REDWOOD COAST Energy Authority

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City of Arcata

2015 Community Greenhouse Gas Emissions Inventory

11/13/2017

Prepared for
City of Arcata

In Collaboration With
Pacific Gas and Electric Corporation

Striving to develop and implement sustainable energy initiatives that reduce energy demand, increase energy efficiency, and advance the use of clean, efficient and renewable resources available in the region.

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Pacific Gas & Electric
Pacific Gas and Electric Company provides comprehensive climate planning assistance to local governments, from providing energy usage data and assistance with greenhouse gas inventories, to training and guidance on climate action plans.

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Executive Summary

This community emissions inventory is serves as an update to past inventories conducted by the City and by the Redwood Coast Energy Authority. It is intended to assist the City in making decisions related to climate action and greenhouse gas emissions reduction.

This community emissions inventory can be utilized to inform existing initiatives and to establish new initiatives that help the City move towards a more sustainable and resilient community. Tracking of carbon dioxide emissions is considered to be an effective method of measuring the success of the Cities climate action initiatives.

There are numerous gases emitted by human activity that have a significant environmental impact. In accordance with version 1.0 of the Community Greenhouse Gas Inventory Protocol drafted by the International Council on Local Environmental Initiatives (ICLEI), three primary greenhouse gases are considered for this inventory: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). There are three other primary greenhouse gases also addressed by the Protocol but are not applicable to the City of Arcata as they are associated only with large industrial processes. Furthermore, in addition to these three primary gases, there are a small handful of refrigerants that are also tracked by this inventory.

These greenhouse gases all vary in their impact on global warming, otherwise known as their global warming potential (GWP). This GWP has to do with the how well these gases absorb and emit heat. The result is that emission of one gas will have a different impact on global warming compared with another gas.

Because of this, all emissions of greenhouse gases are presented as a comparable amount of CO_2, called equivalent CO_2 (CO_2e). This is analogous to possessing different forms of currency and converting the value of all currencies to dollars in order to determine the total value. This means that while there are multiple greenhouse gases tracked in this inventory, all are converted to CO_2e for this report. This inventory uses 100-year GWPs from the IPCC 5th Assessment.

All CO_2e emissions are presented as originating either from a source or an activity. Source emissions are those that occur within the jurisdictional boundaries of the City of Arcata. Activity emissions are those associated with actions by Arcata residents and businesses such as the use of electricity or the creation of solid waste. It is useful to make this distinction in order to facilitate meaningful and effective government initiatives and community action.

In addition, emissions are presented in two frameworks: emissions sources and activities that are within significant influence of the City government, and those sources and activities that are outside significant influence. The first framework highlights those activities and sources that the government of Arcata can have a direct impact on. The latter, also referred to as "upstream" emissions, are included to provide additional information regarding the more global impact of the consumption associated with the activities of residents and businesses. This means that while a reduction in consumption of energy and fuel will reduce the emissions locally that are officially "assigned" to the City of Arcata, there will also be an additional global reduction in upstream emissions that do not occur locally and so are not officially assigned to the City.

The results of this inventory are shown in Figure 1 and summarized in Table 1 and Table 2. Results suggest that future climate action initiatives focus primarily on the reduction of fossil fuel use

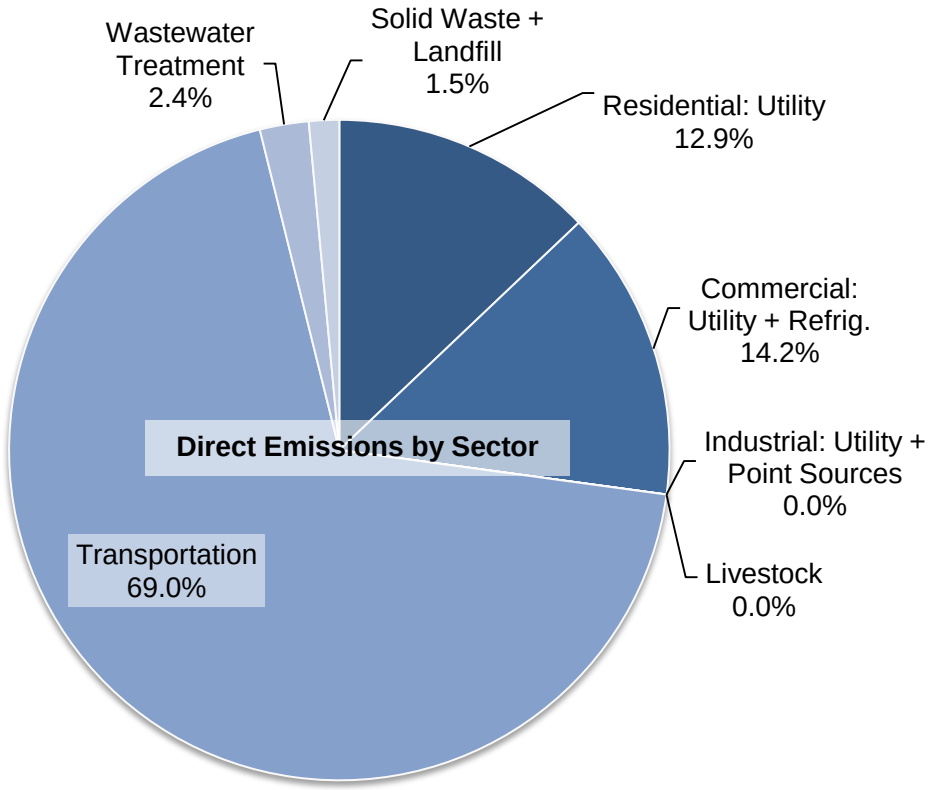
associated with transportation and with cooking and heating. The next two primary emissions sectors are associated with electricity consumption and the generation of solid waste.

Table 1: Summary of emissions sources and activities that are within significant local government influence.

Local Emissions	Quantity of Emissions (Metric Tons of CO_2e)
Activity: Electricity Consumption	17,347
Source: Stationary Combustion of Fuels	29,745
Source: Mobile Combustion	122,359
Activity: Solid Waste Generation	2,629
Source: Wastewater Treatment	4,253
Source: Leaked Refrigerants	1,338
Source: Industrial Point Sources	6
Source: Livestock	0
Source: Landfills	0
Total	**177,677**

Table 2: Summary of upstream emissions sources and activities that are outside significant local government influence.

Upstream Emissions	Quantity of Emissions (Metric Tons of CO_2e)
Activity: Upstream Natural Gas Emissions	6,117
Activity: Upstream Gasoline Emissions	18,343
Activity: Upstream Electricity Emissions	2,873
Activity: Upstream Diesel Emissions	13,831
Activity: Upstream Propane Emissions	606
Total	**41,770**



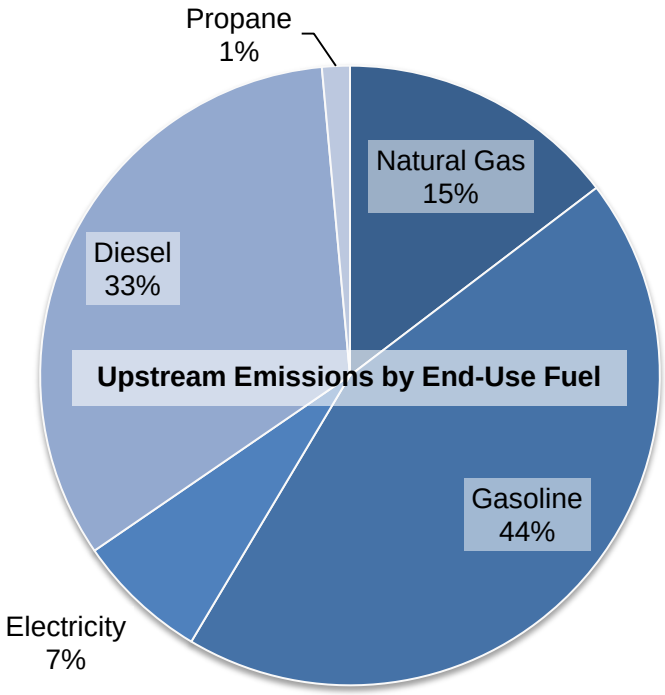


Figure 1: Summary of emissions sources and activities that are within (above) and outside (below) significant local government influence.

Upstream Emissions

The combined result of all emissions from sources and activities both within and outside significant government influence is shown in Figure 2. The overall story conveyed by these results shows that upstream emissions equal roughly 25% of those emissions that are within local influence, resulting in roughly 20% of combined emissions. Furthermore, while local jurisdictions do not have control over the processes that contribute to upstream emissions, they can be reduced directly through a reduction in local energy consumption and activities.

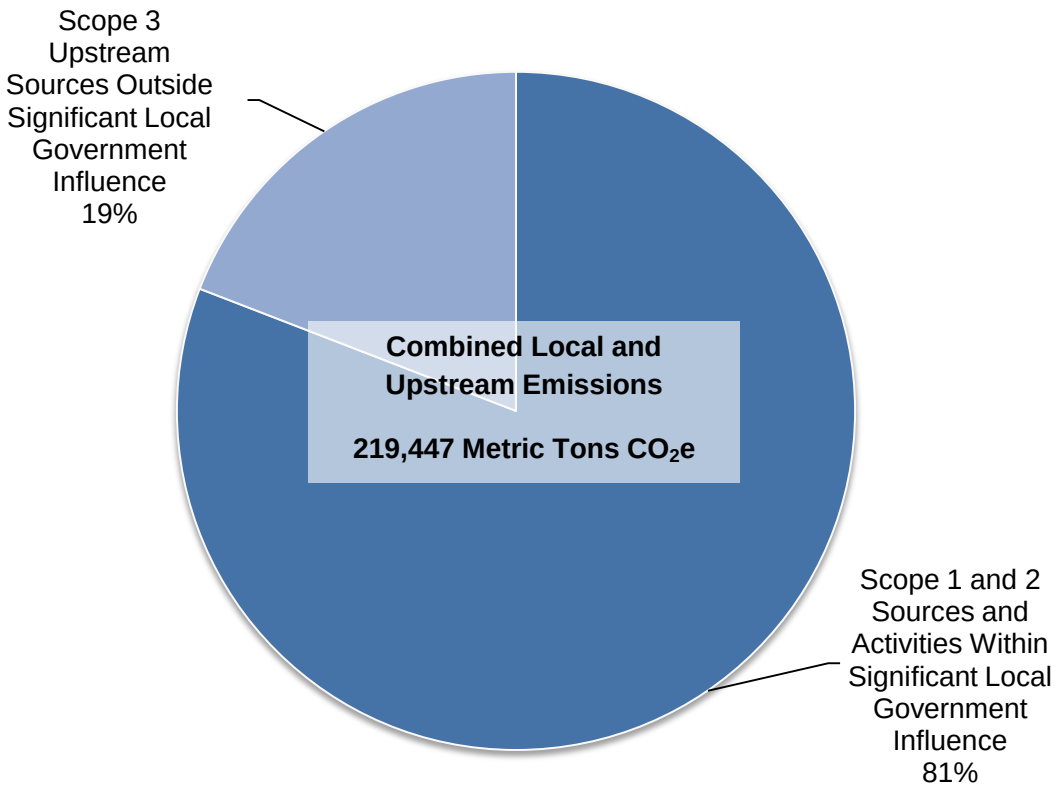


Figure 2: Combined emissions of all sectors both within significant government influence and outside significant government influence. Both direct and upstream emissions are included.

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1 Climate Change Background

Naturally occurring gases dispersed in the atmosphere determine the Earth's climate by trapping solar radiation. This phenomenon is known as the greenhouse effect. Conclusive 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.

Reducing electricity, natural gas, and fossil fuel use in the community can have many benefits in addition to reducing greenhouse gas emissions including;

- more efficient use of energy further decreases utility and transportation costs for residents and businesses,
- money not spent on energy is more likely to be spent at local businesses and add to the local economy
- retrofitting homes and businesses to be more efficient creates local jobs,
- reducing fossil fuel use improves air quality which reduces criteria pollutants that impact the health of the community,
- promoting alternative transportation provides opportunities for walking and bicycling which improves residents' health.

1.1 Climate Adaptation is Insurance Against the Risks of Climate Change

For many of the same reasons that home owners carry fire insurance and car owners carry auto insurance, the City of Arcata has completed this inventory in order to inform decisions that will insure the community against the risks of climate change. Planning for future climate change, and targeting methods of adaptation, will allow Arcata to reap significant benefits in the quality of life, economic health, and environmental stewardship of the community. Regardless of the reasons for climate change, government and community action now will help buffer the citizens of Arcata from future changes in the climate.

1.2 Evidence of Climate Change

There is international scientific consensus that the global climate is changing, and that human actions, primarily the burning of fossil fuels, are a 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."[1] 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 greenhouse gas (GHG) concentrations."

The global average land and ocean temperature over the last 30 years has been increasingly greater than the 20th century average. The years 2014, 2015, and 2016 have consecutively set the record for the largest temperature anomaly recorded since 1880. **Figure 3** shows this trend.[2]

[1] 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.

[2] NOAA National Centers for Environmental information, Climate at a Glance: Global Time Series, published October 2017, retrieved on November 2, 2017 from http://www.ncdc.noaa.gov/cag/

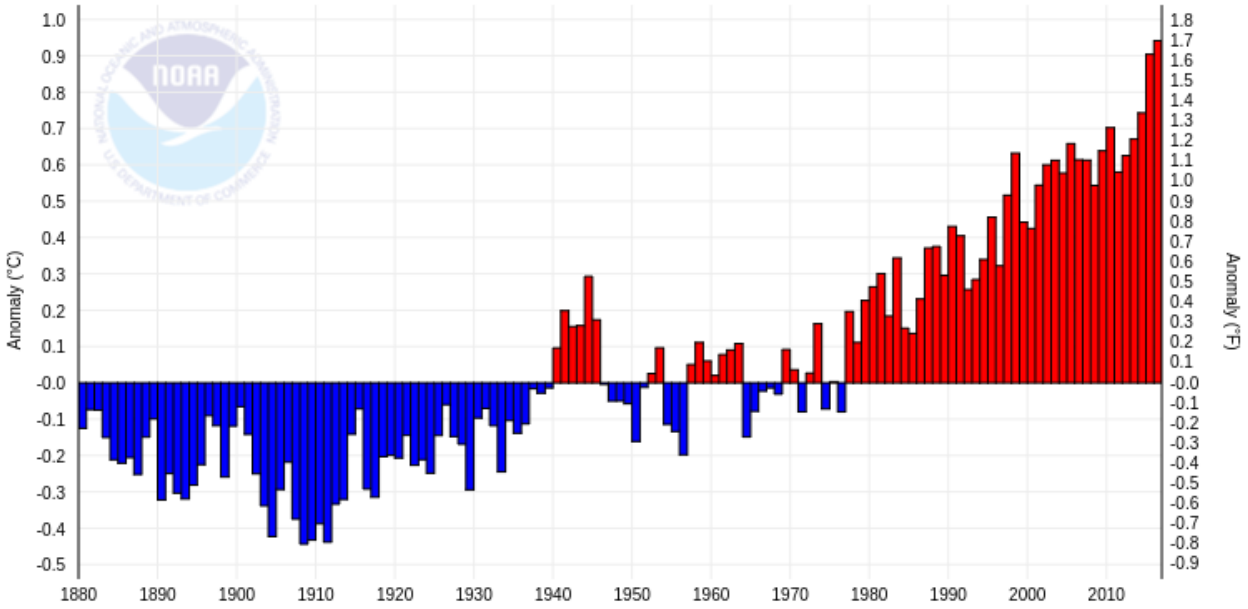


Figure 3: Annual global land and ocean temperature anomalies with respect to the 20th century average.[2]

In addition to the study of the global impacts of climate change, there has been significant scientific work looking at the potential impacts of climate change at the regional level. Results say that the City of Arcata could be impacted by[3];

- a possible fivefold increase in the number of days above 85 °F,
- an 80% to 90% loss in annual snow pack,
- a 3.6% increase in acreage burned by forest fires,
- a roughly 15% reduction in annual precipitation,
- increased vulnerability to extreme weather events (e.g. flooding),
- increased load and stress on community infrastructure such as roads, power lines, and communication systems.

1.3 California Policy

California has a number of state level policies that serve as regulatory drivers for climate action planning at the local government levels, which are described below.

1.3.1 Global Warming Solutions Act (AB32)

California passed the Global Warming Solutions Act (AB 32) in 2006, which charged the California Air Resources Board (CARB) with implementing a comprehensive statewide program to reduce greenhouse gas emissions. AB 32 established the following greenhouse gas emissions reduction targets for the state of California:

- 2000 levels by 2010
- 1990 levels by 2020

1.3.2 SB 375

SB 375 enhances California's ability to reach its AB 32 goals by promoting good planning with the goal of more sustainable communities. SB 375 requires CARB to develop regional greenhouse gas

[3] Local impact estimates obtained from http://cal-adapt.org/ and the California Adaptation Planning Guide available at http://resources.ca.gov/climate_adaptation/docs/APG_Defining_Local_and_Regional_Impacts.pdf

emission reduction targets for passenger vehicles. CARB is to establish targets for 2020 and 2035 for each region covered by one of the State's 18 metropolitan planning organizations (MPOs).

1.3.3 Executive Order S-3-05

Executive Order S-3-05, issued by Governor Schwarzenegger, reinforces these goals and also sets a schedule for the reporting of both the measured impacts of climate change upon California's natural environment and the emissions reduction efforts undertaken by a myriad of state, regional, and local groups. Executive Order S-3-05 establishes an additional target of 80% below 1990 levels by 2050. Arcata's GHG emissions inventory is intended to enable the City to develop effective GHG reduction policies and programs to meet these targets and track emissions reduction progress.

1.3.4 California Environmental Quality Act (CEQA)

CEQA requires public agencies to evaluate the environmental impacts of discretionary development plans and projects in their jurisdictions. CEQA guidelines were updated in March 2010 to require analysis of climate change in CEQA documents. Many jurisdictions are finding that climate change impacts from local government activities are "significant" under CEQA, and are identifying emissions reductions targets and Climate Action Plans as mitigation measures to reduce climate change impacts to less-than-significant levels.

1.4 Sustainability and Climate Change Mitigation Activities in the City of Arcata

Arcata has already taken significant steps that have or will lead to ancillary benefits in the form of community resilience, energy conservation and greenhouse gas mitigation. These include:

- Community Greenhouse Gas Reduction Plan (2005)
- Community Greenhouse Gas Reduction Plan (2006)
- Greenhouse Gas Inventory (2000, 2005, 2006, 2010, 2015)
- Pedestrian and Bicycle Master Plan (2010)
- Reduced energy consumption by as much as 30% in certain facilities since 2006.
- Installation of electric vehicle charging station in downtown Arcata (2008)
- Installation of solar electric systems at City Hall and Arcata Marsh Interpretive Center (2005, 2008)
- Implementation of energy efficiency measures at City-funded low-income housing
- Installation of solar electric and solar hot water systems at City-funded low-income housing
- Waste reduction/diversion of 51 percent since 1990
- Participation in annual Plan It Green Conference
- Carbon Sequestration:
    - Arcata Community Forest management - Management Plan emphasizing carbon sequestration by growing trees on extended rotations, designating reserves and adding forest acres that could otherwise be developed.
    - Riparian forest establishment - Established more than 100 acres of new riparian forest along creeks and bottomlands.
    - Salt Marsh Project - The McDaniel Slough Marsh Restoration Project expects to sequester additional carbon on a 240-acre site. This project is a case study that will be used to help develop sequestration protocols for salt marsh restoration activities.
    - Urban Forestry Program - Active program to expand planting of trees in the urban landscape including parks, roadside greenways, and the downtown area (i.e. The Plaza).

2 Inventory Methodology

The first step toward achieving tangible greenhouse gas emission reductions requires identifying baseline emissions levels and sources and activities generating emissions in the community. This report presents emissions from the Arcata community as a whole; emissions from operations of the Arcata government are presented in the previously released City of Arcata 2005 Government Operations Greenhouse Gas Emissions Inventory. The government operations inventory is mostly a subset of the community inventory, as shown in Figure 3. For example, data on commercial energy use by the community includes energy consumed by municipal buildings, and community vehicle-miles-traveled estimates include miles driven by municipal fleet vehicles.

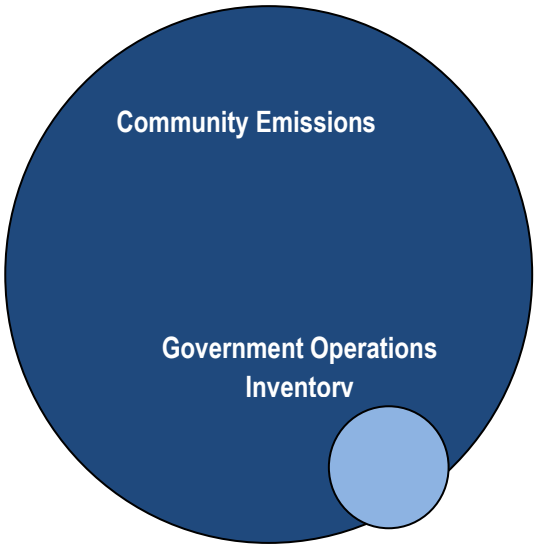


Figure 4: Relationship of community and government operations inventories.

As local governments have continued to join the climate protection movement, the need for a standardized approach to quantify GHG emissions has proven essential. This inventory uses the approach and methods provided by the Community Greenhouse Gas Emissions Protocol (Community Protocol)[4].

2.1 Community Emissions Protocol

The Community Protocol was released by ICLEI in October 2012, and represents a new national standard in guidance to help U.S. local governments develop effective community GHG emissions inventories. It establishes reporting requirements for all community GHG emissions inventories, provides detailed accounting guidance for quantifying GHG emissions associated with a range of emission sources and community activities, and provides a number of optional reporting frameworks to help local governments customize their community GHG emissions inventory reports based on their local goals and capacities. The State of California Governor's Office of Planning and Research recommends that California local governments follow the Community Protocol when undertaking their greenhouse gas emissions inventories.

2.2 Quantifying Greenhouse Gas Emissions

A summary of the approach and method used to quantify emissions are given below. A more detailed methodology that includes data sources and calculations is available in a separate document entitled Humboldt County Greenhouse Gas Emissions Inventory Tool: Calculation Methodologies. This document is available by request from Redwood Coast Energy Authority.

2.2.1 Sources and Activities

Communities contribute to greenhouse gas emissions in many ways. Two central categorizations of emissions are used in the community inventory: 1) GHG emissions that are produced by "sources" located within the community boundary, and 2) GHG emissions produced as a consequence of community "activities". Emissions sources and activities are color coded as shown in the following table.

[4] http://www.icleiusa.org/tools/ghg-protocol/community-protocol

Source	Activity
Any physical process inside the jurisdictional boundary that releases GHG emissions into the atmosphere	The use of energy, materials, and/or services by members of the community that result in the creation of GHG emissions.

By reporting on both GHG emissions "sources" and "activities", local governments can develop and promote a deeper understanding of GHG emissions associated with their communities. A purely source-based emissions inventory could be summed to estimate total emissions released within the community's jurisdictional boundary. In contrast, a purely activity-based emissions inventory could provide perspective on the efficiency of the community, even when the associated emissions occur outside the jurisdictional boundary. The division of emissions into sources and activities replaces the "scopes framework" that is used in government operations inventories, which does not have a clear definition for application to community inventories.

2.2.2 Regional and Upstream Emissions Sources and Activities

In addition to emissions sources and activities that are assigned to the City of Arcata, additional upstream emissions are shown in order to provide a more complete picture of the global impacts from the consumption of energy and fuels. Upstream emissions are those that occur during the manufacture and transportation of raw materials and fuels related to the production of end use products consumed by the City of Arcata. For example, upstream emissions associated with the consumption of electricity is calculated based on the fuels used to produce that electricity. It is possible to estimate the quantity of different petroleum-based fuels used to produce a portion of the electricity consumed. The upstream emissions associated with the production of these fuels (e.g. mining, extraction, and shipping) are estimated and assigned as the upstream emissions for the consumption of electricity. Upstream emissions are color coded as shown in the following table.

Upstream Emissions
Emissions associated with the mining, extraction, and shipping of raw materials required to provide the end use products that are consumed by the City.

2.2.3 Information Items

There are additional emissions sources and activities that are included solely as an information item to further inform policy decisions. Information items are labeled as such for two possible reasons:

- the emissions source is partially due to the activities of Arcata residences and businesses but there is not enough information to guide a fair allocation to individual jurisdictions,
- or emissions associated with a particular source or activity are already accounted for in another sector.

Information items are labeled separately in the tables throughout this inventory. Information items are not included in the total roll up of emissions for the jurisdiction.

2.2.4 Base Year

The inventory process requires the selection of a base year with which to compare current emissions. Arcata's community greenhouse gas emissions inventory utilizes 2005 as its base year. This year was chosen during the City's Municipal Operations Emissions Inventory due to constraints on data availability for earlier years. This same base year is chosen for this inventory to allow consistency with the municipal operations inventory.

2.2.5 Quantification Methods

Greenhouse gas emissions can be quantified in three 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.
- Report / Survey-based methodologies refer to emissions reported to a regulating agency such as the North Coast Unified Air Quality Management District (NCUAQMD).
- Calculation-based methodologies use activity data and emission factors.

Most emissions sources in this inventory are quantified using calculation based methodologies. Activity data refer to the relevant measurement or modeling 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. See the Humboldt County Greenhouse Gas Emissions Inventory Tool: Calculation Methodologies report for additional information.

Some measurement-based data is also used in this inventory. The process emissions from the wastewater treatment plant use recorded biological oxygen demand and average volume of influent. Also, the North Coast Unified Air Quality Management District (NCUAQMD) keeps track of the large emitters in the County. Data from the NCUAQMD is used to estimate emissions from industrial point sources and large refrigeration units.

Some refrigerants considered by this inventory are assigned zero emissions. This is due to the method which the NCUAQMD uses to track refrigerants. Only stationary refrigeration units larger than 50 lbs are tracked. No stationary units larger than 50 lbs are tracked within the jurisdictional boundaries of Arcata, which assumes leakage from these units are negligible. However, transport refrigeration units larger than 3 lbs are included (see Table 12).

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. metric tons CO_2 per kWh of electricity). Emissions factors used for each sector are given in each reporting table. Some calculations compound multiple factors together (for example, the transportation sector uses complex modeling software that uses a large database of emissions factors). In these cases the overall resulting emissions factor is reported.

For this inventory, calculations were made using the Humboldt County Greenhouse Gas Emissions Inventory Tool. This tool was developed by the Redwood Coast Energy Authority to establish a consistent calculation methodology for the County of Humboldt and all incorporated jurisdictions. This tool is built upon an Excel spreadsheet template provided by ICLEI. This spreadsheet is used both for data entry and emissions calculations. This tool, along with a user manual, is available by request from the Redwood Coast Energy Authority.

3 Community Emissions Inventory Results

The Community Protocol recommends reporting results in one or more frameworks. Each framework includes a particular set of emissions sources and activities, and each tells a different story about community emissions. This report looks at Arcata's community emissions through two frameworks:

- Local government significant influence: this framework highlights emissions sources over which the City of Arcata has the most significant influence and has the greatest opportunity to address. These emissions are more regional in the location of occurrence.
- Community-wide activities: this framework highlights emissions associated with the activities of residents and businesses that occur in a more global geography. This is intended to provide a broader picture of the impact associated with consumption.

Some emissions sources and activities are reported in both frameworks, so it is important not to add the emissions presented by both frameworks together. The purpose of these two approaches is to provide different perspectives to better inform and guide both local government action and community action.

3.1 Community Profile

To put emissions inventory data in context for comparison with other jurisdictions, it is helpful to have some basic information about the community such as population and number of households. This information is provided in Table 3.

Table 3: City of Arcata 2015 community indicators.

Indicator	Source[5]	Value
Population	*General Plan Update*[6]	*17,345*
	U.S. Census, ACS 5 year	17,802
Households	*General Plan Update*[6]	*6,384*
	U.S. Census, ACS 5 year	7,697
Jobs	*General Plan Update*[6]	*6,669*
	NAICS	10,094
Commercial Square Feet	General Plan Update[7]	4,774,576
Service Population (Residents + Jobs)	*General Plan Update*	*24,014*
	U.S. Census ACS 5 year + NAICS	27,896
Estimated Number of Registered Vehicles	EMFAC2014[8]	4,798
Average Temperature	Weather Underground[9]	53^{+16}_{-13}°F
Total Heating Degree Days	Weather Underground[9]	4,340
Total Cooling Degree Days	Weather Underground[9]	7

The community indicators were obtained from various sources as indicated by the source and associated footnotes.

[5] For indicators where multiple values are provided, the *italicized* value is used for calculating GHG emissions.
[6] Value is interpolated using General Plan Update estimate for incorporated cities, then allocated to the City using percent of incorporated population from U.S. Census ACS 5 year data.
[7] Value is interpolated using General Plan Update estimate for incorporated cities, then allocated to the City using percent of NAICS jobs in the City.
[8] Past inventories used DMV data. Recent DMV data was not obtained for this inventory. Therefore, the EMFAC2014 model was used. This results in a significant change in estimated registered vehicles from 2010.
[9] www.wunderground.com

3.2 Emissions from Sources and Activities Under Significant Local Government Influence

This framework emphasizes policy relevance, highlighting a set of emission sources and activities that Arcata has the greatest opportunity to address. This frame includes all of the five Basic Emissions Generating Activities required by the Community Protocol, plus additional sources and activities. These are:

- Electricity Consumption
- Stationary Combustion
- Mobile Combustion
- Solid Waste Generation
- Wastewater Treatment
- Potable Water Consumption
- Refrigerant Leakage
- Industrial Point Sources

The total emissions estimated to be **177,677 metric tons of CO_2e** from all of these sectors are summarized in Figure 5. Details regarding each sector are provided in the following sections.

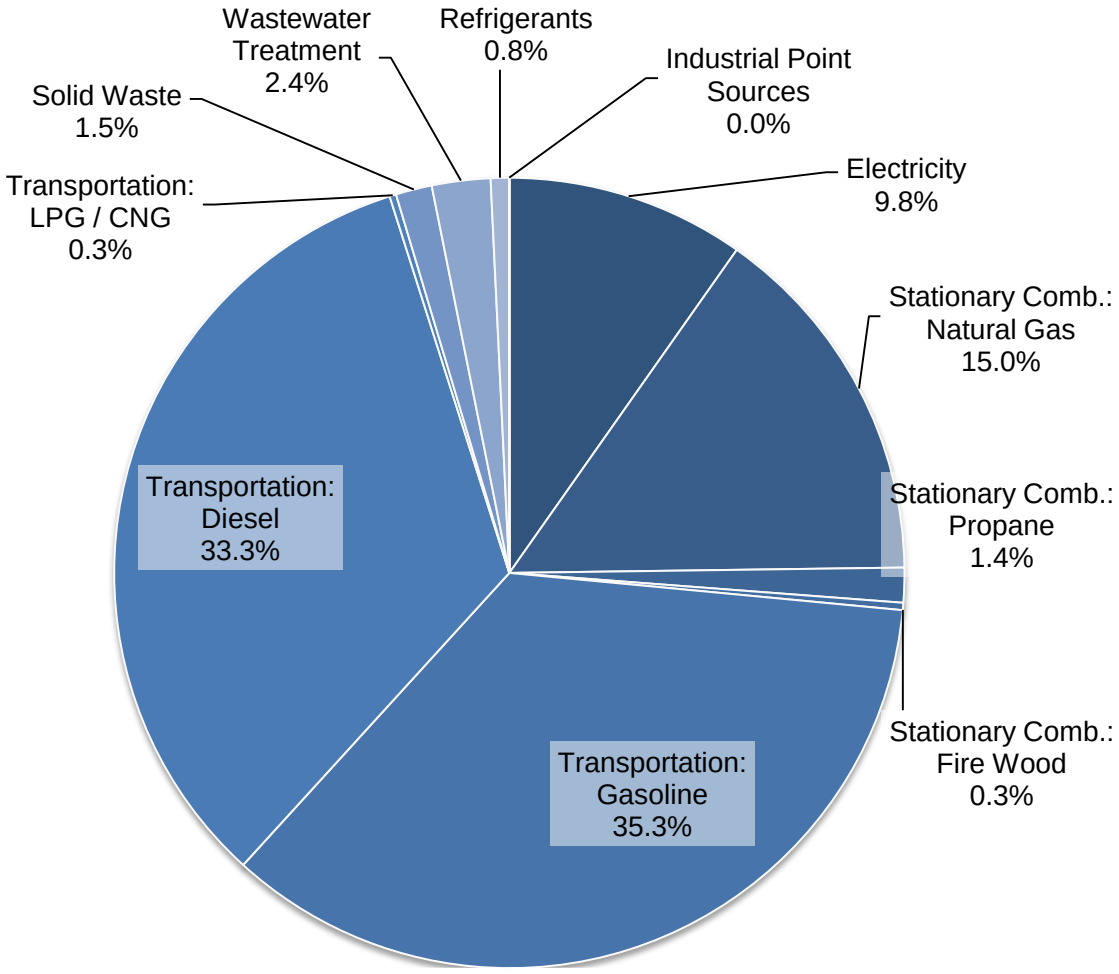


Figure 5: A summary of all emission sources and activities, by emissions sector, that are under significant government influence.

3.2.1 Activity: Electricity Consumption

Electricity consumption contributes to greenhouse gas emissions indirectly, although it is considered within significant local government influence. Emissions are generated at generation plants, usually through the combustion of fuels which generate heat that is then used to drive steam engines. Additional electricity generation fuels, such as hydropower and wind, are also used and are considered to be free of emissions. Emissions factors used are generated by Pacific Gas & Electric (PG&E) on an annual basis and reflect the average mix of electricity generation procured for the inventory year. The results are shown in Table 4.

Electricity consumption by sector is provided by PG&E through the Green Communities Program which supplies data to local governments. The consumption sector classifications of residential, commercial, and industrial are defined by PG&E using the customer rate schedule.

There are data quality challenges associated with the data provided by PG&E that stem from customer privacy rules imposed by the California Public Utilities Commission (CPUC Decision 97-10-031). For residential customers, aggregated consumption data can only be reported if the aggregated data represents more than 100 individual accounts (known as the 100 rule). For commercial, agricultural, industrial, and direct access customers, consumption can only be reported if the following two conditions are met for each classification (known as the 15/15 rule): aggregated data represents at least 15 individual customers, and no single customer comprises more than 15% of the total aggregated data.

If the 15/15 rule is triggered for industrial or agricultural classifications, PG&E attempts to roll the consumption of these classifications into the commercial classification. If the 15/15 rule is still triggered for any one of these two classifications after being aggregated with commercial, then consumption associated with that customer classification is not reported. This has two impacts on the quality of electricity and natural gas data used in this report:

1. Industrial and/or agriculture consumption could be reported under the commercial classification, and
2. There may be a significant amount of consumption that is not reported.

The data provided by PG&E for the year 2015 is impacted by this challenge. The following summarizes the impact of these privacy rules on reported electricity consumption:

- 100 rule: pass for electricity and natural gas
- 15/15 rule:
    - Commercial: pass for electricity and natural gas
    - Agriculture: fail for electricity, rolled into commercial (there is no ag natural gas sector)
    - Industrial: N/A for electricity (no industrial customers), fail for natural gas and not reported
    - Direct Access electricity: fail, not reported

It is not possible to disaggregate those customer classifications indicated above that are aggregated into the commercial classification. However, it is possible to account for unreported consumption using another report provided by the Green Communities program called a Tableau Energy Summary (included in Appendix F). The difference between the non-residential classification in the Tableau Energy Summary and the aggregated commercial, agricultural, industrial, and direct access data reported by PG&E can be used to determine the total unreported utility consumption that is

impacted by the 15/15 rule. These differences are calculated and rolled into the commercial sector (with direct access electricity being assigned the CAMX subregion emissions factor rather than the PG&E emissions factor (see the inventory spreadsheet tool for additional information)).

Some electricity is lost during transmission and distribution (T&D) due to resistive loses within the materials used. This lost electricity is also accounted for, the emissions of which are also shown in Table 4.

Table 4: Emissions associated with the activity of electricity consumption within jurisdictional boundaries.

Activity: Electricity Consumption	Annual Quantity of Electricity Consumed (kWh)		Emissions Factor (annual metric tons CO_2e / kWh)	Annual Emissions (metric tons CO2e)
Residential	Utility:	29,767,210	0.000184386	5,489
	T&D Losses:	1,425,849	0.000258814	369
	Total:	**31,193,059**	**0.000187788**	**5,858**
Commercial	Utility:	36,536,275	0.000184386	6,737
	Direct Access:	15,852,949	0.000258814	4,103
	T&D Losses:	2,509,444	0.000258814	649
	Total:	**54,898,668**	**0.00020928**	**11,489**
Industrial	Utility:	0	---	0
	T&D Losses:	0	---	0
	Total:	**0**	**---**	**0**
All Sectors	Utility:	66,303,485	0.000184386	12,225
	Direct Access:	15,852,949	0.000258814	4,103
	T&D Losses:	3,935,293	0.000258814	1,019
	Total:	**86,091,727**	**0.000201493**	**17,347**

Visual comparisons between the residential, commercial, and industrial sectors are shown in Figure 6. This can help Arcata visualize which sector to prioritize during emissions reduction planning efforts.

3.2.2 Source: Stationary Combustion

Stationary combustion is associated with the combustion of fuels at a specific location. This includes the combustion of natural gas, propane, fire wood, etc. The vast majority of these fuels are combusted for cooking and space heating. Emissions associated with the combustion of these fuels can be considered either a source or an activity since the activity usually occurs at the point of combustion. This inventory considers this sector an emissions source. Table 5 shows the results.

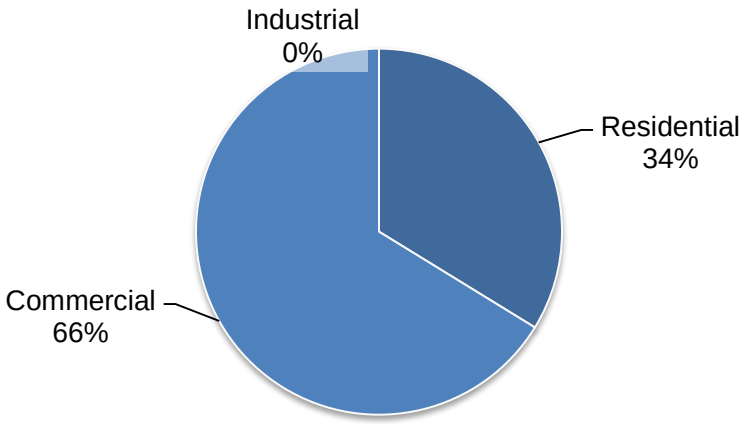


Figure 6: Emissions associated with the activity of electricity consumption within jurisdictional boundaries.

Table 5: Emissions associated with the stationary combustion of fuels within jurisdictional boundaries.

Source: Stationary Combustion	Annual Quantity of Fuel Consumed		Emissions Factor (annual metric tons CO_2e / unit)	Annual Emissions (metric tons CO2e)
Residential	Natural Gas (therm)	2,643,849	0.005307	14,031
	Propane (gal.)	443,695	0.005686	2,523
	Fuel Wood (MMBTU)	53,473	0.009961	533
	Total	**---**	**---**	**17,086**
Commercial	Natural Gas (therm)	2,385,309	0.005307	12,659
	Propane (gal.)	0	---	0
	Fuel Wood (MMBTU)	0	---	0
	Total	**---**	**---**	**12,659**
Industrial	Natural Gas (therm)	0.00	---	0
	Propane (gal.)	0	---	0
	Fuel Wood (MMBTU)	0	---	0
	Total	**---**	**---**	**0**
All Sectors	Natural Gas (therm)	5,029,158	0.005307	26,690
	Propane (gal.)	443,695	0.005686	2,523
	Fuel Wood (MMBTU)	53,473	0.009961	533
	Total	**---**	**---**	**29,745**
Info Item **Commercial Generators**	Diesel (gallons)	16,362	0.0102785	168

3.2.3 Source: Mobile Combustion

Mobile emissions are associated with mobile vehicles and equipment. This includes passenger vehicles, freight and service trucks, off-road vehicles, and construction equipment to name a few. Emissions results are shown in Table 6.

These emissions are considered a source due to the inventory methodology used. Arcata is assigned mobile emissions based on whether the emissions occur within the jurisdictional boundaries of Arcata. For example, under this method, a resident of Arcata that commutes between Arcata and Fortuna only contributes emissions to the City for the miles traveled within the jurisdictional boundaries.

The emissions factors used are those associated with two computer models created by the California Air Resources Board (CARB): EMFAC2014 and OFFROAD2007. A wide range of emissions factors are used by these models that depend on numerous factors such as vehicle age and type, fuel type, and temperature and humidity to name a few. Refer to the Inventory Methodology Report and the documentation for these computed models for more information.

Table 6: Emissions associated with the combustion of fuels by mobile vehicles and equipment.

Source: Mobile Combustion	Annual Quantity of Fuel Consumed (gallons)		Emissions Factor	Annual Emissions (metric tons CO_2e)
On-Road Passenger Vehicles	Gasoline	6,276,698	EMFAC	53,421
	Diesel	51,231	EMFAC	521
	LPG / CNG	Not Modeled		
	Total	**---**	**---**	**53,942**
Retail and Commercial Trucks	Gasoline	827,033	EMFAC	7094
	Diesel	3,624,526	EMFAC	36868
	LPG / CNG	Not Modeled		
	Total	**---**	**---**	**43,962**
Off-Road Vehicles and Equipment	Gasoline	341,222	OFFROAD2007	2131
	Diesel	2,187,889	OFFROAD2007	21844
	LPG / CNG	78,192	OFFROAD2007	479
	Total	**---**	**---**	**24,455**
All Sectors	Gasoline	7,444,953	Combined	62,646
	Diesel	5,863,647	Combined	59,233
	LPG / CNG	78,192	Combined	479
	Total	**---**	**---**	**122,359**
Info Item **Public Transit (2010)**	Gasoline	494		---
	Diesel	37,010	Combined	381
	LPG / CNG	0	---	---
	Total	**---**	**---**	**381**

A visual comparison between passenger vehicles, retail and commercial trucks, and off-road vehicles is shown in Figure 7. This can help Arcata visualize which sector to prioritize during emissions reduction planning efforts.

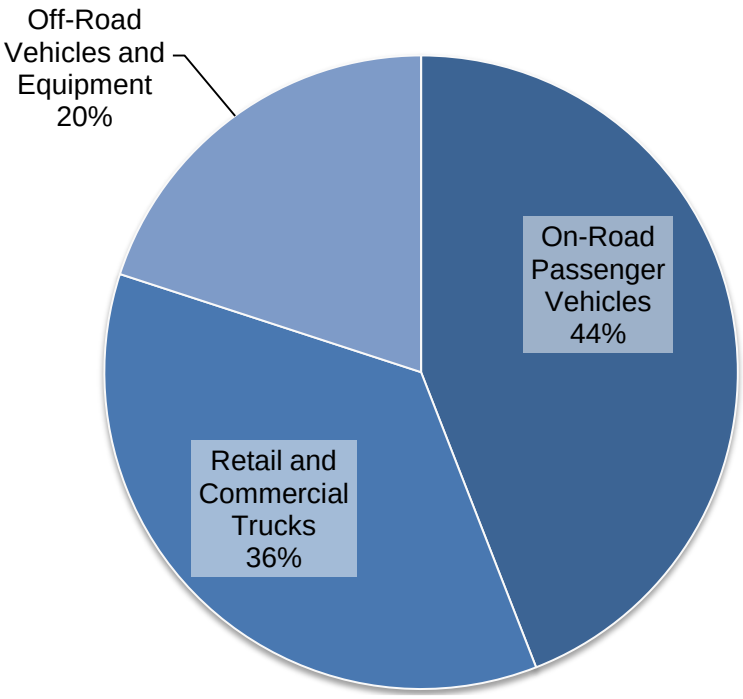


Figure 7: Emissions associated with on- and off-road vehicle travel.

Additional details regarding the primary contributors to on-road vehicle emissions are shown in Figure 8. Results are disaggregated by vehicle type and fuel. This demonstrates that gasoline fueled passenger vehicles and light duty trucks are the primary contributor to emissions in this sector. Note, however, that this is not the case for the off-road vehicle sector where diesel is the dominant fuel.

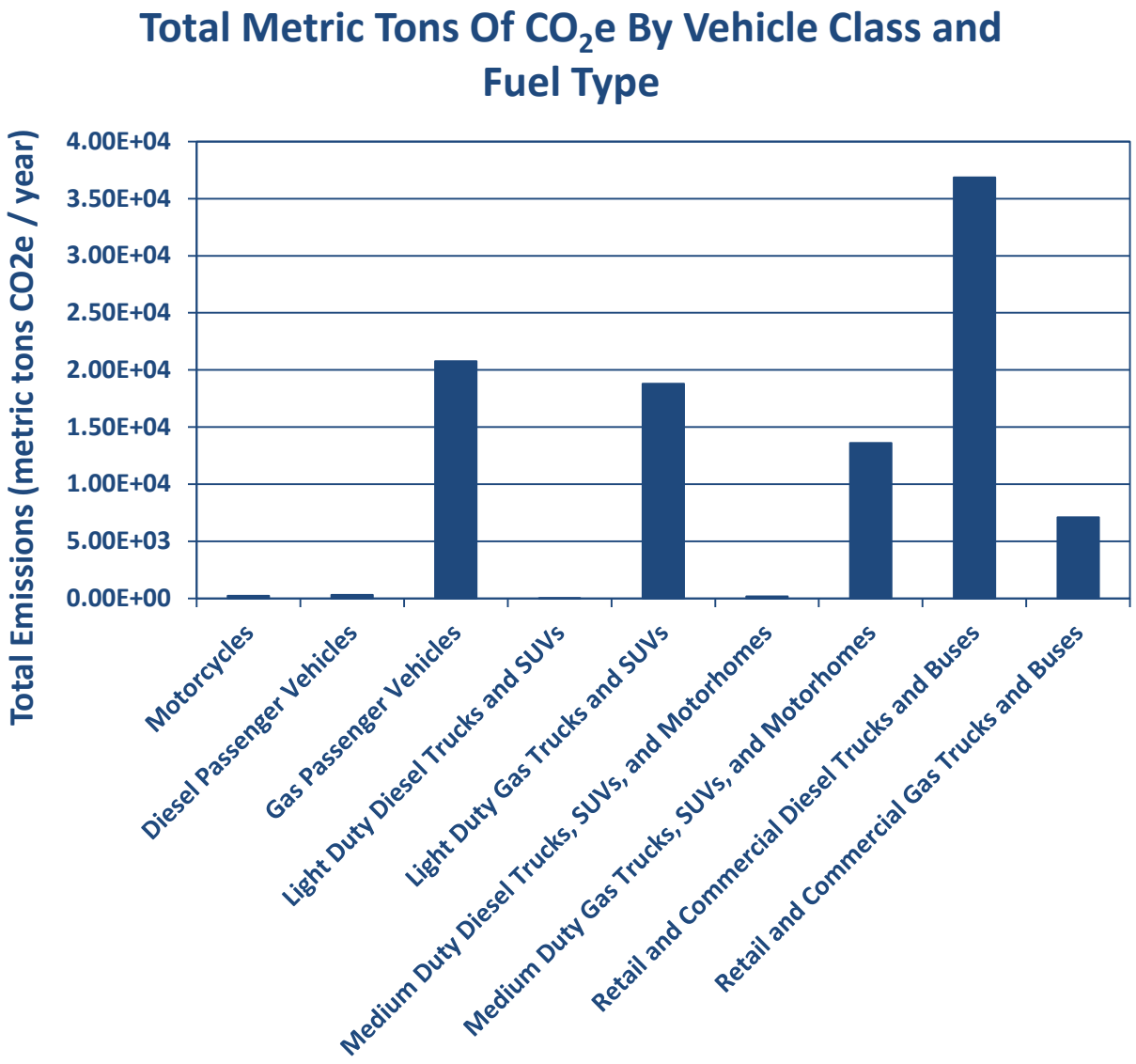


Figure 8: Disaggregation of on-road vehicle emissions by vehicle class and fuel type.

Definitions of the different vehicle classes are shown in Table 7. The relevant fuels are represented by GAS (gasoline) and DSL (diesel). The Retail and Commercial Trucks value represents both gasoline and diesel fuels for all vehicles greater than 8,500 lbs.

Table 7: Description of vehicle class labels.

Vehicle Class Label	Description
LDA	Passenger car
LDT1	Light Duty Truck <= 3,750 lbs
LDT2	Light Duty Truck (3,751 - 5,750 lbs)
MCY	Motorcycles
MDV	Medium Duty Trucks (5,751 - 8,500 lbs)
Retail and Commercial Trucks	All on-road vehicles greater than 8,500 lbs

Off-road transportation emissions are composed of various sectors. These sectors are summarized in Figure 9. What activities compose these different off-road vehicle sectors are described in Table 8.

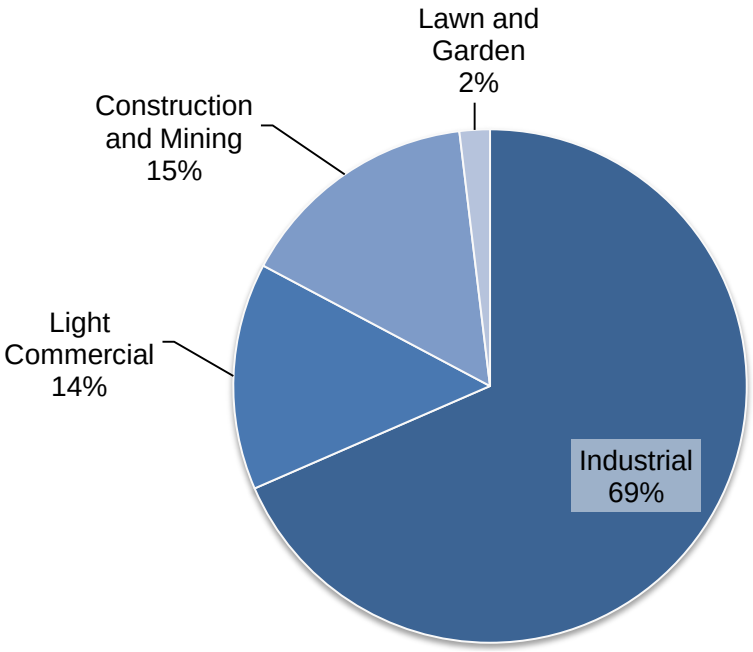


Figure 9: Break down of activity sectors that comprise the off-road transportation emissions sector.

Additional data used to determine emissions from the transportation sector are provided in the Appendices. Refer to the Methodology Report for information regarding how this data is used.

Table 8: Description of the various activities that comprise each off-road vehicle sector.

Off-road Activity Sector	Description
Industrial	Agricultural, industrial, and logging
Construction and Mining	All construction
Light Commercial	Entertainment, light commercial, recreational, and transport refrigeration
Lawn and Garden	Landscaping and maintenance

3.2.4 Activity: Solid Waste Generation

Emissions are generated by the transportation, processing, and decomposition of solid waste. This inventory estimates the emissions associated with all three.

Emissions from the transportation of waste out of the County from the Humboldt Waste Management Authority (HWMA) distribution center are included as an information item as they should be reasonably modeled within the Mobile Combustion sector (see Section 3.2.3). Note that emissions from self-hauling and from trash trucks are also assumed to be reasonably modeled within the Mobile Combustion sector but are not estimated separately due to lack of information.

Waste processing emissions associated with onsite landfill operations are also included as an information item. Different emissions factors are used based on whether the onsite equipment is fueled by either diesel or compressed natural gas (CNG). All landfills that are used by HWMA utilize diesel equipment with the exception of the Altamont Landfill in Livermore, CA. Only a small fraction of waste is trucked to this site and therefore the large majority of process emissions are associated with diesel equipment.

Emissions from the decomposition of waste are associated with paper, food, plant, animal, wood, and textile wastes. Appropriate emissions factors are used for each type of waste. Results of all emissions are shown in Table 9.

Table 9: Emissions associated with the transportation, processing, and decomposition of solid waste.

	Activity: Solid Waste Generation	Quantity of Waste Generated (wet short ton)		Emissions Factor (metric tons CO_2e / short ton)	Emissions (metric tons CO_2e)
	Paper Waste	Waste Decomposition	1,667	Numerous. Refer to Methodology Report.	1,142
	Food Waste		1,802		885
	Plant Waste		1,127		311
	Wood / Textile Waste		754		290
	Other Waste		2,587		0
	All Sectors	Waste Decomposition	7,937	Numerous. Refer to Methodology Report.	2,629
Info Item	**Additional Emissions Sources**	Landfill Process Equipment	7,937	Numerous. Refer to Methodology Report.	130
		On-Road Transportation of Waste	7,937		536

A visual comparison between the emissions produced by the various waste types is shown in Figure 10. This can help Arcata visualize which sector to prioritize during emissions reduction planning efforts. Note that transportation to landfills is estimated to comprise roughly 5% of total emissions from the generation of solid waste.

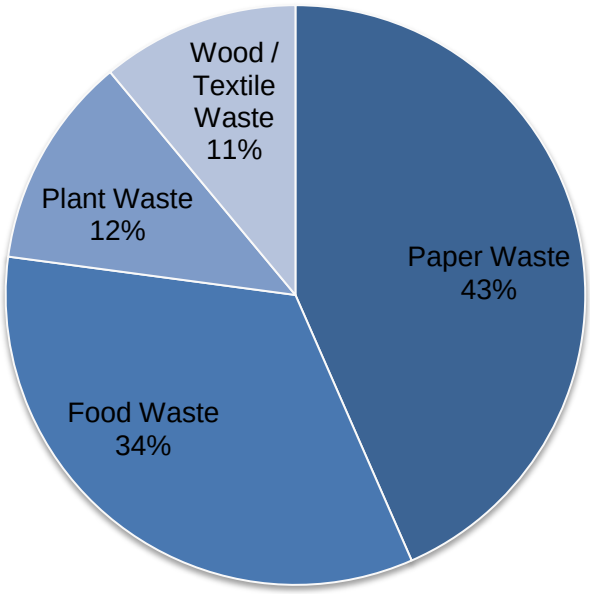


Figure 10: Solid waste emissions by waste type.

3.2.5 Source and Activity: Wastewater Treatment

Greenhouse gases are emitted from processing as well as the energy consumed for processing. Both the central treatment plant and septic systems are considered. Process emissions are considered an emissions source from the central plant.

Central treatment plant process emissions are associated with methane release from anaerobic activity and the creation of nitrous oxide during the conversion of ammonia. Septic system process emissions are associated with methane release from anaerobic conditions. Central treatment plant energy consumption (noted as an information item since this energy consumption is already captured in Sections 3.2.1 and 3.2.2) is associated with the electricity and natural gas required to run the plant. Emissions results are shown in Table 10.

Table 10: Emissions associated with the processing of wastewater from both the central treatment plant and septic systems within jurisdictional boundaries.

Source: Wastewater Treatment		Indicators		Emissions Factor (metric tons CO_2e / unit)	Emissions (metric tons CO_2e)
	Central Treatment Process Emissions	Average influent BOD5 (kg / day)	1,263.00	Numerous. Refer to Methodology Report.	3,919
		Average daily volume of wastewater (gallons)	2,027,255		
		Population served	18,695		
	Fugitive Emissions From Septic	Estimated population served	2,752	0.108 metric tons CO_2e per person per year	334
		Estimated number of permitted septic systems	1,260		
	All Sectors	---	---	---	4,253
Info Item	**Central Treatment Energy Consumption**	Consumed electricity (kWh)	774,444	0.0001844	143
		Consumed natural gas (therms)	9,966	0.005307	53

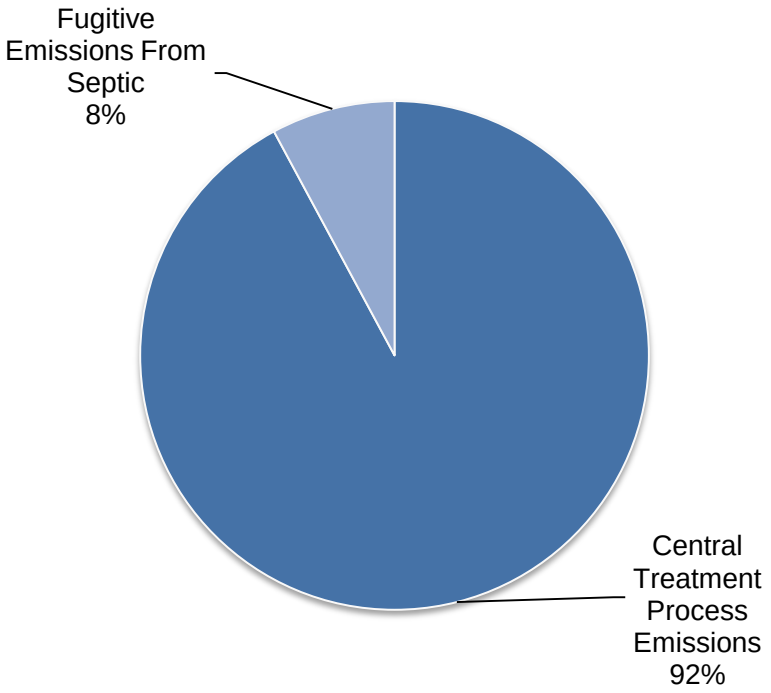


Figure 11: Waste water emissions by type.

3.2.6 Activity: Consumption of Potable Water

The Community Protocol requires reporting of emissions associated with potable water consumption. This sector is highlighted to emphasize the impact that water saving measures can have on reducing a communities emissions. Results of the estimated emissions associated with pumping and treatment of potable water are shown in Table 11.

This emissions source is already accounted for in the Electricity Consumption and Stationary Combustion sectors, so should not be added to these sectors. Instead, this emissions activity should be considered as an information item to guide policy decisions. Note that these emissions primarily occur outside jurisdiction boundaries since much of the extraction, treatment, and transport of water occurs outside the City.

Table 11: Emissions associated with pumping and treatment of potable water served to the City of Arcata.

Activity: Potable Water Consumption		Indicators		Emissions Factor (metric tons CO_2e / million gallons)	Emissions (metric tons CO_2e)
Info Item	**Pumping and Treatment Energy Consumption**	Population served	17,345	0.1670	109
		Gallons of water consumed (MG)	655		
		Energy Intensity (MWh/MG)	0.8486		

3.2.7 Source: Fugitive Leakage of Refrigerants

Leaked refrigerants can be a significant source of greenhouse gases as many refrigerants have extremely large global warming potential factors. Even though the quantity of leaked refrigerants is generally small, their large global warming potential makes their relative impact significant. This inventory estimates the emissions associated with stationary and mobile refrigeration equipment operated within industrial and commercial sectors. Vehicle air conditioning units are not tracked given the difficulty of the task and the lack of local government influence over the emissions source. The estimated emissions associated with leaked refrigerants are shown in Table 12.

Table 12: Estimated emissions associated with the leakage of refrigerants from commercial and industrial stationary and mobile equipment.

Source: Fugitive Refrigerant Emissions	Number of Refrigeration Units		Emissions Factor (metric tons CO_2e / refrigeration unit)	Emissions (metric tons CO_2e)
Stationary Refrigeration Equipment	Size 50 - 200 lbs	38	13.97	531
	Size 200 - 2000 lbs	11	55.88	615
	Size >2000 lbs	0	---	0
	Total	**49**	**---**	**1,146**
Transport Refrigeration Units	3 lbs	127	1.530	192
Mobile A/C Units	Not Estimated	---	---	Not Estimated
All Sectors	**All Sizes**	**176**	**Various**	**1,338**

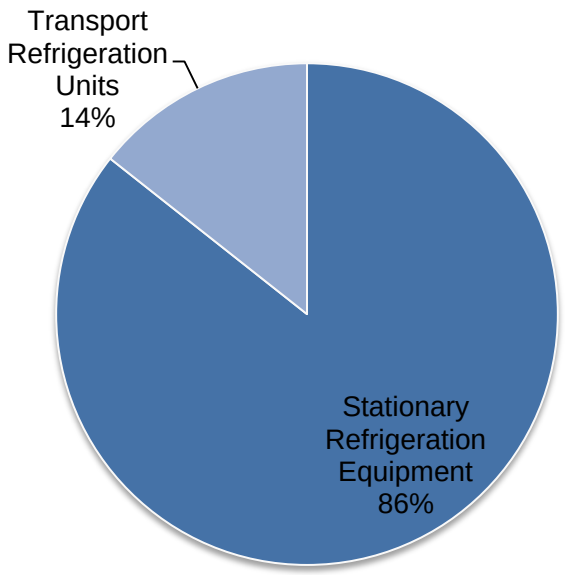


Figure 12: Refrigerant emissions by type.

Data on stationary refrigeration units are obtained from the North Coast Unified Air Quality Management District (NCUAQMD). The size and leakage rate of these units is roughly approximated. See the Methodology Report and the Inventory Tool for additional information.

Transportation units refer to mobile refrigeration units such as those carried by food delivery trucks. This emissions sector is a rough estimate modeled by the OFFROAD2007 emissions model created by the California Air Resources Board (CARB). This model estimates the emissions from this sector at a County level and allocated to the City of Arcata based on the percentage of jobs within the jurisdiction.

3.2.8 Source: Industrial Point Sources

As required by the state, industrial point sources are tracked by the NCUAQMD given their large contribution to overall emissions. Estimated emissions from all industrial sources within the jurisdictional boundary of Arcata are included. In addition, criteria pollutants associated with environmental and health concerns are also included for information purposes. The results are shown in Table 13.

Table 13: Greenhouse gas and criteria pollutant emissions estimates from industrial point sources.

Source: Industrial Point Sources	Quantity of GHGs and Other Criteria Pollutants (metric tons)		Emissions Factor (metric tons CO_2e / unit)	Emissions (metric tons CO_2e)
Sources Tracked by the NCUAQMD	CO_2	6	1	6
	CH_4	0	28	0
	N_2O	Unknown	265	Unknown
	CO	0	---	---
	NO_x	0	---	---
	SO_x	0	---	---
	PM	0	---	---
	TOG	0	---	---
Total	**$CO_2 + CH_4 + N_2O$**	**---**	**---**	**6**

3.3 Additional Emissions Sources Outside of Significant Local Government Influence

Included in these results are additional inventoried sources and activities over which the City of Arcata does not have significant influence. However, consumption of goods and services within the community indirectly contribute to these emissions. Therefore, it is useful to include these sources to provide a more complete picture of the impact the City of Arcata has on global emissions.

The majority of the emissions shown here are upstream emissions of petroleum fuels. These are emissions associated with the production of these fuels. The fuels considered are those used for transportation, those used for stationary combustion, and those used to generate electricity. Also included are estimates of direct emissions, not upstream emissions, associated with commercial and private airplane flights. Figure 13 summarizes these emissions (61,713 Metric Tons of CO_2e).

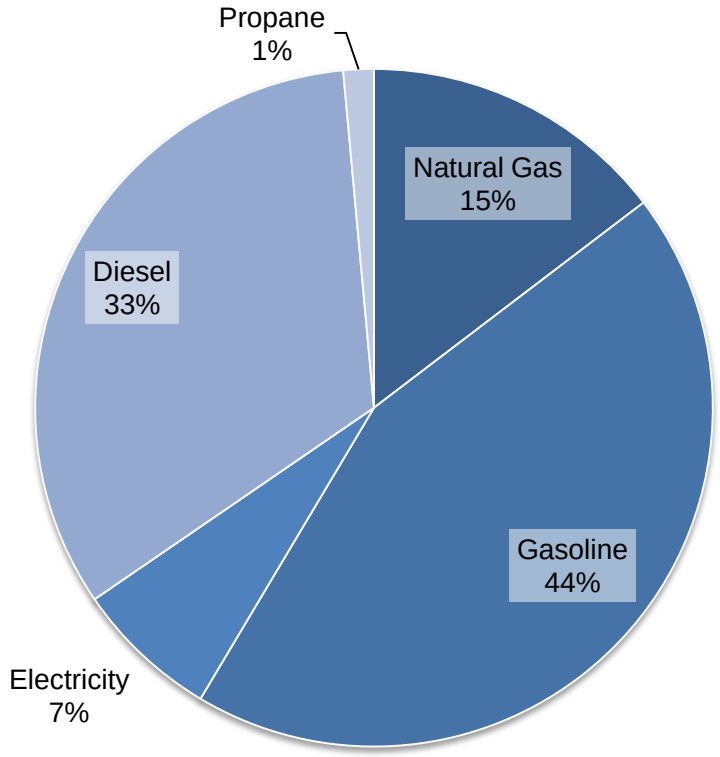


Figure 13: Summary of all emissions outside significant influence by the City of Arcata

3.3.1 Activity: Upstream Emissions from Utility Energy Consumption

In addition to the emissions associated with electricity, natural gas, and propane that are accounted for in Sections 3.2.1 and 3.2.2, there are additional emissions associated with the production of these fuels. These upstream emissions can account for a significant portion of the total emissions associated with the consumption of these fuels, and can often be overlooked since the production of these fuels occurs in places very far removed from the City of Arcata. However, there is a direct connection between the demand for these fuels and the emissions associated with their supply.

Table 14 provides estimates of these upstream emissions. These estimates apply only to the production of fuels, not to the mining of fuels, or to the construction, operation, or decommissioning of fuel processing infrastructure. Hence, while these estimates provide a bigger picture of the impact associated with the consumption of electricity, natural gas, and propane, there are additional emissions not accounted for that further increase this impact.

Table 14: Upstream emissions estimates associated with processing of fuels used to generate electricity and for stationary combustion.

Upstream: Utility Fuel Emissions	Quantity of Fuel Consumed		Emissions Factor (metric tons CO_2e / unit)	Emissions (metric tons CO_2e)
Electricity	Coal (kg)	0	---	0
	Residual Fuel Oil (L)	0	---	0
	Distillate Fuel Oil (L)	0	---	0
	Natural Gas (m^3)	6,456,880	0.0004450	2,873
	Total	**---**	**---**	**2,873**
Stationary Combustion	Natural Gas (therm)	5,029,158	0.001216	6,117
	Propane (gallon)	443,695	0.001162	516
	Generator Fuel (gallon)	72,262	0.00233	168
	Total	**---**	**---**	**6,801**

3.3.2 Activity: Upstream Emissions from Mobile Combustion of Gasoline and Diesel

As with the utility energy-related fuels, there are also emissions associated with the production of gasoline and diesel used in on- and off-road vehicles. These emissions are important to account for as they form a significant fraction of the overall emissions associated with the demand for these fuels. In 2007 the State acknowledged this fact by enacting the Low Carbon Fuel Standard (LCFS). The purpose of the LCFS is to reduce the lifecycle carbon intensity of all fuels utilized by the State, including gasoline and diesel as well as compressed natural gas, ethanol, hydrogen, and other alternative fuels.

The significance of including these upstream emissions is to emphasize the additional impact that a reduction in fuel consumption will have. By reducing the consumption of gasoline and diesel, not only will greenhouse gas emissions, as well as local criteria pollutants that impact the health of community residents, be reduced locally, these emissions will also be reduced in all regions affected by the production and transportation of these fuels.

Upstream emissions factors, also referred to as well-to-pump emissions factors, were pulled from the GREET model[10] developed by the Argonne National Laboratory. These factors are used to estimate the emissions associated with the consumption of gasoline and diesel by the Arcata community. These factors, along with the resulting emissions, are shown in Table 15. Note that, for 2015, the ethanol content in blended California gasoline was 10%[11]. This is also factored in to the total emissions estimate.

[10] Database version 8065 was used to obtain emissions factors.
[11] Determined from California law, and confirmed with historical fuel consumption data obtained from NCUAQMD.

Table 15: Upstream emissions associated with gasoline and diesel fuel consumption.

Upstream: Gas and Diesel Emissions	Quantity of Fuel Consumed (gallons)		Emissions Factor (metric tons CO_2e / gallon)	Emissions (metric tons CO_2e)
Gasoline	CARFG	6,700,458	0.002087	13,984
	Ethanol	744,495	0.005855	4,359
Diesel	California Low Sulfur Diesel	5,863,647	0.002330	13,662
LPG / CNG	Liquid Propane Gas	78,192	0.001162	91

3.3.3 Emissions From Air Travel

Commercial air travel is a difficult emissions source to allocate to jurisdictions within a County because it requires determining the origin and destination of passengers. Commercial air flight emissions are estimated for the County using total in-County sales of jet fuel as a proxy. Small private airplane flight emissions are estimated for the County using 100% of in-County fuel sales of 100LL AvGas.

The total emissions are then allocated, as an information item, to Arcata based on the percent of the County population that resides within jurisdictional boundaries. Again, this is neither a reliable nor fair method, but is given here for information purposes and to give a sense of the impact of air travel to communities over all emissions impact.

Furthermore, aviation fuel sales were obtained only for the year 2012, so are not directly representative of the inventory year. Hence, the numbers provided should be considered only as a ballpark estimate. A change in estimated aviation fuel consumption for the City is solely due to a change in population.

Both direct combustion emissions as well as upstream emissions were quantified for the consumption of aviation fuel. Table 16 shows the direct combustion emissions estimates, and Table 17 shows the upstream emissions estimates.

Table 16: Direct CO_2 emissions estimates associated with commercial and private air travel.

Activity: Air Travel Emissions		Quantity of Fuel Consumed Countywide (gallons)		Emissions Factor (metric tons CO_2e / gallon)	Fraction Allocated To Jurisdiction	Emissions (metric tons CO2e)
Info Item	Commercial and Private Jets	Jet Fuel	49,031	0.009637	13.20%	472.51
	Other Private Small Airplanes	AVGAS (100LL)	9,817	0.008368	13.20%	82.15

Table 17: Upstream CO_2e emissions estimates associated with commercial and private air travel.

Upstream: Air Travel Emissions		Quantity of Fuel Consumed (gallons)		Emissions Factor (metric tons CO_2e / gallon)	Fraction Allocated To Jurisdiction	Emissions (metric tons CO2e)
Info Item	**Commercial and Private Jets**	Jet Fuel	49,031	0.002377	13.20%	116.55
	Other Private Small Airplanes	AVGAS (100LL)	9,817	0.002189	13.20%	21.49

4 Community Emissions Historic Trend and Forecast

The historic trend in modeled emissions[12] between the 2010 and 2015 are driven by the following:

- Significant decrease in residential sector emissions (-25%) due to dramatic reduction in both electricity (-35%) and natural gas (-15%) consumption,
- Notable decrease in the commercial sector emissions (-9.2%) driven by a reduction in natural gas consumption (-16%) that is partially offset by a 2% increase in electricity consumption and a slight increase in the carbon intensity of PG&E's procurement mix,
- Notable increase in transportation sector emissions (+10%) associated with an estimated increase in on-road vehicle miles traveled (+4.4%) and associated gasoline (+9.0%) and diesel (+28%) consumption,[13] and an estimated 34% increase in off-road emissions primarily driven by an increase in the estimated percentage of County jobs within the jurisdiction,
- Drop in industrial emissions to nearly zero due to the closure of the flakeboard factory, and
- Drastic increase in wastewater treatment process emissions due to a significant change in the reported influent BOD5 between inventory years: 181 kg/day for 2010 vs. 1,263 kg/day for 2015 (the former likely being an error which has to date not been investigated).

There is an overall reduction in total estimated emissions (-6.2%). Table 18 summarizes the comparison between the two inventories.

Table 18: Comparison of 2010 and 2015 GHG inventories.

Year	Res	Comm	Ind	Trans	Solid Waste	Wastewater	Total
2010	30,633	27,869	11,812[14]	110,945	2,925	432	184,615
2015	22,944	25,294	6	122,551	2,629	4,253	177,677

[12] See Section 5 for a comparison to year 2000 and 2006 inventories conducted by the City.
[13] Note that a new version of EMFAC (EMFAC2014) was used for the 2015 inventory while EMFAC2011 was used for the 2010 inventory. Model differences could be driving an unknown amount of the estimated change in the transportation sector fuel consumption and emissions.
[14] Note that the 2010 emissions estimate for the industrial sector was corrected from the originally reported value of 26,131 MT CO_2e. The correction was due to the incorrect allocation of point source emissions associated with the following two businesses: Humboldt Bay Municipal Water District operations on West End Road, and Sierra Pacific lumber mill in Manila. These point source emissions are allocated to Unincorporated County.

Forecasting future community emissions is important for understanding how a community can make better choices on how to precede with climate change practices in the future. To support local government climate change initiatives in California the Statewide Energy Efficiency Collaborative (SEEC) provides no-cost resources to communities. SEEC provides the CEMS tool which is used for both greenhouse gas inventories as well as forecasting future community emissions. The SEEC tool was used for this report to both build an accessible greenhouse gas inventory online and provide emissions forecast into the year 2050.

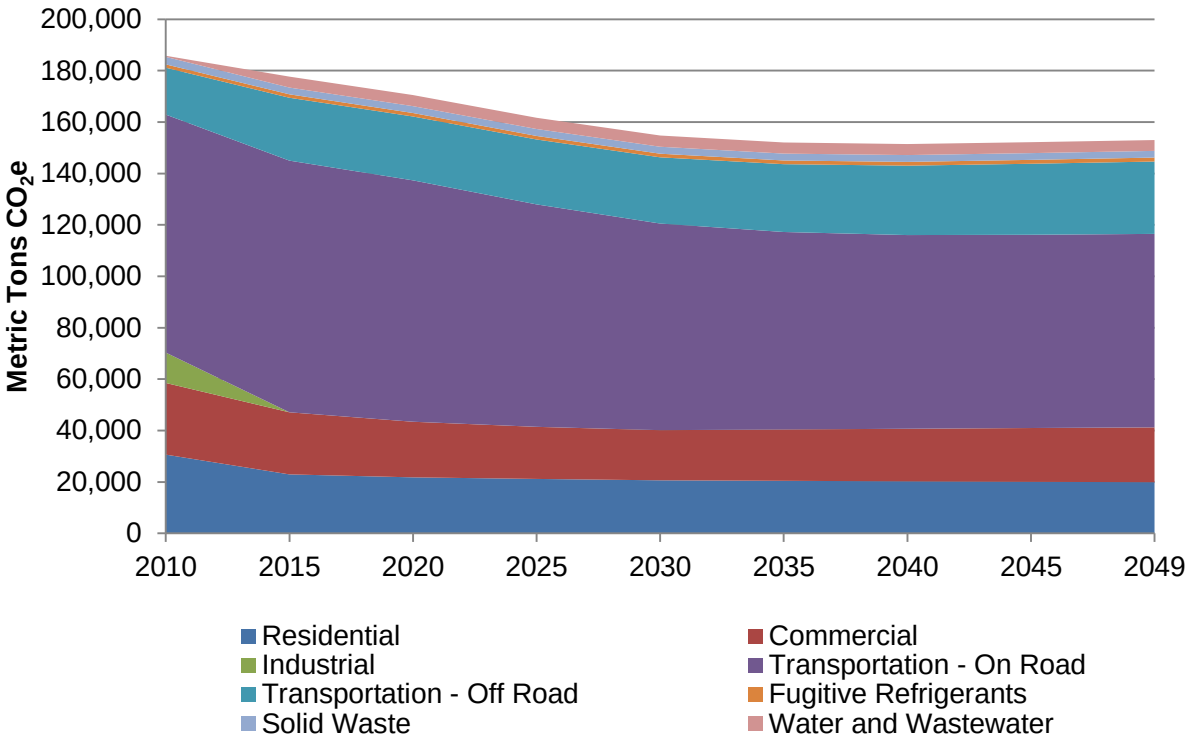


Figure 14: City of Arcata forecasting results.

Figure 14 shows the emissions forecast result for the City of Arcata. Population growth rates were used to forecast the residential sector, solid waste sector, and water/wastewater sectors. Additionally, job growth rates were used for forecasting of the commercial sector and fugitive emission sectors. Growth rates in the amount of vehicle miles traveled were used to predict future emissions for the transportation sector. Refer to Appendix E for tables of the compound annual growth rates used for forecasting.

Furthermore, state and federal impacts on the carbon intensity of vehicle emissions and utility electricity sources are also accounted for. These expected reductions in carbon intensity are reflected as negative compound annual growth rates. The carbon intensity growth rates are also shown in Appendix E. Table 19 summarizes the factor sets used in forecasting for the different sectors.

Table 19: Forecast factors used to estimate emissions for each sector.

Sector	Coefficients	Factor Set
Residential	Growth rate	Incorporated population growth estimates from county general plan update
	Carbon Intensity	Renewable portfolio standard
Commercial	Growth rate	Incorporated job growth estimates from county general plan update
	Carbon Intensity	Renewable portfolio standard
Industrial	Growth rate	Incorporated job growth estimates from county general plan update
Transportation	Growth rate	Off-road: Incorporated job growth estimates from county general plan update On-road: County-wide VMT growth estimate from EMFAC2014
	Carbon Intensity	All traffic Pavley II carbon intensity factors
Water/Wastewater	Growth rate	Incorporated population growth estimates from county general plan update
Solid Waste	Growth rate	Incorporated population growth estimates from county general plan update
Fugitive Emissions	Growth rate	Incorporated job growth estimates from county general plan update

The decline in future emissions is due to decreases associated with the closure of industrial opertations, reduction in future transportation carbon intensities from state regulations, and increased renewable portfolio standard through 2030 (RPS). The forecasting model assumes that population is predicted to increase by the County General Plan through 2030, thus the number of jobs is also expected to grow.

5 Comparison of Inventories Conducted by the City to Those Conducted by RCEA

The City of Arcata has been a front runner in planning associated with climate changes in the community. The City has conducted inventories for years 2000 and 2006. In 2012 RCEA took over inventory efforts and began using the then newly created ICLEI U.S. Community Inventory Protocol. RCEA has conducted inventories for the years 2010 and 2015 (estimates for the year 2005 were generated for comparison but an official inventory was not completed). All inventory results to date are shown in Table 20. Only emissions for those sectors that are included across all inventories are shown. A comparison of 2005, 2010, and 2015 inventories which use the same methodology is shown in the previous section (Section 4).

Table 20: Comparison of all inventories completed to date. Year 2000 and 2006 inventories were completed by the City of Arcata (*italicized*), and year 2005, 2010, and 2015 inventories were completed by RCEA.

Year	Residential	Commercial	Industrial	Transportation	Solid Waste	Total
2000	*28,531*	*47,430*	*25,674*	*37,809*	*2,108*	*142,690*
2005	Res, Com, and Ind = 61,482			105,431	5,890	172,803
2006	*28,137*	*43,814*	*24,462*	*34,465*	*2,149*	*134,566*
2010	30,633	27,869	11,812[14]	110,830	2,925	184,069
2015	22,944	25,294	6	122,551	2,629	173,424

Upon comparing the completed inventory results to the inventory results done by the RCEA, it is clear that there are some major differences in methodologies used to estimate emissions, primarily in the commercial and transportation sectors. This section is intended to help compare and explain some of the reasons why there are major increases in community emissions.

For all inventories, Highway Performance Monitoring System (HPMS) data was used to obtain the daily vehicle miles traveled (DVMT) within the jurisdiction. For the 2000 and 2006 inventories it is not clear what emissions factors were used to convert DVMT to greenhouse gas emissions. For the 2010 and 2015 inventories used the following approach to estimate emissions:

1. Both historic DMV data and the County Transportation Model developed by CalTrans for the Humboldt County Association of Governments (HCAOG) were used to determine the vehicle class distribution in the jurisdiction.

2. The California Air Resources Board (CARB) EMFAC model is used to assign vehicle miles traveled to the various vehicle classes, and calculate transportation emissions.

The above approach likely contributed to the discrepancies in results. Additional factors that may have contributed to the discrepancies in inventories also include:

1. Materials and methodologies were not as readily available when the City of Arcata originally did the former inventories.

2. The global warming potential for methane increased from 21 to 25 in 2007 with a change from the second assessment report to the fourth assessment report.

3. Highway miles were not considered as any part of Arcata's jurisdiction and therefore emissions were not accounted for.

4. Off road emissions were likely not calculated in previous inventories.

Thus, it is apparent that the comparison between the two different methodologies demonstrates that there are some large discrepancies in calculations, which may account for some of the large difference in the transportation sector.

Due to the large discrepancy in the transportation sector methodologies, the inventory tool used for 2010 was also used to complete an emissions inventory for the year 2005 for the City of Arcata. The tool was used to see whether or not there were still large discrepancies in numbers.

Table 21: Inventory results for the year 2005 for the City of Arcata using updated inventory tool.

Local Emissions	Quantity of Emissions (Metric Tons of CO_2e)
Activity: Electricity Consumption	25,435
Source: Stationary Combustion of Fuels	36,047
Source: Mobile Combustion	105,431
Activity: Solid Waste Generation	5,890

As seen above, Table 21 shows values comparable to that of the 2010 inventory that can be seen again in Table 21. Results indicate that there were increases in the transportation sector emissions, but by a comparable amount.

Table 22: Inventory results for the year 2010 for the City of Arcata using updated inventory tool.

Local Emissions	Quantity of Emissions (Metric Tons of CO_2e)
Activity: Electricity Consumption	21,964
Source: Stationary Combustion of Fuels	35,360
Source: Mobile Combustion	110,830
Activity: Solid Waste Generation	2,925

Other discrepancies in comparing inventory results are seen in the commercial and solid waste sectors. Solid waste tonnage for the 2010 inventory was gathered from the Cal Recycle website (http://www.calrecycle.ca.gov). The Cal Recycle website was only available as of 2007. Cal Recycle data for the inventory years can be seen in Table 22. Numbers varied between Cal Recycle for the inventory year of 2006, but not 2000.

Table 23: Cal Recycle data for the City of Arcata GHG inventory years.

Cal Recycle Data Year	Annual Solid Waste (tons)
2000	12,183
2006	6,236
2010	9,890

Increases or decreases in annual solid waste may be from increased populations or changes in waste management systems (such as pilot programs). Discrepancies in the commercial sector where much more difficult to infer from observation. The data received for the commercial section of the inventory did not separate commercial and industrial energy usage, and thus could be part of the number discrepancy seen for the sector.

6 Discussion

Two primary classes of emissions are presented in this report: local emissions activities and sources that are within local government significant influence, and upstream emissions activities and sources that are outside local government influence. Furthermore, emissions results are presented as either an activity or a source. This distinction can help guide local government action by targeting either a

specific source within jurisdictional boundaries, or the activities of the residents and businesses of Arcata. Additional emissions information items are presented to further inform policy decisions.

According to this Greenhouse Gas (GHG) Inventory, total emissions for the City of Arcata in the year 2015 were approximately 177,677 metric tons of CO_2e from local emissions sources and activities, and an additional 41,770 metric tons of CO_2e from upstream emissions. According to the County General Plan Update, population, households and employment within Humboldt County are anticipated to increase through 2030. Therefore it is expected emissions will increase. Furthermore, due to increases in population and jobs over the last 10 years, communities can expect that both total emissions and local emissions have increased. This is true even within the context of both significant strides in the reduction of emissions intensities at the state level (especially building efficiency, cleaner electricity, and increases in on-road vehicle efficiency and reduced gasoline carbon intensity) and un-intended temporary reductions in consumption associated with the economic recession.

The next steps for the City to take based on the results of this inventory are to update the City's

- emissions reduction target, and
- Greenhouse Gas Reduction Plan that identifies specific quantified strategies that can cumulatively meet the City's target.

Arcata should continue to track key energy use and emissions indicators on an on-going basis by completing a re-inventory at least every five years to measure emissions reduction progress.

The City can leverage a number of local and state-level planning documents for identifying specific actionable emissions reduction strategies. These include:

- Redwood Coast energy Authority Comprehensive Action Plan for Energy,
- Northwest California Alternative Fuels Readiness Plan,
- North Coast Electric Vehicle Readiness Plan,
- California Energy Commission Energy Aware Planning Guide,
- Institute for Local Government Energy Efficiency and Conservation Resources, and
- California Air Pollution Control Officers Association Model Policies for Greenhouse Gases in General Plans.

This inventory shows that transportation fuel consumption and utility electricity and natural gas consumption are particularly important to focus on. Through these efforts and others the City of Arcata can achieve additional benefits beyond reducing emissions, including saving money and improving Arcata's economic vitality and quality of life.

Appendix A Inventory Scope and Reporting Table

The Protocol requires summarizing the primary emissions sectors that were inventoried in this report in the following standardized table.

Emissions Type		Source or Activity?	Required	Included	Explanation if Excluded	Explanatory Notes	Emissions ($MTCO_2e$)
Built Environment							
Use of fuel in residential and commercial stationary combustion equipment		Source AND Activity	●	●			29,745
Industrial stationary combustion sources		Source		●			6
Electricity	Power generation in the community	Source			Not Applicable		
	Use of electricity by the community	Activity	●	●			17,347
District Heating/ Cooling	District heating/cooling facilities in the community	Source			Not Applicable		
	Use of district heating/cooling by the community	Activity			Not Applicable		
Industrial process emissions in the community		Source			Included under Industrial stationary combustion as there currently is no way to differentiate		
Refrigerant leakage in the community		Source		●			1,338
Transportation and Other Mobile Sources							
On-road Passenger Vehicles	On-road passenger vehicles operating within the community boundary	Source	● or	●			53,942

Emissions Type		Source or Activity?	Required	Included	Explanation if Excluded	Explanatory Notes	Emissions ($MTCO_2e$)
	On-road passenger vehicle travel associated with community land uses	Activity	●		Not Estimated		
On-road Freight Vehicles	On-road freight and service vehicles operating within the community boundary	Source		●			43,962
	On-road freight and service vehicle travel associated with community land uses	Activity			Not Estimated		
On-road transit vehicles operating within the community boundary		Source		●		Info Item	381
Transit Rail	Transit rail vehicles operating within the community boundary	Source			Not Applicable		
	Use of transit rail travel by the community	Activity			Not Applicable		
Inter-city passenger rail vehicles operating within the community boundary		Source			Not Applicable		
Freight rail vehicles operating within the community boundary		Source			Not Applicable		
Marine	Marine vessels operating within the community boundary	Source			Included Elsewhere	Is included in County-wide inventory	
	Use of ferries by the community	Activity			Not Applicable		

Emissions Type		Source or Activity?	Required	Included	Explanation if Excluded	Explanatory Notes	Emissions ($MTCO_2e$)
Off-road surface vehicles and other mobile equipment operating within the community boundary		Source		●			24,455
Use of air travel by the community		Activity		●		Info Item	555
Solid Waste							
Operation of solid waste disposal facilities in the community		Source			Not Applicable		
Generation and disposal of solid waste by the community		Activity	●	●			2,629
Water and Wastewater							
Potable Water - Energy Use	Operation of water delivery facilities in the community	Source			Not Estimated		
	Use of energy associated with use of potable water by the community	Activity	●	●		Info Item	109
Use of energy associated with generation of wastewater by the community		Activity	●	●		Info Item	196
Centralized Wastewater Systems - Process Emissions	Process emissions from operation of wastewater treatment facilities located in the community	Source		●			3,919
	Process emissions associated with generation of wastewater by the community	Activity			Not Applicable		

Emissions Type	Source or Activity?	Required	Included	Explanation if Excluded	Explanatory Notes	Emissions ($MTCO_2e$)
Use of septic systems in the community	Source AND activity		●			334
Agriculture						
Domesticated animal production	Source			Allocated to Unincorporated County only as there is currently no way to allocate the County crop report to jurisdictions		
Manure decomposition and treatment	Source					
Upstream Impacts of Community-Wide Activities						
Upstream impacts of fuels used in stationary applications by the community	Activity		●			6,801
Upstream and transmission and distribution (T&D) impacts of purchased electricity used by the community	Activity		●			3,892
Upstream impacts of fuels used for transportation in trips associated with the community	Activity		●			32,096
Upstream impacts of fuels used by water and wastewater facilities for water used and wastewater generated within the community boundary	Activity			Not Estimated	Included in electricity and stationary combustion upstream emissions estimate	
Upstream impacts of select materials (concrete, food, paper, carpets, etc.) used by the whole community	Activity			Not Estimated		

Emissions Type	Source or Activity?	Required	Included	Excluded (IE, NA, NO, or NE)	Explanatory Notes	Emissions ($MTCO_2e$)
Independent Consumption-Based Accounting						
Household Consumption (e.g., gas & electricity, transportation, and the purchase of all other food, goods and services by all households in the community)	Activity			Not Estimated		
Government Consumption (e.g., gas & electricity, transportation, and the purchase of all other food, goods and services by all governments in the community)	Activity			Not Estimated		
Life cycle emissions of community businesses (e.g., gas & electricity, transportation, and the purchase of all other food, goods and services by all businesses in the community)	Activity			Not Estimated		

Appendix B Employment Data

As described in the Methodology Report and shown in Table 3, County General Plan job estimates are disaggregated to jurisdictions using census data on the number of jobs for a jurisdiction, classified using the North American Industry Classification System (NAICS). Job estimates are used in a variety of calculations. The percentage of County NAICS jobs within the City is shown in Table 24, and the County General Plan job estimates are shown in Table 25. Summary of job statistics for the jurisdiction is shown in Table 26.

Table 24: NCAIS employment sectors used to allocate County-wide HPMS VMT to retail and commercial truck vehicle classes.

NCAIS Employment Sectors	% Of County Jobs In Jurisdiction
Agriculture, Forestry, Fishing and Hunting	5.2%
Mining, Quarrying, and Oil and Gas Extraction	0.0%
Utilities	0.0%
Construction	29.0%
Manufacturing	39.7%
Wholesale Trade	17.3%
Retail Trade	21.9%
Transportation and Warehousing	10.4%
Information	3.2%
Finance and Insurance	12.0%
Real Estate and Rental and Leasing	19.7%
Professional, Scientific, and Technical Services	23.7%
Management of Companies and Enterprises	5.9%
Administration & Support, Waste Management and Remediation	14.3%
Educational Services	36.4%
Health Care and Social Assistance	22.2%
Arts, Entertainment, and Recreation	26.3%
Accommodation and Food Services	23.9%
Other Services (excluding Public Administration)	27.0%
Public Administration	8.6%

Table 25: County General Plan job projections

Year	County	Cities	Unincorporated
2005	47394	29000	18394
2010	48202	29478	18724
2015	49010	29956	19054
2020	49818	30434	19383
2025	50625	30912	19713
2028	51110	31199	19911
2030	51622	31502	20120
2035	52902	32260	20642
2040	54182	33018	21164

Table 26: Summary of job statistics used for the jurisdiction.

Total Jobs in Jurisdiction	9,588
% County Jobs in Jurisdiction	19.56%
% Incorporated Jobs in Jurisdiction	32.01%

Appendix C DMV Vehicle Population Percentage Values

DMV data was used to further localize the allocation of vehicle miles traveled VMT. The percentage values used for this VMT allocation are shown in Table 27. Refer to the Methodology Report for further details.

Table 27: Percent population of vehicles registered to owners that have an address within the jurisdiction.

Vehicle Class and Fuel	% Total Jurisdiction DMV Population
LDA-Diesel	0.67%
LDA-Electric	0.12%
LDA-Gasoline	51.42%
LDA-Gasoline Hybrid	0.95%
LDA-Propane	0.00%
LDT1-Compressed Natural Gas	0.00%
LDT1-Diesel	0.29%
LDT1-Gasoline	22.41%
LDT1-Gasoline Hybrid	0.09%
LDT2- Compressed Natural Gas	0.01%
LDT2-Diesel	2.47%
LDT2-Gasoline	20.85%
LDT2-Gasoline Hybrid	0.01%
MDV-Diesel	0.49%
MDV-Gasoline	0.20%

Total vehicle population estimate using EMFAC default County-wide population data and allocating to the jurisdiction using above DMV data is shown in Table 28.

Table 28: Vehicle population estimates for jurisdiction by vehicle class.

Vehicle Class and Fuel	% Total Jurisdiction DMV Population
LDA-Dsl	36.05
LDA-Elec	6.81
LDA-Gas	2164.43
LDT1-Dsl	1.54
LDT1-Elec	0.63
LDT1-Gas	473.90
LDT2-Dsl	0.73
LDT2-Gas	1037.89
MCY-Gas	209.13
MDV-Dsl	9.41
MDV-Gas	854.34
LHD1-Dsl	1.54
LHD1-Gas	0.73
LHD2-Dsl	0.25
LHD2-Gas	0.06
MH-Dsl	0.04
MH-Gas	0.18
Motor Coach-Dsl	0.00

OBUS-Gas	0.02
PTO-Dsl	0.00
SBUS-Dsl	0.04
SBUS-Gas	0.00
T6 Ag-Dsl	0.05
T6 CAIRP Heavy-Dsl	0.00
T6 CAIRP Small-Dsl	0.00
T6 Instate Construction Heavy-Dsl	0.00
T6 Instate Construction Small-Dsl	0.01
T6 Instate Heavy-Dsl	0.07
T6 Instate Small-Dsl	0.14
T6 OOS Heavy-Dsl	0.00
T6 OOS Small-Dsl	0.00
T6 Public-Dsl	0.03
T6 Utility-Dsl	0.00
T6TS-Gas	0.05
T7 Ag-Dsl	0.04
T7 CAIRP Construction-Dsl	0.00
T7 CAIRP-Dsl	0.04
T7 NNOOS-Dsl	0.04
T7 NOOS-Dsl	0.02
T7 Other Port-Dsl	0.00
T7 Public-Dsl	0.04
T7 Single Construction-Dsl	0.00
T7 Single-Dsl	0.12
T7 SWCV-Dsl	0.01
T7 Tractor Construction-Dsl	0.00
T7 Tractor-Dsl	0.03
T7 Utility-Dsl	0.00
T7IS-Gas	0.00
UBUS-Dsl	0.01
UBUS-Gas	0.01
All Other Buses-Dsl	0.02

Appendix D Daily Vehicle Miles Traveled Data Used for EMFAC Emissions Modeling

A newer version of EMFAC, EMFAC2014, was used to generate emissions estimates from the on-road vehicle fleet. This new model integrates the multiple modules that comprised the older EMFAC2011 model, and now generates methane emissions directly rather than requiring an additional calculation step. This has resulted in a slight methodology change from the previous 2010 inventory. The total daily VMT values shown in Table 29 are now multiplied by default emissions rates from EMFAC2014 to obtain CO_2 and CH_4 emissions. N_2O is still calculated using NO_x and fuel consumption data.[15]

Table 29: Daily VMT values used to estimate emissions with the EMFAC model. Refer to the Methodology Report for definitions of vehicle classes.

EMFAC Vehicle Classes	Daily VMT
LDA-Dsl	2,878
LDA-Elec	827
LDA-Gas	185,556
LDT1-Dsl	76
LDT1-Elec	51
LDT1-Gas	34,267
LDT2-Dsl	85
LDT2-Gas	92,229
MCY-Gas	3,269
MDV-Dsl	989
MDV-Gas	69,110
MH-Dsl	1
MH-Gas	3
Motor Coach-Dsl	1
OBUS-Gas	3
SBUS-Dsl	3
SBUS-Gas	1
UBUS-Dsl	3
UBUS-Gas	2
All Other Buses-Dsl	3
LHD1-Dsl	46,457
LHD1-Gas	20,059
LHD2-Dsl	8,715
LHD2-Gas	1,889
PTO-Dsl	1,579
T6 Ag-Dsl	892
T6 CAIRP Heavy-Dsl	59
T6 CAIRP Small-Dsl	180

[15] Refer to the Humboldt County Greenhouse Gas Emissions Inventory Tool: Calculation Methodologies for additional information regarding vehicle class definitions as well as the methods used to estimate CH_4 and N_2O emissions.

EMFAC Vehicle Classes	Daily VMT
T6 Instate Construction Heavy-Dsl	108
T6 Instate Construction Small-Dsl	317
T6 Instate Heavy-Dsl	3,347
T6 Instate Small-Dsl	6,914
T6 OOS Heavy-Dsl	34
T6 OOS Small-Dsl	103
T6 Public-Dsl	421
T6 Utility-Dsl	39
T6TS-Gas	1,392
T7 Ag-Dsl	606
T7 CAIRP Construction-Dsl	76
T7 CAIRP-Dsl	8,195
T7 NNOOS-Dsl	10,162
T7 NOOS-Dsl	3,237
T7 Other Port-Dsl	590
T7 Public-Dsl	943
T7 Single Construction-Dsl	198
T7 Single-Dsl	7,951
T7 SWCV-Dsl	355
T7 Tractor Construction-Dsl	148
T7 Tractor-Dsl	4,339
T7 Utility-Dsl	18
T7IS-Gas	249
Total Daily VMT	**518,928**

Appendix E Compound Annual Growth Rates Used to Forecast Future Emissions

To properly forecast for the jurisdiction, specific growth rates were used to estimate growth in population and job sectors. Estimates from the County General Plan update are used for both population and job growth rates. These are shown in Table 30 and Table 31. Growth in vehicle miles traveled is estimated using data from the General Plan update for unincorporated county, and from the EMFAC model (using default settings) for the County which is applied to incorporated jurisdictions. These growth rates are shown in Table 32.

Refer to the inventory tool to gain further information on how growth rates were used to calculate forecasted emissions.

Table 30: Population compound annual growth rates calculated from the County General Plan update, obtained from the County planning department. Italicized years assume value from previous year.

Start Year	End Year	County	Incorporated	Unincorporated
2005	2009	0.0028151	0.0021708	0.0033795
2010	2014	0.0027761	0.0034923	0.0021493
2015	2019	0.0027381	0.0028810	0.0026124
2020	2024	0.0027011	0.0027011	0.0027011
2025	2029	0.0008534	0.0008534	0.0008534
2030	2034	-0.0018808	-0.0018808	-0.0018808
2035	2039	-0.0018986	-0.0018986	-0.0018986
2040	*2044*	*-0.0018986*	*-0.0018986*	*-0.0018986*
2045	*2049*	*-0.0018986*	*-0.0018986*	*-0.0018986*

Table 31: Employment compound annual growth rates calculated from the County General Plan update, obtained from the County planning department. Italicized years assume value from previous year.

Start Year	End Year	County	Incorporated	Unincorporated
2005	2009	0.0033858	0.0032754	0.0035596
2010	2014	0.0033294	0.0032226	0.0034974
2015	2019	0.0032749	0.0031715	0.0034373
2020	2024	0.0032221	0.0031220	0.0033792
2025	2029	0.0039068	0.0037885	0.0040922
2030	2034	0.0049107	0.0047662	0.0051367
2035	2039	0.0047930	0.0046552	0.0050081
2040	*2044*	*0.0047930*	*0.0046552*	*0.0050081*
2045	*2049*	*0.0047930*	*0.0046552*	*0.0050081*

Table 32: Vehicle miles traveled (VMT) compound annual growth rates estimated from County General Plan update for unincorporated county, obtained from the County planning department. EMFAC default VMT projections are used to estimate County VMT growth rates. Italicized years assume value from previous year.

Start Year	End Year	Humboldt County	Unincorporated
2005	2009	-0.0090944	0.004887668
2010	2014	0.0023678	0.004771065
2015	2019	0.0108720	0.004659897
2020	2024	0.0037635	0.004553792
2025	2029	0.0022617	0.002280379
2030	2034	0.0019111	-0.001001899
2035	2039	0.0013396	-0.001006944
2040	*2044*	*0.0013396*	*-0.001006944*
2045	*2049*	*0.0013396*	*-0.001006944*

Two California legislative actions that will reduce carbon emissions are accounted for in forecast projections: Renewable Portfolio Standard (RPS) and Pavley II. The carbon intensity growth rates used are shown in Table 33 and Table 34.

Table 33: Electricity carbon intensity compound annual growth rates estimated to account for the Renewable Portfolio Standard.

Period	Utility RPS Carbon Intensity
2010-2014	-0.045
2015-2019	-0.059
2020-2024	-0.042
2025-2029	-0.042

Table 34: Vehicle emissions carbon intensity compound annual growth rates estimated to account for the Pavley II regulation.

Period	Carbon Intensity Factor
2010-2014	-0.006
2015-2019	-0.017
2020-2024	-0.020
2025-2029	-0.018
2030-2034	-0.012
2035-2039	-0.006
2040-2044	-0.002
2045-2049	-0.001

Appendix F Tableau Energy Summary

This report is attached below. Note that the Multi—family category represents consumption by older master-metered apartment buildings and mobile home parks. The utility rate tariffs associated with these sources are closed to new enrollment. This means that a reduction in consumption in this category could be associated with a decline in customers enrolled under those rate tariffs. Furthermore, any decisions based on energy consumption reported under this category should be targeted towards these master-metered customers. See Section 3.2.1 for a discussion of the role that this report plays in reporting emissions from the consumption of electricity.

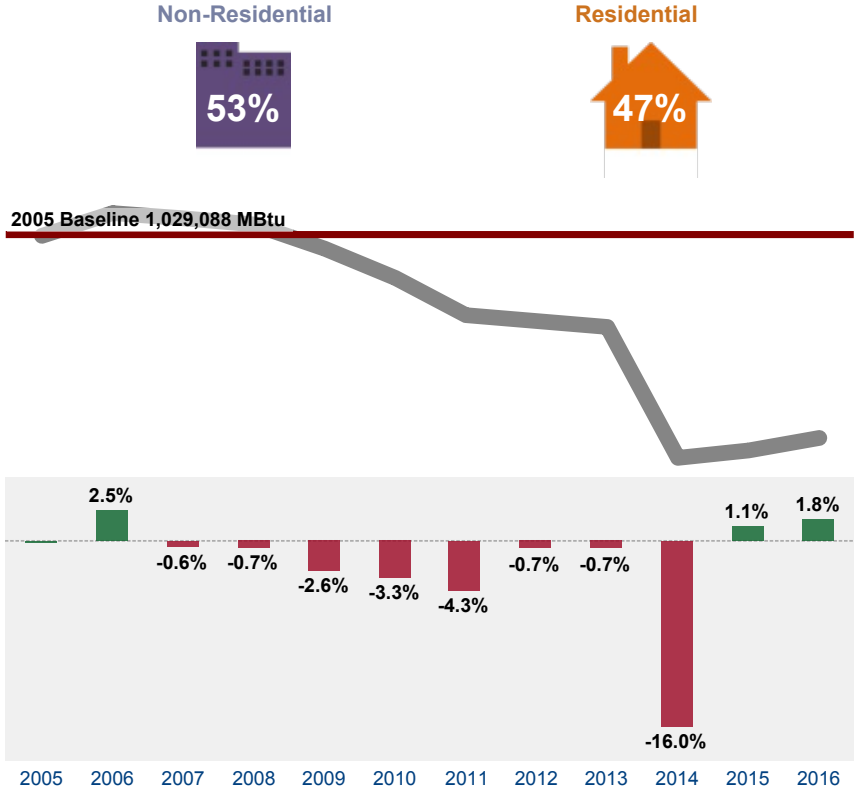
PG&E Energy Summary for Arcata 2005 to 2016

Pacific Gas and Electric Company

This document will help you understand drivers of Arcata's energy usage and the ways the community and PG&E are partnering to decrease energy consumption

Overall energy usage

This is the breakdown between Non-Residential and Residential energy usage in 2016 for Arcata.



800,795

million British thermal units in 2016

Energy usage has changed by -22.2% since 2005

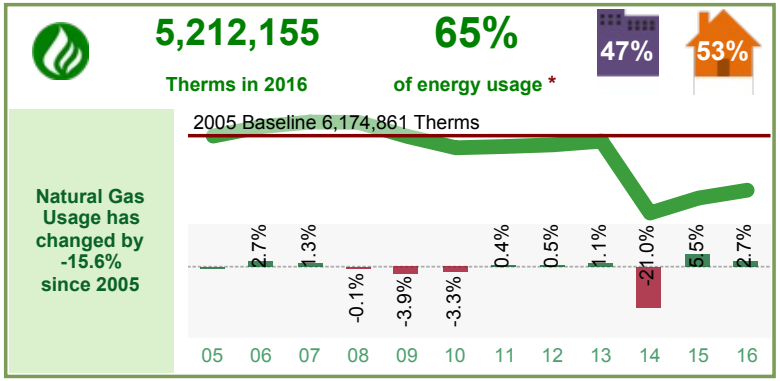
This is the Year over Year change in overall energy usage from the prior year

*Consumption has been converted to British thermal units (Btu) to compare electricity and natural gas usage

Natural Gas

5,212,155 Therms in 2016

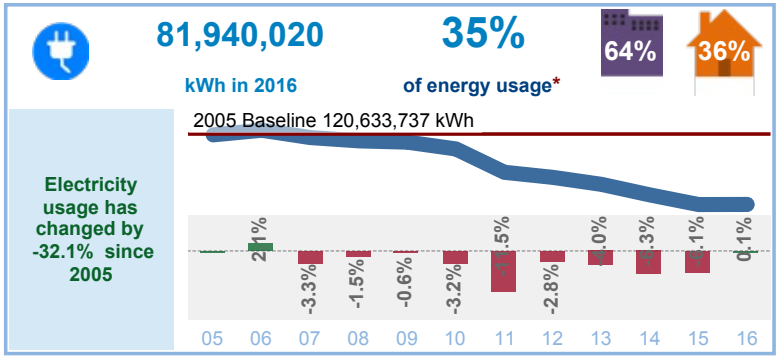
65% of energy usage *



Electricity

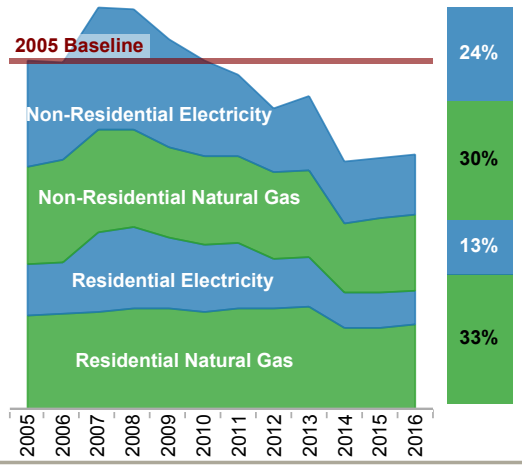
81,940,020 kWh in 2016

35% of energy usage*



Energy Related Emissions

CO2 Emissions from energy usage changed by -26.9% since 2005



43,532 MTCO2

GHG emissions from energy usage in Arcata 2016

13,611 MTCO2 Avoided since 2006 through PG&E programs

equivalent to

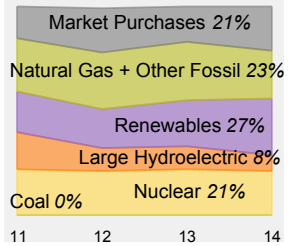
2,272 cars off the road for one year

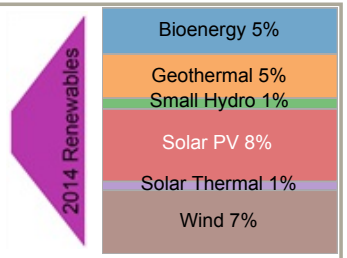
Non-Residential Programs	1,815	10,872 MTCO2
Residential Programs	58	346 MTCO2
Through Manufacturers and Distributors	399	2,392 MTCO2

Pacific Gas and Electric

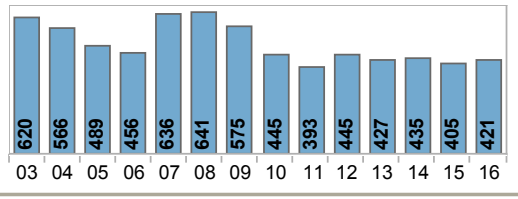
Where Electricity Comes From

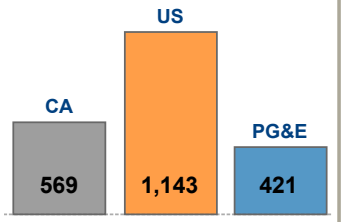
PG&E's delivers some of the cleanest electric power in the nation. Here's how we did it in 2014.





PG&E's 2016 average emissions from delivered electricity were nearly 1/3 the U.S. Average (right)
(shown in lbs CO2 per MWh, 2016 estimated)



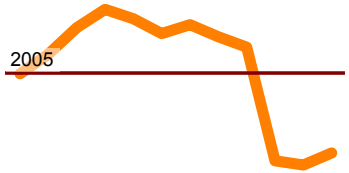


pounds CO2 emitted per megawatt hour

Residential Energy

Usage

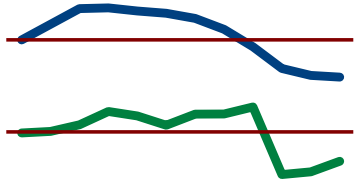
47% of community energy usage (Btu) is from residential customers



Energy usage has changed by -15.5% since 2005

27%

73%



Residential electricity usage changed by -23.5% since 2005

Residential natural gas usage has changed by -13.2% since 2005

Averages

Averages

Monthly Household Averages in 2016

Multi Family	268 kWh per month	-14.3% since 2005
Single Family	319 kWh per month	-29.8% since 2005
Multi Family		
Single Family	31 therms per month	-10.3% since 2005

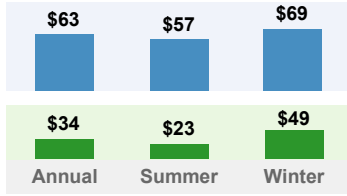
Climate Zone Average: 571 kWh

Climate Zone Average: 36 therms

Climate Zone 01

By Season

Average Monthly Bill (2014 data)



Renewables

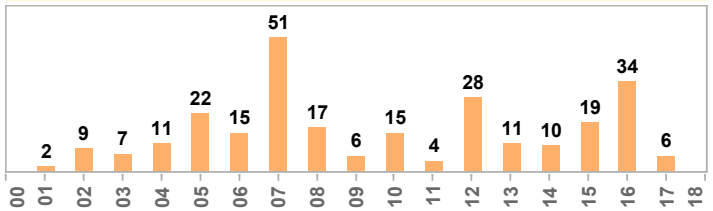
Photovoltaics

227 SItes

1,055 kW

CEC AC Capacity

Residential sites interconnected to the PG&E grid 01 to 17



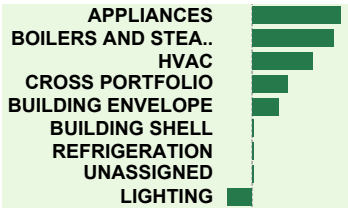
Energy Efficiency

346.4 MTCO2

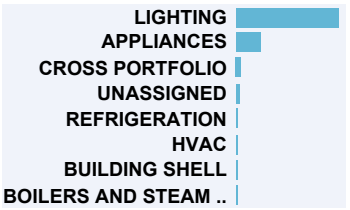
Annual avoided emissions since 2006 through PG&E programs

CO2

38,000 Therms Saved

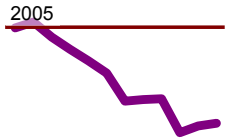


591,000 kWh Saved



Non-Residential Energy Usage

53% of Arcata energy usage (Btu) is from non-residential customers

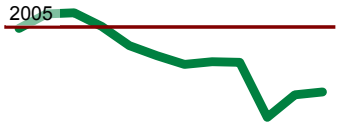


Non-residential energy usage has changed by -28.9% since 2005

42%

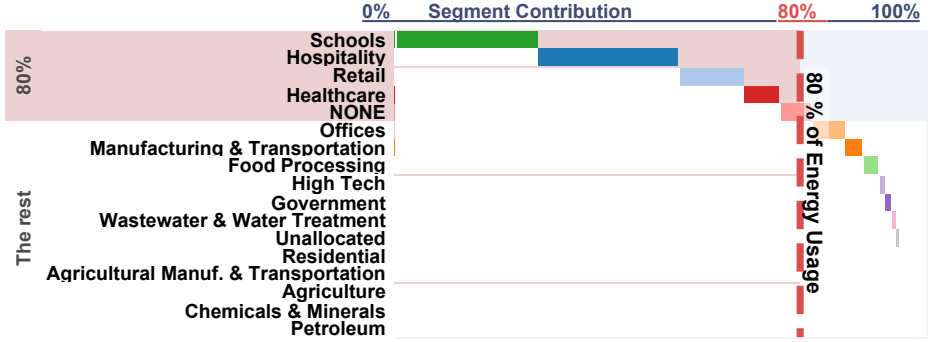
Electricity usage has changed by -36.3% since 2005

58%



Non-residential natural gas usage has changed by -21.4% since 2005

The top **5 Segments** were responsible for **80% of energy usage** in 2015



Renewables

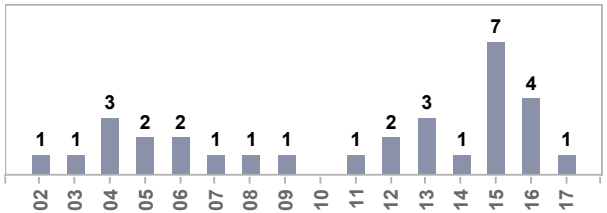
Photovoltaics

31 Sites

558 kW

CEC AC Capacity

Sites Interconnected to the PG&E grid 02 to 17



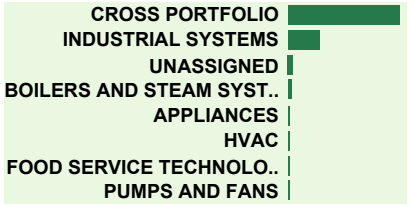
Energy Efficiency

10,872 MTCO2

Annual avoided emissions since 2006 through PG&E programs

CO2

1,338,000 Therms Saved



15,486,000 kWh Saved