CSUN Greenhouse Gas Emissions Report, 1990 -2013

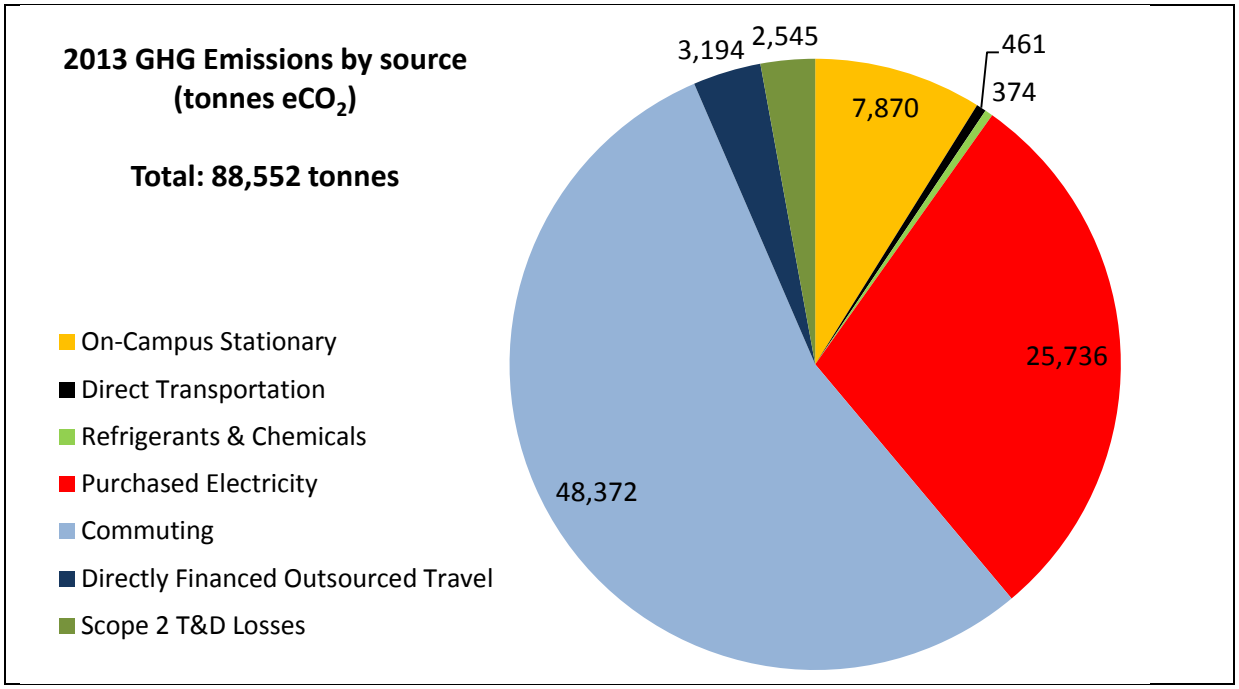
December 1, 2014

California State University Northridge | Institute for Sustainability

Executive Summary

This document reports greenhouse gas (GHG) emissions for California State University, Northridge for the years 1990 through 2013 and was prepared in accordance with the standards established by the Greenhouse Gas Protocol[1] and adopted by the American College and University Presidents' Climate Commitment (ACUPCC). Emissions are divided into Scopes 1, 2 and 3 as defined by those standards. Data for Scopes 1 and 2 are complete for this time period and have been taken from Monthly Energy Reports (MERs), prepared by the campus energy manager and submitted to the Chancellor's Office. These include all fuel and electricity purchases for use on-site and in campus fleet vehicles and equipment. Data for Scope 3 emissions, which are those for the university is indirectly responsible, such as commuting and business travel, are incomplete for this time period and have been extrapolated from available data.

In 2013, total GHG emissions amounted to 88,552 tonnes eCO_2, a 4.8% increase over the 1990 value of 84,456 tonnes. This increase is solely attributable to an increase in the estimated commuting footprint from a larger student body. Direct emissions from the campus for internal energy use fell from 37,857 tonnes eCO_2 in 1990 to 34,442 tonnes in 2013, a drop of 9%. Thus the campus has made great strides in reducing its emissions footprint during a period when its enrollment has grown by 23% (full-time equivalent students) and building space by 3.4 million square feet or 132%.



Using contextual data these numbers can be viewed in terms of emissions intensity by dividing by the number of enrolled students and the building area. Results are shown in the table below. FTES refers to full-time equivalent students, and GSF refers to interior building gross square footage (see definitions in full report).

	Scope 1 emissions (tonnes eCO_2)	Scope 2 emissions (tonnes eCO_2)	Scope 3 emissions (tonnes eCO_2)
1990	13,657	24,200	46,599 (est.)
2013	8,705	25,736	54,111
per FTES 1990 (31,167)	0.438	0.776	1.495 (est.)
per FTES 2013 (38,310)	0.227	0.672	1.412
per GSF 1990 (2,601,699 sq ft)	5.25 kg eCO_2	9.30 kg eCO_2	
per GSF 2013 (6,025,060 sq ft)	1.44 kg eCO_2	4.27 kg eCO_2	

It is evident that although overall emissions have increased slightly over the past two decades, the campus has improved the energy efficiency of its infrastructure to minimize the impact of growth. As the campus moves forward in striving to reduce its GHG emissions, close attention must be paid to commuting practices.

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Thanks also to President Dianne Harrison for signing the ACUPCC and moving the campus on a path towards a more sustainable future, to Elvyra San Juan (Assistant Vice Chancellor for Capital Planning, CSU Chancellor's Office) for many year's work on climate policy within the CSU, and to Provost Harry Hellenbrand and Diane Stephens (AVP, Academic Resources and Planning) for their continued support of the Institute for Sustainability at CSUN.

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1. Introduction

Greenhouse gases are atmospheric gases that absorb infrared radiation (or radiated heat) emitted from the earth. These gases then emit part of this absorbed energy back towards the earth's surface thus "trapping" heat much like a glass greenhouse traps heat from escaping its confines. This process causes the earth's surface and lower atmosphere to be warmer than they would be in the absence of these gases. The most abundant greenhouse gas is water vapor, which exists naturally in the atmosphere through the hydrologic cycle; the next most abundant are carbon dioxide, methane and nitrous oxide, which have both natural and anthropogenic sources. Because of the increase in man-made sources of these gases, particularly post-industrialization, their concentration in the atmosphere has increased by more than a third over the past century and is responsible for a concomitant rise in surface and ocean temperatures. The resulting climate change effects are numerous and potentially devastating. In response to this threat, the international community signed a global agreement in 2005, the Kyoto Protocol, to reduce emissions from participating countries. This agreement, which failed to curb global emissions, expired in 2012 and subsequent negotiations to reach a new international agreement have fallen short. As a result, administrative units from nations to states to cities, collective entities and organizations to individuals, have committed to reduce their emissions through a variety of measures which range from laws to non-binding pledges, plans and voluntary agreements.

At a national level, the EPA recently released its Clean Power Plan[2] which sets standards for carbon dioxide emissions from power plants, aiming to reduce them nationwide by 30 percent below 2005 levels by 2030. Many states are ahead of this national policy.

California implemented the legally binding Global Warming Solutions Act[3] (AB32) in 2006, which commits the state to reducing its emissions to 1990 levels by 2020, and by an additional 80 percent by 2050. The strategies to achieve this include emissions reporting requirements for the largest industrial sources in the state and the establishment of a cap and trade program. This state-level action ensures that over time power producers, industrial facilities and suppliers of transportation fuels operating in the state transition to cleaner energy sources, but it does not hold commercial entities, organizations or individuals responsible for their emissions.

At a city level Los Angles has its own Climate Action Plan, Green LA[4]. The Plan sets forth a goal of reducing the city's greenhouse gas emissions to 35% below 1990 levels by the year 2030, one of the most aggressive goals of any big city in the U.S. This is a voluntary plan

that identifies specific actions items to be taken by municipal facilities and operations, and local communities.

In 2006 the 23-campus California State University system joined the now defunct California Climate Action Registry (CCAR), a voluntary reporting repository for greenhouse gas emissions data. CSU joined the registry to better understand its carbon footprint, participate in the regulatory development process under AB32, and establish a starting point from which to improve the efficiency of its operations. Since then CCAR has been subsumed by a national reporting database, The Climate Registry, but the CSU system has not reported its greenhouse emissions since 2006. Under a new CSU sustainability policy approved by the Board of Trustees in May 2014, CSU campuses will be asked to reduce greenhouse gas emissions to 1990 levels by 2020, and to 80% below these by 2040. (See Appendix A of the CSUN Sustainability Plan Annual Update, 2014[5] for the full text.)

In March, 2013, CSUN President Dianne Harrison signed the American College and University Presidents' Climate Commitment (ACUPCC), which commits the university to the development of a comprehensive plan to achieve climate neutrality (zero net greenhouse gas emissions). The ACUPCC has taken a leadership role in raising awareness of climate change amongst universities and colleges across the nation, asking them to sign a commitment to conduct biannual emissions' inventories, reduce emissions according to a self-authored climate action plan (CAP), and integrate sustainability into their university curriculum.

This document represents the first step in that process, documenting the campus's greenhouse gas emissions from 1990 through 2013.

2. Methodology

CSUN's greenhouse gas emissions result primarily from campus-related energy use which includes on-campus stationary sources (natural gas), direct transportation sources from the university vehicle fleet (gasoline and diesel), and indirect sources resulting from electricity consumption. This inventory is consistent with the standards of the Greenhouse Gas Protocol[6] and uses the Excel-based version of Clean Air – Cool Planet's Campus Carbon Calculator, CPCC (v6.75)[7], which is designed specifically for campuses and is the most commonly used tool for campus inventories. The GHG Protocol defines three "scopes" for GHG accounting and reporting purposes. Direct sources are referred to as Scope 1 emissions, and indirect sources in which emissions result from the generation of electricity by a third party (the utility company or its supplier) are referred to as Scope 2. A third class

of emissions, referred to as Scope 3, includes other emissions that occur indirectly as a result of CSUN-related activities but come from sources not owned by or controlled by the university. Examples of such sources include commuting, business-related travel, electricity-related activities not covered in Scope 2 (e.g. transmission and distribution), outsourced activities, waste disposal, resource consumption, etc. The Climate Registry and other reporting bodies require that participants report Scope 1 and 2 emissions, but reporting of Scope 3 activities is generally optional as such emissions can potentially be double-counted through reporting by the responsible party and the indirect one. ACUPCC reporting requirements dictate that Scope 1 and 2 emissions be reported, together with Scope 3 emissions from two specified sources - air travel paid for by or through the institution and regular daily commuting to and from campus by students, faculty, and staff. This report conforms to the ACUPCC standards.

2.1 Organizational Boundaries

The organizational boundaries determine which operations are owned or controlled by CSUN and are included in this inventory. These are based on an Operational Control Approach, in that GHG emissions from operations under CSUN's operational control are included. These include the auxiliaries operating within the geographic boundaries of the main campus – Student Housing, University Student Union, The University Corporation, Associated Students as well as the main campus. The campus is bounded on north by Halsted and Devonshire Streets, on the east by Zelzah Ave, on the south by Nordhoff St., and on the west by Darby and Lindley Avenues[8]. It covers a geographic area of 356 acres, housing a total of 91 facilities with a gross square footage of 7,362,074 sq ft (including some outdoor physical education areas). All operating entities within this geographic area are covered by this report with the exception of Medtronic, which is an independent company outside CSUN's operational control.

2.2 Operational Boundaries

Operational boundaries determine which operations and sources generate emissions, which sources are included in the inventory, and how those sources are classified.

Scope 1 emissions are direct GHG emissions from sources that CSUN owns or controls. These come from:

- Onsite generation of electricity (fuel cell)
- Onsite generation of heat (boilers, stoves)
- Mobile combustion sources (transportation in vehicles owned by CSUN)
- Fugitive emissions (uncontrolled, unintentional emissions)

Scope 2 emissions are the indirect emissions that occur when the electricity that CSUN purchases and consumes is generated at a source not owned or controlled by CSUN. CSUN's Scope 2 emissions are governed by the campus's total electricity purchases coupled with the fuel mix of Los Angeles Department of Water and Power (LADWP), which determines the emissions factor (i.e. the mass of greenhouse gas emissions per unit of electrical energy generated). Electricity generated on campus by the fuel cell falls under Scope 1 (i.e., the natural gas used to generate it). Solar energy generated on campus has zero emissions.

Scope 3 includes all other indirect emissions (besides those associated with the generation of purchased electricity). Included in this report are those from:

- Business travel in vehicles not owned/controlled by CSUN
- Commuting (students, faculty and staff)
- Transmission and distribution losses from purchased electricity

2.3 Temporal Boundary

This report covers the twelve month period, Jan 1 – Dec 31, 2013. Because this is CSUN's first GHG Inventory Report, data for the years 1990 – 2012 are also included to the extent that data are available. 1990 serves as the base year.

2.4 Gases

Under the GHG Protocol standards, emissions of the six greenhouse gases covered under the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6) should be tracked and reported. However, PFCs and SF_6 do not originate on campus, and emissions of CH_4, N_2O, and HFCs are only a small percentage of CSUN's total GHG emissions. Thus the primary focus of the inventory is CO_2 emissions. Because each gas has a different potential for warming the atmosphere (which depends on its molecular structure), they each have vastly different effects on climate. To account for this the gas amount is multiplied by a Global Warming Potential (GWP), which is its warming efficiency relative to carbon dioxide. In this manner emissions are converted to eCO_2 (equivalent CO_2) emissions. (See Appendix A for a list of the GWP values used in this report.)

Emissions data reported here are in units of tonnes. One tonne is a thousand kilograms or 2200 lbs, close to a long (imperial) ton (2240 lbs), and 10% larger than a short ton (2000 lbs).

2.5 Scope 1 Emissions

Scope 1 emissions include campus use of natural gas for space and water heating and for the fuel cell, together with fugitive emissions from refrigerants and chemicals, and direct transportation fuels.

The campus is served by Southern California Gas Company for natural gas. Meter readings and other data from the utility bills are entered into Monthly Energy Reports (MERs) by the Energy Manager and staff in Physical Plant Management (PPM). Gas is metered separately for each auxiliary-operated location, for the general campus, and for the fuel cell. The MERs are the source of data for this report.

Data on leakage and disposal of refrigerants and chemicals are only available for years 2010 through 2013 so fugitive emissions are only computed for these years. Since these account for less than 0.5% of total emissions for the years in which they are available it can be assumed that they fall under the de minimis category (materially insignificant) which can be used for small emission sources that collectively comprise less than 5% of the institution's total GHG emissions.

The campus has a fueling station on campus which provides gasoline, diesel and propane fuel for use in fleet and maintenance equipment. Consumption data are documented through purchasing records and included in the MERs. These records are used to deduce mobile emissions, and in some cases stationary sources.

2.6 Scope 2 Emissions

The campus is served by Los Angeles Department of Water and Power (LADWP) for electricity. Data from the utility bills received from LADWP are entered into the Monthly Energy Reports by staff in Physical Plant Management (PPM) and utilized in this report. Electricity is metered separately for each auxiliary-operated location and for the general campus. In addition electricity generated on campus through photovoltaic installations and the fuel cell is metered but not reported here as these generations do not contribute to GHG emissions.

2.7 Scope 3 Emissions

Business travel falls under Scope 3 emissions. There are no specific records of miles traveled or mode of transport with respect to business travel, so these have been derived from the travel requisition log, which records the traveler, purpose of trip, costs and travel

destination for all CSUN-funded travel. Travel requisition logs were available for 2010-2013. Because of a lack of data on transportation mode, for the purpose of this report an assumption is made that travel within 200 miles of CSUN is most likely in a car, and travel beyond that is via a plane. To compute vehicle and flight miles the destination locations were mapped in a Geographic Information System (GIS) using the Batchgeo website[9] to geocode all destinations. This geocoding operation was followed by spatial projection of the locations to a custom projection created based on equidistance from CSUN. Once the locations were plotted in the GIS, a 200 mile buffer was created around the campus to separate travel into assumed driving trips and flights. For driving trips the distance to destination was computed on the road network. For flights, the point to point straight line distance from LAX to the destination was computed in the GIS; driving distance from CSUN to LAX was added to these trips. These driving and flight distances were recorded in the CPCC, in which energy consumption and accompanying emissions were computed based on national energy efficiency data for vehicles and planes available from the U.S. Department of Transportation, Bureau of Transportation Statistics[10].

To obtain an estimate of the business travel emissions for years prior to 2010, averages of flight miles per employee (faculty + staff) and miles driven per employee (faculty + staff) were computed for the four years of record (2010 – 2013). Over these four years the average distance flown per employee during a year was 1,125 miles, and driven was 111 miles. These data were used to extrapolate years 1990 – 2009 using the actual number of employees (faculty + staff) for each year.

Commuting emissions also fall under Scope 3 and are estimated from a 2010 campus commuting survey which recorded affiliation (student, faculty or staff), mode of transport, average number of trips to campus per week and round trip mileage. The results of the survey, which gained 2,264 responses, were extrapolated to the entire campus population to generate campus-wide emission estimates for 2010. For previous and subsequent years calculations assume the same per capita patterns (mode of transport, average number of trips per week, round trip mileage) but with year-appropriate student[11], faculty and staff headcounts and fuel efficiencies from the U.S. Department of Transportation.

Also falling under Scope 3 emissions are the losses associated with the transmission and distribution of the electricity that the campus purchases from the utility company.

2.8 Normalization and Contextual Data

In computing normalized data (per FTES, per student, per square foot etc.) the following definitions were used.

The CPCC calculator assumes that part-time students are equivalent to a half-time student so that the full-time equivalent number of students is computed as # full-time + 0.5 * # part-time. However, this report is completed under ACUPCC guidelines[12], which uses the campus definition of FTES (full-time equivalent students) as the equivalent number of students taking 15 units of course work per semester (i.e. the sum over all classes of (# units x student enrollment) divided by 15). For graduate students the FTES is based on a course load of 12 units.

Headcount = total number of full-time plus part-time enrolled students.

Building Space is computed as the gross building square footage within CSUN's organizational boundaries. Gross square footage is defined by the U.S. Department of Education's Postsecondary Education Facilities Inventory and Classification Manual[13] and includes all internal floored spaces, plus: "excavated basement areas; interstitial space (i.e., mechanical floor or walkways), mezzanines, penthouses, and attics; garages; covered porches, whether walled or not; inner or outer balconies to the extent of a drip line from a roof or balcony immediately above, whether walled or not, if they are utilized for operational functions; and corridors or walkways, whether walled or not, provided they are either within the outside face lines of the building to the extent of the roof drip line or, if covered, to the extent of their cover's drip line. The footprints of stairways, elevator shafts, and vertical duct shafts are to be counted as gross area on each floor through which they pass." The area excludes open areas such as parking lots, playing fields, pools, courts, etc. Although CSUN's total GSF (2014) is officially listed as 7,362,074 sq ft[14], this includes some outdoor areas such as playing fields. The data employed in this report exclude these areas. For 2014 the total building GSF is 6,025,060 sq ft.

2.9 Emission Factors

The greenhouse gas emissions associated with power generation are based on the fuel mix of the utility company. LADWP has traditionally relied heavily on coal for power production but is moving towards cleaner fuels. The mix of fuels is specified in the utility company's power content label[15]. In 2012 LADWP produced 33% of its power from coal compared to a statewide average of 8%, and 21% from natural gas compared to a statewide average of 43%. Because natural gas is a much cleaner burning fuel than coal, generating about 1.2 lbs

CO_2/kWh compared to coal at 2.1 lbs CO_2/kWh, electricity purchased from LADWP is accompanied by much higher greenhouse gas emissions than the state average. Thus the same electricity use in a region covered by a different utility, such as Southern California Edison, would yield significantly lower GHG emissions. The emission factors employed in this study are given in Appendix B.

3. Greenhouse Gas Emissions

3.1 2013 Emissions

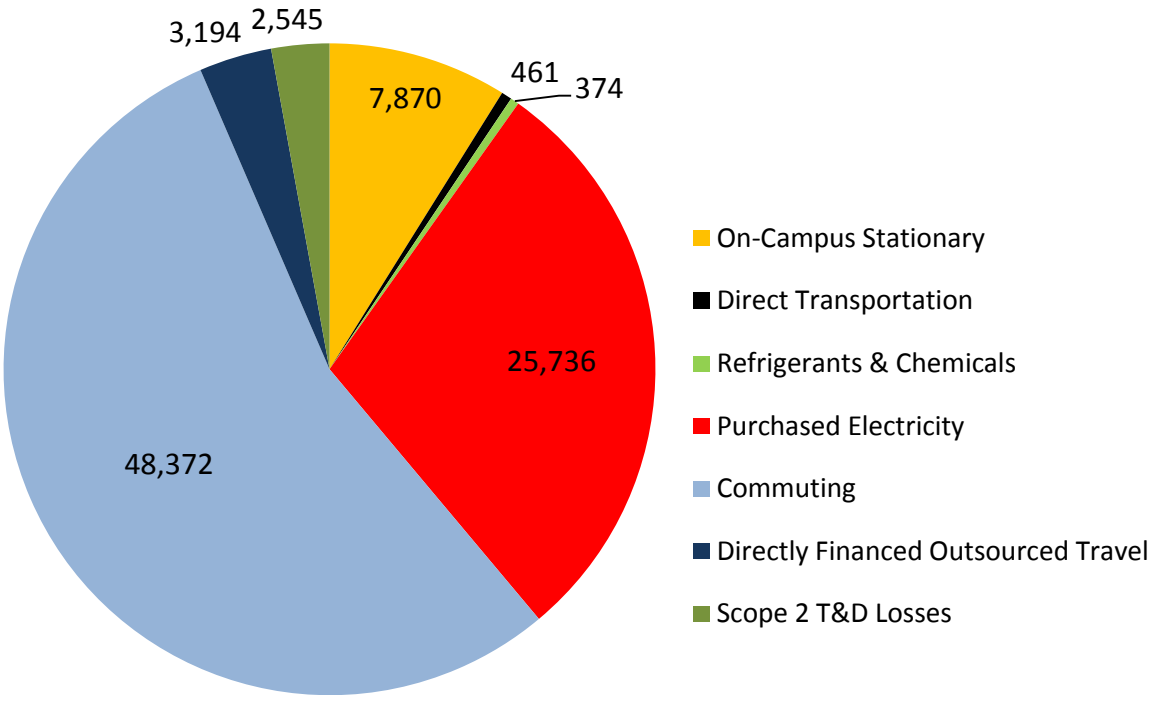

Figure 1. 2013 Greenhouse gas emissions by source. Shown in (equivalent) tonnes of CO_2. Total emissions were 88,552 tonnes.

Total greenhouse gas emissions for CSUN for the 2013 calendar year were 88,552 tonnes eCO_2, broken down by source as shown in Figures 1 and 2.

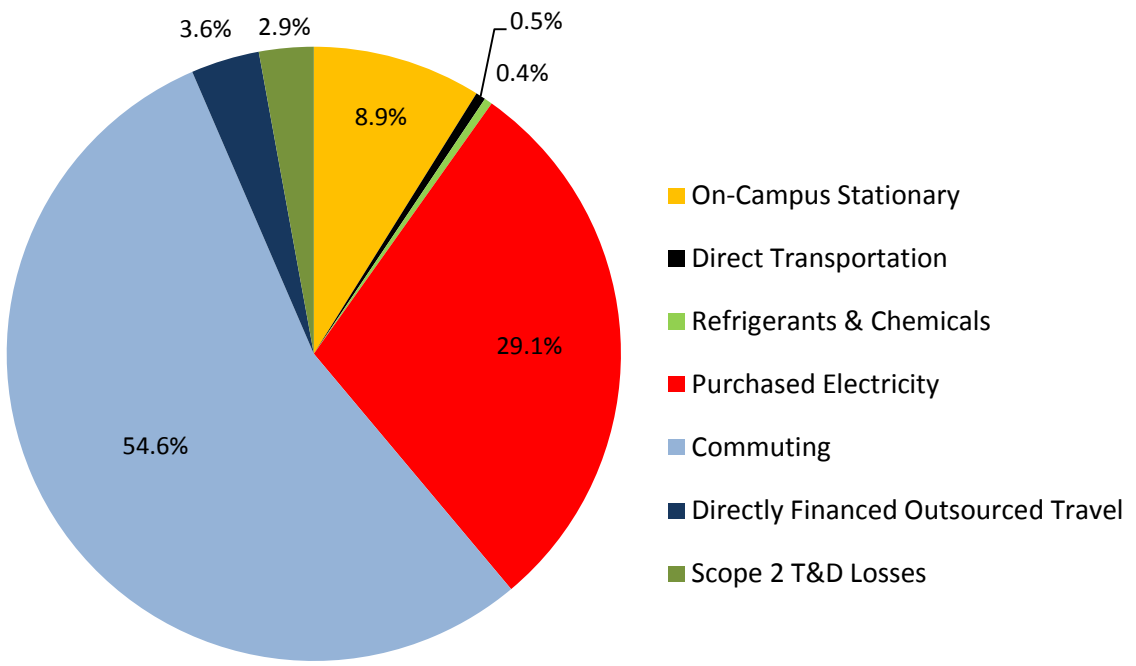

Figure 2. 2013 Greenhouse gas emissions. Percent by source.

Clearly the commuting footprint dominates campus emissions. In terms of those emissions that the campus takes direct responsibility for, power consumption is by far the most significant. This includes air conditioning, lighting (indoor and outdoor) and plug-in loads.

3.2 Historical emissions

Historical annual emissions since 1990 reflect a similar pattern, although the commuting footprint was less dominant in the 1990s and early 2000s due to a smaller student population. These emissions are shown in Figure 3. Note the following assumptions made in these calculations:

- **On-Campus Stationary** (actual 1990-2013): Data obtained from monthly energy reports
- **Direct Transportation** (actual 1990-2013): Data obtained from monthly energy reports
- **Refrigerants and Chemicals** (set at zero prior to 2010; actual 2010-2013): No data prior to 2010
- **Purchased Electricity** (actual 1990-2013): Data obtained from monthly energy reports (employs LADWP emission factors)

- **Commuting** (estimated prior to 2010; actual 2010, estimated 2011-2013): Data extrapolated from 2010 commuting survey using same mode of transport split and average commute distances; employs year-appropriate student, faculty and staff headcounts.
- **Directly-Financed Outsourced Travel** (estimated prior to 2010; actual 2010-2013): Data extrapolated from 2010-2013 averages using year-appropriate faculty/staff headcounts
- **Scope 2 Transmission and Distribution Losses** (actual 1990-2013): Based on 9% loss and purchased electricity from monthly energy reports.

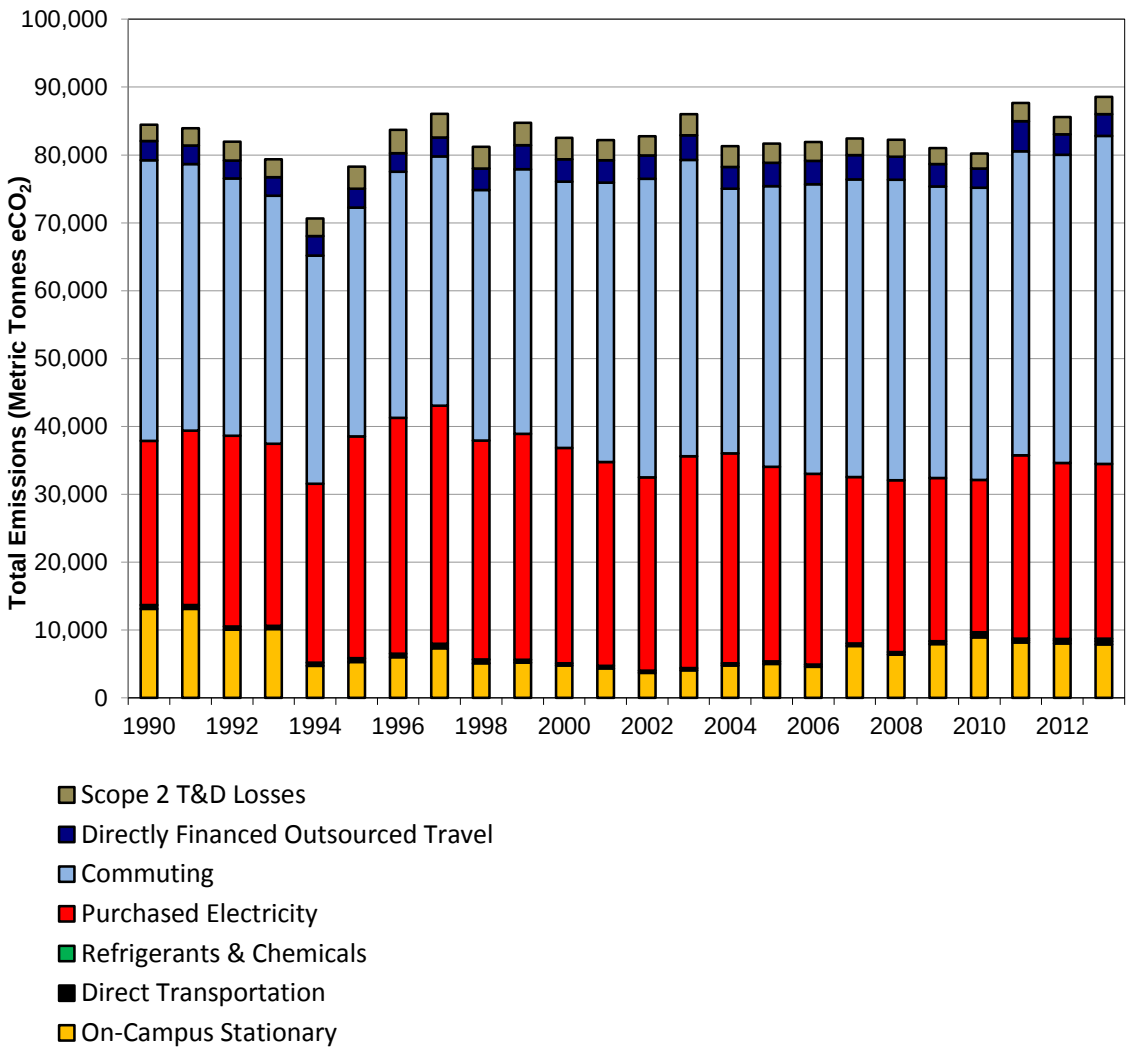

Figure 3. Historical annual emissions by source, 1990 – 2013.

As a result of the data extrapolations based on headcount, the historical Scope 3 emissions estimated here will reflect the growth of the campus.

The historical evolution of Scope 1 and 2 emissions, which are under direct control of CSUN Facilities Planning and Operations are shown below:

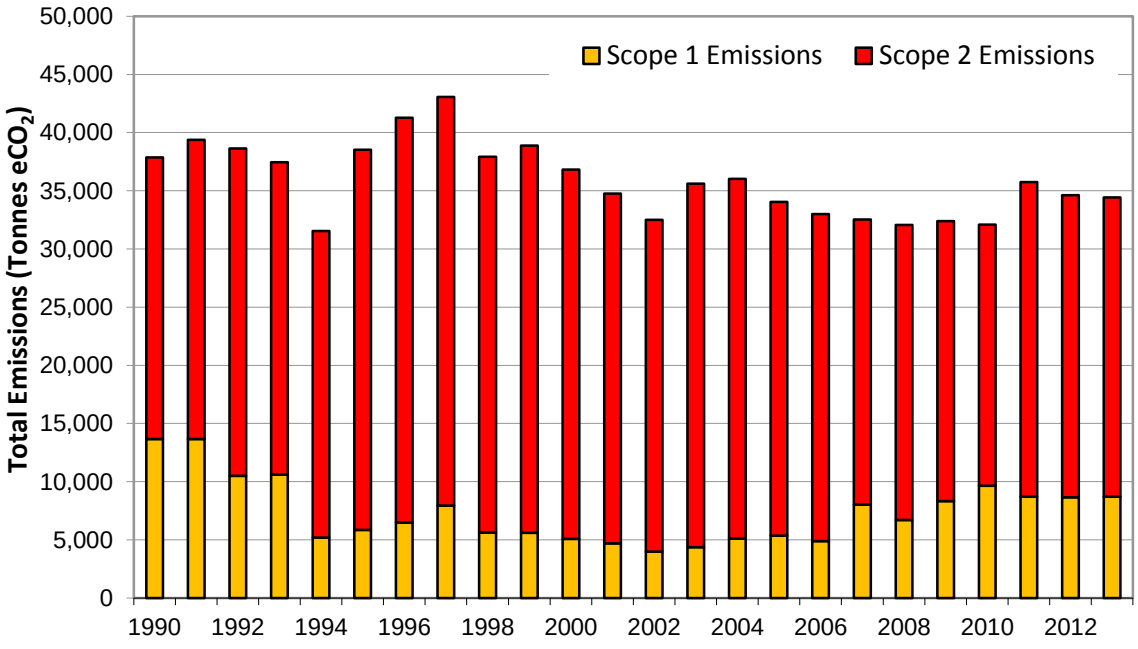

Figure 4. Historical annual emissions under direct control (Scopes 1 and 2), 1990 – 2013.

The impact of the 1994 Northridge earthquake is evident. The pattern generally reflects changes made to campus energy infrastructure as detailed in the CSUN Energy Report[16] including construction of a new Central Plant in 1998 and the completion of the fuel cell in 2007 which led to an increase in gas consumption (Scope 1) but a reduction in purchased electricity (Scope 2). Total emissions have held steady at just under 35,000 tonnes per year for the past two years, after a jump in 2011 when construction of the new Student Recreation Center was completed. Scope 1 and 2 emissions in 2013 were 3,415 tonnes lower than 1990 values. This is equivalent to a 9% reduction since 1990, all of which fall within Scope 1 and attributable to improvements made in the physical plant heating infrastructure.

In 2006, the CSU system joined CCAR and published its systemwide greenhouse gas inventory[17]. As part of that report, CSUN emissions were calculated based on monthly energy reports submitted by each campus. These covered Scope 1 and 2 emissions only. The data from that report is shown in Figure 5 and compared to the data reported here.

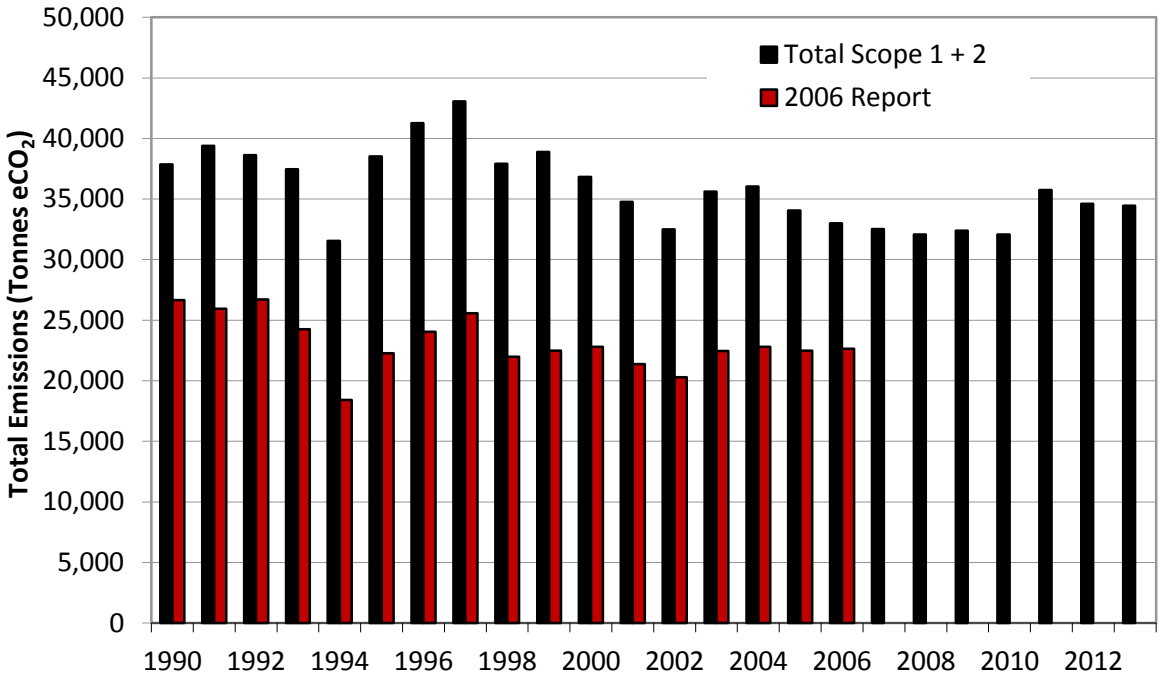

Figure 5. Historical annual emissions for Scopes 1 and 2 as reported here and in the CSU 2006 report[18]

The large difference between the current data and the earlier report is a result of the factor used to calculate the carbon emissions from electricity generation. Since the 2006 report covered the entire CSU system throughout California, a statewide emission factor for the WECC California eGRID Subregion[19] was employed. The California power mix is significantly cleaner than that of the local utility company serving CSUN and therefore emissions per kWh of electricity generated are much lower for California overall than for the campus. A value of 804.54 lbs/MWh (or 365.7 kg/MWh) was used in the 2006 report. LADWP factors used in this report are given in Appendix B and vary from almost twice this in 1990 at 1,551 lbs/MWh (or 705 kg/MWh) to 1,279 lbs/MWh (or 581.4 kg/MWh) in 2006 and 1,094 lbs/MWh (or 497.3 kg/MWh) in 2012.

Table 1. Greenhouse gas emissions by type and scope, 1990 – 2013 (tonnes eCO_2)

	On-Campus Stationary	Direct Transportation	Refrig. & Chemical	Purchased Electricity	Commute	Directly Financed Travel	Scope 2 T&D Losses	Scope 1	Scope 2	Scope 3	Total Emissions
1990	13,079	578	0	24,200	41,365	2,840	2,393	13,657	24,200	46,599	84,456
1991	13,112	561	0	25,708	39,266	2,726	2,543	13,673	25,708	44,535	83,916
1992	10,037	477	0	28,112	37,899	2,633	2,780	10,514	28,112	43,312	81,938
1993	10,148	462	0	26,846	36,550	2,693	2,655	10,610	26,846	41,898	79,355
1994	4,692	499	0	26,349	33,633	2,859	2,606	5,192	26,349	39,098	70,638
1995	5,273	585	0	32,666	33,739	2,769	3,231	5,858	32,666	39,738	78,263
1996	5,960	538	0	34,768	36,275	2,706	3,439	6,498	34,768	42,420	83,686
1997	7,297	654	0	35,103	36,752	2,769	3,472	7,951	35,103	42,993	86,047
1998	5,087	539	0	32,286	36,933	3,152	3,193	5,626	32,286	43,278	81,190
1999	5,186	409	0	33,281	39,026	3,540	3,292	5,595	33,281	45,858	84,734
2000	4,738	353	0	31,736	39,220	3,329	3,139	5,091	31,736	45,687	82,514
2001	4,344	352	0	30,074	41,140	3,300	2,974	4,696	30,074	47,415	82,185
2002	3,649	330	0	28,510	43,996	3,463	2,820	3,979	28,510	50,278	82,768
2003	4,039	317	0	31,246	43,657	3,663	3,090	4,356	31,246	50,410	86,012
2004	4,764	335	0	30,935	38,970	3,223	3,059	5,099	30,935	45,253	81,287
2005	5,002	356	0	28,692	41,360	3,449	2,838	5,358	28,692	47,647	81,697
2006	4,540	354	0	28,107	42,701	3,448	2,780	4,895	28,107	48,929	81,930
2007	7,633	393	0	24,495	43,878	3,590	2,423	8,027	24,495	49,891	82,412
2008	6,341	369	0	25,360	44,272	3,400	2,508	6,710	25,360	50,180	82,250
2009	7,931	386	0	24,070	42,971	3,283	2,381	8,317	24,070	48,634	81,021
2010	8,878	469	302	22,436	43,100	2,822	2,219	9,649	22,436	48,141	80,227
2011	8,150	339	232	27,019	44,823	4,419	2,672	8,722	27,019	51,914	87,655
2012	8,015	407	246	25,943	45,432	3,002	2,566	8,668	25,943	50,999	85,611
2013	7,870	461	374	25,736	48,372	3,194	2,545	8,705	25,736	54,111	88,552

3.3 Emissions intensity

Since the campus has grown significantly over the past two decades both physically and in terms of the number of students served, it is useful to examine how closely emissions are tied to growth (Figures 6 and 7). The campus has grown steadily in numbers since 1994. Emissions per student fell between 1995 and 2002, thereafter showing a slight increase in 2004 and hovering just above 0.9 tonnes eCO_2 per FTES for Scope 1 & 2 emissions and 2.3 tonnes eCO_2 per FTES for total emissions over the past five years.

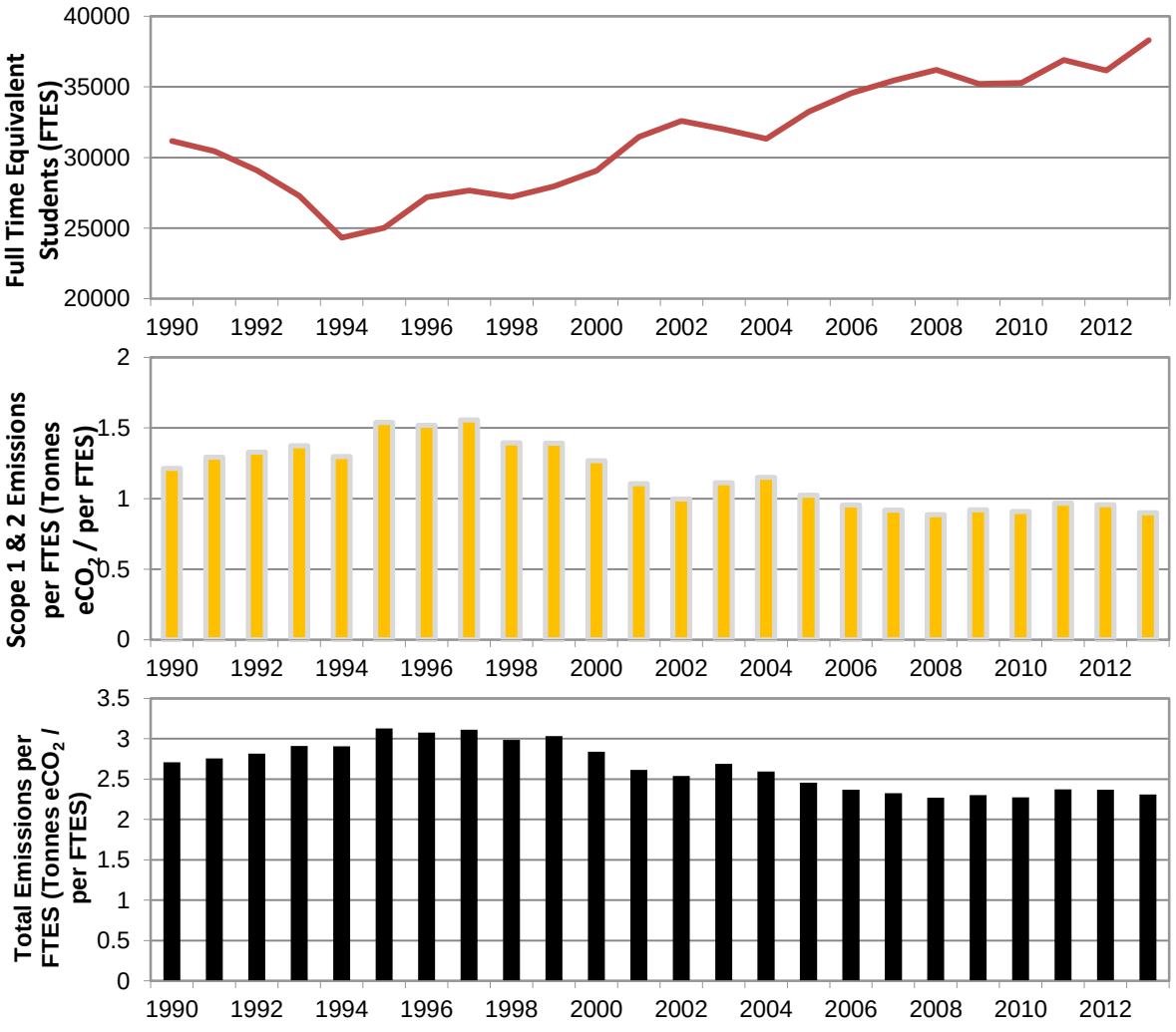

Figure 6. Top panel: Number of full-time equivalent students (FTES); Middle panel: Scope 1 and 2 emissions (tonnes eCO_2 per FTES); Bottom panel: Total (Scope 1,2 and 3) emissions (tonnes eCO_2 per FTES)

The campus has also grown in terms of building area (gross square footage, GSF). Using the U.S. Department of Education's Postsecondary Education Facilities definition of GSF as employed by the ACUPCC, Figure 7 shows the evolution of building area and emissions intensity over the past two decades. As buildings have become more energy efficient the associated energy-related emissions per gross square foot have decreased, holding fairly steady between 14 and 15 kg/sq ft. for the past five years.

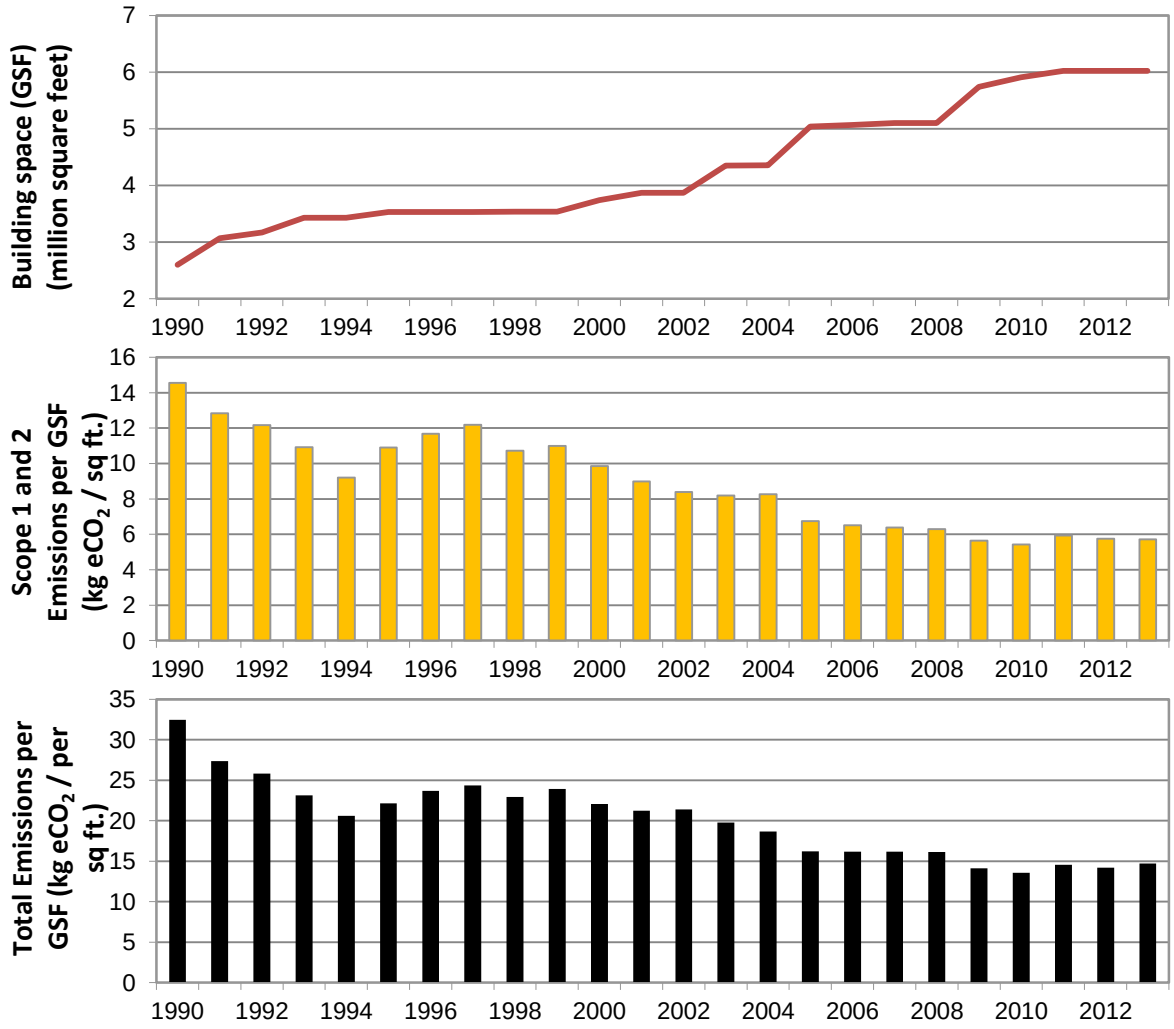

Figure 7. Top panel: Total building space (GSF); Middle panel: Scope 1 and 2 emissions (kg eCO_2 per GSF); Bottom panel: Total (Scope 1,2 and 3) emissions (kg eCO_2 per GSF)

3.4 Energy use

A 2012 report[20] on historical energy use at CSUN presents a detailed analysis of Scope 1 and 2 energy consumption by sector. A brief overview of the energy used in generating the emissions reported here follows.

Figure 8 shows energy consumption broken down by source for the years 1990 – 2013 as calculated by the CPCC. The energy units are MMBtu (million British thermal units). For direct fuel use (i.e. natural gas combustion, diesel fuel, gasoline, etc.) the energy content of the fuels is taken from the Energy Information Administration (EIA)[21]. For purchased electricity, the energy computation is based on the amount of energy consumed in generating the power, known as the Energy Use Factor (MMBtu / kWh). Since the LADWP fuel mix for all years was not available, this report utilizes California average values based on the CALI eGRID Region (pre-2006) and the CAMX eGRID Region (post-2006) which are embedded in the CPCC.

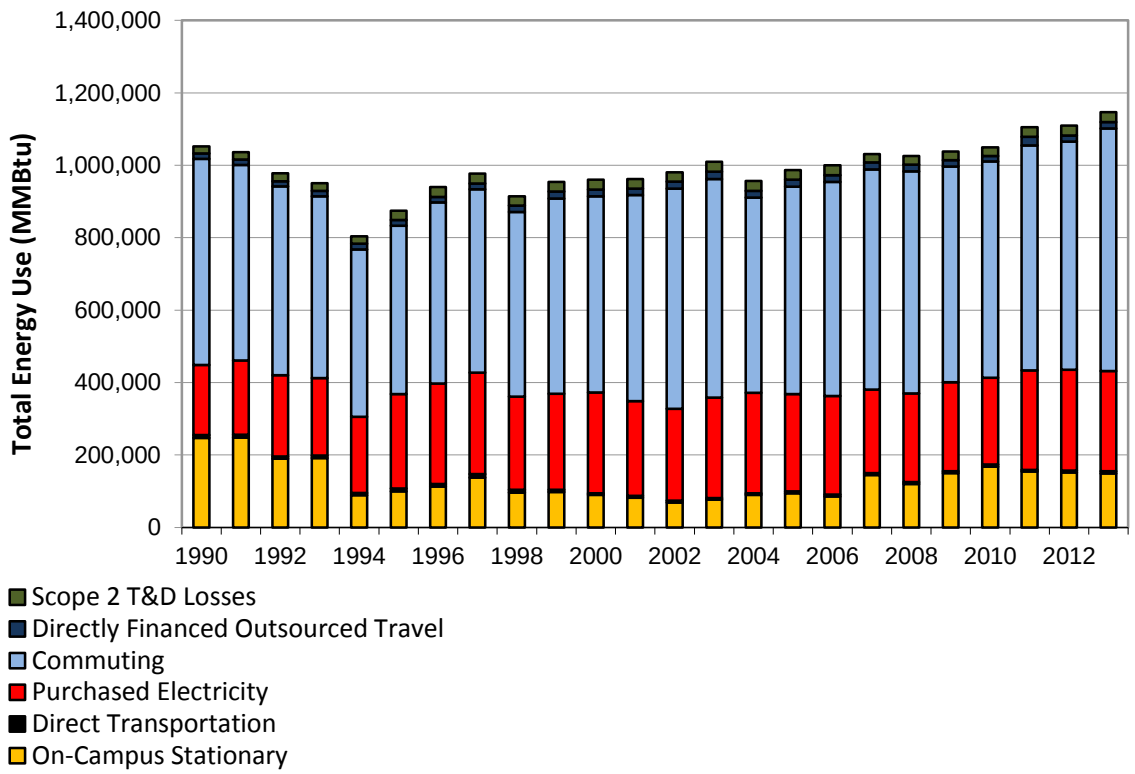

Figure 8. CSUN energy consumption, 1990 – 2013. Scope 2 values are based on the energy consumed in generating the electricity purchased.

In evaluating the energy efficiency of CSUN's buildings it is instructive to examine the energy intensity per gross square foot of buildings as shown in Figure 9.

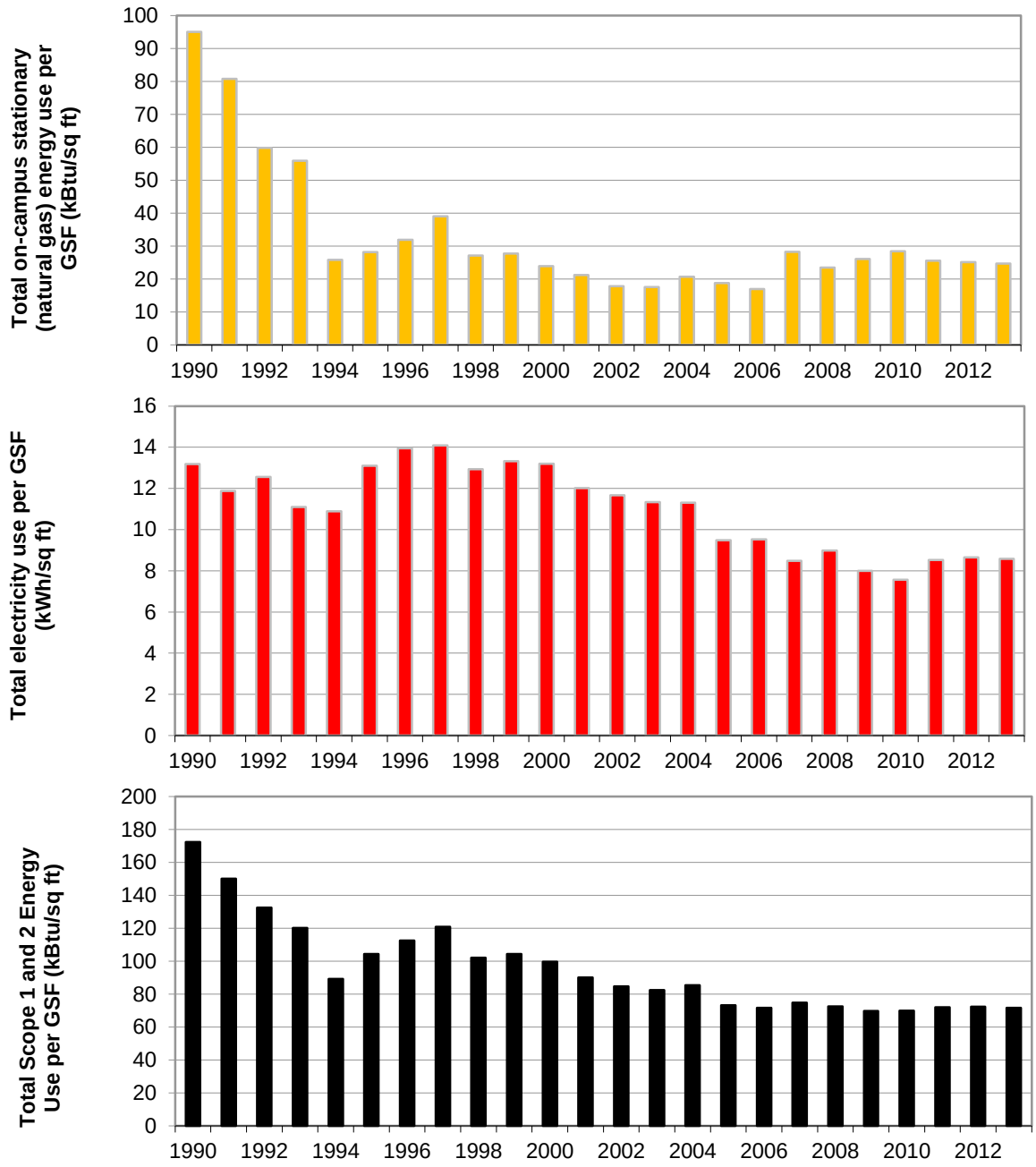

Figure 9: Top panel: On-campus (stationary) energy use (kBtu per GSF); Middle panel: Electricity purchased (kWh/GSF); Bottom panel: Total (Scope 1 and 2) energy use (kBtu per GSF) – includes energy used to generate electricity purchased

The energy efficiency of campus buildings has improved considerably over the past two decades. Over the past five years the campus natural gas use for space heating, water heating and the fuel cell has averaged 26 kBtu/sq ft per year (0.26 therms/sq ft per year). This is coincidentally exactly the same as the average for commercial buildings throughout the Pacific region[22] (for which the breakdown is 15.2 kBtu/sq ft for space heating + 7.9 kBtu/sq ft for water heating and 2.9 kBtu/sq ft for cooking). Until the installation of the fuel cell in 2007, natural gas use per GSF declined from 1997 onwards due to an increase in the amount of unheated space (parking structures) and improvement in the efficiency of campus infrastructure.

Electricity use intensity has also fallen since the late 1990s falling to an annual average of 8.3 kWh/sq ft. This compares favorably with a value of 10.3 kWh/sq ft for educational buildings throughout the U.S. according to the 2003 CBECS survey[23] released by the U.S. Department of Energy in 2008. More recent data from the 2012 survey is not yet available. CSUN's electricity use presented here is the amount purchased from the utility company and does not include that generated from the fuel cell or solar panels which together contribute 15 – 18% of the campus electricity consumption.

In terms of total energy intensity use for the campus, CSUN has shown a significant decline since 1997, averaging 71.1 kBtu/sq ft over the past five years, a value on par with Pacific region commercial buildings of 71.6 kBtu/sq ft and exceeding the average for U.S. educational establishments of 83.1 kBtu/sq ft, in part due to the milder climate of the region.

4. Moving forward

This report provides a detailed baseline of the university's GHG emissions between 1990 and 2013, and will thus serve as a useful reference for comparison of annual data in the future. By making these data available, students, faculty and staff will be able to understand the sources of our emissions and help in their reduction. The university has a sustainability plan[24] in place which details strategies and actions to be taken to reduce resource use and emissions in ten different focus areas. As we move forward in executing this, and in developing and implementing a Climate Action Plan focused specifically on the reduction of GHG emissions, our campus community is working together on modeling ways to minimize global warming emissions.

Appendix A: Global Warming Potentials (GWPs)

GWPs were taken from the Fourth Assessment Report, IPCC 2007 based on 100 year time horizon. http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html#table-2-14.

The chemicals and GWPs used in this report are listed below.

Chemical	100-year GWP
CO_2	1
CH_4	25
N_2O	298
HFC-32	550
HFC-125	3,400
HFC-134a	1,300
HFC-404a	3,260
HCFC-22	1700

Appendix B: Los Angeles Department of Water and Power Generation Emissions Factors

HISTORICAL LADWP POWER GENERATION CO_2 EMISSIONS				
Year	Total CO_2 Emissions from Owned & Purchased Generation (metric tons)	Total CO_2 Emissions from Owned & Purchased Generation minus Wholesale Power Sales (metric tons)	Total Owned & Purchased Generation (MWh)	LADWP System CO_2 Intensity Metric (lbs CO_2/MWh)
1990	17,925,410	17,764,874	25,481,532	1,551
2000	18,464,480	16,992,238	28,806,750	1,413
2001	18,086,034	16,663,305	28,032,375	1,422
2002	16,873,841	16,237,832	26,808,569	1,388
2003	17,274,623	16,710,232	27,337,694	1,393
2004	17,609,759	16,604,943	28,138,391	1,380
2005	16,928,681	15,854,278	28,301,700	1,319
2006	16,838,147	15,885,136	29,029,883	1,279
2007	16,461,774	15,523,035	29,141,703	1,245
2008	16,232,608	15,650,115	29,394,809	1,217
2009	14,651,016	13,834,001	28,041,998	1,152
2010	13,771,166	12,623,181	27,490,842	1,104
2011				1,156*
2012				1,094*
2013				1,094**

Table from: Los Angeles Department of Water and Power 2011 Integrated Resource Plan, Appendix C: Environmental Issues.

*Mark Sedlacek, LADPW (Private communication)

**Data not available, 2012 value used.

References and Notes

[1] http://www.ghgprotocol.org/
[2] http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule
[3] http://www.arb.ca.gov/cc/ab32/ab32.htm
[4] http://environmentla.org/ead_GreenLAClimateLA.htm
[5] http://www.csun.edu/sustainability/wp-content/uploads/2013/11/CSUN_SustPlan_update_final.pdf
[6] http://www.ghgprotocol.org/
[7] http://www.sustainableunh.unh.edu/calculator
[8] http://www.csun.edu/sites/default/files/campus_map_9_4.pdf
[9] http://batchgeo.com/
[10] http://www.rita.dot.gov/bts/home
[11] Note: One adjustment was made to the CPCC calculator function for the commuting footprint calculation. The calculator was pre-programmed to count the total number of commuting students as the number of full-time plus half the number of part-time students. However, since the data gathered from our survey included a mix of students (FT and PT) and based the average number of trips per week on this mix, all students were included in the commuting headcount, with no fractional weighting for part-time students.
[12] http://rs.acupcc.org/instructions/ghg/
[13] http://nces.ed.gov/pubs2006/ficm/content.asp?ContentType=Section&chapter=3&section=2&subsection=1
[14] http://www.csun.edu/institutional-research/facilities-information
[15] https://www.ladwp.com/ladwp/faces/ladwp/aboutus/a-power/a-p-powercontentlabel?_adf.ctrl-state=r2ghq7yo6_4&_afrLoop=329157515580523
[16] http://www.csun.edu/sustainability/wp-content/uploads/2012/11/Energy_Report_final.pdf
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[24] http://www.csun.edu/sustainability/wp-content/uploads/2013/06/CSUN_Sust_Plan.pdf

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