CALIFORNIA STATE UNIVERSITY

EAST BAY

Academic Year 2013/2014

Greenhouse Gas Inventory

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Introduction

The American College & University Presidents' Climate Commitment

"The American College & University Presidents' Climate Commitment is a high-visibility effort to address global climate disruption undertaken by a network of colleges and universities that have made institutional commitments to eliminate net greenhouse gas emissions from specified campus operations, and to promote the research and educational efforts of higher education to equip society to re-stabilize the earth's climate. Its mission is to accelerate progress towards climate neutrality and sustainability by empowering the higher education sector to educate students, create solutions, and provide leadership-by-example for the rest of society." (Second Nature, *American College & University Presidents' Climate Commitment Mission and History,* 2007)

On January 26, 2015, California State University East Bay (CSUEB) President, Leroy M. Morishita, signed the American College and University Presidents' Climate Commitment (ACUPCC)[1], thereby joining 600+ signatories and committing the campus to pursuing a path toward climate neutrality.

As an ACUPCC signatory, CSUEB is required to:

1. Develop an institutional structure to guide the development and implementation of an action plan to reach climate neutrality;
2. Create a biennial campus-specific comprehensive greenhouse gas inventory, starting with a baseline inventory developed within one year of the President's signing of the ACUPCC;
3. Create a biennial climate action plan that includes a target date for climate neutrality, actions to make climate neutrality and sustainability part of curricular and co-curricular activities, actions to expand climate neutrality research, and mechanisms to track metrics and goals
4. Identify tangible actions to reduce greenhouse gas emissions while the plan is being developed; and

[1] In October 2015 the ACUPCC was renamed the Carbon Commitment.

5. Publicize all documentation (inventories, plans, reports, etc.) associated with the ACUPCC.

This report fulfills the University's commitment to develop the baseline inventory specified in the second requirement above. This work also addresses ACUPCC requirement 3, in part, in that this greenhouse gas inventory was conducted by the students of Environmental Studies 3480 (ENVT 3480, Applied Field Studies) under the guidance of the instructor (Professor Karina Garbesi) in collaboration with CSUEB's Director of Sustainability (Jillian Buckholz), thereby leveraging the inventory process as a teaching opportunity on climate change and carbon neutrality.

Methods

Campus greenhouse gas (GHG) emissions were calculated using the Clean Air-Cool Planet (CA-CP) Campus Carbon Calculator, one of three commonly used tools recommended by the ACUPCC for this purpose. The CA-CP Calculator takes various inputs on GHG-generating activities and calculates emissions, given the climate impact intensity of the specific gases. Baseline data for the GHG inventory is from the 2013/2014 academic year, the most recent year for which complete emissions data were available at the time the data were assembled.

This report provides an overview of the institutional data, summarizes data inputs to the CA-CP Calculator and presents the findings, broken down by emissions type.

Overview of the University

Founded in 1957, California State University East Bay (CSUEB) is a public, 4-year institution, offering undergraduate and graduate degrees—one of the twenty-three universities in the California State University System. CSUEB is comprised of two campuses: Hayward (main) and Concord (satellite). In addition, Continuing Education classes are also held at the Oakland Center. Because of the relatively small number of classes taught at the Oakland Center, and

because CSUEB does not own or maintain the building were it operates, the Center has been excluded from this inventory.[2]

The tables below show the head counts of students (Table 1a) and of faculty and staff (Table 1b) at CSUEB during the AY13/14 baseline year.

Table 1a. Population Headcount (Students)

Institutional Data - Student Population	Total # of Students
Full Time Students	11,885
Part-Time Students	9,886

Table 1b. Population Headcount (Faculty/Staff)

Institutional Data - Faculty/Staff Population	Population Total
Faculty	518
Staff	828

As shown in Table 2, the Hayward and Concord campuses combined include a total of just over 2 million square feet of building space. Also shown is research space, which is a subset of the Hayward Campus total building space. The CA-CP Calculator distinguishes research space from total campus building space because of their expected difference in GHG emissions intensity.

Table 2. Total Building Space

Building Space Breakdown	Sq Ft
Concord Total Building Space	89,363
Hayward Total Building Space	1,897,943
Total University Building Space	1,987,306
Research Building Space(*)	22,643

(*) Research space is a subset of Hayward total space. No research is recorded for Concord.

[2] FTE at the Oakland campus in AY13/14 was 532, a very small fraction of the total population of students.

Data by Emissions Type

As is common practice, this inventory breaks down emissions by scope[3]. The three scopes are constituted of the following types of emissions.

- Scope 1: all direct emissions from sources owned or controlled by the campus
- Scope 2: indirect emissions from purchased electricity, steam, heating, and cooling
- Scope 3: all other indirect emissions upstream and downstream

The following sections provide more details on each scope and summarize CSUEB emissions sources by scope. The results of the emissions analysis are presented in the Results section.

Scope 1

Scope 1 emissions include the following:

> *"Direct emissions from sources that are owned and/or controlled by your institution. This includes combustion of fossil fuels in college-owned facilities or vehicles, fugitive emissions from refrigeration, and emissions from on-campus agriculture or livestock husbandry. Your institution has complete control over these emissions, and they are no-one else's responsibility."* (Clean Air-Cool Planet Campus Carbon Calculator, *User's Guide*, v6.5)

The CA-CP Calculator breaks down Scope 1 emissions into the following sources.

- Stationary resources (natural gas)
- Campus-owned transportation (diesel and gasoline)
- Refrigeration (R-22, R-134, R-410A)
- Cogeneration (natural gas)
- Agriculture (fertilizer and animal husbandry)

The following sections describe CSUEB's contributions to those source types.

Stationary Sources (natural gas)

While the CA-CP Calculator addresses many potential stationary sources (including heating oil, wood pellets, propane, and other) the single stationary source fuel used by CSUEB on-site is natural gas. Specifically, natural gas is used for space heating, water heating, and cooking on

[3] Scope definitions vary by agency.

campus. The following table details natural gas used by on campus stationary sources in the AY13/14 year. The data are reported in therms and MMBtu (10^6 Btu), for consistency with both institutional data keeping (in therms) and CA-CP Calculator input requirements (highlighted in red).

Table 3. Natural Gas Usage AY2013/2014

Measured in Therms **Stationary NGAS**

	CSUEB	FIELD HOUSE	CONCORD	Pioneer Heights	TOTAL
2013 JUNE	21,504	466	720	5611	28,301
2013 JULY	19,131	410	439	3553	23,533
2013 AUG	18,799	696	253	3986	23,734
2013 SEPT	15,708	577	108	3683	20,076
2013 OCT	41,399	829	742	8737	51,707
2013 NOV	55,998	1,204	1,444	12315	70,961
2013 DEC	82,530	1,762	2,939	15643	102,874
2014 JAN	73,441	1,616	1,917	13213	90,187
2014 FEB	67,420	1,912	2,063	14478	85,873
2014 MAR	50,584	1,635	1,310	9610	63,139
2014 APR	49,927	1,151	1,112	11093	63,283
2014 MAY	38,353	741	321	8079	47,494

TOTAL	671,162	Therms
	67,116	MMBTU

Campus Owned Mobile Sources

Campus owned mobile sources include fleet-vehicles and landscaping equipment.
Fleet vehicles include gasoline and diesel powered fleet vehicles as well as electric vehicles. However, the GHG impact of electric vehicles is accounted for through campus electricity consumption (Scope 2). The impacts of the gasoline and diesel powered (liquid-fueled) vehicles are accounted for here.

CSUEB tracks fuel usage by what is purchased off-site (unleaded gasoline purchased using Voyager credit card) and what is dispensed on site (unleaded gasoline and diesel). Table 4 documents both sources of AY13/14 usage. The totals, which were used as inputs to the CA-CP Calculator, are highlighted in red. On-site fueling includes both that used for vehicles and for landscaping equipment.

Table 4. Purchased Fuel AY13/14

Measured in Gallons	Fleet Vehicle Fueled on Campus				
	Voyager Unleaded	Onsite Unleaded	Total Unleaded	Diesel	
2013 JUNE	394	1,251	1,645	198	
2013 JULY	393	997	1,390	372	
2013 AUG	413	1,024	1,437	1,205	
2013 SEPT	321		321		
2013 OCT	416	1,500	1,916	203	
2013 NOV	328	1,498	1,826	195	
2013 DEC	212	1,499	1,711	198	
2014 JAN	933	1,002	1,935	198	
2014 FEB	937	1,295	2,232	207	
2014 MAR	1,070		1,070		
2014 APR	1,031	2,851	3,882	400	
2014 MAY	904	1,503	2,407	200	
TOTAL	7,352	14,420	21,772	3,376	Gallons

Refrigeration

The CA-CP Calculator accounts for refrigerant leakage. In AY13/14, CSUEB tracked leakage for three different refrigerants, R-22, R-134a, and R-410A[4]. CSUEB tracks these data in kilograms, while the CA-CP Calculator submission is in pounds. Both are recorded in Table 5.

Table 5. Refrigerant Leakage for AY13/14 in kilograms and pounds

Refrigerant	Total Leakage (kg)	Total Leakage (lbs.)
R-22	218.33	481.34
R-134a	55.00	121.25
R-410A	2.12	4.67

Cogeneration (natural gas)

The Hayward Campus houses a 1.4 megawatt fuel cell facility that cogenerates heat and electricity. The facility is a Pacific Gas and Electric (PG&E) company demonstration project, the

[4] In the CA-CP Calculator R-22 and R-134a equivalents are listed as HCFC-22 and HFC-134a, respectively.

electricity from which is put directly onto the PG&E power grid, with no impact on the University's electricity load. However, some of the heat from the system is used to offset the University's heating load—specifically, to supplement space and swimming pool heating. The system is setup to deliver fuel cell waste heat into the heating system of the following buildings: Physical Education (including the swimming pool), Music, Theater, and Robinson Hall. However, during times of the year when that heat is not needed it is not used. Unfortunately, the fraction that is used is not quantified. For these reasons, this offset is not entered into the CA-CP Calculator. But, it is noted that if the demonstration project were to be removed, the Hayward campus's natural gas load would increase correspondingly.

Table 6 quantifies the waste heat captured by the cogeneration equipment, setting an upper bound on the potential of the system to offset the campus's heating demand. Given the total campus natural gas usage of 67,116 MMBtu: that upper bound on the contribution is fairly significant, at 13%

Table 6. Fuel Cell Heat Recovery

Fuel Cell Contribution to CSUEB	
Heat CoGen Production	8,768 MMBtu
Total Campus N-gas Usage	67,116 MMBtu
Potential Upper Bound Contribution	13%

Agriculture

CA-CP Calculator accounts for agricultural emissions from animal husbandry and fertilizers—only the latter applies to CSUEB. CSUEB uses approximately 4,000 pounds of synthetic nitrogen fertilizers each season. The CA-CP Calculator accounts for emissions of synthetic nitrogen fertilizer using the pounds applied and the percent nitrogen, which varies seasonally at CSUEB, as shown in the following table.

Table 7. Fertilizer Usage at CSUEB in AY 13/14

Seasonal Fertilizer	Percent Nitrogen
Fall	21%
Winter	19%
Spring	18%
Summer	25%

Scope 2

Scope 2 emissions include the following:

> *"Indirect emissions from sources that are neither owned nor operated by your institution but whose products are directly linked to on-campus energy consumption. This includes purchased energy: electricity, steam, and chilled water. Although your institution is not directly responsible for these emissions, it is strongly implicated. These emissions come from converting energy sources that release greenhouse gas emissions when used (fossil fuels) to energy sources that do not (electricity, steam, or chilled water). Although your institution did not burn the coal to make the electricity you use, someone had to, and although the electricity producer emitted the gasses, they did not use any of the energy produced."* (Clean Air-Cool Planet Campus Carbon Calculator, *User's Guide*, v6.5)

Specifically, the CA-CP Calculator considers the following Scope 2 emissions sources:

- Purchased electricity
- Purchased steam
- Purchased chilled water

Among these, only purchased electricity applies to CSUEB.

Grid Electricity

Table 8 documents monthly and total annual grid-electricity consumption based on readings at the three meters on the Hayward Campus (Main, Lot F, and Pioneer Heights) and the single meter at the satellite campus (Concord). Pioneer Heights is the on-campus dormitory facility.

The data are recorded in kilowatt-hours (kWh). CSUEB also obtains electricity from a 1.4 mega-watt solar electric system located on the Hayward campus, described in the next section.

Table 8. Total Grid Electricity Consumed by CSUEB in kWh for AY13/14

Measured in kWh	Electricity				
	Hayward Campus			Concord Campus	
	Main Meter	LOT F	Pioneer Heights	Entire Campus	TOTAL
2013 JUNE	1,232,328	2,118	153,859	88,570	1,476,875
2013 JULY	1,275,444	2,231	142,693	13,748	1,434,115
2013 AUG	1,221,620	2,775	146,301	104,373	1,475,069
2013 SEPT	1,215,219	2,805	135,250	99,910	1,453,184
2013 OCT	1,340,336	3,059	185,403	96,445	1,625,243
2013 NOV	1,199,658	3,493	193,974	80,874	1,477,999
2013 DEC	1,117,790	4,081	182,081	73,387	1,377,339
2014 JAN	1,230,641	3,927	184,307	72,772	1,491,647
2014 FEB	1,112,837	3,568	198,548	74,743	1,389,696
2014 MAR	1,188,458	3,352	173,115	76,435	1,441,360
2014 APR	1,201,375	3,330	194,056	75,848	1,474,609
2014 MAY	1,242,131	2,812	186,932	84,240	1,516,115
TOTAL				17,633,250	kWh

Grid electricity is obtained through a multiple-CSU campus direct-access contract with Shell Energy. The contract is managed by the Chancellor's Office. The authors contacted the Chancellor's office to obtain information on the power mix (shown in Table 9) needed to estimate the carbon emissions factor for the contracted electricity. The CA-CP Calculator allows the power mix to be specified. Note however that almost one quarter of the power mix is unspecified. Depending on what that 24% is constituted of, the carbon emissions factor could be very different. Lacking that knowledge, the authors assumed the worst case, that 100% of the unspecified power was generated from coal.

Table 9. Shell Energy Power Grid Mix

POWER CONTENT		
ENERGY RESOURCES	**2014 POWER MIX** Shell Energy Contract	**2014 CA POWER MIX****
Eligible Renewable	**34.5%**	**20%**
-- Biomass & waste	3.8%	3%
-- Geothermal	3%	4%
-- Small hydroelectric	2%	1%
-- Solar	3.7%	4%
-- Wind	22%	8%
Coal	0%	6%
Large Hydroelectric	3.9%	6%
Natural Gas	32%	45%
Nuclear	5.5%	9%
Other	0%	0%
Unspecified sources of power*	**24.1%**	**14%**
TOTAL	**100%**	**100%**
* "Unspecified sources of power" means electricity from transactions that are not traceable to specific generation sources and ISO imports.		
** Percentages are estimated annually by the California Energy Commission based on the electricity sold to California consumers during the previous year.		
2014 Power Mix represents Shell Energy purchases from specific eligible renewable energy resources and ISO System Power on behalf of the California State Universities.		

To account for the mix of fuels used to generate the grid electricity consumed at CSUEB, and for the 6.6% of total electricity generated by the on-site solar energy system, we customized the fuel mix in the GHG inventory. This was achieved by first aggregating fuel-types from the Shell Energy Contract into the categories used by CA-CP, and readjusting those shares to reflect the 93.4% (100% minus 6.6%) of CSUEB electricity consumption. Geothermal and small hydro, which are not included in the CA-CP Calculator, were added to CA-CP's 'solar and wind' category because these are considered 'green power' by the State of California. Then the 6.6% of consumption from on-site solar was also added to the solar category in CA-CP, thereby accounting for 100% of total consumption. The results are show in Table 10.

Table 10. Custom Fuel Mix Used in the CA-CP Calculator as Derived from the Shell Energy Contract Fuel Mix and On-Site Solar.

	Shell Energy Contract Fuel Mix	CA-CP Custom Fuel Mix
Solar, Wind, Geothermal, and Small Hydro	30.7%	35.3%
Biomass and Waste	3.8%	3.5%
Large Hydro	3.9%	3.6%
Nuclear	5.5%	5.1%
Natural Gas	32.0%	29.9%
Coal*	24.1%	22.5%
Total	100%	100%

(*) Assumes that all unspecified power is coal-fired.

Solar Electricity

As indicated above, the campus obtains some of its electricity from a one mega-watt solar photovoltaic electric system. The system is installed on four buildings on the Hayward campus—Physical Education, Music, Art and Education, and Meiklejohn Hall—a part of which (PE and Music) are shown in the image below. Table 11 reports the systems monthly power production, and its total production in AY13/14 in kWh.

Image 1: Arial View of Solar Array on Music and Physical Education Buildings (addition arrays on the Meiklejohn and the Art and Education buildings not shown).

Credit: CSUEB University Advancement

Table 11. Total Electricity Generated by CSUEB Solar Array in kWh for AY 13/14

Measured in kWh **PV Data**

Date:	ART & EDUCATION	MEIKLEJOHN HALL	MUSIC & BUSINESS	PHYSICAL EDUCATION	TOTAL	
6/1/2013	17,183	16,448	42,764	83,885	160,279	
7/1/2013	17,596	16,855	42,972	85,551	162,973	
8/1/2013	14,544	13,994	35,467	70,610	134,615	
9/1/2013	11,516	10,999	28,276	55,845	106,636	
10/1/2013	9,594	9,464	25,431	48,891	93,379	
11/1/2013	5,734	5,916	16,450	31,249	59,349	
12/1/2013	4,720	5,443	15,065	28,399	53,627	
1/1/2014	5,155	5,459	15,568	29,156	55,338	
2/1/2014	5,962	5,728	16,337	31,057	59,085	
3/1/2014	10,392	9,799	27,670	53,010	100,871	
4/1/2014	10,550	9,649	27,273	52,106	99,578	
5/1/2014	17,168	15,776	44,789	85,293	163,025	
TOTAL	130,115	125,528	338,060	655,053	**1,248,756**	**kWh**

While the campus does not currently own the renewable energy credits (RECs) associated with the system, which were used to help finance the system, the system does offset about 7% of the campus's energy use, as shown in Table 12. Therefore, while CA-CP does not credit GHG emissions reductions associated with the facility, the avoided emissions associated with transmission and distribution losses, as described in Appendix II.

Table 12. CSUEB Solar Array: Contribution to Campus Electricity Use

PV Production	Total Campus Electricity Usage(*)	Contribution
1,248,756 kWh	18,882,006 kWh	6.6%

(*) This is the sum of the grid electricity usage and the PV production.

Scope 3

Scope 3 emissions include the following:

> *"Other emissions attributed to your institution, deemed "optional" emissions by corporate inventories. This includes emissions from sources that are neither owned nor operated by your institution but are either directly financed (i.e. commercial air travel paid for by the institution) or are otherwise linked to the campus via influence or encouragement (i.e. air travel for study abroad programs, regular faculty, staff, and student commuting). Many Scope 3 emissions are considered "upstream" like the emissions associated with making and transporting plastic silverware. To prevent institutions from accounting for too many upstream emissions, most campuses define distinct financial or control boundaries to distinguish which Scope 3 emissions they are indeed responsible for."* (Clean Air-Cool Planet Campus Carbon Calculator, *User's Guide*, v6.5)

Specifically, the CA-CP Calculator considers the following Scope 3 emissions sources:[5]

- Domestic Commuting[6]
- Outsourced and International Travel
    - Directly Financed Outsourced Travel
    - Study Abroad Travel
    - International Student Travel[7]
- Solid waste
- Waste water
- Paper use

CSUEB contributes emissions associated with all of these sources, as described in the following sections.

[5] CA-CP Calculator also accounts for carbon offsets in Scope 3.

[6] Referred to by the CA-CP Calculator as Commuting.

[7] Referred to by the CA-CP Calculator as Student Travel to/from Home

Domestic Commuting

The CA-CP Calculator calculates the carbon emissions from domestic commuting using the following inputs:

- The full- time equivalent number of commuting
    - students (FTES),
    - faculty (FTEF), and
    - staff (FTESt);
- The percentages of commuting conducted via the relevant modes (mode percentages)
    - single occupancy vehicle,
    - car-pooling, bus,
    - commuter rail,
    - light rail,
    - bicycling,
    - walking;
- And the average distances traveled per mode.

Estimation of Commuting Emissions

For each population, the emissions per mode are estimated from the product of the following quantities:

- The population in FTE,
- The percentage of the population using the given mode,
- The average distance travelled for that mode (miles), and
- The average GHG emissions per mile for that mode.

The entire annual FTES was used, including all four quarters. It was deemed important to ensure that summer enrollments were included for another reason: As a year-round quarter campus CSUEB has had historically high summer enrollments, but that has changed recently and is likely to change even more when the campus moves to the semester system.

The total full-time-equivalent number of commuting students (**$FTES_{com}$**) was determined from the total FTES of matriculated students (**$FTES_{Mat}$**) plus the total FTES of non-matriculated students (**$FTES\text{-}_{NonMat}$**) minus the number of students who are assumed not to commute either

because they live in campus housing (**$FTES_{dorm}$**) or they are enrolled for 100% of their units in online courses (**$FTES_{online}$**). The associated data are reported in the table below.

Table 13. Estimation of the Full-Time-Equivalent Number of Commuting Students

Symbol	Value	Variable Description and Source
Total Annualized FTES of Matriculated and Non-matriculated Students		
$FTES_{Mat}$	13,757	The CSUEB annualized full-time equivalent students at Hayward and Concord reported on by CSEUB Institution Research (see FTES Enrollment Table 3.3, CY13/14). Per personal communication with David Garcia, Institutional Research, these data include only matriculated students.
$FTES_{-NonMat}$	1,743	The college year annual FTES of non-matriculated students studying on campus at Hayward and Oakland. Exclude self-support students studying online or at the Oakland Center. Source: Data supplied by David Garcia, Institutional Research.
FTES of Non-Commuting Students		
$FTES_{online}$	674	FTES students studying 100% online. Based on a randomly selected sample of 2000 students received from David Garcia, Institutional Research, 4.9% of students study 100% online. (0.049*13,757 = 674)
$FTES_{dorm}$	1,457	The number of students living in campus houses, all of which are assumed to be matriculated full-time students. Source: Personal Communication (email), Mark Almeida, Housing and Residential Life, February 19, 2015
$FTES_{com}$	13,369	**$FTES_{Mat}$ + $FTES_{-Nonmat}$ - $FTES_{online}$ - $FTES_{dorm}$**

Excludes Oakland Center students.

Estimation of Mode Percentages and Average Commute Distances by Mode

The mode percentages and average distances travelled by mode could not be estimated from existing data. The ENVT 3480 class therefore attempted to use existing residential zip-code data to determine commute distances and found a very high fraction of the students reported addresses that are clearly outside of commuting range (presumably family addresses).

Therefore this approach was abandoned in favor of a commute survey, one for students and one for faculty and staff (see Appendix I), the results of which are shown below.

Table 14. Average Commute Distance by Personal Vehicle in Miles

Faculty	Staff	Students
21 miles	13 miles	22 miles

Table 15. Faculty and Staff Commuting by Mode

Mode	Faculty	Staff	Students
Personal Vehicle	93.9%	96.44%	82.7%
Carpool	2.3%	3.56%	4.6%
Vanpool	0.0%	0.0%	--
BART	3.8%	0.0%	7.9%
Bus	0.0%	0.0%	3.0%
Bicycle	0.0%	0.0%	0.0%
Walk	0.0%	0.0%	1.7%

Vanpool at CSUEB is only offered to faculty and staff in specific locations: Lathrop, Tracy, Modesto, and Manteca, CA

Unsurprisingly, given the campuses' locations and nature of our student demographics, most commuting is conducted by personal vehicle. The campus is located on a hill in a suburban portion of Hayward. Most students work, as well as go to school, and many are older with families, making commuting needs complex.

On the bright side, alternative fueled vehicles are emerging among campus commuters (especially faculty and staff), and the University is supporting that trend by providing free electric vehicle (EV) charging on campus. The campus now has 14 charging stations on the Hayward campus, which together enable 28 vehicles to be charged simultaneously on the Hayward campus.[8]. The charging stations are well utilized, with station occupancy typically filling between about 9 and 10 am.

[8] In Fall 2015 CSUEB added 8 additional EV charging stations, more than doubling the number of electric vehicles that can be charged on campus.

Table 16, shows the breakdown of vehicle types among campus commuters, according to the survey. More than 12% of faculty and staff drive efficient hybrid vehicles and almost five percent drive electric vehicles according to the survey. Although EV usage is currently rare enough among students that it does not show up in the statistics, it is clear from conversations at the charging stations that some of the EV-commuters are students.

Table 16. Alternative Fuel Commute Vehicles by Type and Population

Fuel Type	Faculty/Staff	Students
Gasoline	81.3%	95.4%
Hybrid	12.5%	3.1%
Electric	4.7%	0.0%
Diesel	1.6%	1.5%

The transportation emissions factors (GHG emissions per mile) were obtained from different sources for the different modes of travel. For passenger vehicles, all emissions factors and fuel efficiencies (MPG) are derived from national averages embedded in the CA-CP Calculator. For public transit, the emissions factors were modified from their default values to reflect local transit characteristics. The inventory assumes the most recently reported estimates of carbon dioxide emissions per passenger mile for local public transit, as reported in the following table. These data were also used in the estimation of emissions from reimbursed travel.

Table 17. Carbon Emissions Factors (CEF) for Public Transportation.

Carbon Emissions Factors for Public Transportation					
Transportation Source	**Transportation Form**	**CEF: Lbs (kg) of CO2 per Passenger Mile**	**Year of Data Information**	**Source of Information**	**Data Source Accessed**
AC Transit	Bus	0.728 (.330)	2007	http://www.fta.dot.gov/documents/PublicTransportationsRoleInRespondingToClimateChange.pdf	02/20/15
BART (Bay Area Rapid Transit) (1)	Electric Commuter Rail	0.13 (.060)	2007	*http://www.bart.gov/guide/carbon*,	02/20/15
Amtrak Caltrain	Diesel Commuter Rail(2)	0.342 (.147)	2007	*http://www.fta.dot.gov/documents/PublicTransportationsRoleInRespondingToClimateChange.pdf*	3/6/15

(1) BART is the only rail transit that has a stop near enough to campus to service commutes to campus. Note that BART reports a different carbon emissions factor for BART than does the US Department of Transportation and Federal Transit Administration. We used BART's information, assuming it was the primary source.

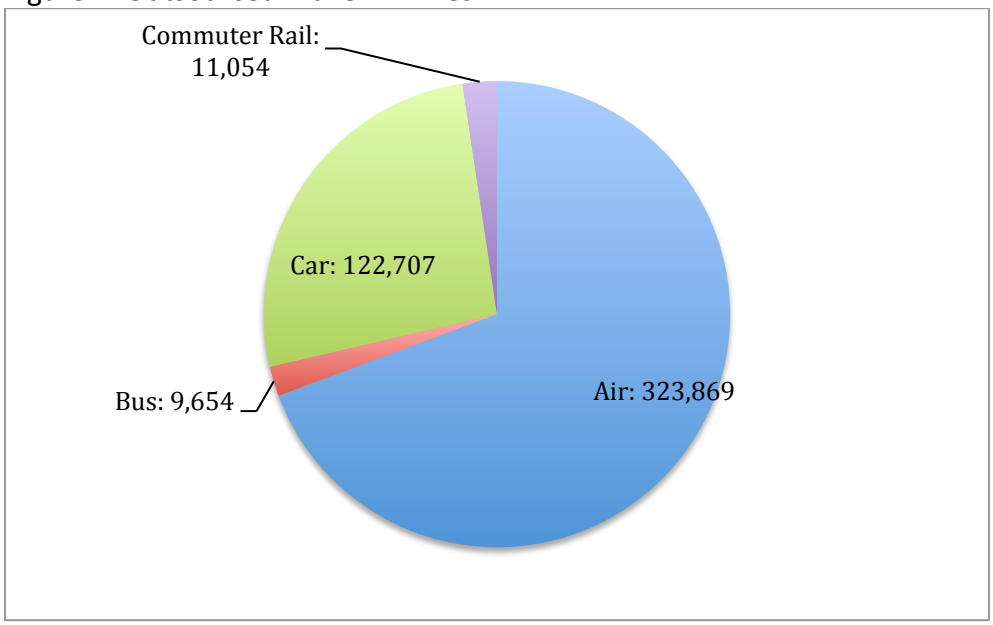
(2) Amtrak and Caltrain, while they do not stop near campus, could service reimbursed travel, which often starts at the point of residence, rather than on campus. Amtrak is the only choice for rail service out of the region. We used the carbon emissions factor for the Massachusetts Bay Transportation Authority (diesel commuter rail) to represent emissions for Amtrak and Caltrain because we were unable to find carbon emissions factors for Amtrak and Caltrain (also diesel commuter rail).

Outsourced and International Travel

Directly Financed Outsourced Travel

Outsourced travel for this inventory takes into consideration off-campus travel for the University by faculty, staff, and students that is reimbursed by the University: for example reimbursed travel to conferences. The CA-CP Calculator uses the total number of miles travelled by mode and the mode-specific carbon emissions factors to calculate the mode-specific emissions. The ENVT 3480 class estimated the total miles travelled by mode from a sample of all reported directly financed outsourced travel. Then, the class estimated the average number of miles travelled per mode per trip, and the total number of travel claims per mode, to determine the total miles travelled per mode. Specifically, 40 travel claims were sampled from a total of 2,850 travel claims (see Figure 1). For reporting purposes, data for BART and train were combined because the CA-CP Calculator does not differentiate between rail sources.

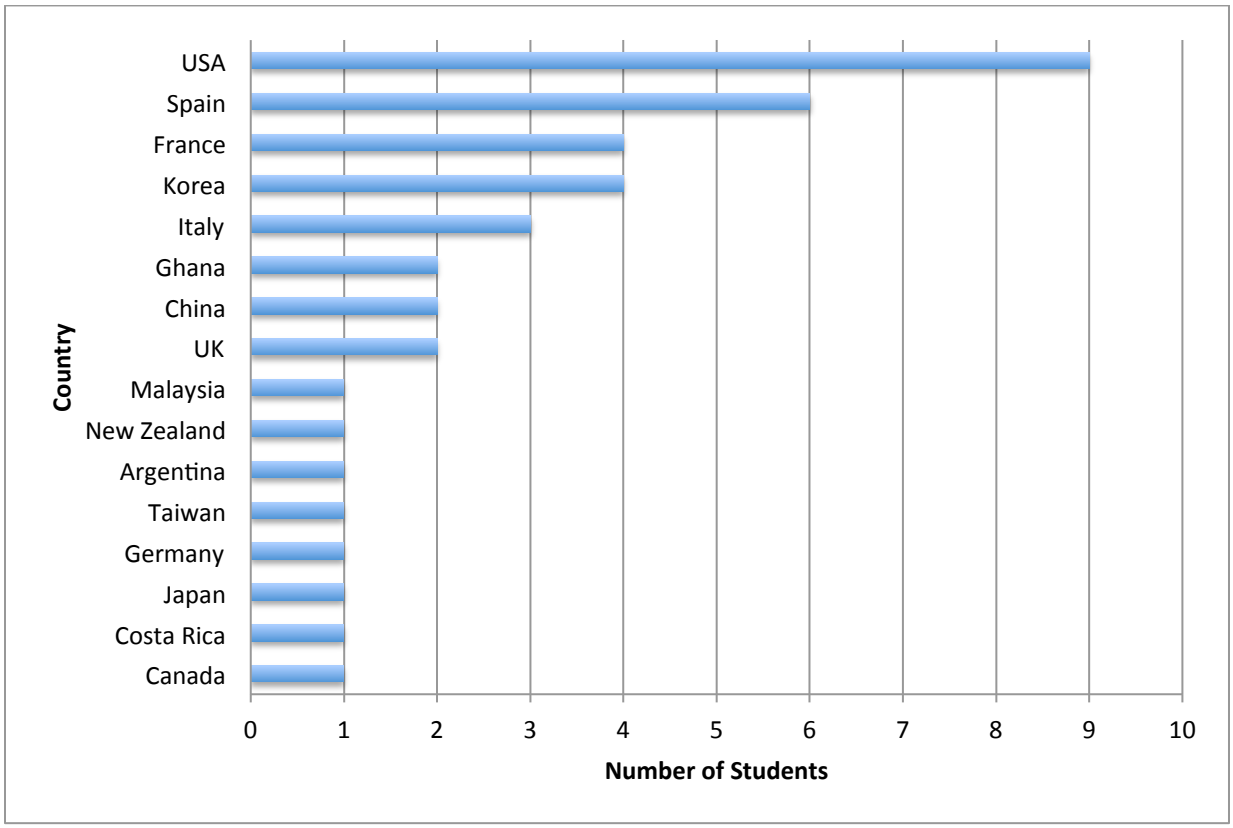
Figure 1: Outsourced Travel in Miles



Study Abroad Travel & International Student Travel

The inventory considered two types of student international travel: study abroad and the travel of international students to and from their home countries (one round trip). Travel miles for study abroad and international students were determined as follows: The total flight miles were calculated based on the number of students and the travel distances. The distances were determined by the distance from San Francisco International Airport to the destination / origin counties' largest international airport (or the largest airport in the state for national exchange students[9]). Those distances were multiplied by the corresponding number of students.

Figure 2. Number of Study Abroad Students by Country in AY13/14



Study Abroad includes CSUEB students that participate in a national exchange program.

[9] National exchange students were taken into consideration with Study Abroad and International Student Travel since national exchange includes CSUEB using transportation to attend classes at an institution in other US states.

Figure 3. Number of CSUEB International Students by Country of Citizenship

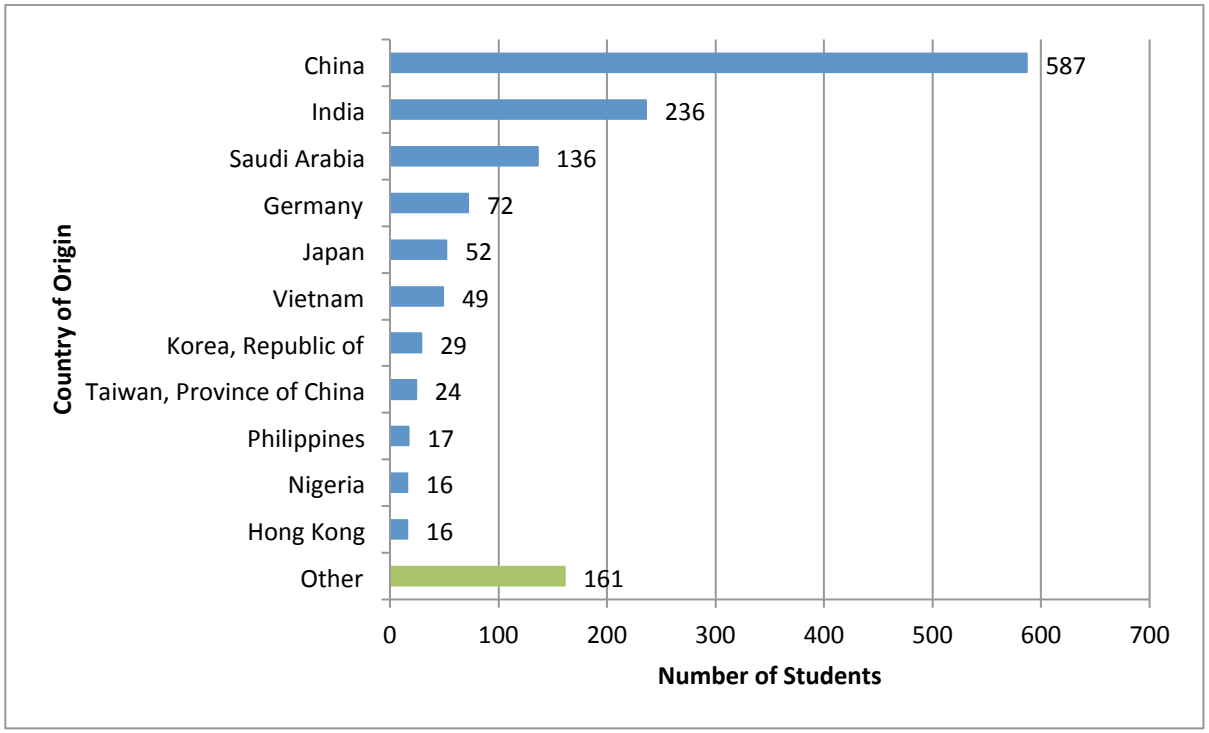


Figure 4. Total Miles Traveled by Country: Study Abroad and International Students Combined

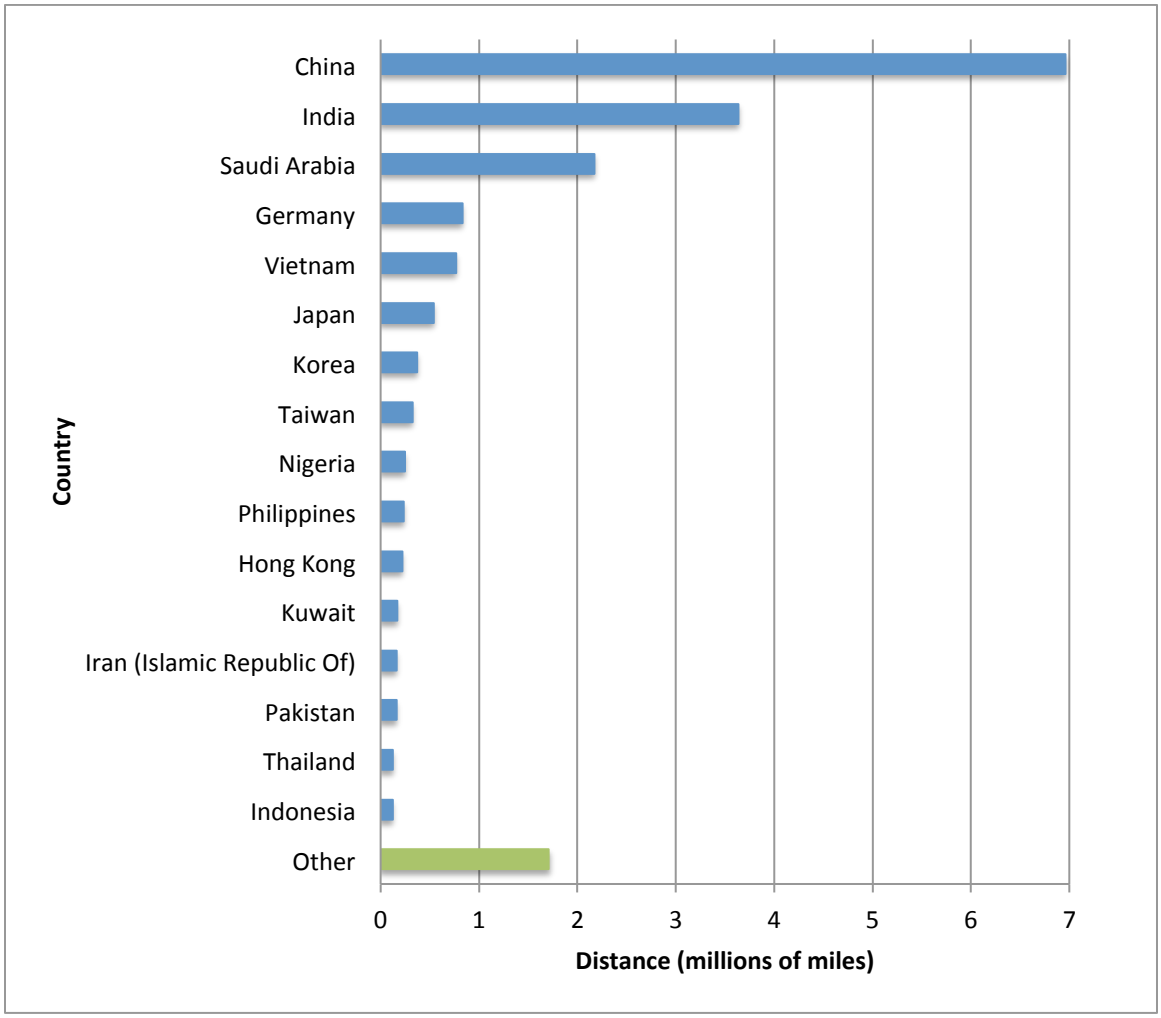


Table 18. Number and Distance Traveled for Study Abroad and International Student Travel

Type	Number of Students	Total Distance Traveled (in Miles)
International Students	1,395	18,375,052
Study Abroad	40	409,920
Total	**1,435**	**18,784,972**

Wastewater

In its estimation of emissions from wastewater treatment the CA-CP Calculator separately considers the following wastewater treatment methods:

- Aerobic
- Anaerobic

- Anaerobic digestion

The Hayward campus, which produces the vast majority of the campus's wastewater is treated at the Hayward Wastewater Treatment Plant.[10] The facility treats it entire input flow aerobically. In addition a volume equivalent to about 1% of that flow goes to anaerobic digestion. For that reason, the latter is neglected in this inventory.

Table 19. CSUEB Waste Water Treated by Year, Amount, and Campus by Calendar Year

Hayward (2013)	Hayward (2014)	Concord (2013)	Concord (2014)
35,902,000 gallons	33,577,000 gallons	564,000 gallons	501,000 gallons

To calculate the input to the CA-CP Calculator the gallons above were summed and divided in half.

Paper Purchasing

The CA-CP Calculator accounts for emissions associated with purchased paper. Data inputs include the percentage of recycled content by paper type and weight. These data were not included in the CSUEB greenhouse gas inventory because paper purchased is currently tracked by dollars spent, not percentage of recycled content by paper type and weight. Paper purchased will be included in future inventories.

Table 20. Paper Purchased Data Fields in the CA-CP Calculator

Paper Type
Uncoated and Coated Freesheet
Uncoated and Coated Groundwood
Super Calendared
Corrugated: Unbleached, Semi-bleached, Bleached
Paperboard: SBS, CUK, Uncoated Bleached Kraft, Uncoated Unbleached Kraft, Coated Recycled

Solid Waste

The CA-CP Calculator accounts for emissions from landfilled waste, considering the tonnage of waste treated in the following ways:

- No methane recovery
- Methane recovery and flaring
- Methane recovery and electricity generation

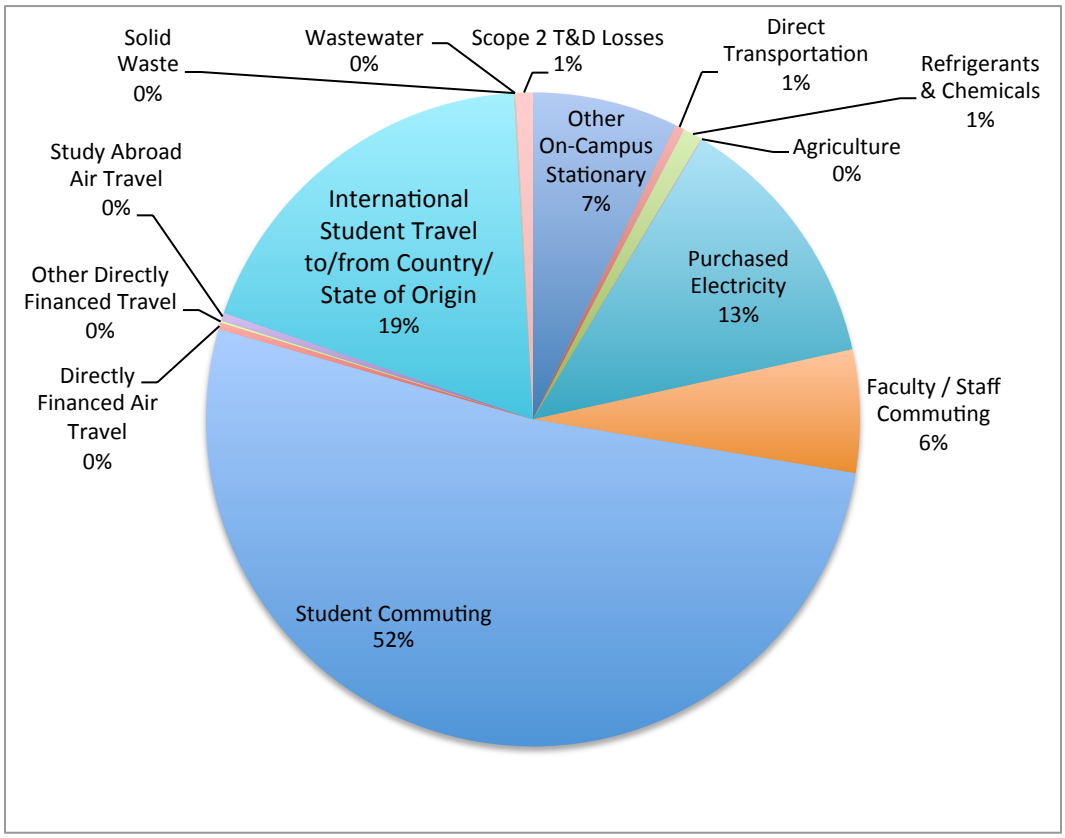
[10] Information on Hayward's wastewater treatment processes were provided by Ray Bush the Water Pollution Control Facility Manager (02/25/2015).

CSUEB currently sends its refuse to the Altamont Landfill in Livermore. The landfill is a joint project of Waste Management and Linde North America. The plant recovers methane generated by the decomposition of organic matter in the landfill and uses it to generate electricity. Therefore, it is assumed that all CSUEB waste is treated in that fashion. In AY 13/14, 740 tons of CSUEB waste were landfilled.

Results

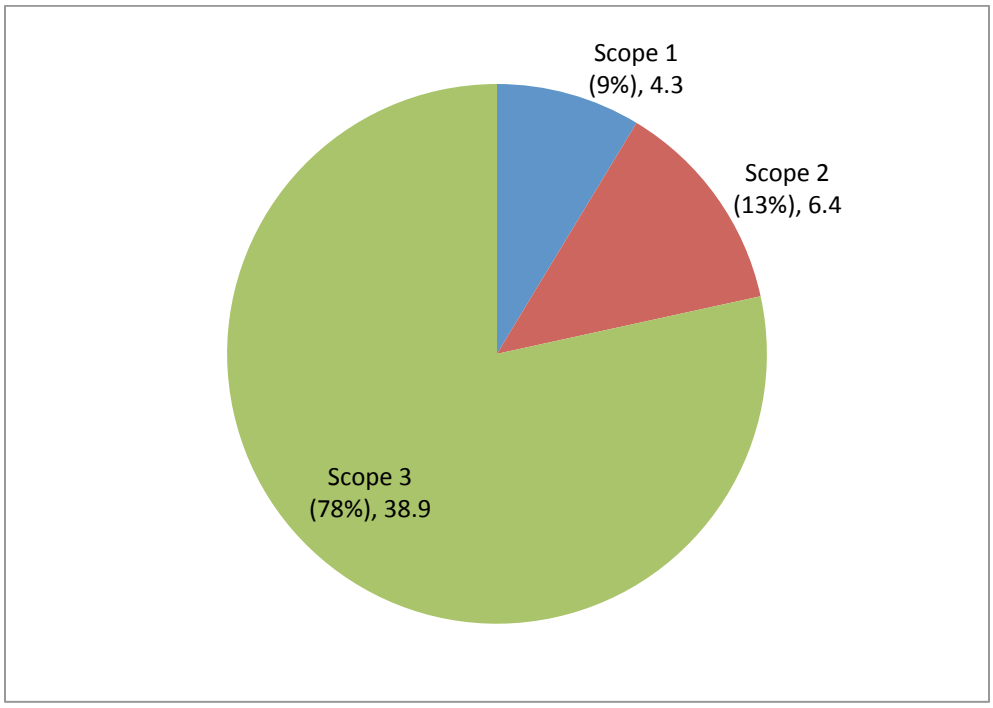
A summary of overall annual emissions (Figure 5) indicates commuting and travel account for more than ¾ of campus-related emissions. Student commuting alone accounts for more than 50% of total GHG emissions. The next largest sources are purchased electricity, at 13% of the total, and then stationary sources, at 7%. This breakdown also roughly reflects the breakdown by Scope, shown in Figure 6. Figure 7, takes a closer look at Scope 3 emissions.

Figure 5: Overall Annual Emissions Summary: Percentage by Source Type



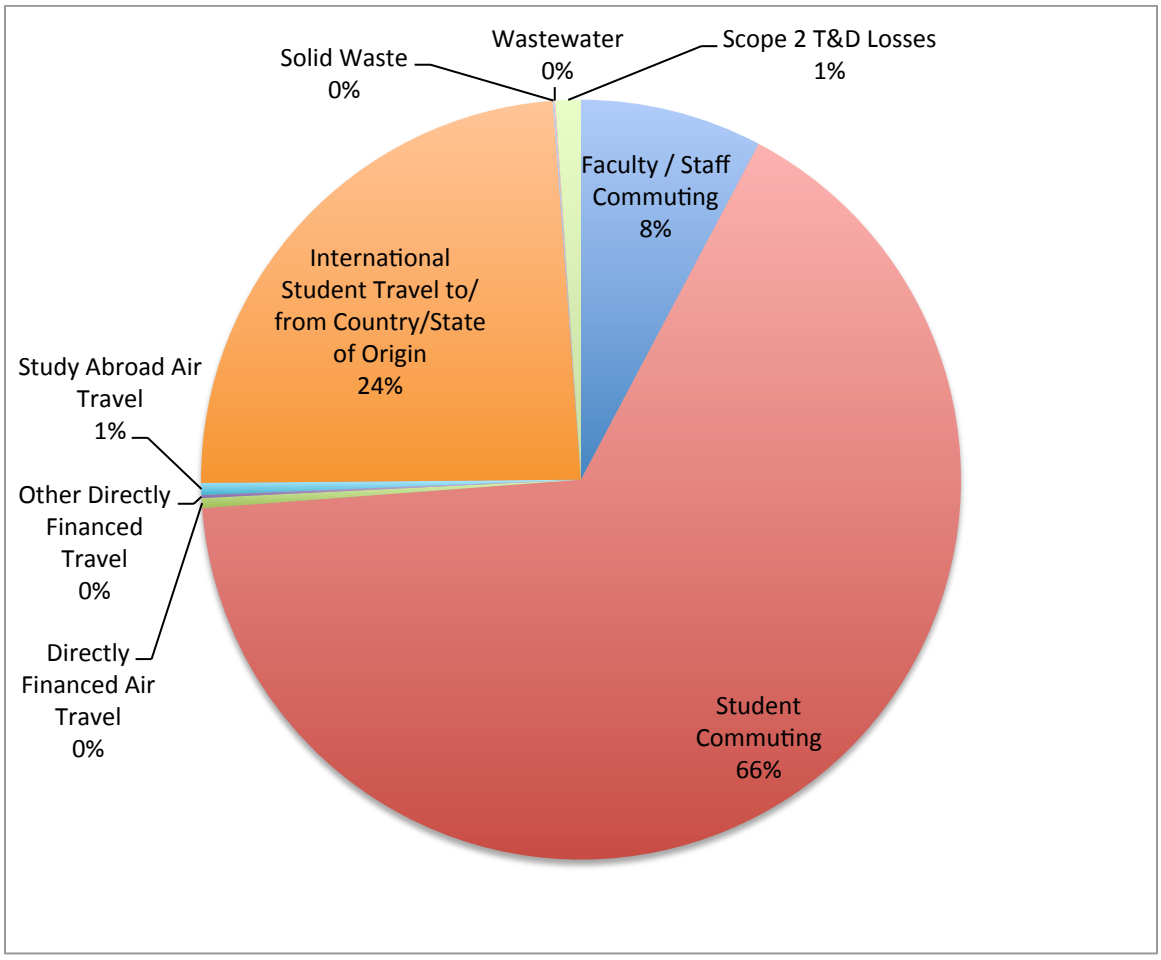
See Appendix III for table of data were figure was derived.

Figure 6: GHG Emissions by Scope in Percent and 1000s of Metric Tonnes CO2



See Appendix III for table of data were figure was derived.

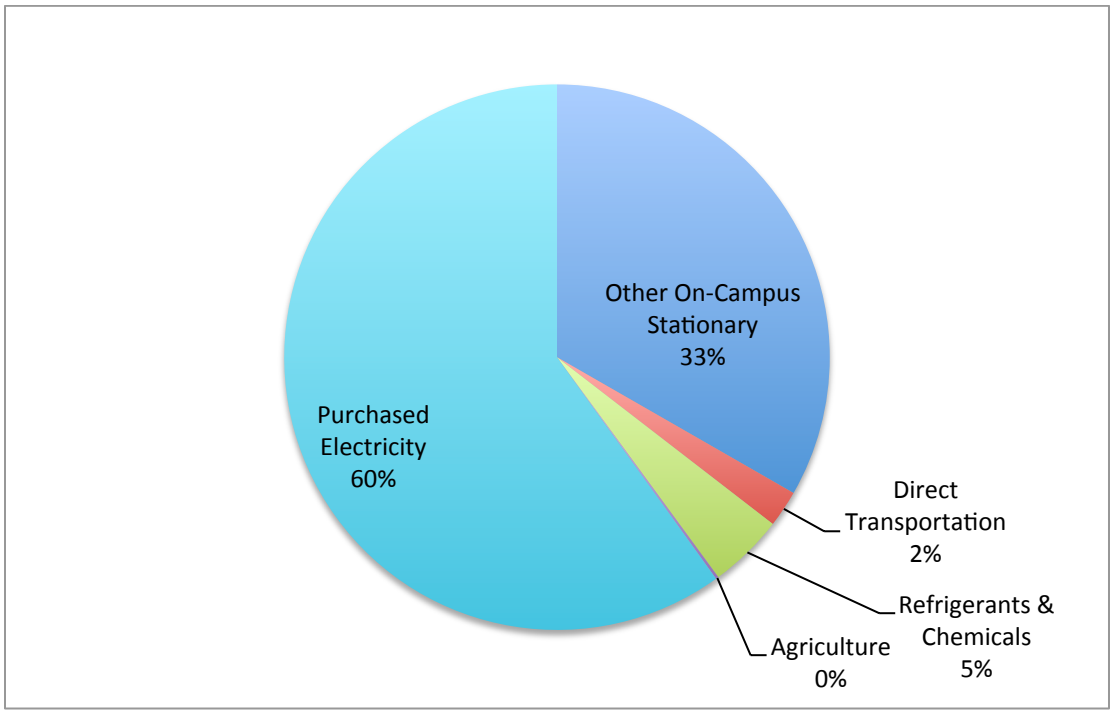
Figure 7. Scope 3 Annual Emissions in Percentage. Values showing as zero are finite, but rounding to zero. Estimated values show in Appendix III.



If Scope 3 emissions are removed from the analysis, and only Scope 1 and Scope 2 emissions are considered, purchased electricity makes up 60% of the Scope 1 greenhouse gas emissions at CSUEB.[11] Other on-campus stationary sources (natural gas) are the next highest source of Scope 1 greenhouse gas emissions, about 33% (Figure 8 below).

[11] As described in the Scope 2 Grid Electricity section it was assumed that the unspecified power content in the power mix was all coal—a worst case assumption that appears prudent given the lack of information.

Figure 8. Scope 1 and Scope 2 Annual Emissions Summary in Percentage. Values showing as zero are finite, but rounding to zero. Estimated values show in Appendix III.



Conclusion

This inventory fulfills step 2 of the University's Carbon Commitment, as outlined on pages 1 and 2 of this document. The inventory's findings constitute a foundation for CSUEB's climate action planning, which begins January 2016, under the guidance of the Campus Sustainability Committee (CSC). The creation of the Committee itself fulfills step 1. Work on step 3 of the commitment—creating a Climate Action Plan to reach climate neutrality—commences January 2015, under the guidance of the CSC.

Appendix I. Commute Surveys

Student Commute Survey Questions

1. What type of student were you?
2. What was your major?
3. How many units did you take in total?
    a. Hayward Campus
    b. Concord Campus
    c. Oakland Campus
    d. Online Courses
4. How many days were you absent from school?
5. What was your city of residence?
6. What was your zip code of residence?
7. Were you an international student?
8. If you are an international student, what is your country of origin?
9. Did you live in the dorms?
10. Did you commute to campus?
11. How many days/week did you commute to CSUEB on a typical week?
    a. Personal Vehicle (driving alone)
    b. Personal Vehicle (carpooling)
    c. BART
    d. Bus
    e. Bicycle
    f. Walking
12. If you drive or carpool to campus, what is the year of the vehicle(s) you use?
13. If you drive or carpool to campus, what is the vehicle type(s)?
14. If you drive or carpool to campus, what is the fuel type of your vehicle(s)?
15. If you carpool to campus, what is the typical number of people in the carpool (including you)
16. If you use BART to commute to campus, what station do you usually embark from on your way to campus?
17. If you use BART to commute to campus, what station do you terminate at on the campus end?
18. If you have to drive to BART, about how many miles do you drive (one-way)?

Faculty/Staff Commute Survey Questions

1. How many days per week did you work at each campus?
    a. Hayward
    b. Concord
    c. Oakland Center
    d. At home or online
2. What was your city of residence?
3. What was your zip code of residence?
4. What was your primary role on campus?
5. How many days were you absent from the campus that quarter?
6. How many days do you commute to CSUEB during a typical work week?
7. On a typical full-time school week, how many days per week did you typically commute via the following modes of transportation?
    a. Personal Vehicle (Driving Alone)
    b. Personal Vehicle (Carpool)
    c. Vanpool
    d. Bus
    e. Bicycle
    f. Walking
8. If you drive or carpool to campus, what is the year of the vehicle(s) you use?
9. If you drive or carpool to campus, what is the vehicle type(s)?
10. If you drive or carpool to campus, what is the fuel type of your vehicle(s)?
11. If you carpool to campus, what is the typical number of people in the carpool (including you)
12. If you vanpool to campus, what is the typical number of people in the vanpool (including you)
13. If you use BART to commute to campus, what station do you usually embark from on your way to campus?
14. If you use BART to commute to campus, what station do you terminate at on the campus end?
15. If you have to drive to BART, about how many miles do you drive (one-way)?

APPENDIX II. When Renewable Energy Credits are Not Owned by the University

While CSUEB owns and operates the photovoltaic electricity system on the Hayward Campus, it does not currently own the renewable energy credits, which it sold to offset some of the system costs. The email below, from CA-CP staff, explains how this is accounted for in the CA-CP Calculator.

Email from Clean Air Cool Planet Staff Member, Nicholas Shaw (nnr8@wildcats.unh.edu)
October 14, 2015

"Assuming that you're not using 100% solar electricity, you are going to have to use the custom fuel mix. In the scope 2 input section you will input your *total kWh* of purchased electricity. When you are prompted to set your grid region, you will see the option to enable custom fuel mix. Then set your custom fuel mix to appropriate percentages to account for your solar electricity. Next, you will want to go the *offset* section of the input page and look for the *Green Power Certificate* column. Here you will enter your *total kWh* of purchased electricity and multiply it by the percentage of solar electricity used in your custom fuel mix. Lastly, you are going to add a negative sign the *kWh* associated with solar electricity in the *Green Power Certificate* column. The reason for this is because you don't own the REC's associated with this solar power, therefore you can't claim them as true offsets. In the case that you one day do own these REC's you can delete that negative sign. Deleting the negative sign will cause those kWhs to be deducted from your carbon emissions rather than be added."

Based on these instructions, we set the custom fuel mix to account for the solar electricity produced on campus. Because Shell Energy reports solar and wind together, we do not know the fraction of grid energy coming from solar. In the inventory, we therefore assume it was negligible compared to wind, and we account only for the kWh or PV produced by the on-campus solar system in the correction to Green Power Certificates.

APPENDIX III. Summary of CA-CP Calculator Data for AY13/14

Table 21. CA-CP Calculator Summary Information from an Inventoried Year

Summary					
Overview of Annual Emissions					
CSU East Bay					
2014	**Energy Consumption**	**CO_2**	**CH_4**	**N_2O**	**eCO_2**
	MMBtu	kg	kg	kg	Metric Tonnes
Other On-Campus Stationary	67,116.2	3,558,500.9	318.1	6.4	3,568.3
Direct Transportation	3,173.6	227,669.4	42.5	14.5	233.0
Refrigerants & Chemicals	-	-	-	-	477.5
Agriculture	-	-	-	58.4	17.4
Purchased Electricity	150,313.2	6,318,274.3	2,899.1	98.1	6,420.0
Faculty / Staff Commuting	41,330.8	2,944,532.0	619.8	206.3	3,021.5
Student Commuting	354,540.8	25,116,864.0	5,232.2	1,713.2	25,758.2
Directly Financed Air Travel	841.0	164,014.3	1.6	1.9	164.6
Other Directly Financed Travel	693.5	49,469.8	9.7	3.3	50.7
Study Abroad Air Travel	1,007.7	196,541.2	1.9	2.2	197.3
Student Travel to/from Home (OPTIONAL)	47,713.3	9,305,523.6	92.2	106.0	9,339.4
Solid Waste	-	-	(888.0)	-	(22.2)
Wastewater	-	-	-	57.5	17.1
Scope 2 T&D Losses	9,901.3	416,189.9	191.0	6.5	422.9
Non-Additional					454.7
Scope 1	70,289.8	3,786,170.3	360.6	79.2	4,296.3
Scope 2	150,313.2	6,318,274.3	2,899.1	98.1	6,420.0
Scope 3	456,028.4	38,193,134.9	5,260.5	2,096.9	38,949.5
All Scopes	676,631.5	48,297,579.5	8,520.2	2,274.2	49,665.8
All Offsets					454.7
				Net Emissions:	**50,120.4**

Waste values are negative because the emissions factor built into the CA-CP Calculator is taken from the EPA's WARM model, which takes into consideration when waste is used to generate electricity.