



# Greenhouse Gas Emissions Inventories, Future Projections, and Reduction Target

## Overview

The Ukiah greenhouse gas (GHG) inventories serve multiple purposes. They quantify the GHG emissions resulting from activities taking place throughout the City of Ukiah and caused by the City's residents, businesses, and local government (i.e., community-wide emissions), as well as emissions attributed to operation of the local government (i.e., municipal emissions). The inventories provide an understanding of where GHG emissions are originating, and create an emissions baseline against which the City can set emissions reduction targets and measure future progress. The inventories further allow the City to develop effective policies, strategies, and programs to reduce emissions.

The 2005 and 2010 inventories provide a breakdown of GHG emissions by sector to illustrate the contribution of various sources in the community and in municipal operations. The year 2005 was chosen as the baseline based on guidance from the California Air Resources Board (CARB) and the California State-wide Energy Efficiency Collaborative (SEEC), and is consistent with most local government climate action plans in California. The 2010 updated inventory show more recent data and the general trend for each sector over time.

In addition to accounting for the 2005 baseline and 2010 updated emissions, this document forecasts future emissions using current best estimates for population, households, and job growth within the City under "business-as-usual" conditions. This document further provides a reduction target for 2020, based on guidance from CARB.

The boundaries of analysis, along with the methodology and assumptions used to develop Ukiah's GHG inventories and future projections, are included as [Appendix A](#). The technical report on transportation modeling of base year and future conditions in Ukiah, provided by Fehr & Peers, is included as [Appendix B](#).

# Community-Wide Emissions

The emission sources and activities chosen for inclusion in the community-wide inventory are based on the reporting framework for local governments developed by ICLEI in their *U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions*. As such, emissions in the community-wide inventory include those that derive from sources located within the jurisdiction and from activities by community members for which the local government has significant influence to mitigate by 2020. This generally includes activities taking place within the City's geopolitical boundary where the local government has jurisdictional authority, as well as community-related activities taking place outside of City-limits that are attributable to community activities (e.g., landfill waste from City residents). Emissions from sources not subject to significant influence by the community were not included within this inventory, such as the upstream impacts of materials used by the community, since the local government has limited means to influence community material uses.

The community-wide inventory includes emissions from residential, commercial, and industrial activities, as well as municipal operations, broken into 12 sectors: Residential Electricity, Residential Natural Gas, Commercial/Industrial Electricity, Commercial/Industrial Natural Gas, Stationary Sources Energy, Water Conveyance Electricity, On-road Transportation, Off-road Transportation, Agricultural Equipment, Wastewater Treatment (process emissions<sup>1</sup>), Solid Waste Generation, and City Landfill.

The baseline 2005 GHG inventory for the community of Ukiah totals 155,480 metric tons (MT) of carbon dioxide equivalent (CO<sub>2</sub>e<sup>2</sup>). [Figure 1](#) and [Table 1](#) show total GHG emissions by sector. In 2005, On-road Transportation accounted for the largest portion of overall community-wide emissions, constituting 47.9 percent of total emissions. Contributions from other sectors, in order of magnitude, include: City-operated Landfill<sup>3</sup> (23.8 percent), Residential Energy (electricity and natural gas, 10.4 percent), Commercial/Industrial Energy (electricity and natural gas, 9.0 percent), Solid Waste Generation (3.0 percent), Agriculture (2.8 percent), Off-road Transportation (2.7 percent), Wastewater Treatment (0.2 percent), Water Conveyance Electricity (0.1 percent), and Stationary Sources (<0.1 percent).

Between 2005 and 2010, community-wide emissions decreased by approximately 7 percent to 144,625 MT CO<sub>2</sub>e, with 9 of the 12 sectors experiencing a decrease. The 44 percent reduction in emissions from Solid Waste Generation is due to a large increase in waste diversion between 2005 and 2010 (i.e., increased recycling). The decrease at the City-operated Landfill is due to the natural attenuation of methane (CH<sub>4</sub>) emissions as the waste in place decomposes and releases less landfill gas over time. Electricity-related reductions (Residential, Commercial, and Water Conveyance) can be attributed to lower power consumption resulting from the economic downturn, and an increase in the amount of low-carbon renewable energy sources in the City's electricity portfolio from 2005 to 2010. Overall, the percent that each sector contributed to total emissions did not change significantly between 2005 and 2010, with On-road Transportation continuing to comprise the largest sector (51.1 percent), followed by the City Landfill (21.1 percent), and Residential Energy (electricity and natural gas, 11.2 percent).

[Figure 2](#) shows changes in GHG emissions by sector between 2005 and 2010.

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<sup>1</sup> Process emissions consist of methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) generated by combustion of digester gas, plant processes, and fugitive emissions from effluent discharge. Natural gas and electricity consumed by the Wastewater Treatment plant are captured in the natural gas and electricity sectors.

<sup>2</sup> Carbon dioxide equivalent (CO<sub>2</sub>e) includes carbon dioxide, methane (CH<sub>4</sub>) and/or nitrous oxide (N<sub>2</sub>O).

<sup>3</sup> The City-Operated Landfill stopped accepting new waste in 2000. However, it continues to emit GHGs from the breakdown of stored waste.

Figure 1: 2005 Baseline Community GHG Emissions by Sector

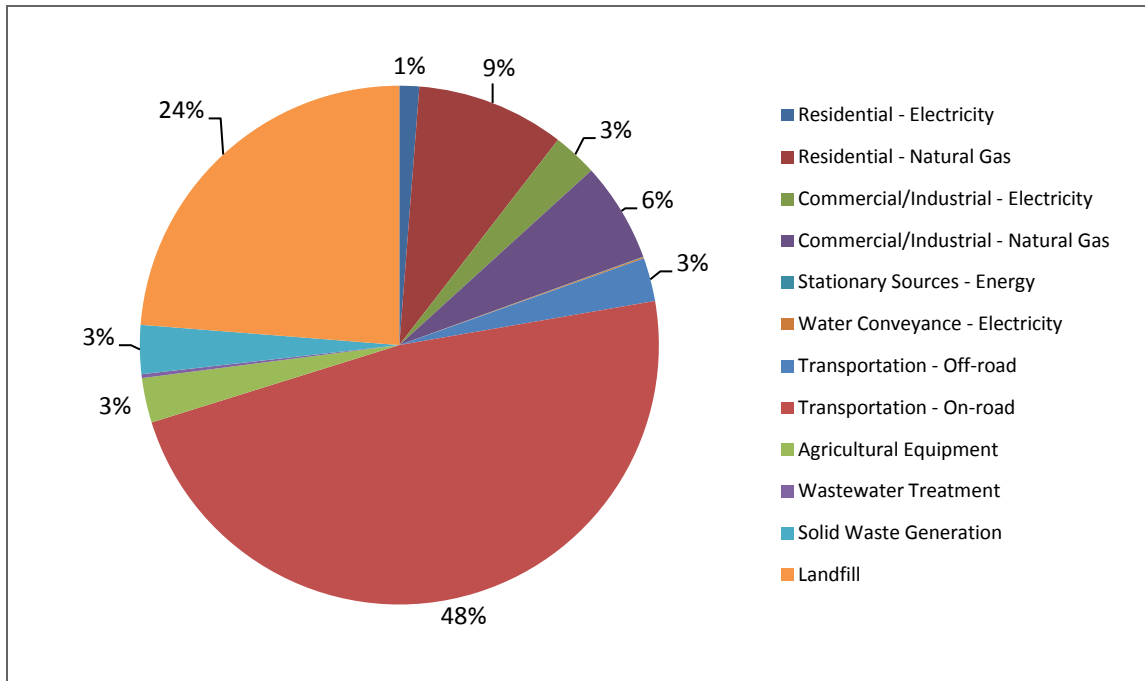
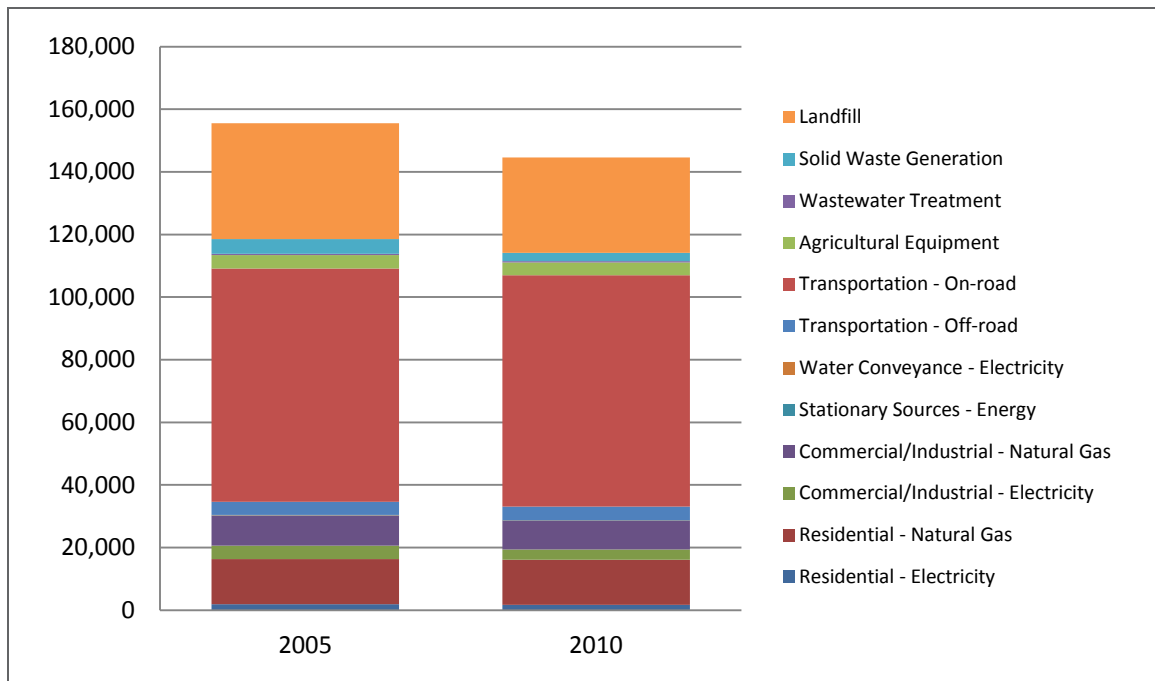


Table 1: 2005 Baseline and 2010 Updated Community GHG Emissions by Sector

Emission Sector	2005 Baseline (MT CO2e)	2005 (% Total)	2010 (MT CO2e)	2010 (% Total)	2005-2010 (% Change)
Residential - Electricity	1,918	1.2%	1,679	1.2%	-12.4%
Residential - Natural Gas	14,370	9.2%	14,490	10.0%	0.8%
Commercial/Industrial - Electricity	4,323	2.8%	3,212	2.2%	-25.7%
Commercial/Industrial - Natural Gas	9,658	6.2%	9,231	6.4%	-4.4%
Stationary Sources - Energy	47	<0.1%	48	<0.1%	0.8%
Water Conveyance - Electricity	126	0.1%	78	0.1%	-38.1%
Transportation - Off-road	4,200	2.7%	4,302	3.0%	2.4%
Transportation - On-road	74,477	47.9%	73,896	51.1%	-0.8%
Agricultural Equipment	4,330	2.8%	4,134	2.9%	-4.5%
Wastewater Treatment	377	0.2%	372	0.3%	-1.3%
Solid Waste Generation	4,722	3.0%	2,641	1.8%	-44.1%
City Landfill	36,934	23.8%	30,543	21.1%	-17.3%
<b>Total</b>	<b>155,480</b>	<b>100%</b>	<b>144,625</b>	<b>100%</b>	<b>-7.0%</b>

Figure 2: 2005 and 2010 Community GHG Emissions by Sector (MT CO2e)



## Municipal Operations Emissions

Although emissions from Ukiah municipal operations are included in the community inventory, this document provides added detail on the GHG emissions from municipal operations. The municipal energy use inventory includes all energy-consuming activities under the direct control of the City, and details emissions from eight categories: Electricity, Natural Gas, City Vehicle Fleet (fuel), Solid Waste Generation, Employee Commute, Stationary Sources, Wastewater Treatment (process emissions), and City Landfill.

As shown in [Table 2](#), in 2005 municipal operations were responsible for approximately 1,969 MT CO2e, excluding emissions associated with operation of the City Landfill, and 38,903 MT CO2e including City Landfill emissions. Because the City Landfill generates a disproportionately large percentage of emissions from municipal operations, this inventory shows municipal operations both with and without City Landfill emissions, to give a clearer picture of contribution of each sector.

[Figure 3](#) shows 2005 baseline municipal GHG emissions by sector, excluding City Landfill emissions. The primary sources were City Vehicle Fleet Fuel (27.9 percent), Wastewater Treatment processes (24.1 percent), and Electricity for facilities and streetlights (23.6 percent). Remaining emissions came from Employee Commuting (14.1 percent), Natural Gas for facilities (6.6 percent), Solid Waste Generation (2.4 percent), and Stationary Sources fuel (1.3 percent). [Figure 4](#) shows baseline emissions including the City Landfill, in which case the City Landfill generated approximately 94.9 percent of total municipal operations emissions.

As shown in [Table 2](#), between 2005 and 2010 municipal operations emissions decreased by approximately 7.8 percent (excluding City Landfill emissions) to 1,814 MT CO2e. Including the City Landfill, municipal emissions decreased 16.8 percent to 32,357 MT CO2e. As discussed previously for community-wide emissions, the 17.3 percent emission decrease at the City-operated Landfill is due to a natural reduction in

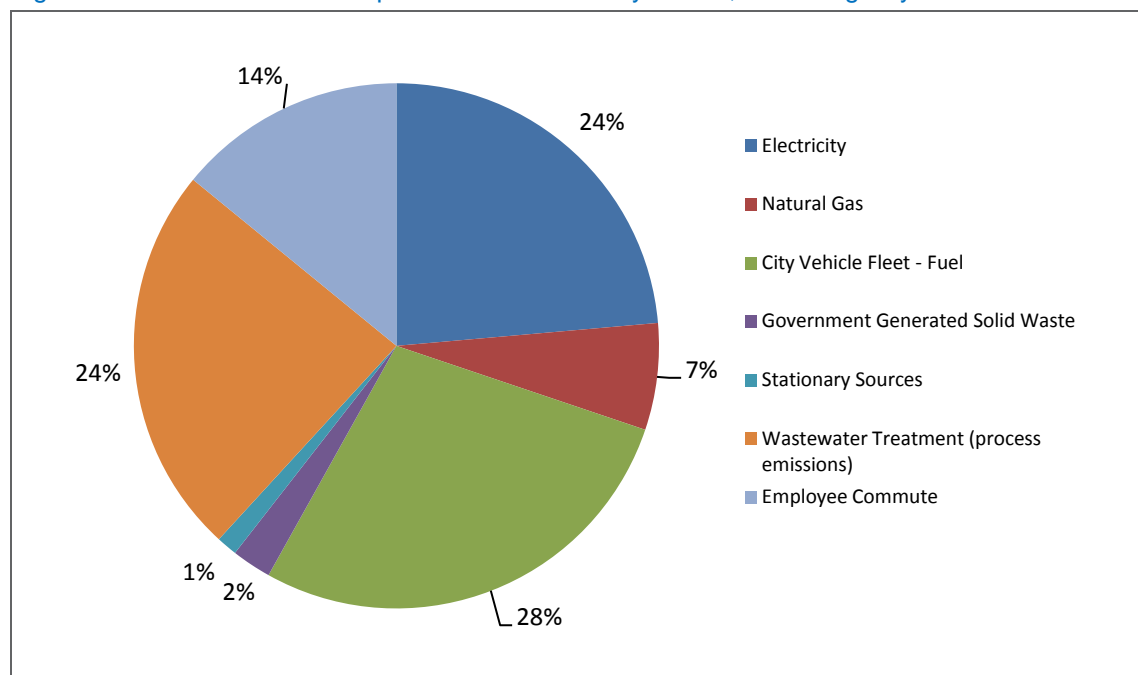
Table 2: 2005 Baseline and 2010 Updated Municipal Operations GHG Emissions by Sector

Emission Sector	2005 Baseline (MT CO2e)	2005 (% Total)*	2010 Update (MT CO2e)	2010 (% Total)*	2005-2010 (% Change)
Electricity	465	23.6%	283	15.6%	-39.1%
Natural Gas	129	6.6%	164	9.0%	26.4%
City Vehicle Fleet - Fuel	550	27.9%	549	30.2%	-0.2%
Solid Waste Generation	48	2.4%	29	1.6%	-40.1%
Stationary Sources	25	1.3%	24	1.3%	-3.8%
Wastewater Treatment	474	24.1%	475	26.2%	0.1%
Employee Commute	277	14.1%	291	16.0%	4.9%
<b>Total (without City Landfill)</b>	<b>1,969</b>	<b>100%</b>	<b>1,814</b>	<b>100%</b>	<b>-7.8%</b>
City Landfill	36,934	94.9%**	30,543	94.4%**	-17.3%
<b>Total (with City Landfill)</b>	<b>38,903</b>	<b>100%</b>	<b>32,357</b>	<b>100%</b>	<b>-16.8%</b>

\* Excluding City Landfill

\*\* Including City Landfill

Figure 3: 2005 Baseline Municipal GHG Emissions by Sector, Excluding City Landfill



the decomposition rate of deposited waste over time, and the 40.1 percent decrease in emissions from Solid Waste Generation is likely due to a large increase in waste diversion. Electricity-related emissions also show a sharp decrease (39.1 percent), both from lower electricity consumption in 2010 likely due to a smaller staff, and an increase in the amount low-carbon renewable energy sources in the City’s electricity portfolio. Natural Gas for municipal facilities increased 26.4 percent between 2005 and 2010, primarily due to four new facilities being brought online. Like in 2005, in 2010 the three sectors with the highest emissions remained City Vehicle Fleet Fuel (30.2 percent), Wastewater Treatment processes (26.2 percent), and Electricity for facilities and streetlights (15.6 percent). Figure 5 shows changes in GHG emissions by sector between 2005 and 2010.

Figure 4: 2005 Baseline Municipal GHG Emissions by Sector, Including City Landfill

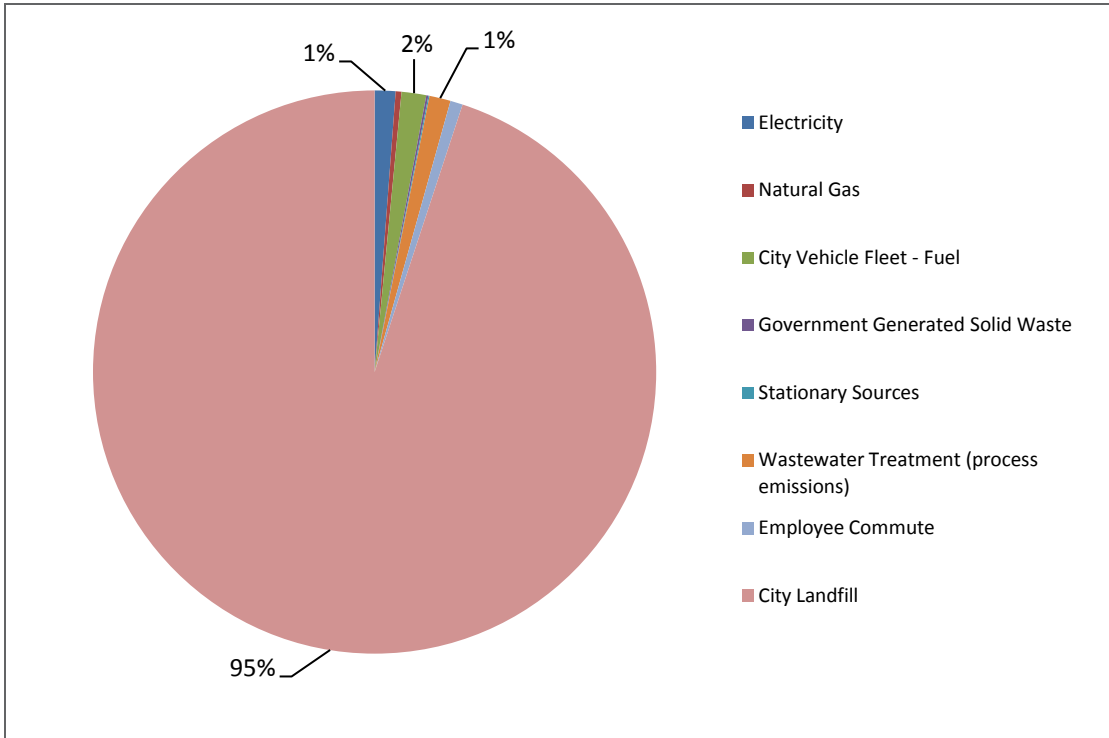
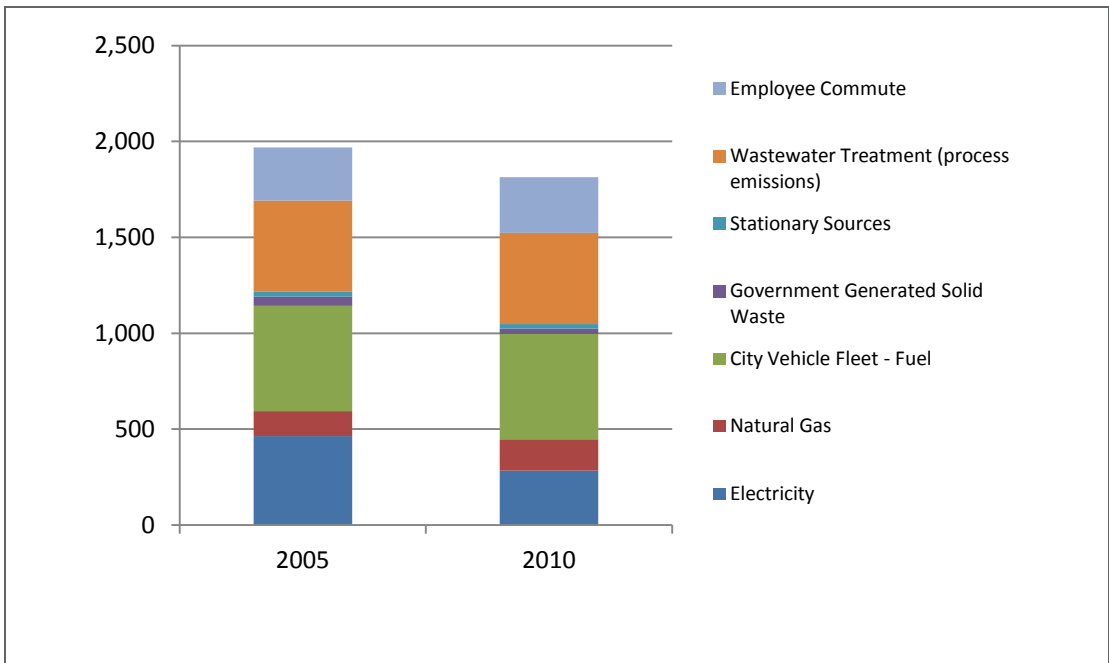


Figure 5: 2005 Baseline and 2010 Updated Municipal Emissions by Sector (MT CO2e) (Excluding City Landfill)



# Emissions Forecasts

GHG emissions projections for 2020 and 2030 were developed under a business-as-usual (BAU) scenario, i.e., a scenario that does not include regulatory actions or GHG reduction measures that were not in place by the 2005 base year. For community-wide emissions, this section also includes a 2020 “adjusted” forecast that includes the effects of state-wide emissions reductions measures such as updates to building energy standards and implementation of programs to decrease emissions from on-road vehicles.

## Business-as-Usual Forecast

GHG emissions projections for the community and for municipal operations were based primarily on anticipated growth in total population, employment and/or housing in the City of Ukiah for the periods 2010 to 2020 and 2010 to 2030. Historical City population data was obtained from the California Department of Finance (DOF, 2012)<sup>4</sup>, and future population projections were taken from the City of Ukiah 2010 Urban Water Management Plan. For community-wide employment, historical estimates were obtained from the 2010-2011 Mendocino County Economic & Development Profile (labor force only). Future employment projections were taken from the model used to estimate future vehicle miles traveled (see Appendix B). Historical housing data was obtained from the California Department of Finance, and future housing estimates were taken from the Fehr & Peers Ukiah VMT Inventory Memo (see Appendix B)<sup>5</sup>. For municipal employment, historical estimates were obtained from City records and projected trends were calculated using historical growth patterns. See Appendix A for more detail on growth factors and estimates.

## Community-wide Projections

Table 3 shows anticipated GHG emissions for the twelve sectors included in the City’s community-wide 2005 and 2010 GHG inventories. The table includes a description of the specific growth projections used as a proxy to project future emissions for each sector.

**Table 3: Community-wide Baseline and Projected GHG Emissions 2005-2030 under a BAU Scenario (MT CO2e)**

Emission Sector	2005 Emissions	2010 Emissions	2020 Emissions	2030 Emissions	Growth Proxy
Residential - Electricity	1,918	1,679	1,799	2,126	Average of population and household growth
Residential - Natural Gas	14,370	14,490	15,519	18,344	Average of population and household growth
Commercial/Industrial - Electricity	4,323	3,212	3,523	3,808	Employment growth
Commercial/Industrial - Natural Gas	9,658	9,231	10,124	10,946	Employment growth
Stationary Sources - Energy	47	48	51	61	Average of population and household growth
Water Conveyance - Electricity	126	78	84	96	Average of pop., household, and employment growth

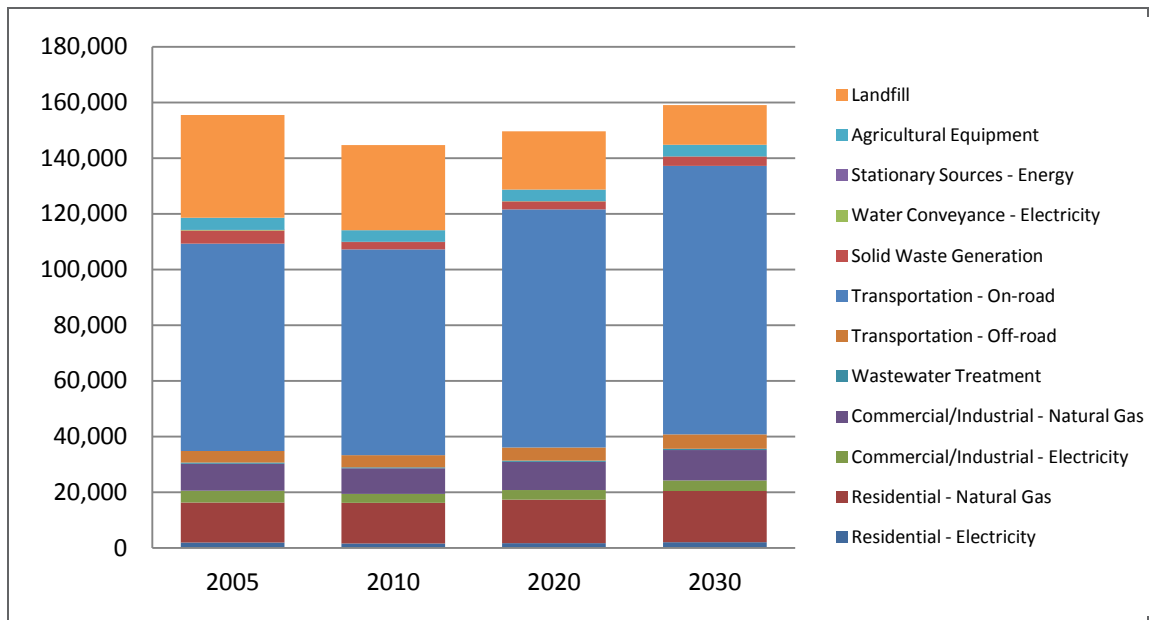
<sup>4</sup> California Department of Finance, (E-8 Historical Population and Housing Estimates for Cities, Counties and the State, 2000-2010). Accessible at: <http://www.dof.ca.gov/research/demographic/reports/view.php#objCollapsiblePanelEstimatesAnchor>

<sup>5</sup> See Appendix B.

**Table 3: Community-wide Baseline and Projected GHG Emissions 2005-2030 under a BAU Scenario (MT CO2e) (continued)**

Emission Sector	2005 Emissions	2010 Emissions	2020 Emissions	2030 Emissions	Growth Proxy
Transportation – Off-road	4,200	4,302	4,718	5,101	Employment growth
Transportation – On-road	74,477	73,896	85,523	96,456	Vehicle miles traveled (VMT)
Agricultural Equipment	4,330	4,134	4,134	4,134	No growth
Wastewater Treatment	377	372	402	461	Average of pop., household, and employment growth
Solid Waste Generation	4,722	2,641	2,851	3,271	Average of pop., household, and employment growth
Landfill	36,934	30,543	20,887	14,215	N/A (Projections used California ARB Landfill Emissions Tool, and EPA’s LandGEM software)
<b>Total</b>	<b>155,480</b>	<b>144,625</b>	<b>149,615</b>	<b>159,021</b>	

**Figure 6: 2005 Baseline, 2010 Update, and 2020 and 2030 BAU Community Emissions by Sector (MT CO2e)**



### Municipal Projections

For projecting municipal emissions, it was assumed that wastewater treatment (process emissions) would grow commensurate with population growth, whereas other municipal departments, facilities, and services would grow in proportion to municipal employment trends. Municipal employment is anticipated to grow at a slightly slower rate than the City population from 2010 to 2020 and 2030, following the same annual rate



of growth in municipal employment during the 2000 to 2011 period. Table 4 shows historic and projected GHG emissions for municipal sources.

**Table 4: Municipal Baseline and Projected GHG Emissions 2005-2030 under a BAU Scenario (MT CO<sub>2</sub>e)**

Emission Sector	2005 Emissions	2010 Emissions	2020 Emissions	2030 Emissions	Growth Proxy
Electricity	465	283	303	324	City employee FTE
Natural Gas	129	164	175	187	City employee FTE
City Vehicle Fleet - Fuel	550	549	586	627	City employee FTE
Solid Waste Generation	48	29	31	33	City employee FTE
Stationary Sources	25	24	26	28	City employee FTE
Wastewater Treatment	474	475	513	588	Average of pop., household and employment growth
Employee Commute	277	291	311	333	City employee FTE
<b>Total (without City Landfill)</b>	<b>1,969</b>	<b>1,814</b>	<b>1,944</b>	<b>2,118</b>	
City Landfill	36,934	30,543	20,887	14,215	Historical landfill emissions
<b>Total (with City Landfill)</b>	<b>38,903</b>	<b>32,357</b>	<b>22,831</b>	<b>16,334</b>	

## ‘Adjusted’ Business-as-Usual Forecast

State-wide emissions reduction measures will contribute to Ukiah’s overall GHG reductions by 2020. Several high-impact state-wide measures included in the AB 32 Scoping Plan target emissions from transportation and power generation.

The Low Carbon Fuel Standard (LCFS) to reduce the carbon intensity of transportation fuels and the Pavley Bill for reducing passenger vehicle emissions (Assembly Bill 1493) are each expected to provide significant emissions reduction benefits for the City of Ukiah, particularly since on-road emissions constitute such a large proportion of total community-wide emissions (57.7% in 2020). By 2020, the impact of both the Pavley Bill and the LCFS in Mendocino County is projected to reduce on-road transportation emissions by approximately 19.3 percent<sup>6</sup>.

In addition, updates to California’s Title 24 (Building Energy Efficiency Standards for Residential and Non-residential Buildings) will provide improvements to the energy efficiency of new residential and commercial structures constructed between 2005 and 2020. By 2020, residential energy improvements for electricity and natural gas are projected reach approximately 10.0 percent and 22.7 percent above pre-2005 Title standards, respectively, and commercial energy improvements for electricity and natural gas are projected to reach 9.4 percent and 4.9 percent<sup>7</sup>. These energy and resulting emissions savings will impact new development in the

<sup>6</sup> EMFAC 2011 Model Run for Mendocino County, accessed February, 2013.

<sup>7</sup> Impact Analysis: 2008 Update to the California Energy Efficiency Standards for Residential and Nonresidential Buildings Available at: [http://www.energy.ca.gov/title24/2008standards/rulemaking/documents/2007-11-07\\_IMPACT\\_ANALYSIS.PDF](http://www.energy.ca.gov/title24/2008standards/rulemaking/documents/2007-11-07_IMPACT_ANALYSIS.PDF)

City of Ukiah from the between the base year (2005) and 2020, resulting in reduction in electricity-related emissions of 28 MT CO<sub>2</sub>e, and a reduction in natural gas-related emissions of 131 MT CO<sub>2</sub>e.

The state’s Renewable Portfolio Standard (RPS) requires the renewable energy portion of a utility’s portfolio to be 33 percent by 2020, which will reduce the emissions associated with the portion of the City’s electricity purchased from PG&E. RPS rules require the renewable energy portion of a utility’s electricity portfolio to be 33 percent by 2020. However, the portfolio of electricity consumed by Ukiah already far exceeds 33 percent. In 2010, eligible renewable already accounted for 55 percent of the electricity portfolio, with hydroelectricity providing an additional 21 percent and nuclear a further 4 percent. Moreover, PG&E provides less than 1 percent of the City of Ukiah’s energy needs. The State-wide RPS is therefore not expected have a significant effect on emissions in 2020, and is so is not included as a State Reduction Measure for calculation purposes.

The collective impact of these state-wide measures on helping the City achieve its 2020 reduction target is presented in [Table 5](#). By 2020, these measures are expected to reduce city-wide GHG emissions by an estimated 11.1 percent, resulting in annual emissions of approximately 132,944 MT CO<sub>2</sub>e.

**Table 5. Annual GHG Reductions from State-wide Measures by 2020**

State Measure	GHG Emissions (MT CO <sub>2</sub> e/year)
2008 Title 24 –Electricity	28
2008 Title 24 –Natural Gas	131
Pavley Bill and Low Carbon Fuel Standard	16,513
<b>Total Reductions</b>	<b>16,671</b>

## Emissions Reduction Target

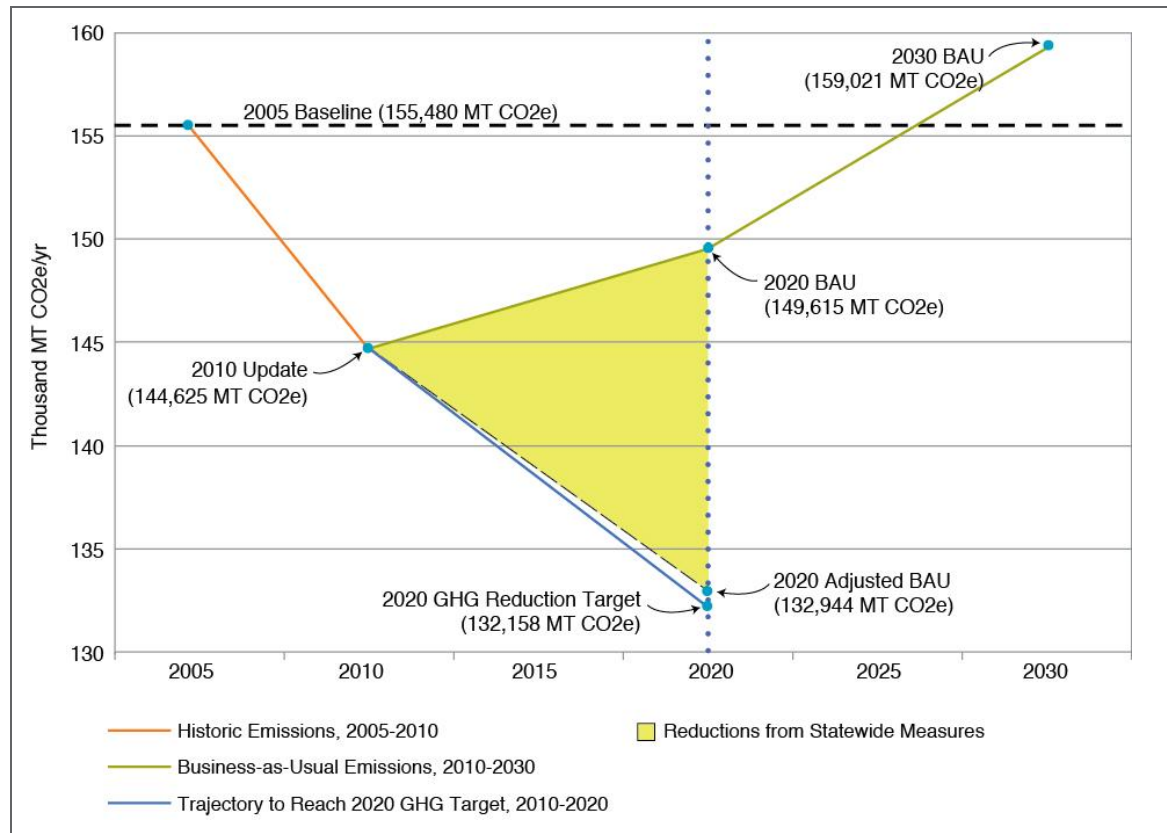
The City of Ukiah is considering a community-wide emissions reduction target of 15 percent below its 2005 baseline by the year 2020, for both community-wide and municipal emissions. A 15 percent reduction target is deemed by CARB and the California Attorney General to be consistent with the state-wide AB 32 goal of reducing emissions to 1990 levels,<sup>8</sup> and is in line with current best practice for climate action plans developed for numerous California cities, many of which use a 2005 baseline.

## Community Emissions

The City’s target of 15 percent below 2005 baseline by 2020 equates to 132,158 MT CO<sub>2</sub>e per year for community emissions, which is 23,322 MT CO<sub>2</sub>e below the baseline (2005), 17,457 MT CO<sub>2</sub>e below the projected 2020 BAU emissions, and 786 MT CO<sub>2</sub>e below the adjusted BAU. The community-wide emissions reduction target is depicted graphically in [Figure 7](#).

<sup>8</sup> In its Climate Change Scoping Plan of September 2008, CARB recommends that local governments adopt a GHG reduction target consistent with the State’s commitment to reach 1990 levels by 2020. This is identified as equivalent to 15% below “current” levels at the time of writing (2008).

Figure 7: Community-wide GHG Emissions under 2005 Baseline, 2010 Update, 2020 BAU, 2020 Adjusted BAU, and 15% Reduction Target for 2020



## Municipal Operations Emissions

Though municipal operations emissions are much smaller than emissions from the overall community, a reduction target for municipal operations is appropriate because many of the measures included in this Climate Action Plan apply to facilities or operations under the direct control of the City, and because the City intends to lead by example in meeting the mandates of AB 32. Applying the 15 percent reduction to the 2005 baseline emissions results in a 2020 target of 1,673 MT CO<sub>2</sub>e, representing a reduction below business-as-usual of 271 MT CO<sub>2</sub>e per year in 2020.