimate the leaked refrigerant for existing equipment, the full charge capacity, operating emissions factor, and annual time in operation was either obtained directly from the equipment label or a default factor was used.

Emissions from R-22 were included as an information item and can be found in the *2010 Oakley Local Government Operations Inventory*. The Montreal Protocol established requirements to phase out ozone depleting CFC's and certain HCFC's worldwide. Under this protocol the U.S. is required to reduce its consumption of HCFC's by 99.5 percent below the U.S. baseline by 2020 and chemical manufacturer are prohibited from producing R-22 to service existing equipment.[18] The Global Warming Potential was obtained from the Intergovernmental Panel on Climate Change (IPCC) [19] in order to manually calculate the CO2e equivalent for each substance.

The following information has been included from the 2005 baseline inventory regarding methodology for obtaining information on fire suppression. Oakley does not use any fire suppression chemicals with global warming potential. ABC Dry Chemical is used in the fire extinguishers at city facilities and is included as an "Information Item" only. Total

[17] Refers to the measure of CO2 emitted per kilo-watt hour of electricity or per therm of natural gas.
[18] http://www.epa.gov/ozone/title6/phaseout/22phaseout.html
[19] http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html

capacity of ABC Dry Chemical in city equipment was estimated based on the number of units and the capacity of each unit provided by Bill Fee of Mazzy's Fire Protection, the City's service provider.

Energy Use

All energy related sectors including Public Lighting, Water Delivery, Buildings and Other Facilities were obtained from John Joseph at PG&E. This data was provided in terms of kWh, and therms. Detailed information can be found in the *2010 Oakley Local Government Operations Inventory*.

Wastewater Treatment Facilities

Data on population, and wastewater treatment processes were provided by Jenny Skrell, District Engineer at Ironhouse Sanitary District. Ironhouse Sanitary District is operated by a special district and is located within Oakley's City boundaries. This facility serves Oakley and Bethel Island residents.

Vehicle Fleet and Mobile Equipment

A detailed invoice of fuel purchased for the Police department was provided by Jeff Billeci, Assistant to Police Chief. A complete years' worth of fuel consumption data was not available for 2010; therefore 2011 was used as a proxy year. The detailed invoice consists of 12 monthly statements from January through December 2011 with vehicle miles traveled each provided for each vehicle. These statements do not track fuel consumption. A copy of these invoices can be found in the *2010 Local Government Operations Master data Workbook* in the 'VF-Raw Data' tab. In order to calculate fuel consumption, average fuel economy was obtained for each vehicle based on vehicle make, model and year were taken using the EPA's MPG estimates[20].

Government-Generated Solid Waste

Waste data for 2010 was obtained Dave Adler at Oakley Disposal. For entry in CACP 2009, waste volumes were grouped by facility. Waste Characterization data based on default figures from the 2008 Statewide Waste Characterization Study by California Integrated Waste Management Board (CIWMB). The assumption that landfills operating within Contra Costa County are managed landfills was made. USA default was used as the coefficients for waste products set.

Employee Commute

An employee commute survey was administered in 2011 for the baseline inventory. The results of the survey were also used for this inventory assuming employee commute patterns remained constant.

[20] Under the Energy Policy Act of 1992, the EPA and the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy are required to provide consumers with data on vehicle fuel economy. This data is maintained by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy and available at http://www.fueleconomy.gov/feg/Find.do?action=sbsSelect

Conclusion

This analysis found that the Oakley community as a whole was responsible for emitting 132,494 metric tons of CO_2e in 2010, with emissions from the Transportation contributing the most to this total. (See summary table in Appendix A for more detail.)

Based on the ICLEI methodology and recommendations, the City of Oakley should begin to document emissions reduction measures that have been implemented since 2010 and should quantify the emissions benefits of these measures to demonstrate progress made to date.

As Oakley moves forward with considering emission reduction strategies and works to create a local climate action plan, the City should identify and quantify the emission reduction benefits of climate and sustainability strategies that could be implemented in the future, including energy efficiency, renewable energy, vehicle fuel efficiency, alternative transportation, vehicle trip reduction, land use and transit planning, waste reduction and other strategies. Through these efforts and others the City of Oakley can achieve additional benefits beyond reducing emissions, including saving money and improving Oakley's economic vitality and its quality of life. City staff will continue to update this inventory as additional data become available.

Appendices

Appendix A - Detailed Community Greenhouse Gas Emissions in 2010

Sector	Emissions Source	Equiv CO_2 (metric tons)	Equiv CO_2 (%)	Data Source
Residential				
	Electricity	18755	14	PG&E
	Natural Gas	23952	18	PG&E
Subtotal Residential			**32**	
Commercial/Industrial				
	Electricity	7973	6	
	Natural Gas	3088	2	
Subtotal Commercial			**9**	
Transportation				
Local Roads AVMT		33,736	25	MTC/HPMS
State Highways AVMT		19,124	14	MTC/HPMS
Off Road Equipment		22,517	17	EMFAC 2011
Subtotal Transportation			**57**	
Waste		3195	2	CalRecycle
ADC		2	0	
	Plant Debris			
Total Waste Disposed (w/o ADC)				
	Paper Products	556	.4	
	Food Waste	495	.3	
	Plant Debris	230	.1	
	Wood/Textiles	885	.6	
Subtotal Waste		**3197**	**3**	
Grand Total		**132,494**	**100**	

Appendix B – Community Residential Sector Notes

Data Inputs:

Residential	Electricity Consumption	kWh	18,755
	Natural Gas Consumption	Therms	23,952
	Other Fuel	Units	n/a

Data Sources:

1. Data on residential electricity consumption provided by PG&E: John Joseph, JGJ3@pge.com, (415) 973-5737. Data Source: Contra Costa Cities Community-Wide PG&E data-includes DA.xls
2. Natural gas consumption provided by PG&E: John Joseph, JGJ3pge.com, (415) 973-5737 Data Source: Contra Costa Cities Community-Wide PG&E data-includes DA.xls

Notes:

1. The emissions associated with electricity supplied by PG&E were given in terms of metric tonnes of CO_2, N_2O and CH_4. For non direct access data PG&E applied the appropriate utility emission factor for electricity consumed by each sector (residential, commercial/industrial). Utility-specific verified electricity emission factors can be found in Table G.6 of the Local Government Operations Protocol or through the California Climate Action Registry.[21] PG&E also applied the California average emission factors for direct access data which has been aggregated with non direct access electricity consumption figures. California Grid Average Electricity Factors are calculated from total in-state and imported electricity emissions divided by total consumption in MWh. Emissions from California Air Resources Board, Greenhouse Gas Inventory, 1990-2004.[22]
2. Natural Gas was provided by PG&E in therms.

[21] http//www.climateregistry.org/CARROT/public/reports.aspx

[22] http://www.arb.ca.gov/cc/inventory/data/data.htm
http://www.energy.ca.gov

Appendix C – Community Commercial / Industrial Sector Notes

Data Inputs:

Commercial/Industrial	Electricity Consumption	kWh	7,973
	Natural Gas Consumption	Therms	3,088
Direct Access (see below for DA emission factor)	Electricity Direct Access (from PG&E)	kWh	Direct Access data and non-direct access data has been aggregated by PG&E and reported in terms of kWh and CO_2, CH_4, and N_2O for each sector (residential, commercial, industrial)

Data Sources:

1. Data on commercial electricity and natural gas consumption provided by John Joseph, JGJ3@pge.com. (415) 973-5737
   Data Source: Contra Costa Cities Community-Wide PG&E data-includes DA.xls
2. Data on industrial electricity consumption was combined with commercial electricity consumption.

Notes:

1. Direct Access data refers to electricity that is generated by independent energy service providers (non-PG&E), but transmitted or distributed by PG&E's electricity lines. As of September 2012, the data provided by PG&E does not differentiation between direct access data and non-direct access for electricity in the residential, commercial and industrial sectors. Direct access data has been aggregated with non-direct access data. PG&E reports the aggregated kWh for each sector as well as the emissions in terms of CO_2, N_2O and CH_4.

Appendix D – Community Transportation Sector Notes

Data Inputs:

Transportation	Local Roads (VMT)[2]	Annual VMT	55,973,854 AVMT
	State Highway VMT [3]	Annual VMT	31,737,827 AVMT
	Off-road Vehicles	Diesel (gallons)	22,517 CO_2e
		Gasoline (gallons)	

Data Sources:

1. Local Roads Vehicle Miles Traveled (VMT) 2009 data provided by the Metropolitan Transportation Commission (MTC). This data is also available from the Highway Performance Monitoring System's 2010 California Public Road Data Report.[23]
   For questions, please contact Benjamin Espinosa, Transportation Planner, Metropolitan Transportation Commission, BEspinosa@mtc.ca.gov, (510) 817-5744. For transportation emission calculations see 'On-Road Raw Data' tab in Oakley Community Masterdata Workbook and 'Table 14' tab in Oakley Community GHG Inventory Data Conditioning Sheet.xls. In order to quantify DVMT by vehicle type, a breakdown of vehicle type DVMT was obtained for Contra Costa County by generating a report using the California Air Resources Board EMFAC 2011 online platform.[24]
2. State Highway (VMT) 2010 data provided by Local Roads Vehicle Miles Traveled (VMT) 2009 data provided by the Metropolitan Transportation Commission (MTC). State hwy DVMT figures were adjusted to exclude DVMT from hwy 160 after receiving feedback from City staff reporting that hwy 160 does not pass through the City of Oakley. Only a segment of hwy 4 passes through Oakley. Additional MTC data was obtained to determine DVMT from the specified segment of hwy 4. Detailed calculations can be found in the *2010 Oakley State Hwy VMT data.xls*.
   For questions, please contact Benjamin Espinosa, Transportation Planner, Metropolitan Transportation Commission, BEspinosa@mtc.ca.gov, (510) 817-5744. In order to quantify DVMT by vehicle type, a breakdown of vehicle type DVMT was obtained for Contra Costa County by generating a report using the California Air Resources Board EMFAC 2011 online platform.[25]
3. Off-road Vehicles (gallons) data obtained from the California Air Resources Board OFFROAD 2007 model.[26] See 'Off Road Fuel Working Data' tab in *2010 Oakley Community Inventory* for data.

Notes:

1. 2009 Local Roads DVMT and Local Roads (miles) for the City of Oakley were provided by the Metropolitan Transportation Commission (MTC). The Contra Costa County breakdown of DVMT by vehicle type on local

[23] www.dot.ca.gov/hq/tsip/hpms/datalibrary.php
[24] www.arb.ca.gov/jpub/webapp//EMFAC2011WebApp/emsSelectionPage_1.jsp
[25] www.arb.ca.gov/jpub/webapp//EMFAC2011WebApp/emsSelectionPage_1.jsp
[26] http://www.arb.ca.gov/msei/offroad/offroad.htm

roads was used to quantify the breakdown of Oakley's local DVMT by vehicle type. AVMT was obtained by multiplying DVMT by the number of days in a calendar year.

2. Emissions for State hwy were entered into CACP using the Transport Assistant tool. Vehicle Type was grouped by passenger cars, light trucks and heavy trucks.
3. The OFFROAD 2007 model generates emissions inventories by equipment type, accounting for age and a given calendar year. Off-road equipment consists of diesel, gasoline and compressed natural gas used in the following: agricultural equipment, construction and mining equipment, entertainment equipment, industrial equipment, lawn and garden equipment, light commercial equipment, oil drilling, pleasure craft, rail yard operations, transport and refrigeration units. Data on gallons and CO2e emissions per equipment has been obtained for this inventory. In order to determine the emissions resulting from off road equipment in Oakley, an emissions and fuel consumption report was generated for Contra Costa County. A population ratio of Oakley to Contra Costa County was applied to quantify the emissions and fuel consumption for off road equipment in Oakley. The emissions inventory is calculated using the following equation:

   Emissions in tons/day = EF * Pop * AvgHp * Load * Activity

   Where:

   AvgHp = Maximum rated average horsepower
   Load = Load factor
   Activity = Annual activity in hours per year (hr/yr)
   EF = Emission factor in grams per horsepower-hour (g/bhp-hr)
   Pop = Population

4. Off-road Vehicles (gallons) data obtained from the California Air Resources Board OFFROAD 2007 model.[27] See 'Off Road Fuel Working Data' tab in Oakley Community Inventory for data.

[27] http://www.arb.ca.gov/msei/offroad/offroad.htm

Appendix E – Community Waste Sector Notes

Data Inputs:

Waste	Total Landfill Waste (See Waste Table)	Short Tons	18,138
	Total Alternative Daily Cover (See Waste Table)	Short Tons	15.4
	% ADC Green Material	%	100

Data Sources:

1. 2010 Waste Disposal Figures for the City of Oakley were obtained from the following source:
   -CalRecycle[28]
   For questions, please contact LAMD@calrecycle.ca.gov. (916) 341-6199

Data File: 2010 CalRecycle Oakley Landfill data.xls

2. Waste Characterization data based on 2008 Statewide Waste Characterization Study by Center for Integrated Waste Management Board (CIWMB). This state average waste characterization accounts for residential, commercial and self haul waste.[29]

Data File: 2008 Statewide Waste Characterization Study by CIWMB.pdf

Methods:

1. CO_2e emissions from 2010 waste disposal were calculated using the methane commitment method in the CACP 2009 software, which uses a simplified version of the EPA WARM model. Waste types include the following categories: paper products, food waste, plant debris, wood/textiles, all other waste. Each of these waste types is assumed to contain a different amount of biodegradable material and to decompose at a different rate. Disposal Method included 'Managed Landfill' and coefficient set was set to 'USA Default'. The CACP 2009 methane recovery factor was set to 75%. The methane commitment method used by CACP 2009 involves the following general formula:

   $CO_2e = W_t * (1\text{-}R)\ A$

   Where:
   W_t is the quantity of waste type 't',
   R is the methane recover factor,
   A is the CO_2e emissions of methane per metric ton of waste at the disposal site (the methane factor)

[28] http://www.calrecycle.ca.gov/LGCentral/
[29] http://www.ciwmb.ca.gov/Publications/default.asp?pubid=1097