MEMORANDUM

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SUBJECT Community and Government Operations GHG Inventories – Summary of Results

1. Introduction

PlaceWorks is working with Butte County (the County) to prepare an update to the County's Climate Action Plan (CAP), which was adopted in 2014. The CAP is a plan to reduce greenhouse gas (GHG) emissions and improve community resilience to hazardous conditions associated with climate change. As part of this work, PlaceWorks has been preparing a set of new and revised GHG inventories, which are technical analyses to assess the total annual GHG emissions attributed to Butte County from various activities. A GHG inventory is the first step in creating a strategy to reduce Butte County's annual emissions. Determining the annual level of GHG emissions will aid the County in establishing an attainable goal for reducing their emissions year over year, building on work that has been a community priority for over a decade. Furthermore, knowing which activities release these GHG emissions allows the County to develop policies and programs that facilitate a decrease in emissions for each activity.

GHG emissions are generated by various activities that are largely commonplace in daily life. Some daily activities release GHG emissions in the location of the activity, such as gases released anytime an internal combustion engine car is driven. On the other hand, some activities cause GHG emissions to be released elsewhere, such as someone using non-renewable or non-carbon-free electricity to power their home, which generates GHG emissions in the location of the power plant that supplies the power, and not in the home itself. Therefore, Butte County must consider the GHG emissions caused by activities attributed to the community, including GHG emissions generated both inside and outside their jurisdictional boundaries.

The County has two types of GHG inventories: 1) community-wide inventories and 2) County operations inventories.

- A community-wide GHG inventory identifies GHG emissions that result from activities of unincorporated Butte County residents, employees, visitors, and other community members. Examples include residents driving cars, homes using water, and businesses using electricity.
- A County operations GHG inventory summarizes emissions that are a direct result of Butte County's government operations. Examples include electricity and water used in County buildings or the fuel used for County vehicles.

As part of the preparation of the 2014 CAP, Butte County and its regional partners and technical consultants prepared community-wide and County operations GHG inventories for the calendar year 2006. As part of preparation of the 2014 CAP, the County prepared a GHG inventory for the year 2006 to serve as a baseline year for emission reductions, as this was considered a year with good data availability at the time, consistent with State guidance, and without any unusual factors that might affect GHG emissions.

As part of the 2020 CAP update process, PlaceWorks revised the existing 2006 community-wide and 2006 County operations GHG inventories to use consistent and current methods and data sources while preserving the existing GHG inventory baseline. PlaceWorks also prepared a new 2019 community-wide and County operations GHG inventory. The 2020 CAP will compare the 2019 inventory, which is the most recent year with available data, to the updated 2006 inventory as a way of showing changes to GHG emissions since the 2006 baseline. This memo presents the results of the updated and new Butte County community-wide and County operations GHG inventories and is the most up-to-date summary of Butte County's community-wide and County operations GHG emissions.

This memo contains a discussion of the methods used to prepare and update the GHG inventories (Section 2), a summary of the changes to the existing GHG inventories as a result of the update process (Section 3), selected results from the community-wide GHG inventory (Section 4), and the results of the County operations GHG inventory (Section 5) along with next steps (Section 6).

2. Methods

PROTOCOLS

A series of guidance documents, called protocols, provide recommendations on how to adequately assess GHG emissions. The project team prepared the new GHG inventories and updates to past GHG inventories consistent with the guidance in widely adopted, standard protocol documents. These protocols provide guidance on what activities should be evaluated in the GHG inventories and how emissions from those activities should be assessed. Using standard methods also allows for an easy comparison of GHG emission levels across multiple years and communities.

- The County operations GHG inventory relies on the Local Government Operations Protocol (LGOP), which was first developed in 2008 and was updated in 2010. The LGOP is a tool for accounting and reporting GHG emissions of local government (municipal) operations and is used throughout California and the United States. The LGOP includes guidance from several existing programs as well as the state's mandatory GHG reporting regulations.
- The community-wide GHG inventory uses the United States Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions (U.S. Community Protocol), which was first developed in 2012 and updated most recently in 2019. The California Governor's Office of Planning and Research encourages cities and counties in California to follow the U.S. Community Protocol for community-wide GHG emissions.

GHG inventories are estimates of GHG emissions based on these standard methods and verified datasets. While they are not direct measurements of GHG emissions, the use of the standard methods identified in the protocols, in combination with accurate data from appropriate sources, allows GHG inventories to provide reliable estimates of local emission levels.

Since the 2006 inventory was prepared, new datasets have become available. These datasets include revised numbers for previous years, including 2006. Recommended analysis methods have also changed, in response to increased scientific awareness and evolving best practices. To ensure greater accuracy and ease of comparison between the 2006 and 2019 inventories, PlaceWorks has revised relevant sections of the 2006 inventory to use the most recent datasets and recommended methods. However, due to potential data limitations, some inconsistencies in methods may still remain. Any concerns about inconsistent methods are noted in the appropriate sector discussion. For more information on the methods used to prepare and update the GHG inventories, refer to Appendix A of this memorandum.

EMISSION FACTORS

PlaceWorks has calculated most of the GHG emissions using data on GHG-generating activities in combination with emission factors. An emissions factor describes how many $MTCO_2e$ are released per unit of an activity. For instance, an emissions factor for electricity describes the $MTCO_2e$ produced per kWh of electricity used, or an emission factor for on-road transportation describes the $MTCO_2e$ produced per mile of driving. Table 1 shows the emissions factors for 2006 and 2019. Some sectors, including agriculture and off-road emissions, are calculated using formulae or models and do not have specific emission factors.

Table 1: Change in Emissions Factors between 2006 and 2019

SECTOR	UNIT	2006	2019	PERCENT CHANGE	SOURCE
Electricity	Per kWh	0.000208	0.000108	-48%	PG&E
Natural gas	Per therm	0.005323	0.005323	0%	US Community Protocol
Propane	Per gallon	0.005844	0.005644	-3%	US Community Protocol
On-road transportation (light duty)	Per mile	0.000661	0.000356	-46%	California Air Resources Board
On-road transportation (heavy duty)	Per mile	0.001562	0.001154	-26%	California Air Resources Board
On-road transportation (combined)	Per mile	0.001202	0.000755	-37%	California Air Resources Board
Solid waste (municipal solid waste)	Per ton	0.293000	0.286000	-2%	CalRecycle
Solid waste (alternative daily cover)	Per ton	0.246000	0.246000	0%	CalRecycle

UNITS OF MEASUREMENT

These GHG inventories assess emissions in a unit called carbon dioxide equivalent (CO_2e), which is a combined unit of all GHGs analyzed in the inventory. As different GHGs have different effects on the processes that drive climate change, CO_2e is a weighted unit that reflects the relative potency of the different GHGs. These inventories report amounts of GHGs in metric tons of CO_2e ($MTCO_2e$), equal to 1,000 kilograms or approximately 2,205 pounds.

3. Summary of Changes

As previously noted, PlaceWorks updated the County's existing GHG inventories to be consistent with current guidance and best practices. One major edit to the existing GHG inventories was to revise the global warming potentials (GWPs) used in all inventories to account for the relative difference in potencies of different GHGs. These numbers have changed as the science of GHGs have advanced. Butte County's existing inventories used GWPs from the Intergovernmental Panel on Climate Change's (IPCC's) Second Assessment Report, released in 1995. At the time the original 2006 inventory was prepared, the Second Assessment Report values were the most widely used. PlaceWorks updated these values to use the GWPs from the most recent IPCC report, the

Fifth Assessment Report, [1] released in 2013 and now commonly used to show consistency with the best available science. The Fifth Assessment Report values also most accurately shows the impacts of methane, which were largely understated in previous studies. **Table 2** shows the differences in GWPs by gas.

Table 2: Change in Global Warming Protocols (GWPs) by GHG

GAS	SECOND ASSESSMENT REPORT GWP	FIFTH ASSESSMENT REPORT GWP
Carbon dioxide (CO_2)	1	1
Methane (CH_4)	21	28
Nitrous oxide (N_2O)	310	265

In addition to these universal edits, PlaceWorks has made the following changes:

- PlaceWorks adjusted the methodology and data used to calculate emissions from the Agriculture sector to reflect current practices, primarily for emissions from enteric fermentation associated with livestock, fertilizer, manure, and rice harvesting.
- PlaceWorks added emissions associated with land use and sequestration, and with wildfire and controlled burns as informational items.
- PlaceWorks revised the data used to calculate water and wastewater emissions, using adjusted datasets built on the 2019 water and wastewater figures, which are more accurate than the estimated data used in the 2006 inventory. The 2006 wastewater emission calculations have also been updated to use current recommended methods.
- PG&E provided updated 2006 electricity and natural gas use figures. PlaceWorks has revised the 2006 inventory to use these updated numbers.

4. Community-Wide GHG Inventory

A community-wide GHG inventory identifies GHG emissions that result from activities of residents, employees, and other community members occurring within the community. PlaceWorks prepared an update to the 2006 community-wide inventory and new inventory for the calendar year 2019.

SECTORS

The community-wide GHG inventory assessed GHG emissions from the following 10 categories of activities, known as sectors.

- **Agriculture** includes GHG emissions from various agricultural activities, including agricultural equipment, crop cultivation and harvesting, and livestock operations.
- **Transportation** includes GHG emissions created by driving on-road vehicles, including passenger and freight vehicles.
- **Residential energy** includes GHG emissions attributed to the use of electricity, natural gas, and propane in residential buildings.
- **Nonresidential energy** includes GHG emissions attributed to the use of electricity and natural gas in nonresidential buildings.

[1] IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp. 659–740. https://www.ipcc.ch/site/assets/uploads/2018/02/WG1AR5_Chapter08_FINAL.pdf.

- Solid Waste includes the GHG emissions released from trash collected in the unincorporated areas of Butte County, as well as collective annual emissions from waste already in place at the Neal Road Landfill.
- Off-road equipment includes GHG emissions from equipment that does not provide on-road transportation (excluding agricultural equipment), such as tractors for construction or equipment used for landscape maintenance.
- Water and wastewater accounts for the electricity used to transport every gallon of water or wastewater to incorporated county residents and businesses, as well as direct emissions resulting from the processing of waste material.
- Stationary sources are those emitted at large industrial sites, commercial businesses, warehouses, or power plants.
- Land Use and Sequestration includes GHG emissions absorbed and stored in trees and soils on locally-controlled lands as part of healthy ecosystems and released into the atmosphere from development of previously undeveloped land.
- Wildfire and controlled burns includes emissions released as a result of wildfires and controlled burns.

INVENTORY RESULTS

Table 3 shows the overall amount of community-wide GHG emissions associated with each sector in 2006 and 2019 as well as the proportion of each sector's contribution to annual GHG emissions. As shown, GHG emissions in each sector do not remain consistent between the years 2006 and 2019.

Table 3: Proportions of Annual GHG Emissions by Sector in 2006 and 2019

Sector	2006 $MTCO_2E$	2006 Proportion of Total	2019 $MTCO_2E$	2019 Proportion of Total
Agriculture	521,650	48%	501,630	50%
Transportation	264,420	24%	229,110	23%
Residential energy	133,350	12%	90,730	9%
Nonresidential energy	58,670	5%	37,350	4%
Off-road equipment	56,070	5%	59,310	6%
Solid waste	40,830	4%	61,120	6%
Water and wastewater	20,190	2%	16,960	2%
Total Annual $MTCO_2e$ (not including land use and sequestration)	**1,095,190**	**100%**	**996,210**	**100%**
Land use and sequestration	-346,340	—	-346,340	—
Total Annual $MTCO_2e$ (including land use and sequestration)	**748,850**		**649,870**	
Informational Items				
*Stationary sources**	*3,960*	*<1%*	—	—
*Wildfire and controlled burns***	*8,280*	—	*15,730*	—

Note: The 2019 proportion of total percentages do not include emissions as a result of the land use and sequestration sector.

*Stationary source data for 2019 was not provided at the time the inventory was completed and is therefore not included.

**Wildfires in 2006 include the Skyway, Woodleaf, and Philbrook fires. The wildfires counted in 2019 include the Swedes and the Forbestown fires.

All numbers are rounded to the nearest 10. Totals may not equal the sum of individual rows.

The agriculture sector has remained the largest source of GHG emissions in unincorporated Butte County, increasing slightly from 48 percent of total GHG emissions in 2006 to 50 percent of total GHG emissions in 2019. The transportation sector has remained the second largest source of GHG emissions between 2006 and 2019 and decreased slightly from 24 percent of total GHG emissions in 2006 to 23 percent of the total share of GHG emissions in 2019.

Residential and nonresidential energy made up 12 and 5 percent of total community-wide 2006 GHG emissions, respectively. By 2019, the residential and nonresidential energy sectors both declined in total share of GHG emissions. Residential energy GHG emissions decreased to 9 percent of total GHG emissions in 2019 while nonresidential energy decreased slightly to make up 4 percent of total GHG emissions in 2019.

GHG emissions from solid waste and off-road equipment increased between 2006 and 2019, while GHG emissions from water and wastewater declined slightly. The solid waste sector accounted for 4 percent of total community-wide GHG emissions in 2006, increasing to 6 percent in 2019. The off-road equipment sector increased similarly from 5 percent to 6 percent. The water and wastewater sector remained at 2 percent of the community-wide total.

As shown in **Table 4**, Butte County's community-wide GHG emissions decreased by approximately 9 percent between the years 2006 and 2019, when not accounting for land use and sequestration, and decreased approximately 13 percent when accounting for land use and sequestration.

Table 4: Percent Change in Total GHG Emissions between 2006 and 2019 by Sector

SECTOR	2006	2019	2006 TO 2019
Agriculture	521,650	501,630	-4%
Transportation	264,420	229,110	-13%
Residential energy	133,350	90,730	-32%
Nonresidential energy	58,670	37,350	-36%
Off-road equipment	56,070	59,310	6%
Solid waste	40,830	61,120	50%
Water and wastewater	20,190	16,960	-16%
Total Annual $MTCO_2e$ (not including land use and sequestration)	**1,095,190**	**996,210**	**-9%**
Land use and sequestration	-346,340	-346,340	0%
Total Annual $MTCO_2e$ (including land use and sequestration)	**748,850**	**649,870**	**-13%**
Informational Items			
*Stationary sources**	*3,960*	—	—
*Wildfire and controlled burns***	*8,280*	*15,730*	*90%*

*Stationary source data for 2019 was not provided at the time the inventory was completed and is therefore not included.**
**Wildfires in 2006 include the Skyway, Woodleaf, and Philbrook fires. The wildfires counted in 2019 include the Swedes and the Forbestown fires.

All numbers are rounded to the nearest 10. Totals may not equal the sum of individual rows.

The sectors that experienced the largest decrease in annual GHG emissions were residential and nonresidential energy, which reduced by 32 and 36 percent, respectively. The energy sector decreased due to less electricity use in both residential and nonresidential development, a substantial increase in renewable and carbon-free sources of electricity, and a decline in residential natural gas use, as shown through Pacific Gas & Electric (PG&E) Activity data in Table 1 above and Table 10 below. However, there was an increase in emissions associated with residential propane use and nonresidential natural gas use.

The sector to experience the next-largest decrease was transportation with a 13-percent decline in GHG emissions. Despite VMT increasing 15 percent between 2006 and 2019, emissions decreased largely due to more fuel-efficient vehicles and a wider adoption of electric vehicles, as reported by Caltrans and as shown in Table 1.

Emissions from the agricultural sector decreased by approximately 4 percent between 2006 and 2019. While most agricultural activities saw some change between 2006 and 2019, the largest changes appear due to decreases in rice growing acreage, changes in the amount of soil amendments, decreases in residue burning, and replacing older diesel irrigation pumps.

Water and wastewater emissions also declined from 2006 to 2019 levels. Although water use increased during this period, increases in clean electricity supplies resulted in less GHG emissions from the energy needed to move and process water, decreasing the overall emissions from the water and wastewater sector.

The solid waste and off-road equipment sectors experienced an increase in GHG emissions. Emissions associated with the solid waste sector increased by 50 percent, while emissions from off-road activities rose by

6 percent. The increase in solid waste is primarily the result of a larger-than-normal amount of waste generated by the community as a result of clean-up activities from the 2018 Camp Fire. The modest increase in off-road equipment is likely due to the purchasing and use of more off-road equipment (such as lawn mowers and other gardening equipment) as the Butte County population has grown since the 2006 inventory year.

Emissions associated with wildfires increased by 90 percent between 2006 and 2019; however, these emissions are not accounted for in the final total of annual community-wide emissions and are noted for informational purposes only. This change is due to an increase in acreage burned in wildfires, along with an increase in controlled burn activity, which rose substantially from 2006 to 2019 as a wildfire management strategy.

Increases in the amount of electricity from renewable or carbon-free sources played a significant role in how Butte County's GHG emissions changed from 2006 to 2019. Most sectors that involve electricity use saw their emissions decline due to this change. PG&E's sources of electricity released 51 percent fewer GHG emissions per unit of electricity used in 2019 than they did in 2006.

Revisions to 2006 inventory

As mentioned previously, PlaceWorks updated Butte County's existing inventory to be consistent with current guidance and best practices. Due to these changes, the inventory results presented in this memo will be different than results that have been shown previously and that were cited in the 2014 CAP. Increases in emissions between the original and the updated 2006 inventory were made to the agriculture, residential energy, nonresidential energy, solid waste, off-road equipment, and water and wastewater sectors. Increases in the agriculture sector are largely due to new methods for quantifying agricultural emissions. Increases to the solid waste sector are due to changes in method and the inclusion of landfill emissions, which were previously treated as an informational item, while increases to the water and wastewater sector are due to revised datasets that more accurately reflect water use conditions in Butte County. The change to off-road equipment emissions is due to adding in types of off-road equipment that had previously been excluded, although there were no other changes to the method used. The off-road equipment subsectors originally included in the 2006 inventory were only lawn and garden and construction and mining equipment. The revisions to the 2006 inventory added emissions related to equipment used for entertainment, industrial, light commercial, logging, oil drilling, pleasure craft (personal watercraft), recreation, and refrigerated transport. The changes to emissions from residential and nonresidential energy sectors are the results of PG&E providing updated energy use data, which differed from the original data. Table 5 compares the original 2006 inventory, excluding informational items, to the updated inventory results.

Table 5: Original and Revised 2006 Baseline Inventory Results

Sector	Original Inventory Results	Updated Inventory Results	Percent Change
Agriculture	390,400	521,650	34%
Transportation	265,450	264,420	Less than -1%
Residential	150,630	133,350	-11%
Nonresidential	61,450	58,670	-5%
Off-road Equipment	17,360	56,070	223%
Solid waste	13,980	40,830	192%
Water and wastewater	12,360	20,190	63%
Total Annual $MTCO_2e$	**911,630**	**1,095,190**	**20%**

All numbers are rounded to the nearest 10. Totals may not equal the sum of individual rows.

SECTOR DETAILS

Agriculture

GHG emissions associated with the agriculture sector decreased by approximately 4 percent between 2006 and 2019 (see Table 6). This overall decrease is the result of several factors, including a decline in the use of agricultural diesel pumps, declines in emissions from manure management, decreases in the amounts of lime and urea applied, and an 8-percent decrease in GHG emissions associated with rice cultivation. GHG emissions in some sub-sectors did increase, including those associated with fertilizer, which increased by 15 percent, likely due to changes in the mix of crops kept in the county.[2,3] Emissions associated with residue burning on agricultural land are due to a change in the method of emissions calculations and a difference in available data.

[2] Butte County, 2006, Butte County Agricultural Crop Report, https://www.buttecounty.net/Portals/2/CropReports/2006CropReport.pdf.

[3] Butte County, 2019, Butte County 2019 Crop & Livestock Report, https://www.buttecounty.net/Portals/2/CropReports/2019CROPREPORT.pdf?ver=2020-09-29-122937-093.

Table 6: Agriculture Activity Data and GHG Emissions between 2006 and 2019 by Subsector

SECTOR	2006	2019	PERCENT CHANGE
Activity Data			
Diesel Pumps (Number of pumps)	490	320	-35%
Enteric Fermentation (Number of livestock)	15,790	14,550	-8%
Fertilizer (tons)	19,700	22,700	15%
Lime (tons)	7,030	750	-89%
Manure (Number of livestock)	17,620	16,300	-7%
Pesticides (pounds)	9,770	1,520	-84%
Agriculture Residue Burning *	—	—	—
Rice (acres)	105,670	96,770	-8%
Urea (tons)	4,880	2,860	-41%
Agricultural equipment*	—	—	—
Emissions ($MTCO_2e$)			
Diesel Pumps	28,060	18,810	-33%
Enteric Fermentation	14,960	14,570	-3%
Fertilizer	74,400	85,760	15%
Lime	2,920	310	-89%
Manure	5,700	4,760	-16%
Pesticides	10	Less than 10	-85%
Agriculture Residue Burning	36,440	44,310	22%
Rice	281,310	257,620	-8%
Urea	3,570	1,900	-47%
Agricultural equipment	74,280	73,580	-1%
Total Annual $MTCO_2e$	**521,650**	**501,620**	**-4%**

*Activity data for agricultural residue burning and equipment are not available.

All numbers are rounded to the nearest 10. Totals may not equal the sum of individual rows.

Transportation

Butte County community members drove approximately 464.3 million vehicle miles in 2006, increasing to approximately 533.6 million vehicle miles in 2019.[4] The VMT in 2006 resulted in GHG emissions of approximately 264,420 $MTCO_2e$, which dropped to approximately 229,100 in 2019, a 13-percent decrease. Although vehicle miles increased between 2006 and 2019, total emissions decreased due to increasingly fuel-efficient vehicles, along with a wider adoption of electric vehicles. The average vehicle in Butte County emitted

[4] California Air Resources Board, 2021, https://arb.ca.gov/emfac/.

33 percent fewer GHG emissions in 2019 than in 2006, as shown above in **Table 1**. **Table 7** provides a breakdown of the activity data and emissions for on-road transportation by each individual year included in the updated community inventory.

Table 7: Transportation Activity Data and GHG Emissions between 2006 and 2019 by Sector

SECTOR	2006	2019	PERCENT CHANGE
Activity Data (VMT)			
On-road transportation	464,302,670	533,626,990	15%
Emissions ($MTCO_2e$)			
On-road transportation	264,420	229,110	-13%
Total Annual $MTCO_2e$	**264,420**	**229,110**	**-13%**

All numbers are rounded to the nearest 10. Totals may not equal the sum of individual rows.

Solid Waste

Butte County's community-wide GHG emissions associated with solid waste includes municipal solid waste (MSW) thrown away by community members, alternative daily cover (ADC) applied at landfills, and emissions associated with all waste in place at the Neal Road Landfill. Emissions increased by 50 percent due to population growth and accumulation of waste in the landfill over time. Debris from the 2018 Camp Fire additionally resulted in a higher proportion of waste in place at the Neal Road landfill, increasing landfill and solid waste emissions. **Table 8** presents solid waste emissions data for each year.

Table 8: Solid Waste Activity Data and GHG Emissions between 2006 and 2019 by Subsector

SECTOR	2006	2019	PERCENT CHANGE
Activity Data (Tons)			
Solid Waste	66,530	101,000	52%
Waste in place	2,624,150	4,758,220	81%
Emissions ($MTCO_2e$)			
Solid Waste	19,500	28,820	48%
Waste in place	21,330	32,300	51%
Total Annual $MTCO_2e$	**40,830**	**61,120**	**50%**

All numbers are rounded to the nearest 10. Totals may not equal the sum of individual rows.

Off-Road Equipment

According to data shown in **Table 9**, emissions from off-road equipment in Butte County increased approximately 6 percent between 2006 and 2019, from 56,070 $MTCO_2e$ in 2006 to 59,310 $MTCO_2e$ in 2019. This increase is likely due to the purchasing and use of more off-road equipment (such as lawn mowers and other gardening equipment) as the Butte County population has grown since the 2006 inventory year.

Table 9: Off-Road Equipment GHG Emissions between 2006 and 2019 by Sector

Sector	2006	2019	Percent Change
Total Annual $MTCO_2e$			
Off-road equipment	56,070	59,310	6%

All numbers are rounded to the nearest 10. Totals may not equal the sum of individual rows.

Residential Energy

Butte County's GHG emissions from residential energy totaled approximately 90,720 $MTCO_2e$ in 2019, compared to 133,350 $MTCO_2e$ in 2006, a decline of 32 percent. Residential electricity and natural gas GHG emissions decreased largely due to a decrease in overall use, while residential electricity also experienced a decline due to cleaner sources of electricity, supported by State programs that require that PG&E source an increased amount of their electricity from renewable sources. Table 10 provides a breakdown of the activity data and GHG emissions for residential energy.

Table 10: Residential Energy Activity Data and GHG Emissions between 2006 and 2019 by Subsector

Sector	2006	2019	Percent Change
Activity Data			
Residential Electricity (kWh)	322,460,310	253,167,490	-21%
Residential Natural Gas (therms)	5,887,630	5,140,530	-13%
Residential Propane (gallons)	5,960,640	6,371,650	7%
Emissions ($MTCO_2e$)			
Residential Electricity	67,170	27,390	-59%
Residential Natural Gas	31,340	27,370	-13%
Residential Propane	34,840	35,960	3%
Total Annual $MTCO_2e$	**133,350**	**90,720**	**-32%**

All numbers are rounded to the nearest 10. Totals may not equal the sum of individual rows.

Nonresidential Energy

Butte County's GHG emissions from nonresidential energy totaled approximately 37,350 $MTCO_2e$ in 2019, compared to 58,670 $MTCO_2e$ in 2006, a decline of 36 percent. The decrease is primarily driven by a large decline in electricity use, coupled with increasing supplies of cleaner electricity as a result of State programs that create a further reduction in electricity-related emissions. However, using PG&E's revised energy use numbers for 2006, natural gas use and related emissions increased 33 percent from 2006 to 2019. This may be a result of increased heating demand in nonresidential buildings or increases in industrial activity, although other less-apparent factors may also be involved. Table 11 provides a breakdown of the activity data and GHG emissions for nonresidential energy.

Table 11: Nonresidential Energy Activity Data and GHG Emissions between 2006 and 2019 by Subsector

Sector	2006	2019	Percent Change
Activity Data			
Nonresidential Electricity (kWh)	203,365,720	153,391,250	-25%
Nonresidential Natural Gas (therms)	2,925,420	3,897,830	33%
Emissions ($MTCO_2e$)			
Nonresidential Electricity	43,100	16,600	-61%
Nonresidential Natural Gas	15,570	20,750	33%
Total Annual $MTCO_2e$	**58,670**	**37,350**	**-36%**

All numbers are rounded to the nearest 10. Totals may not equal the sum of individual rows.

Water and Wastewater

Emissions associated with the water and wastewater sector are counted in indirect or direct emissions. Indirect water emissions refer to emissions created by the electricity required to treat and move water to where it is used. Indirect wastewater emissions refer to electricity needed to move wastewater to water treatment facilities, and to process and discharge it. Direct wastewater emissions refer to emissions produced directly by decomposing materials in wastewater. GHG emissions from Butte County's water and wastewater consumption decreased between 2006 and 2019. Indirect water GHG emissions decreased by 44 percent while emissions from wastewater decreased by 3 percent. The emissions data in **Table 12** shows an increase in emissions from water use and direct wastewater. This is despite an increase in total water use from 2006 to 2019, likely as a result of a growing population. The decrease in emissions from indirect water use is linked to cleaner sources of energy being used to treat and move water supplies. The slight decline in wastewater-related emissions is a result of a slight estimated decrease in the number of properties using septic tanks.

Table 12: Water and Wastewater Activity Data and GHG Emissions between 2006– and 019 by Subsector

Sector	2006	2019	Percent Change
Activity Data (Million Gallons)			
Indirect water	18,250	19,850	9%
Indirect wastewater	10	10	<1%
Emissions ($MTCO_2e$)			
Indirect water	6,450	3,640	-44%
Indirect wastewater	10	10	Less than 1%
Direct wastewater	13,730	13,310	-3%
Total Annual $MTCO_2e$	**20,190**	**16,960**	**-16%**

*Activity data for 2006 direct wastewater was not provided.

All numbers are rounded to the nearest 10. Totals may not equal the sum of individual rows.

Stationary Sources

Stationary source data in 2006 reflected a total of 3,960 $MTCO_2e$ resulting from this sector. Stationary source sector data were not available for 2019 and is therefore not included in this report. Efforts to obtain these data remain ongoing.

Land Use and Sequestration

GHG emissions from land use and sequestration can be either positive (a source of emissions) or negative (removing emissions from the atmosphere, creating what is known as an emissions "sink"). Natural lands and street trees absorb carbon, storing it in wood, plants, and soil. As a result, when natural land is preserved or when more street trees are planted, emissions from this sector are negative because GHGs are being removed from the atmosphere. However, developing natural lands or converting them to a different form (for example, replacing forests with crop land) or removing street trees causes carbon to be released, creating GHG emissions.

This sector includes emission sources and sinks from three types of activities: sequestration of GHG emissions in locally-controlled forested lands, sequestration of GHG emissions in street trees in urbanized unincorporated areas, and emissions caused by permanently removing vegetation from natural lands or farmlands as a part of development.

Emissions and sequestered amounts remained constant in both years for all three activities. Locally-controlled forests and street trees have not had their sequestration capabilities changed by human activities during the inventory period. While there was some development activity that caused a loss of sequestered GHG emissions, records of when the development specifically occurred are not available, and so the GHG emissions have been assigned equally to both inventory years, hence the lack of changes. These emissions do not include any changes in sequestration potential as a result of fire activity.

Wildfire and Controlled Burns

Emissions associated with wildfires and controlled burns in 2006 totaled 3,630 $MTCO_2e$, rising in 2019 to a total of 4,030 $MTCO_2e$. This increase of 11 percent is the result of natural variation in wildfire patterns. Controlled burn activity increased substantively from 2006 to 2019 as a result of increased fuel control efforts. However, wildfire emissions are not calculated in the totals presented in this memorandum and are for informational purposes only.

5. County Operations GHG Inventory

A County operations GHG inventory summarizes GHG emissions that are a direct result of Butte County's government operations. As part of the 2014 CAP, Butte County prepared a County operations GHG inventory for the calendar year 2006. PlaceWorks updated the 2006 inventory to be consistent with current guidance and best practices, using the same process that was used to update the community-wide inventories shown in Section 4.

The County operations inventory is treated separately from the community-wide inventory. For example, the two are not added together or combined in any way to determine the "total" emissions in Butte County. Some sources of emissions in the County operations inventory are not included in the community-wide inventory. For example, energy use at County facilities in Oroville is included in the County operations inventory, but not in the community-wide inventory because that focuses on activities in the unincorporated area. Other sources of emissions are included in both the community-wide and County operations inventories, such as the decomposition of waste at the Neal Road landfill facility. However, since the inventories are not combined, these common sources of emissions are not counted twice in any one place.

SECTORS

The County operations GHG inventory assessed six sectors, as follows:

- **Energy** includes the GHG emissions of electricity and natural gas used to power County buildings, facilities, and operations.
- **Commute** covers GHG emissions that result from the total annual miles that County staff drive to get to and from work.
- **Fleet** includes the GHG emissions released by County vehicles based on the total gallons of fuel used.
- **Solid Waste** accounts for the GHG emissions released from the collection of trash at County buildings and facilities, as well as emissions from waste in place at the County-operated Neal Road facility.
- **Water and Wastewater** accounts for the energy used to transport and process the water used and the wastewater generated at County buildings and facilities.
- **Refrigerant** includes the amounts of refrigerants used to refill air conditioners in County buildings and vehicles.

COUNTY OPERATIONS GHG INVENTORY RESULTS

The proportion of each sector's contribution to annual County operations GHG emissions is not fully consistent between the years 2006 and 2019. As **Table 13** illustrates, the highest emitter of GHG emissions by County operations remained solid waste between 2006 and 2019, increasing from 55 percent in 2006 to 71 percent in 2019. The reason for these shifts are described in more detail in each sector section below.

Employee commutes accounted for the second-highest proportion of emissions at 18 percent in 2006, later declining to only 12 percent in 2019. Energy accounted for the third-highest source of emissions in 2006, decreasing to 6 percent of emissions in 2019, largely due to more renewable and carbon-free sources of energy. Emissions from the fleet sector decreased slightly, accounting for 12 percent of emissions in 2006 and 11 percent in 2019. Emissions from water and wastewater increased very slightly due to the same factors. Note that no refrigerant data was reported for 2006.

Table 13: Proportions of Annual County Operations GHG Emissions by Sector

SECTOR	2006	2019
Energy	15%	6%
Commute	18%	12%
Fleet	12%	11%
Solid Waste	55%	71%
Water and Wastewater	Less than 1%	Less than1%
Refrigerants	—	Less than1%

As shown in **Table 14**, annual County GHG emissions increased by 18 percent between 2006 and 2019. The largest decrease in emissions came from the energy sector at 55 percent. The decrease in energy is partly due to switching to more efficient appliances, such as LED light bulbs, as well as the use of increasingly more renewable and carbon-free sources of electricity, as previously shown in **Table 1**. The commute sector also decreased in emissions by 22 percent, largely due to an increase in fuel-efficient vehicles and a decrease in County employees (2,267 in 2006 compared to 2,129 in 2019). Emissions from water and wastewater declined due to a decrease in County employees and an increase in the amount of renewable and carbon-free sources of electricity used to move and process water and wastewater. GHG emissions from the fleet sector increased by 13 percent, which could be due to changes in County vehicle fleet mix despite overall increase in vehicle

fuel efficiency and may also be linked to changes in fleet vehicle use or policies. Solid waste GHG emissions increased by 51 percent due predominantly to an accumulation of waste in place at the Neal Road Landfill due to clean up activities from the 2018 Camp Fire.

Table 14: Percent Change in Total GHG Emissions between 2006 and 2019 by Sector

Sector	2006 $MTCO_2E$	2019 $MTCO_2E$	Percent Change
Energy	5,900	2,640	-55%
Commute	6,850	5,330	-22%
Fleet	4,550	5,140	13%
Solid Waste	21,340	32,310	51%
Water and Wastewater	90	60	-33%
Refrigerants*	—	20	—
Total	**38,730**	**45,500**	**17%**

*Refrigerant activity data for 2006 was not available.

All numbers are rounded to the nearest 10. Totals may not equal the sum of individual rows.

SECTOR DETAILS

Energy

As shown in **Table 15**, Butte County's GHG emissions from County operations energy use totaled 2,640 $MTCO_2e$ in 2019, a decrease of 55 percent from 2006 levels. GHG emissions associated with building and facility electricity use, building and facility natural gas use, and electricity used for public lighting all decreased during this same period, by 62, 48, and 88 percent, respectively. This is primarily due to PG&E increasing their share of renewable sources of electricity along with County energy conservation and efficiency efforts. A decrease in kWh for building and facilities and public lighting (e.g. streetlights, traffic signals, and outdoor lighting at County-owned public facilities) is due to more energy efficient appliances such as HVAC and LED lighting.

Table 15: Energy Activity Data and GHG Emissions Change between 2006 and 2019 by Subsector

Sector	2006	2019	Percent Change
Activity Data			
Building and Facility electricity use (kWh)	13,310,570	9,607,510	-28%
Public Lighting electricity use (kWh)	329,530	80,580	-76%
Building and Facility natural gas use (therms)	577,560	298,240	-48%
Emissions ($MTCO_2e$)			
Building and Facility electricity use	2,750	1,040	-62%
Public Lighting electricity use	3,070	1,590	-48%
Building and Facility natural gas use	80	10	-88%
Total Overall Emissions	**5,900**	**2,640**	**-55%**

All numbers are rounded to the nearest 10. Totals may not equal the sum of individual rows.

Employee Commute

Commute GHG emissions are calculated in VMT, representing the annual miles driven by County employees to get to and from work. The data come from surveys of County employees conducted in 2006, which were then aggregated to 2019 based on the change in employees. Employee commutes were aggregated in place of conducting a new employee commute survey due to the impacts of the COVID-19 pandemic. As shown in **Table 16**, annual GHG emissions from the commute sector decreased from 6,850 $MTCO_2e$ in 2006 to 5,330 $MTCO_2e$ in 2019, a 22-percent reduction. The drop in GHG emissions is driven by a decline in overall employee commute VMT along with increasingly fuel-efficient vehicles.

Table 16: Commute GHG Emissions Change between 2006 and 2019

Sector	2006	2019	Percent Change
Activity Data (VMT)			
Commute Trips	15,800,790	14,839,930	-6%
Emissions ($MTCO_2e$)			
Commute Trips	6,850	5,330	-22%
Total Overall Emissions	**6,850**	**5,330**	**-22%**

All numbers are rounded to the nearest 10. Totals may not equal the sum of individual rows.

Fleet

Fleet data includes the gallons of gasoline and diesel associated with the County's vehicle fleet. The County does not have any electric vehicles in their fleet; therefore, electric vehicles are not included in **Table 17**. Overall fleet GHG emissions increased from 4,550 $MTCO_2e$ in 2006 to 5,140 $MTCO_2e$ in 2019, an increase of 13 percent. This increase is due at least in part to the fact that the 2019 GHG inventory included emissions from County off-road equipment, whereas the 2006 inventory did not.

Table 17: Fleet GHG Emissions Change between 2006 and 2019

Sector	2006	2019	Percent Change
Activity Data (gallons)			
Fleet	471,730	566,800	20%
Emissions ($MTCO_2e$)			
Fleet	4,550	5,140	13%
Total Overall Emissions	**4,550**	**5,140**	**13%**

All numbers are rounded to the nearest 10. Totals may not equal the sum of individual rows.

Solid Waste

As shown in **Table 18**, County GHG emissions related to solid waste increased by 51 percent between 2006 and 2019. The primary reason for this increase is an increase in the amount of waste deposited at the Neal Road landfill due to clean up activities from the 2018 Camp Fire. As this facility is under County jurisdiction, changes in emissions are part of the County's government operations emissions profile. There was a slight decline in the amount of waste produced as part of County government activities, which is likely due to a lower number of County employees (2,267 in 2006 compared to 2,129 in 2019).

Table 18: Solid Waste Activity Data and GHG Emissions Change between 2006 and 2019 by Subsector

Sector	2006	2019	Percent Change
Activity Data (tons)			
Solid waste	20	19	-5%
Waste in place	2,624,150	4,758,220	81%
Emissions ($MTCO_2e$)			
Alternative Daily Cover/Municipal Solid Waste	Less than 10	Less than 10	-9%
Waste in place	21,330	32,300	51%
Total Overall Emissions	**21,340**	**32,300**	**51%**

* Activity data for the landfill subsector was not available.
All numbers are rounded to the nearest 10. Totals may not equal the sum of individual rows.

Water and Wastewater

Water and wastewater GHG emissions decreased 33 percent from 2006 to 2019, as shown in **Table 19**. This is partially the result of fewer County employees in 2019 than in 2006, which resulted in reduced water use. Additionally, as sources of electricity became more renewable from 2006 to 2019, this resulted in a decrease in the GHG emissions associated with the energy needed to move and process water and wastewater.

Table 19: Water and Wastewater Emissions Change between 2006 and 2019 by Subsector

Sector	2006	2019	Percent Change
Activity Data (million gallons)			
Indirect Water Use	41	39	-5%
Indirect Wastewater	16	15	-6%
Emissions ($MTCO_2e$)			
Indirect Water Use	20	10	-50%
Indirect Wastewater	10	Less than 10	-61%
Direct Wastewater	60	50	-17%
Total Overall Emissions	**90**	**60**	**-33%**

*Emissions data for direct wastewater is not available for 2006.
All numbers are rounded to the nearest 10. Totals may not equal the sum of individual rows.

Refrigerants

GHG emissions associated with refrigerants were not reported in 2006. In 2019, a total of 30 pounds of refrigerant was used for a total of 20 $MTCO_2e$. PlaceWorks will incorporate refrigerant data from 2006 into this inventory if it becomes available.

6. Next Steps

Following County review of these GHG inventory results and any revisions that may be needed, PlaceWorks will prepare 2030, 2040, and 2050 forecasts of community-wide and County operations GHG emissions and will assess the GHG reduction benefits from existing and planned state, regional, and local activities GHG emissions. The results of the GHG inventory, forecast, and benefits of existing and planned activities will help inform new policies to reduce both community-wide and County operations GHG emissions.

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Appendix A- Butte County CAP GHG Inventory Methods and Sector Memorandum

MEMORANDUM

DATE September 9, 2020

TO Dan Breedon, Butte County, Planning Division Manager

Tristan Weems, Butte County, Associate Planner

FROM Tammy L. Seale, PlaceWorks, Climate Action & Resilience Associate Principal

Eli Krispi, PlaceWorks, Climate Action & Resilience Senior Associate
Torina Wilson, PlaceWorks, Project Planner

SUBJECT Butte County Climate Action Plan 2020 – Draft Greenhouse Gas (GHG) Inventory Methods, Sectors, and Metrics (Tasks 1B and 1C)

Introduction

PlaceWorks is working with Butte County to update County's climate action plan (CAP), a strategic plan to reduce greenhouse gas (GHG) emissions associated with Butte County. This work includes multiple GHG inventories, which are assessments of the sources and amounts of GHG emissions resulting from community-wide and County operations activities. This work involves updating the County's existing community-wide and County operations inventories for the calendar year 2006 to be consistent with the best available data sources and current practices, as well as preparing new GHG inventories for the calendar year 2019. This draft memo contains a discussion of the methods that PlaceWorks will use to update the County's existing GHG inventories and prepare new ones, a summary of key changes between the existing GHG inventories and the proposed updated/new analyses, the sources of GHG emissions that will be assessed in the GHG inventories, and the associated metrics needed to track and analyze GHG reduction measures.

Inventory Methods

PlaceWorks will prepare the updated and new GHG inventories to be consistent with widely adopted and standard guidance documents, known as protocols. These protocols provide recommendations on how to effectively assess GHG emissions, including guidance on what activities to evaluate in the GHG inventories and methods for how to measure emissions from these activities. The use of these standard methods will allow for an easy comparison of emission levels between the 2006 and 2019 inventories, as well as a comparison of Butte County's emissions with those of other communities.

GHG inventories are estimates of emissions based on standard methods and verified datasets, not direct measurements of GHG emissions. However, the use of these standard methods in the protocols, in combination with accurate data from appropriate sources, allows the GHG inventories to provide reliable estimates of local emission levels. This reliability will support a more effective and defensible CAP, allowing for greater success in CAP implementation. PlaceWorks will collect information on the types of activities that contribute to GHG emissions (activity data) and information on the amount of emissions released per unit of activity (emissions factors). PlaceWorks will collect these data from the same sources as used during the preparation of the adopted CAP, to the extent these data remain available and accurate. Consistent with the data in the adopted CAP, all GHG emissions will be presented as metric tons of carbon dioxide equivalent

($MTCO_2e$). This is a commonly-used unit in GHG inventories and reflects the relative heat-trapping potential of different GHGs.

Butte County's existing 2006 GHG inventories rely on two protocol documents. The County operations inventory uses the Local Government Operations Protocol (LGOP), which was developed in 2008 and last updated in 2010 [5]. The LGOP is a guide for accounting and reporting the GHG emissions from activities of local government agencies, such as cities, towns, and counties. It is widely used throughout California and the United States and includes recommendations from several existing programs, as well as California's mandatory GHG reporting regulations. The community-wide GHG inventory uses the United States Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions (U.S. Community Protocol), which was first developed in 2012 and last updated in 2019 [6]. This protocol is commonly used across the United States to guide preparation of community-wide GHG inventories. The California Governor's Office of Planning and Research also encourages cities and counties to follow the U.S. Community Protocol for community-wide GHG inventories.

PlaceWorks recommends that the updated and new GHG inventories continue to follow the LGOP and U.S. Community Protocol as appropriate, as these two protocols remain the standard guidance documents for preparation of GHG inventories in California. As noted above, continued use of these existing protocols will also allow for more effective comparison of GHG inventory results between Butte County and other communities.

Method Changes

Although PlaceWorks proposes continuing to use the same protocols as were used in the preparation of the adopted CAP, we recommend that the new and updated GHG inventories are prepared using slightly different methods than were used originally. These recommendations are in response to updated scientific information, changes to data availability, and revisions to the protocol guidance itself. All recommendations remain consistent with the guidance in the most recent versions of the LGOP and US Community Protocol.

Global Warming Potentials

When assessing GHG emissions, it is important to be aware that different GHGs have different relative potencies (for example, a pound of methane contributes substantially more to climate change than a pound of carbon dioxide). Values known as global warming potentials (GWPs) quantify these relative differences. As the science understanding of GHGs advances, GWPs are revised to account for new information. The 2006 inventories used GWPs from the Intergovernmental Panel on Climate Change's (IPCC) Second Assessment Report, released in 1995. PlaceWorks proposes updating these values to use the GWPs from the most recent IPCC report (the Fifth Assessment Report, released in 2013) and to use these values in the new 2019 inventory [7]. Table 1 shows the differences in GWPs by gas.

[5] https://ww2.arb.ca.gov/local-government-operations-protocol-greenhouse-gas-assessments
[6] https://icleiusa.org/us-community-protocol/

[7] https://www.ipcc.ch/site/assets/uploads/2018/02/WG1AR5_Chapter08_FINAL.pdf

Table 1: Change in GWPs by GHG

GAS	SECOND ASSESSMENT REPORT GWP	FIFTH ASSESSMENT REPORT GWP
Carbon dioxide (CO_2)	1	1
Methane (CH_4)	21	28
Nitrous oxide (N_2O)	310	265

Transportation Data Sources

The community-wide GHG inventory includes emissions from on-road vehicles (cars, trucks, buses, etc.) traveling to, from, and within the unincorporated areas of Butte County. The number of vehicle miles traveled (VMT) attributed to Butte County comes from the Butte County Association of Government's (BCAG) Travel Development Forecasting Model, which estimates VMT based on factors such as land use, demographic, and surveys of transportation patterns. The 2006 inventory used the version of BCAG's model that was current at the time. However, since then, BCAG has revised the model three times to account for updates in modeling techniques and changes in county transportation patterns, including temporary and permanent migrations due to the 2018 Camp Fire. While the 2006 inventory can continue to use the same VMT figures from the older version of the model, we recommend that the 2019 inventory use VMT data from the most recent model version. Fehr & Peers will provide VMT from the BCAG model.

Waste GHG Emissions Method

The community-wide GHG inventory includes emissions caused by the decay of solid waste in a landfill environment. The 2006 GHG inventory uses a method developed by the California Air Resources Board (CARB) to calculate these GHG emissions based on the amount of solid waste generated by the community. Since the 2006 GHG inventory was prepared, CARB has prepared an updated method that can more accurately assess the longer-term emissions from solid waste. While these two methods are largely similar and both are consistent with the U.S. Community Protocol, PlaceWorks recommends using the newer method for both the 2006 and 2019 inventories to provide greater accuracy.

Inventory Sectors

The community-wide and County operations GHG inventories assess emissions from several different sources, known as sectors. Many of the sectors included in the GHG inventories are required under the relevant protocols. Additional sectors are not required, but the protocols recommend their inclusion if they are relevant and if the necessary data to assess these GHG emissions are available. PlaceWorks proposes maintaining the same sources of GHG emissions as included in the original 2006 GHG inventories with one addition. The U.S. Community Protocol was updated in 2019 with a requirement that GHG emissions associated with changes in biomass now be assessed. The protocol requires that these emissions be assessed for street trees and forested land (including any deforestation activities), while changes in biomass from other vegetation types are optional. PlaceWorks proposes including these GHG emissions in the 2006 and 2019 GHG inventories in accordance with the U.S. Community Protocol, provided the necessary data are available. Tables 2 and 3 show the sectors recommended for inclusion in the updated and new GHG inventories.

Table 2: Recommended Community-Wide GHG Inventory Sectors

Sector Name	Description	Included in original 2006 Inventory?
Agriculture	Emissions from fertilizer and agriculture off-road equipment/vehicles	Yes
Transportation	Emissions from vehicle travel to, from, and within the community	Yes
Residential energy	Emissions from residential electricity, natural gas, and propane use	Yes
Nonresidential energy	Emissions from nonresidential electricity and natural gas use	Yes
Off-road equipment and vehicles	Emissions from off-road gas, diesel, and CNG fuel use	Yes
Solid waste	Emissions from solid waste decomposition in landfills	Yes
Water	Emissions from energy needed to process and transport water	Yes
Wastewater	Emissions from energy needed to move and treat wastewater, and direct emissions from decomposition of waste material	Yes
Land use and sequestration	Emissions absorbed and emitted from street trees and natural vegetation	No

Table 3: Recommended County Operations GHG Inventory Sectors

Sector Name	Description	Included in original 2006 Inventory?
Building energy	Emissions from electricity and natural gas used at County facilities	Yes
Lighting	Emissions from electricity use of streetlights, traffic signals, and public outdoor lighting	Yes
Water and wastewater	Emissions from electricity used to move and treat water and wastewater used and generated by County facilities, and direct emissions from County government-generated wastewater	Yes
Vehicle fleet	Emissions from gasoline and diesel fuel use of County-owned vehicles	Yes
Landfill	Emissions from County-owned landfills	Yes
Employee commute and travel	Emissions from County employee commute and business-related travel	Yes
Government-generated solid waste	Emissions from solid waste generated by County activities	Yes

Tracking Metrics

The updated CAP will include new and revised reduction measures intended to decrease community-wide and County operations GHG emissions to meet the County's GHG emission reduction targets. As a part of the reduction measure development process, PlaceWorks will also work with County staff to identify tracking metrics that County staff can use to monitor the effectiveness of these measures. Such metrics should be readily available, either through the County's existing activities or from an external source, meaningful, and directly related to the measures. Specific tracking metrics will depend on the final measure language (for example, a measure to increase electric vehicle adoption will rely on electric vehicle registration data), but GHG emission reductions will ultimately depend on a handful of key datasets. Tables 4 and 5 show these anticipated high-level tracking metrics by emission sector, although PlaceWorks will finalize this list during preparation of the GHG emission reduction measures.

Table 4: General Tracking Metrics for Community-wide Sectors

SECTOR	DATA NEEDED	UNITS	SOURCES
Agriculture	Crop acreage, livestock population, miscellaneous agricultural activity	Acres, heads of livestock, others as needed	County Agricultural Commissioner, Air Quality Management District
Transportation	Vehicle miles traveled	VMT	BCAG
Residential energy	Electricity, natural gas, and propane use	kWh, therms, gallons	PG&E, other energy suppliers
Nonresidential energy	Electricity and natural gas use	kWh, therms	PG&E, other energy suppliers
Off-road equipment and vehicles	Off-road equipment and vehicle emissions	Emissions	CARB
Solid waste	Solid waste generation	Tons	CalRecycle
Water	Amount of water used	Gallons	County Environmental Health, water providers *
Wastewater	Amount of wastewater produced	Gallons	County Environmental Health, wastewater providers *
Land use and sequestration	Acreage of land uses, street tree coverage	Acres	County Planning *

* Depending on data availability, some or all data for this sector may need to be estimated.

Table 5: General Tracking Metrics for County Operations Sectors

SECTOR	DATA NEEDED	UNITS	SOURCES
Building energy	Electricity and natural gas use	kWh, therms	PG&E, other energy suppliers
Lighting	Electricity use	kWh	PG&E, other energy suppliers
Water and wastewater	Amount of water used and wastewater produced	Gallons	County General Services *
Vehicle fleet	Fuel use from County fleet	Gallons	County General Services *
Landfill	Solid waste in place	Tons	CalRecycle
Employee commute and travel	Commute and travel miles	VMT	County General Services *
Government-generated solid waste	Solid waste generation	Tons	County General Services *

* Depending on data availability, some or all data for this sector may need to be estimated.

Next Steps

PlaceWorks will work with County staff to confirm the methods and GHG emission sources identified in this draft memo. Following confirmation of these points, PlaceWorks will update the 2006 GHG inventory and prepare the 2019 GHG inventory in accordance with this process.