HUMBOLDT STATE UNIVERSITY

Greenhouse Gas Emissions Inventory Report

HSU Office of Sustainability

December, 2014

PLANNING ◆ DESIGN ◆ CONSTRUCTION ◆ SUSTAINABILITY ◆ OPERATIONS ◆ MANAGEMENT

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EXECUTIVE SUMMARY

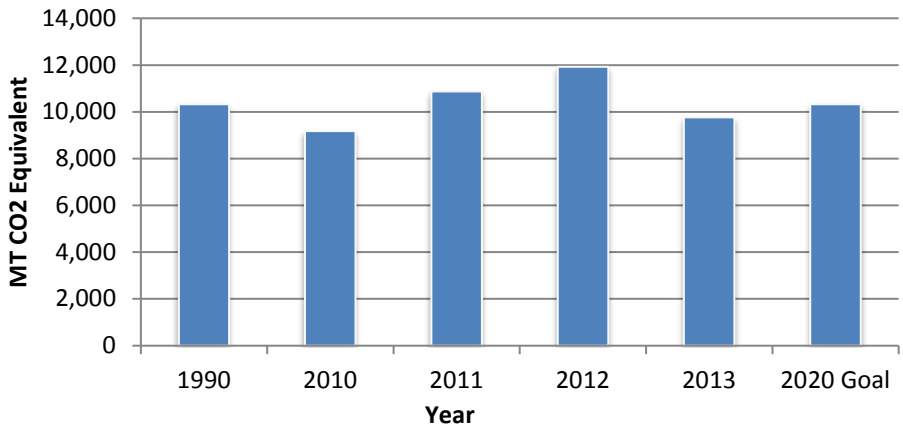
Humboldt State University (HSU) has a longstanding commitment to environmental and social responsibility and is a leader in the integration of sustainability into its operations and academics. Many of HSU's operational and business activities generate greenhouse gases, however, which contribute to global climate change and its associated affects on social, economic and environmental systems. Measuring emissions and identifying their sources is the first step towards identifying effective mitigation strategies. This report documents an inventory of HSU's greenhouse gas emissions, from 1990 to the present, from standard emissions sources from State side as well as auxiliary (i.e., Housing and Dining) operations. These include direct emissions (Scope 1) from on-site combustion of fossil fuels, and indirect emissions (Scope 2) from purchased electricity. Also included in this report are indirect emissions (Scope 3) from business travel, commuting, and solid waste disposal. The chart below (Figure 1) summarizes Scopes 1-3 emissions for 1990 and 2010-13.

Figure 1. Total Measured Emissions in MTCO2e

	1990	2010	2011	2012	2013
Scope 1	7,001	5,710	5,903	6,897	6,106
Scope 2	3,324	3,472	4,975	5,031	3,662
Scope 3	7,033	6,237	6,355	6,303	6,390
TOTAL	**17,358**	**15,419**	**17,233**	**18,231**	**16,158**

As with other California State Universities, HSU has the goal of reducing its Scopes 1 and 2 greenhouse gas emissions to 1990 levels by 2020, and to further reduce greenhouse gas emissions to 80% below 1990 levels by 2040. Figure 2 illustrates HSU's progress towards achieving this goal, based on the University's Scope 1 and 2 emissions reported by the CSU Chancellor's Office from 1990 to the present. As of the 2013 reporting year, HSU had dropped its measured Scopes 1 and 2 emissions by 557 MTCO2e below 1990's total.

Figure 2.0 Meeting the Goal of 1990 Level GHG Emissions by 2020 (Scopes 1&2)



1.0 INTRODUCTION

This report presents results of an inventory of the greenhouse gas emissions generated by Humboldt State University's primary operations and associated activities since 1990. A greenhouse gas (GHG) is generally defined as a gas that traps heat in the atmosphere. Anthropogenic emissions of GHG are driving global climate change, as they are responsible for nearly all of the increase in greenhouse gases in the atmosphere over the last 150 years.[i]

Humboldt State University is poised to join other institutions in reducing its GHG emissions through the development and implementation of a Climate Action Plan (CAP). The CAP will be driven in part by the intent and specific goals of the Global Warming Solutions Act, the State of California's landmark legislation to address climate change, and the California State University Sustainability Policy, which states that

The CSU will strive to reduce system-wide facility greenhouse gas (GHG) emissions to 1990 levels, or below, by 2020 consistent with AB 32, California's Global Warming Solutions Act of 2006, and to further reduce greenhouse gas emissions to 80% below 1990 levels by 2040. (HSC §38550).[ii]

The CAP will be a planning and policy document designed to guide and prioritize the University's efforts to curb GHG emissions moving forward. To that end, this Greenhouse Gas Inventory report provides a baseline measurement from which to track changes in the University's yearly emissions.

Greenhouse gas emissions are divided into three scopes. Direct emissions from combustion of fuels by campus owned or operated equipment falls under Scope 1. Scope 2 comprises indirect emissions (i.e., emissions at the power plant) from electricity purchased by HSU, while Scope 3 includes emissions from related activities – business travel, student and employee commute, and solid waste disposal. This report presents Scopes 1-3 emissions for the years 1990, 2010, 2011, 2012, and 2013. Emissions are reported in Metric Tons of Carbon Dioxide Equivalent, or MTCO2e, the most accepted unit of impact.[iii] Updated GHG emissions inventories will be conducted every two years, utilizing the same methodology presented below, following the formalized establishment of the CAP.

2.0 METHODOLOGY AND RESULTS

2.1 Scopes 1 and 2 Reporting

The Sustainability Office utilized emissions reports from the CSU to inventory Scopes 1 and 2 emissions. The CSU emissions reports are based off of monthly energy reports from HSU and are organized in accordance with the Climate Registry General Reporting Protocol[iv]. Scope 1 includes emissions released from sources that are owned or controlled by the university, such as vehicles, generators and boilers. These emissions were inventoried from the following sources:

- Natural gas consumption by Cogeneration (Combined Heat and Power) systems, as well as by Non-Cogeneration systems like boilers, space and water heaters, and laboratory equipment;
- Gasoline, diesel, and propane purchased for campus-owned vehicles

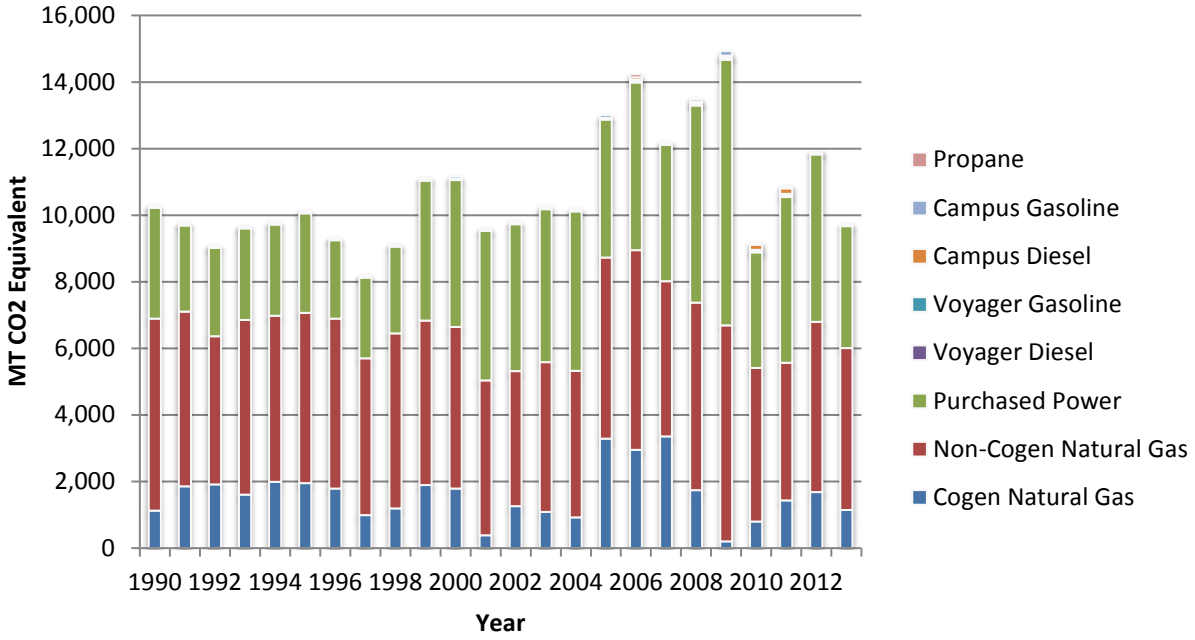
The CSU utilized fuel and natural gas consumption totals, tracked on a monthly basis by HSU Facilities Management, to identify Scope 1 emissions. See table below for Scope 1 emissions factors reported by the CSU:

Figure 3. Scope 1 Emission Factors

Source	CO2	CH4	NOx
Natural Gas (kg/mmBtu)	52.78	0.004	0.001361
Gasoline (kg/gallon)	8.55	0.04	0.04
Diesel (kg/gallon)	9.96	0.06	0.05
Propane (kg/gallon)	5.67	0.001	0.001

Scope 2 is comprised of emissions released as a result of campus purchased electricity. HSU, along with other universities in the Cal State University system, purchases the majority of its electricity through a Direct Access agreement with Shell Energy North America, an Energy Service Provider (ESP). Less than 10% of auxiliary and campus electricity is purchased directly from PG&E. The university currently does not purchase renewable energy credits (RECs), nor does it have any significant solar photovoltaic or other green self-generation installations to offset purchased power[v]. The CSU utilized purchased electricity data and Direct Access specific emissions factors to identify Scope 2 (i.e., purchased power) emissions. Figure 4.0 shows HSU's Scopes 1 & 2 emissions since 1990:

Figure 4. HSU Scopes 1 & 2 Emissions



2.2 Scope 3 Reporting

2.2.1 Business Travel

HSU policy requires a travel pre-authorization and expense claim process for domestic and international travel. Business travel includes:

- Faculty and staff travel for university sanctioned activities, meetings and conferences
- Student recruitment efforts
- Athletics and sports team travel
- International travel, including study abroad programs

Researchers utilized archived travel expense claim forms, campus population data, and current and historical fuel economy averages to identify business travel-related emissions for the reporting years. Expense claim forms give access to a wide range of data, including destinations, dates, vehicle type, and trip description. Methods for extracting travel mileage from each claim form varied based on the degree of detail – in some instances mapping software was utilized to approximate travel distances.

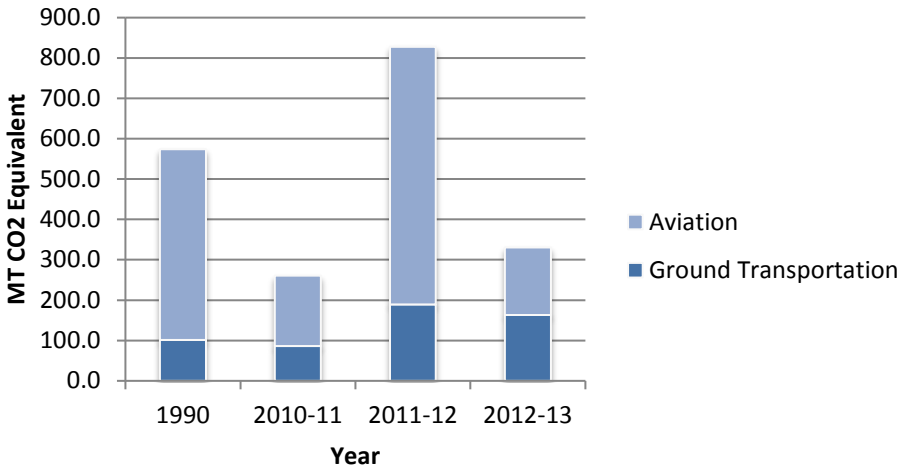
The university has no archived record of 1990 travel claims. To estimate emissions from business travel for 1990, researchers calculated a mileage for both air and ground transport from a 3% sample of travel claim forms in each reporting year, establishing a "miles driven per person" total by dividing total miles driven by the employee count for the reporting year. By assuming the amount of travel per employee remained relatively constant from year to year, researchers approximated miles driven in 1990 by applying the 1990 employee count to average miles driven per person from the other reporting years

and taking the average[vi]. Researchers also included emissions from an additional 40 miles of assumed ground travel (e.g., taxi to/from airport) associated with air travel, and then utilized 1990 Corporate Average Fuel Economy (CAFE) standard miles per gallon to determine total fuel amount used for that year[vii].

Researchers calculated air travel emissions utilizing Tier 3 inventory methodology[viii]. Tier 3 methodology utilizes "data for each flight containing aircraft type and flight distance, subdivided into domestic and international". Researchers utilized a flight tracking website (www.flightaware.com) to determine average aircraft flying in and out of the Arcata/Eureka airport as well as other domestic and international flights. Emissions were calculated using Climb/Cruise/Descent (CCD) and Landing and Takeoff Oscillation (LTO) cycle emission projections in the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013 Appendix D and interpolated emissions using nautical miles for the specified flight. Researchers approximated 1990 air transport emissions by multiplying 1990 employee count with average air emissions per person per year.

Due to significant increases in efficiency between 1990 and now, data suggests that current business travel is less carbon intensive than it was in 1990. Overall, emissions associated with business related travel have seen a considerable reduction except for fiscal year 2011-12 (Figure 5.0). CO2e emissions during 2011-12 were approximately 30% higher than estimated 1990 levels, and considerably less than 1990 levels in the 2010-11 and 2012-13 fiscal years.

Figure 5. Business Travel Emissions



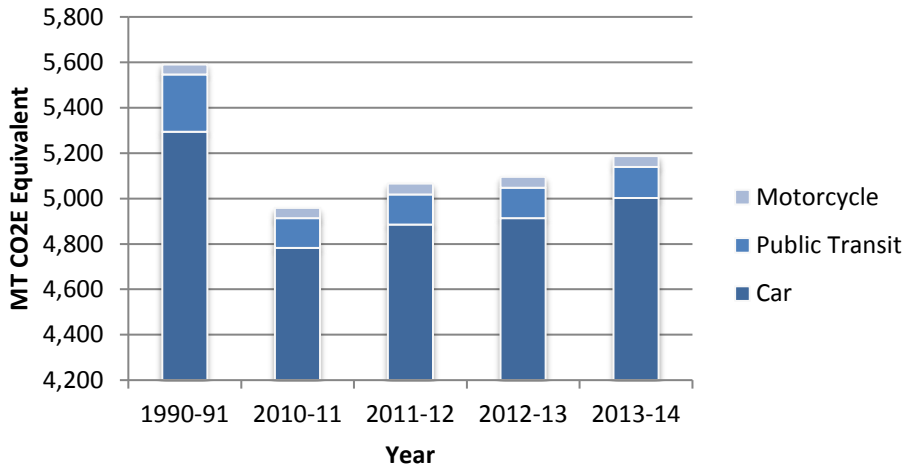
2.2.2 Commuting

Commute is defined as regular travel from residence to HSU for work, instruction, recreation or other campus activity. To estimate emissions associated with commuting, the Sustainability Office released a campus-wide survey in 2014, which posed a series of questions to assess the commuting and parking practices of students, faculty and staff – namely, modes of travel, distance from points of origin, frequency of commute, and parking preferences. Approximately 20% of the randomly selected students,

faculty and staff responded to the survey. Researchers estimated commute emissions (Figure 6.0) using the following procedure:

- Determined the total number of miles traveled per mode by multiplying number of commutes per week per mode by the respondents' corresponding average distance in miles.
- The total number of miles per week using each mode of transportation was multiplied by 30 (weeks) to determine the total number of miles traveled per academic year. [ix]
- Researchers divided the total number of miles traveled per academic year (for all modes of transportation) by the number of respondents to determine average miles traveled per person.
- Researchers then multiplied the average miles traveled per person by the campus population in the reporting years to determine total miles traveled in each academic year by the entire campus population.[x] Total miles traveled in each academic year were multiplied by the percentage of miles traveled by each mode of transportation (dividing the total number of miles traveled using each mode of transportation by total number of miles traveled using all modes of transportation) to determine the total number of miles traveled by the campus population, using each mode of transportation, for the reporting years.[xi]
- The total miles traveled by car and motorcycle in each academic year were divided by the respective CAFE average miles-per-gallon in each year to determine total gallons of fuel used each year.
- The total number of gallons of fuel for each year was multiplied by 8.5 kg to find the CO_2 equivalent from car and motorcycle. For public transit (i.e., buses), the total number of gallons for each year was multiplied by 8.5 kg then divided by the estimated passengers per bus. Researchers assumed the average number of passengers per bus in 1990 was 9.2, the national average. Based on survey results, researchers estimated ridership to have doubled to 18.4 since the inception of the Jack Pass.[xii]

Figure 6. Commute Emissions



2.2.3 Waste Disposal

The Sustainability Office tracks the total tons of municipal solid waste (MSW) collected on campus each year. MSW refers to solid waste consisting of common trash items. It excludes construction & demolition debris, recycling, and organic waste recycling[xiii]. When MSW is landfilled, anaerobic bacteria degrade the materials, producing the greenhouse gases methane (CH4) and carbon dioxide (CO2).

Researchers utilized Version 13 of the EPA Waste Reduction Model (WARM) to estimate emissions associated with the hauling and landfilling of MSW.[xiv] Solid waste emissions include landfill emissions as well as the tailpipe emissions from the trucks hauling waste to the landfill. WARM utilizes material tonnage, distance to landfill, and information on landfill gas recovery operations to establish an emissions total.

- In 1990, HSU was sending its MSW to the Cummings Road Landfill in Eureka, CA, approximately 11 miles distant. Cummings Landfill had no landfill gas (LFG) recovery system in place.
- In subsequent reporting years, MSW generated on the HSU campus has been hauled to the Anderson Landfill in Anderson, CA, approximately 190 miles away. The Anderson landfill utilizes a LFG recovery system.

Figure 7 summarizes reported solid waste emissions:

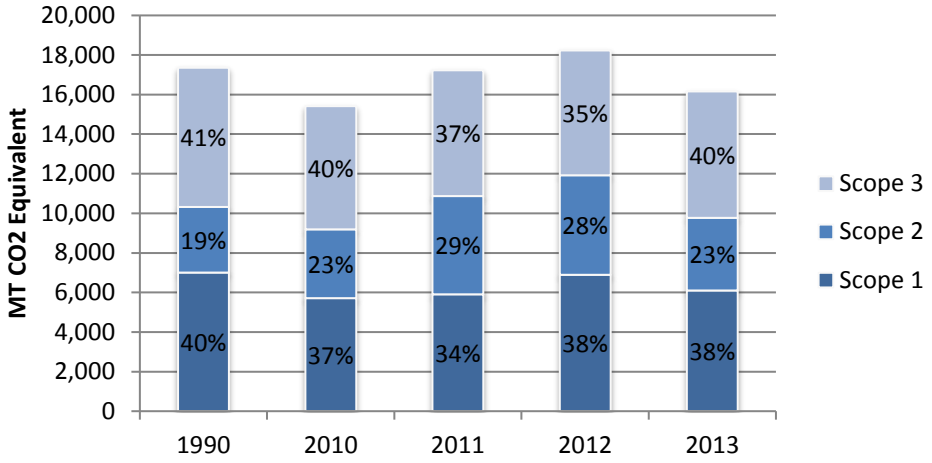
Figure 7. Municipal Solid Waste Emissions

Year	MSW (Lbs)	Short tons	Miles to Landfill	LFG Recovery?	Total Emissions (MTCO2e)
1990	838,830	419.415	11	N	540
2010-11	1,239,680	619.84	190	Y	342
2011-12	1,213,860	606.93	190	Y	334
2012-13	893,700	446.85	190	Y	247
2013-14	816,940	408.47	190	Y	225

3.0 CONCLUSION

Figure 8 below identifies the percent contribution each scope makes to HSU's emissions footprint. Scope 1 and 3 contribute similar amounts of emissions to the campus' overall emissions footprint, with each resulting in over 6,000 metric tons of CO2e per reporting year. Meanwhile, purchased electricity (Scope 2) continues to be approximately one quarter of the overall emissions footprint. These results are in part indicative of the geographical, climatic, and rural aspects of HSU. For example, campuses in hot climates have significant, energy-intensive cooling loads (i.e., electrical air conditioning, chilled water). HSU enjoys a mild climate year-round, leading to a nominal electrical cooling load limited to server rooms and other sensitive areas. At the same time, however, HSU's rural isolation lends to longer distances traveled and increased business travel emissions compared to other institutions.

Figure 8. Scopes 1-3 Emissions



Emissions rose annually between 2010-12, as a result of a number of factors including student population growth, increased business travel, construction projects, and cooler winter conditions. Overall, however, HSU's emissions are trending towards meeting the goal of 1990 level emissions by 2020, due to external and internal influences and activities. These include but are not limited to:

- Significant improvements in fuel economy within ground and air transport over the past 2.5 decades;
- Emission factors for electricity have changed over the years as a result of State regulations requiring cleaner fuels for electrical power production. For example, California's Renewables Portfolio Standard (RPS) is requiring utilities and energy providers to continually increase procurement from eligible renewable energy resources to 33% of total procurement by 2020;
- The addition of electric vehicles to the campus fleet;
- The expansion of recycling and waste reduction operations and the addition of a composting program;
- Adoption of the Jack Pass, Zip Car, Zim Ride and other alternative transportation programs;
- Ongoing energy efficiency upgrades to campus infrastructure, and
- Expanding awareness of, and participation in sustainability efforts by the campus community.

HSU will utilize the information presented in this report to develop a Climate Action Plan, or CAP. The CAP will be a planning document outlining emissions reduction goals and subsequent implementation steps by emissions sector. Updated GHG emissions inventories will be conducted every two years, utilizing the same methodology presented in this report, following the formalized establishment of the CAP.

4.0 ENDNOTES

[i] IPCC (2007). Summary for Policymakers. In: *Climate Change 2007: The Physical Science Basis*. *Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.). Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.].

[ii] To view the complete Sustainability Policy, go to http://www.calstate.edu/cpdc/sustainability/policies-reports/

[iii] CO2e allows many types of greenhouse gases with different heat trapping capacities, also referred to as global warming potential (GWP), to be converted to a standardized unit.

[iv] The Climate Registry General Reporting Protocol, http://www.theclimateregistry.org/resources/protocols/general-reporting-protocol/

[v] HSU's largest self-generation system, a 10 kW solar photovoltaic system installed on the roof of the Music A building in 2009, generates approximately 12,500 kWh a year, or enough electricity to power two to four single family homes.

[vi] To see the complete report, go to University Travel Emissions Auditing Project, ENVS 410 Senior Capstone project, 2013. http://www2.humboldt.edu/sustainability/node/182

[vii] National Highway Traffic Safety Administration – CAFE Fuel Economy, http://www.nhtsa.gov/fuel-economy

[viii] EEA (2013). *EMEP/EEA Air Pollutant Emission Inventory Guidebook 2013*. Technical Guidance to Prepare National Emission Inventories, Part B, Combustion.

[ix] Although there are 32 weeks in an academic year, the weeks of Thanksgiving and Spring Break are excluded.

[x] It was assumed that that the 1990 population distribution, in regards to the distance that individuals lived from HSU, was generally the same in each category of commute distance as in the 2014 commuter survey.

[xi] The total number of miles traveled by carpool was divided by two, assuming two people per carpool.

[xii] Jack Pass is a student fee-funded program enabling unlimited access to Humboldt County bus systems. Staff, faculty and Extended Education students can buy into the program for $60.00 per semester.

[xiii] Organic waste includes green waste, used vegetable oil, food waste, and other organics. In 2013 HSU sent 138 tons of food waste to a commercial composting facility. In 2014 the loss of a regional food waste diversion program forced HSU to suspend its large scale food waste collection. HSU is planning to resume this program in 2015.

[xiv] US Environmental Protection Agency's Waste Reduction Model (WARM), http://epa.gov/epawaste/conserve/tools/warm/index.html