CSUN Climate Action Plan, 2016

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CSUN | INSTITUTE FOR SUSTAINABILITY

Executive Summary

California State University, Northridge's Climate Action Plan will achieve 1990 greenhouse gas levels by 2020 and net zero emissions (carbon neutrality) by 2040. This document defines a path to achieving these goals and describes the strategies which will be employed.

In March 2013 President Dianne Harrison signed the American College and University Presidents' Climate Commitment (ACUPCC) and later that year CSUN published its ten-year Sustainability Plan detailing the actions to be taken on a path towards campus sustainability. That plan set the stage for institutionalizing sustainability and directed the university along a path towards reduced resource use, improved energy and water conservation, increased education and awareness of sustainability and climate change, and comprehensive collaborative sustainability-related initiatives across campus departments. In 2014 the university completed and reported its Greenhouse Gas (GHG) Emissions Inventory, covering the period from 1990-2013 in preparation for the development of this Climate Action Plan (CAP).

This plan addresses greenhouse gas (aka "carbon") emissions generated by energy use on the CSUN campus ("Scope 1 and 2" emissions) and from activities related, but not directly controlled by the campus, such as commuting and business travel (so-called "Scope 3" emissions). A comprehensive plan, based on a Strategic Energy Plan and modelled emissions, has been developed that establishes a clear path towards eliminating Scope 1 and 2 emissions by 2040 through a number of defined energy conservation and efficiency projects combined with increased use of renewable energy by both CSUN and the local utility company. Scope 3 emissions will be reduced through a number of strategies which alter the mode mix of transportation used by CSUN students and employees, combined with increased use of electric and hybrid vehicles, and improved vehicle fuel economy standards established by the Environmental Protection Agency.

As part of this CAP, a model was constructed to project CSUN's Business As Usual (BAU) emissions based on projected student numbers and building expansion coupled with anticipated changes in the fuel mix used by Los Angeles Department of Water and Power (LADWP) to generate electricity and vehicle fuel economy standards established by the Environmental Protection Agency (EPA). This model projects a 17% increase over 2013 in direct emissions due to fuel (primarily natural gas) use on campus, a 44% decrease in electricity-related emissions due to the expanding role of clean energy in grid-supplied power, and a 49% decrease in activity-related emissions, mainly our commuting footprint, due to new CAFÉ (Corporate Average Fuel Economy) and Clean Air Act standards.

This year, a campus Strategic Energy Plan was commissioned which identified a number of projects with projected electricity savings ranging from 10,000 kWh to 6.3 million kWh, some with accompanying savings in natural gas use. Project costs range from $10,000 to $84 million (2015 dollars), which will be recouped over time by savings in utility costs. The impacts of these projects on BAU carbon emissions were evaluated using the same model and are projected to reduce the

(Scope 1 and 2) emissions by approximately one third. It is proposed that remaining emissions be eliminated through solar PV installations which, analysis of CSUN's solar potential indicates, are both feasible and cost-effective. Approximately 20 MW of solar by 2040 is required to eliminate all electricity-related emissions, and an additional similar amount would be required to negate the emissions resulting from natural gas use.

A number of strategies are planned to reduce CSUN's transportation footprint. These include expansion of bicycling services and infrastructure, better access to public transit, improved rideshare services, provision of shuttle services, electrification of the vehicle fleet, and a number of options to reduce the number and distance of trips made. With CSUN-related commuting making up more than half of current emissions, eliminating these completely presents a challenge. However, the electrification and improved fuel efficiency of personal vehicles and public transit aid GHG reductions significantly. By 2040, transit is likely to look very different from today. Driverless vehicles coupled with smart technology may make buses redundant, self-charging solar or hydrogen powered vehicles may be available, and clean fast regional transit may be the new norm. Based on model projections conducted here, total emissions are projected to fall to under twenty thousand tonnes, or a fifth of current values, stemming from Scope 3 (commuting and travel) sources. Given the rapid evolution in vehicle technologies, these emissions could potentially be lower. Under this plan, any remaining emissions in 2040 may be offset through carbon offset purchases.

This document sets forth an ambitious plan to move the campus forward on a path towards zero net carbon emissions by 2040. This significantly exceeds the target set by the CSU Chancellor's Office to reduce Scope 1 and 2 emissions to 80% of their 1990 value by 2040. Cost, funding mechanisms, incentives and resource availability together with external factors will dictate the timing of project implementation. Progress towards our goal will be monitored annually and through ACUPCC as required.

Milestones

- Reduce commuting carbon footprint to below 1990 levels by 2020
- Reduce total GHG emissions to below 1990 levels by 2020
- Reduce Scope 1 and 2 GHG emission levels to 50% below 1990 levels by 2030
- Reduce Scope 1 and 2 GHG emission levels to 80% below 1990 levels by 2035
- Reduce Scope 3 GHG emission levels to 50% below 1990 levels by 2035
- Reduce total GHG emissions to net zero by 2040

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Key to Acronyms and Abbreviations

ACUPCC = American College and University Presidents' Climate Commitment

BAU = Business As Usual

Btu = British thermal unit

CAP = Climate Action Plan

CF = compact fluorescent

CFM = cubic feet per minute

CH_4 = methane

CO_2 = carbon dioxide

eCO_2 = equivalent CO_2 emissions (Greenhouse gases have different global warming potentials. Rather than specify the quantity of each different greenhouse gas emitted, it is common practice to specify the total in terms of the equivalent quantity of CO_2 which would cause the same warming.)

EMS = Energy Management System

EPA = Environmental Protection Agency

EV = Electric Vehicle

FTES = Full-Time Equivalent Students

GHG = greenhouse gas

GSF = gross square feet

HHW = heated hot water loop

HVAC = heating, ventilations and air conditioning

IES = Illuminating Engineering Society

kW = kilowatt = 1,000 watts (of power)

kWh = kilowatt-hour

LADWP = Los Angeles Department of Water and Power

LED = light-emitting diode

MBtu or MMBtu = a million Btus = 1,000,000 Btu (of energy)

MW = megawatt = 1,000,000 watts (of power)

MWh = megawatt-hour

N_2O = nitrous oxide

PPA = Power Purchase Agreement

PPM = Physical Plant Management

PV = photovoltaic(s)

Scope 1 emissions = direct emissions of greenhouse gases (e.g. from combustion of fossil fuels)

Scope 2 emissions = indirect emissions of greenhouse gases released in generating electricity

Scope 3 emissions = emissions related to, but not under control of, the campus (e.g. commuting)

SEP = Strategic Energy Plan

tonne or MT = metric ton = 1,000 kilograms = 2204.6 lbs

ZEV = zero emission vehicle

1. Introduction

1.1 Context

California State University, Northridge was an early pioneer in alternative energy technology and innovation, inspired by dedicated leadership in Facilities Planning and Physical Plant Management and a strong partnership with faculty in the College of Engineering and Computer Science. This partnership led to the installation of solar panels, a fuel cell plant and a rainforest in the 2000s, much of which included cutting-edge technology at the time. Joint ventures between these departments have continued since then and inspired development of new partnerships between the operational and academic units on campus. In 2008, initiated by a faculty-driven effort, the Provost and Deans of the colleges formed a new university-wide Institute for Sustainability at CSUN whose mission is to "promote, facilitate, and develop educational, research, and university and community programs related to sustainability." Interest and activities in sustainability have grown rapidly since that time led by a Core Green Team of over two dozen active members who inspire, lead, and collaborate on projects to green the CSUN campus, its operations and curriculum.

In 2012, newly appointed President Dianne Harrison established sustainability as one of her seven priorities and requested the development of a campus Sustainability Plan[1], which was adopted in 2013. In 2013 the President signed the American College and University Presidents' Climate Commitment (ACUPCC) and in 2014 CSUN hired its first sustainability program manager to coordinate and manage campus projects. Ten Sustainability Plan working groups implement projects and execute actions in alignment with the goals and objectives of that plan.

In 2014 the university completed and reported its Greenhouse Gas Emissions Inventory, covering the period from 1990-2013 in preparation for the development of its Climate Action Plan. In a phased-in approach (ten per year, est.) the campus has begun installing meters at a building-level throughout campus, which will allow for a better understanding of energy consumption and help inform our strategic energy and climate action plans. Another important benchmarking activity was the completion in 2015 of a commuting survey of faculty, staff and students. With more than half of the university's carbon emissions resulting from commuting, we are working to support alternative transportation options on multiple fronts. A strategic energy plan for the university was also completed in 2015 to inform the development of this Plan.

The Plan laid out here will include strategies and trajectories for our future carbon emissions based on recommended actions. Regardless of these mitigation strategies and those of others, planetary global temperatures will continue to rise. Thus we also lay out plans for improving resilience to climate change for the campus and broader community through resiliency planning. We will conduct a campus-community resilience assessment including initial indicators and current

[1] http://www.csun.edu/sites/default/files/CSUN_Sust_Plan-m.pdf

vulnerability, engage the community in the development of a joint climate action and resiliency plan, and work with the community on projects in support of this effort.

1.2 Impacts of climate change. Why carbon neutrality?

Warming of the global climate is now unequivocal and has manifested itself in a number of ways from increasing land surface temperatures and warming oceans, to a reduction in snow and ice, melting glaciers and rising sea levels. Each of the last three decades has been successively warmer than any preceding decade since 1850, the Greenland and Antarctic ice sheets have been losing mass at an unprecedented rate and the rate of sea level rise since the mid-19th century has been larger than the mean rate during the previous two millennia[2]. The primary cause of climate change is the increase in atmospheric concentrations of greenhouse gases (notably carbon dioxide, methane, and nitrous oxide) to levels unprecedented in at least the last 800,000 years. Carbon dioxide concentrations have increased by 40% since pre-industrial times, primarily from fossil fuel emissions, our primary energy source. The ocean has absorbed about 30% of the emitted anthropogenic carbon dioxide, causing ocean acidification, which harms shell-forming organisms and has potentially far-reaching effects on the entire marine food chain.

Projections for future climate are predicated on future emissions, which themselves depend on population, economic development, energy demand and sources. Using a range of representative concentration pathways and sophisticated computer climate models, scientists are able to project future climate scenarios and the results are alarming.

By the end of the century we can expect a 1.5°C to 6°C increase in global average temperature (depending on emissions). Temperature increases of 3°C or more are likely to have disastrous effects causing famine in much of the subtropics and mass migrations. With 5°C of global warming, the world will be almost unrecognizable. Average inland temperatures would be 18°F higher. Southern U.S. would likely become a desert, along with Australia, Southern Europe, and Central America[3].

Projections of global sea-level are equally alarming. They range from 20 cm to as much as 2 m by the end of the century and sea level will not stop rising then. Without adaptation, a rise of 0.5 m would displace 3.8 million people in the most fertile part of the Nile River Delta. A rise of 2 m could displace 187 million people globally.[4]

Regional and local projections are for a 2°C to 7°C rise in average temperatures for California by the end of the century. By mid-century, the number of extremely hot days (98th percentile) is likely to triple or quadruple for the vast majority of people living in Southern California[5]. By mid-century the

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[2] Climate Change 2013: The Physical Science Basis, Intergovernmental Panel on Climate Change
[3] Mark Lynas, Six Degrees, National Geographic (October 7, 2008), p336.
[4] Willis and Church (Science, 4 May 2012: Vol. 336 no. 6081 pp. 550-551.)
[5] UCLA Center for Climate Change Solutions, 2012

region's mountains may see a reduction in snowfall of up to 42% of their annual averages, if greenhouse gas emissions continue to increase at their current rate, and 66% of their snowfall by the end of the century, compared with present day.

Other impacts include sea level rise, wildfires and drought. A study, commissioned by California, Oregon, Washington and several federal agencies predicts that sea levels along the California coast will rise up by 1 ft in 20 years, 2 ft by 2050 and as much as 5½ ft by the end of the century, because of the combination of warmer seas and sinking land[6]. The number of acres burned by wildfires has been increasing since 1950. The size, severity, duration and frequency of wildfires are greatly influenced by climate. The three largest fire years on record in California occurred in the last decade, and annual acreage burned since 2000 is almost twice that for the 1950-2000 period according to a California EPA report[7]. The current persistent drought is a harbinger of likely future conditions. "While previous long-term droughts in southwest North America arose from natural causes, climate models project that this region will under-go progressive aridification as part of a general drying and poleward expansion of the subtropical dry zones driven by rising greenhouse gases. Because of the very long lifetime of the anthropogenic atmospheric CO_2 perturbation, such drying induced by global warming would be largely irreversible on millennium time scale."[8]

Such impacts will be disastrous for humans here and worldwide. In 1996, the European Union proposed to limit global warming to 2°C relative to pre-industrial times. The 2°C target was reaffirmed by the 2009 Copenhagen Accord and remains the international target, being recognized as the highest "safe" limit. In order to stay within this limit emission reductions of the order of 80% must be in force by the middle of the century with reductions beginning immediately. As a national educational leader the university recognizes its role in reducing its own emissions, in educating students and future leaders about climate change and emissions reductions, and in working with the larger community to mitigate climate change and build resilience against its impacts. This Plan lays out our strategies for carrying out this mission.

2. Greenhouse Gas Emissions

2.1 Historical Emissions

CSUN's 2013 greenhouse gas emission breakdown by source is shown in Figure 1 below. The total emissions amounted to 88,552 tonnes, of which almost 55% were the result of commuting, 30% came from purchased electricity and 9% from natural gas (which is used for heating and the generation of approximately 15% of the campus's electricity from a fuel cell).[9] Electricity is

[6] http://www.nap.edu/catalog/13389/sea-level-rise-for-the-coasts-of-california-oregon-and-washington
[7] http://www.calepa.ca.gov/pressroom/Releases/2013/ClimateRpt.pdf
[8] IPCC Report on Climate Change 2013.
[9] http://www.csun.edu/sites/default/files/CSUN_GHG_report_final-Web-Version-Jan-12-2015-m.pdf

purchased from our local utility provider, Los Angeles Department of Water and Power (LADWP), who have historically purchased a significant portion of their portfolio from coal-generation. Thus the GHG emissions intensity for this power is considerably higher than the statewide average. Renewables on the campus include three solar installations with capacities of 225 kW, 467 kW and 90kW, which generate approx. 2% of our electricity with zero emissions. The most recent of these is on the roof of the Student Recreation Center and was installed when that facility was constructed in 2011; the other installations provide shade over surface parking and date back to 2003 and 2005.

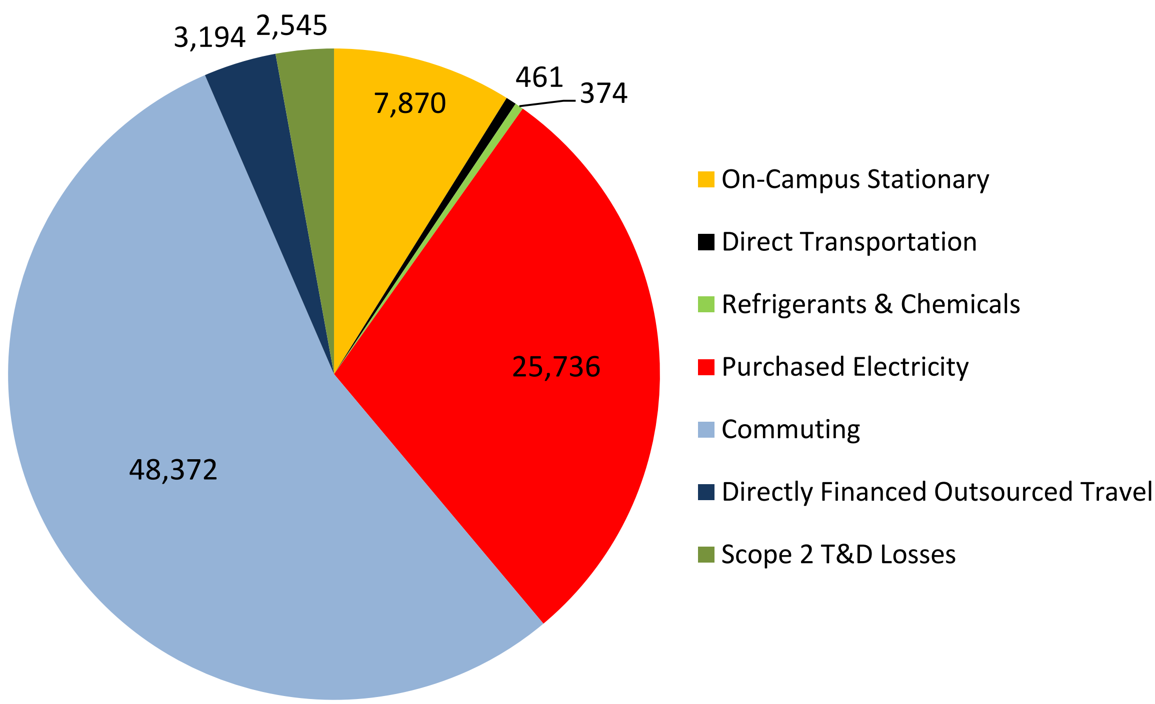


Figure 1. 2013 Greenhouse gas emissions by source. Shown in (equivalent) tonnes of CO_2. Total emissions were 88,552 tonnes.

Historically GHG emissions have held fairly steady in the face of increasing student numbers and campus expansion (Figure 2). The commuting footprint presented is directly proportional to student numbers as the data were estimated from the transport mode split determined from a 2010 survey and extrapolated to other years utilizing year-appropriate student and employee counts. Historical emissions associated with directly financed travel also utilize extrapolations based on headcount, and thus reflect the growth of the campus. Other data were based on actual monthly energy reports, which include utility billing data. 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[10] 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 held steady at just under 35,000 tonnes per year for

[10] http://www.csun.edu/sites/default/files/Energy_Report_final-m.pdf

2012 and 2013 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.

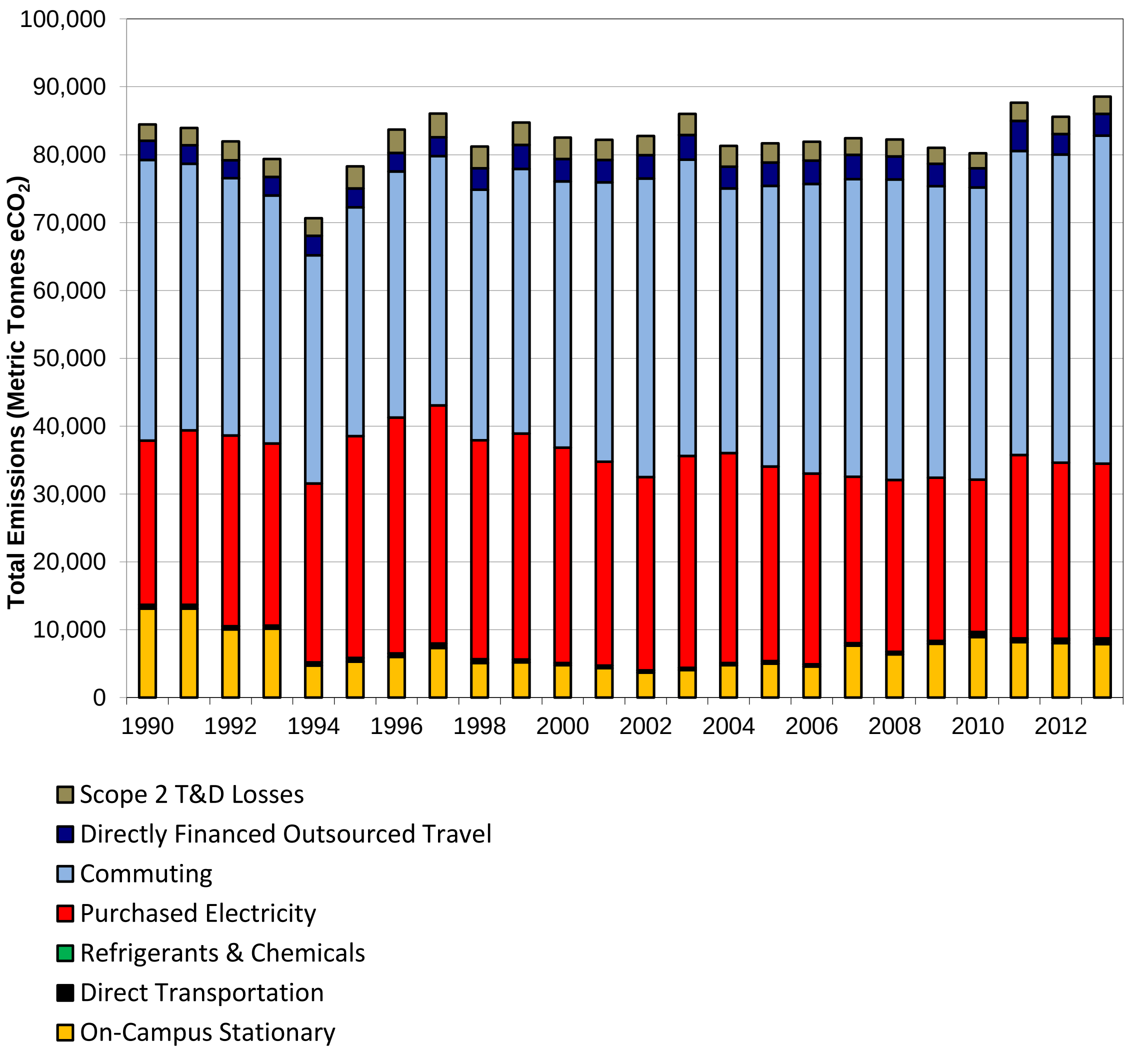


Figure 2. Historical annual emissions by source, 1990 – 2013.

The campus has grown significantly over the past two decades both physically and in terms of the number of students served. Emissions per student (Figure 3) fell between 1995 and 2002, thereafter showing a slight increase in 2003 and hovering around 2.3 tonnes eCO_2 per FTES for total emissions over the past seven years.

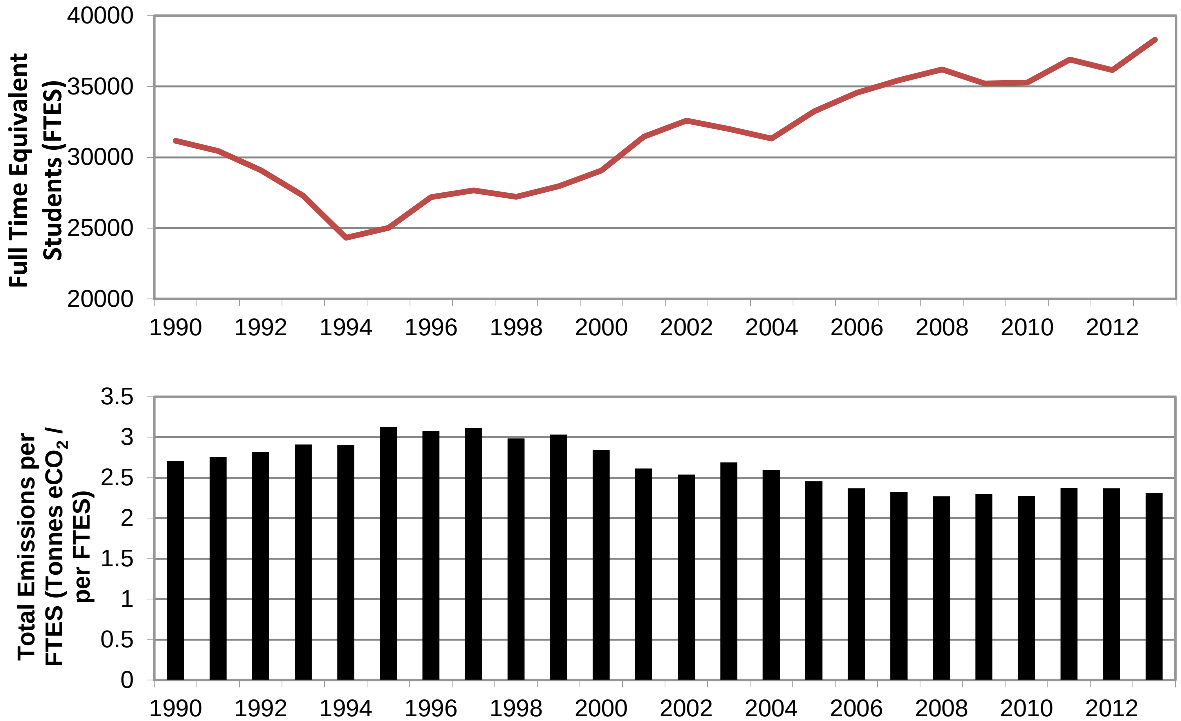
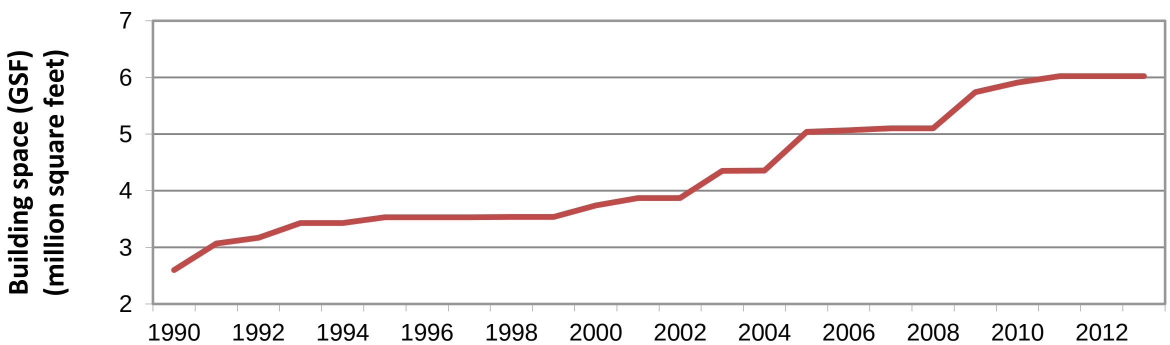


Figure 3. Top panel: Number of full-time equivalent students (FTES); Bottom panel: Total (Scope 1, 2 and 3) emissions (tonnes eCO_2 per FTES).

Buildings have become more energy efficient the associated energy-related emissions per gross square foot (Figure 4) have decreased, holding fairly steady just below 6 kg/sq ft. for the past five years.



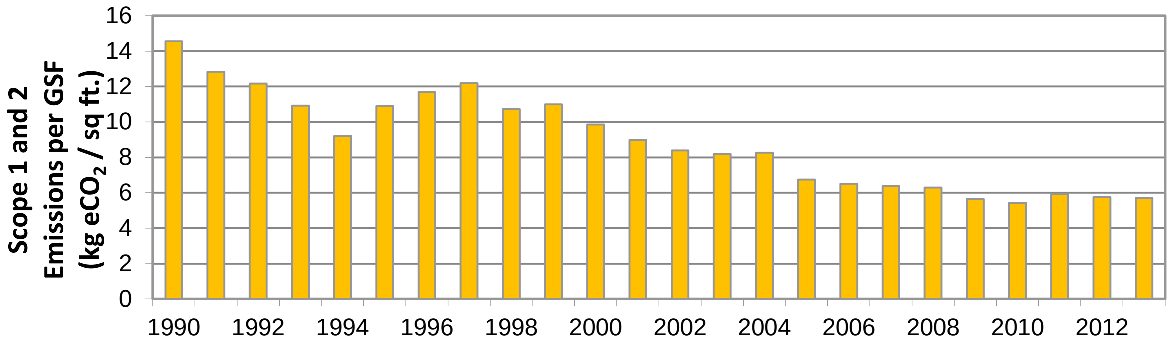


Figure 4. Top panel: Total building space (GSF); Bottom panel: Scope 1 and 2 emissions (kg eCO_2 per GSF).

2.2 Future Projections

Future emission projections are based on campus growth and other factors, such as changes in the fuel mix of the utility supplier, student numbers, and vehicle fuel economy. In modelling the Business As Usual (BAU) future scenario, the following assumptions were made:

- Building expansion was based on the 2005 Master Plan. Parking lots and other outdoor areas were not included (Figure 5).
- All energy (Scope 1 and 2) consumption was projected based on building square footage with energy densities for each emission source based on the 2012 and 2013 averages.
- Emissions from projected electricity use are based on LADWP's 2014 Power Integrated Resource Plan[11] (Figure 6).
- Student headcount projections were based on a 2% decrease annually for 2016, 2017 and 2018 based on impaction, and thereafter growth at an annual rate of 1.5% through 2028 until an FTES target of 35,000 is met. From 2026 onwards the FTES is held at 35,000 and headcount at 43,200 (Figure 5).
- Faculty and staff headcounts were based on current values projected out at the same growth rate as the student FTES and headcount.
- Business travel footprint projections were based on faculty and staff headcounts and per capita averages from 2010 – 2014.
- Commuting projections were based on 2010 mode mixes, headcount projections and additional assumptions for future fuel economy improvements of vehicles based on new EPA standards[12]. These assume a 5% per year improvement in the fuel efficiency (mpg) of automobiles until a value of 60 miles per gallon is reached in 2035, and an improvement rate of 3.5% per year for buses and trains throughout the same timeframe.

[11] https://www.ladwp.com/ladwp/faces/wcnav_externalId/a-p-doc?_adf.ctrl-state=r1wlftn8v_4&_afrLoop=43721225950530

[12] http://www3.epa.gov/otaq/climate/documents/420f12051.pdf

The eCO_2 contents of various fuels (natural gas, gasoline, diesel, jet fuel) were based on calculations carried out for the GHG inventory. This allowed a direct fuel to eCO_2 computation to be carried out without the need to calculate CO_2, CH_4 and N_2O emissions separately.

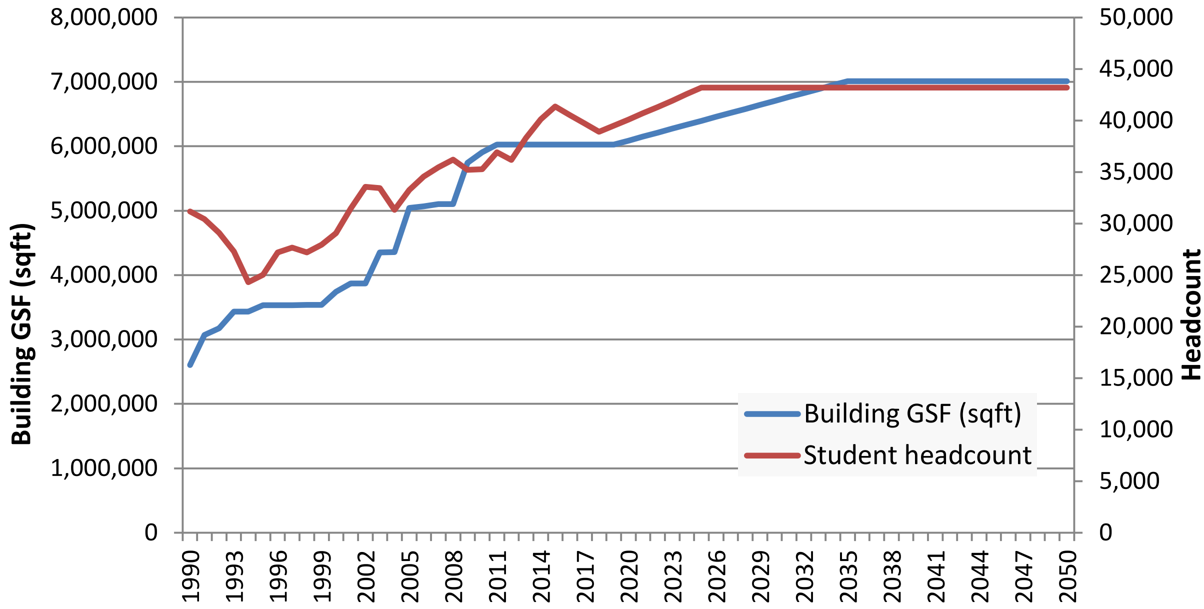


Figure 5. Projected building gross square feet (GSF) based on the 2005 Master Plan; projected student headcount based on Full-Time Equivalent Student (FTES) targets.

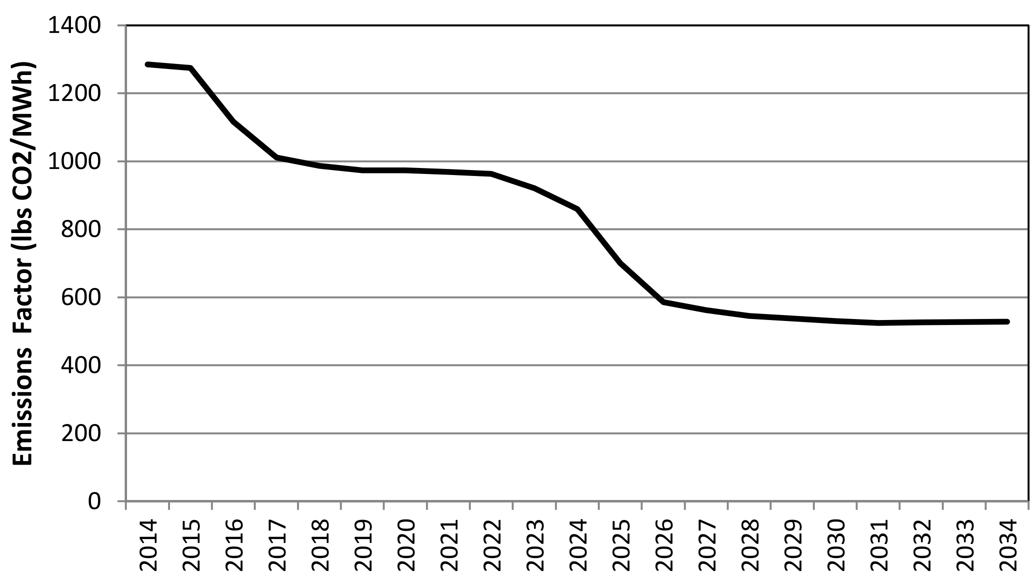


Figure 6. LADWP's projected emissions factor based on: 1) 50% RPS by 2030, 2) 15% Energy Efficiency by 2020, 3) 800 MW local solar by 2023, and 4) high transportation electrification[13].

[13] Personal communication

Past, current and projected GHG emissions for each Scope based on these assumptions are shown in Figure 7 below. Scope 1, comprised of natural gas and vehicle use on campus is projected to hold fairly steady but with a slight rise over the next thirty five years due to building expansion. The projected trend parallels that of building GSF shown in Figure 4. Scope 2 emissions, which result from grid electricity consumption, are anticipated to fall. Although electricity consumption is projected to rise as a result of building growth, the change in emissions factor of utility-generated power by far outweighs the increased demand and is projected to lead to a substantial reduction in associated emissions. Scope 3 emissions are also projected to fall, despite a slight increase in projected numbers of students, faculty and staff. This is a result of the anticipated improvement in the fuel efficiency of all modes of transport, resulting from further market penetration of electric vehicles, hybrid vehicles and more efficient design, engines, transmission and other vehicle components.

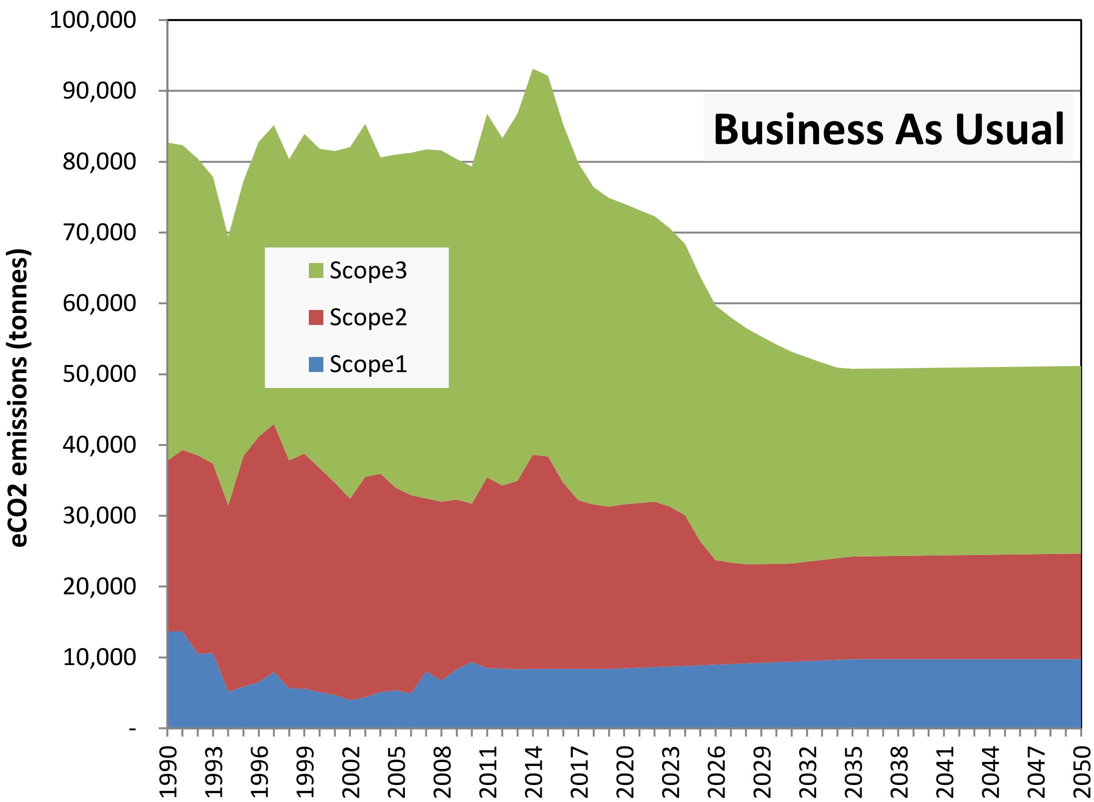


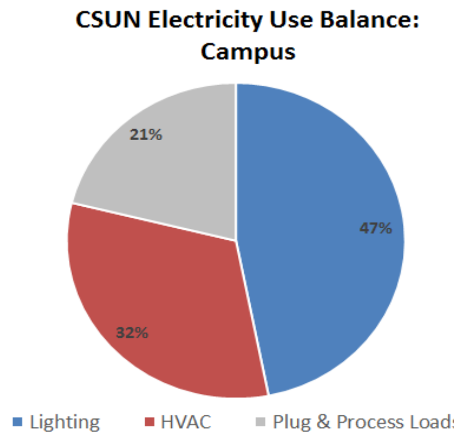
Figure 7. Projected GHG emissions for Scope 1 (direct), Scope 2 (electricity) and Scope 3 (activity-related or indirect) based on assumptions described above.

3. Climate Action Plan

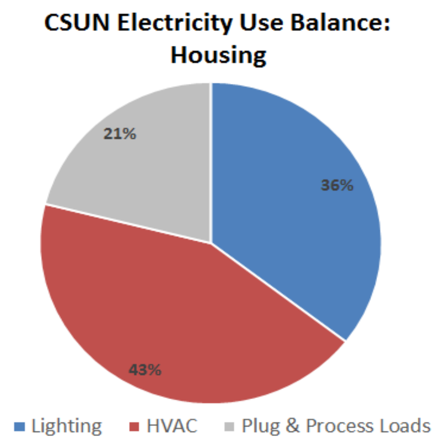
3.1 Energy and Buildings

Energy, for the purpose of this section, includes grid electricity, self generation electricity and natural gas.

CSUN has several sources of electricity on campus, including the Los Angeles Department of Water and Power (LADWP) grid supply, on site photovoltaic solar (PV) and fuel cell generation. Grid supplied electricity makes up the vast majority, between 81 and 86%, of the electricity consumed at CSUN. Unfortunately, the electricity currently supplied by LADWP has an emissions factor of 1,135 pounds of CO_2 per MWh of electricity consumed, one of the highest in the state. Fuel cell electricity generation makes up 13-17%, with solar contributing the remaining 2%.



Electricity is used in every building on campus. With such a widely used resource, it is important to understand how it is being used. In order to accomplish this, the University developed a Strategic Energy Plan (SEP) to identify energy conservation measures associated with the CAP. The SEP evaluated electricity use on both the main campus and housing to determine current efficiencies, identify opportunities for improvement, and list energy efficiency measures for implementation. The study revealed that on average, 47% of the electricity consumed in campus buildings was from lighting, with HVAC load consuming 32% and plug loads making up the remaining 21%. Student Housing showed a slightly different energy balance with HVAC loads being the largest consumer at 43%, lighting loads at 36% and the remaining 21% from plug-in loads. This information is crucial in building a strategic plan to for energy conservation and greenhouse gas reductions in both academic and residential buildings.



Electricity is used in a variety of applications to support the normal operations of the campus, including: heating and cooling, lighting, plug loads, EV charging stations, pumps, kitchens, vending machines, refrigerators, labs, etc. While both water and power are provided to CSUN by LADWP, the campus receives natural gas from two sources, Southern California Gas Company (SoCal Gas) and Department of General Services.

SoCal Gas provides all of the natural gas that is used in campus buildings, dining facilities, student housing as well as the boilers in the Satellite Plant. Natural gas is not heavily used in academic buildings, but there are some exceptions. It is used in laboratory buildings for certain equipment like Bunsen burners, the Art and Design Center uses a large kiln for firing ceramics and the Valley Performing Arts Center utilizes a gas fired humidifier. Although the majority of the buildings on campus are connected on our heated hot water and chilled water loop for heating and cooling, there are still several buildings that use natural gas fired boilers for heating building space and domestic water for restrooms. The largest consumption of natural gas within campus buildings occurs where there are dining facilities with kitchens that include cooking equipment. Student housing is also a large consumer of natural gas, with the primary use being to heat water for showers and sinks.

Department of General Services provides the natural gas for the larger-scale utility type operations including the Central Plant and Fuel Cell. The Central Plant consumes over 400,000 therms of natural gas annually to produce heated water for the hot water loop used to heat most campus buildings. The fuel cell consumes 770,000 therms of natural gas annually in producing over 7.7 million kWh of electricity. The fuel cell's waste heat is recovered and fed into the hot water loop. These two entities account for the majority of natural gas consumed on an annual basis.

In planning future projects towards climate neutrality, it is useful to understand and recognize the energy-reduction initiatives and accomplishments to-date. Completed within the last 5 years:

1. Education Administration Building air handler replacement
2. Nordhoff Hall five air handlers replaced
3. Lowered HHW loop temperature set-point per as part of the Central Plant retro commissioning recommendations
4. Central Plant boiler replacement, including installation of smaller boilers at both the Central and Satellite Plants to allow for more efficient operations
5. Chilled water temperature set-point reset at the Satellite Plant as recommended by retro commissioning
6. Eighty-nine outdated and inefficient refrigerators replaced with EnergyStar rated units campus wide
7. Redwood Hall fan replacement with a fan wall allowing for considerable reduction in fan energy
8. Chilled water delta pressure set-point reset based on the most open valve on campus as recommended by retro commissioning
9. Static pressure reset in PPM based on the most open damper
10. University Hall Enlighted Lighting Controls pilot project
11. University Hall UV limiting window film was added
12. A hundred and fifty street and walkway lights were replaced with LED units

Strategies

The following lists potential energy-conservation strategies to be implemented and their estimated energy and emission savings, costs and payback times based on the SEP.

Strategy	Potential Energy Savings	Estimated Project cost (one-time and ongoing)
1. LED lighting for interior spaces	6,313,835 kWh	$24,983,364
2. Task area lighting	168,517 kWh	$966,645
3. Lighting occupancy sensors	1,825,920 kWh	$941,921
4. Stairwell bi-level lighting	56,100 kWh	$45,146
5. Daylight harvesting at perimeter zones	381,253 kWh	$252,219
6. Occupancy-based book-stack lighting	73,878 kWh	$610,766
7. LED lighting & bi-level controls for exterior	1,452,080 kWh	$1,550,228
8. New AHUs w/ economizers	1,127,051 kWh & 1,482 MMBTU's gas/year	$84,638,304
9. Pneumatic to DDC controls	697,570 kWh & 1,295 MMBTU's gas/year	$3,602,435
10. Demand controlled ventilation (DCV)	781,321 kWh & 2,666 MMBTU's gas/year	$4,456,332
11. Occupancy-based HVAC	2,301,631 kWh & 3,166 MMBTU's gas/year	$5,280,376
12. High-efficiency motors at elevators	10,277 kWh	$2,800,000
13. Computer shut-down management	447,454 kWh	$186,625
14. Vending misers for vending machines	37,215 kWh	$10,125
15. High efficiency windows	1,010,156 kWh & 2,494 MMBTU's gas/year	$1,750,469
16. Network Thermostats	1,631,847 kWh & 3,469 MMBTU's gas/year	$429,000
17. Central Plant Chiller Retrofit	908,645 kWh	$2,646,000
18. Central Plant Chiller Savings from Building Measures	2,110,532 kWh	
TOTAL (all energy conservation projects)		**$135,149,955**

1. LED lighting for interior spaces

Complete interior lighting modernization to LED technology. Existing interior lighting is primarily composed of linear fluorescent and compact fluorescent fixtures. This project will convert existing lighting to LED throughout all spaces which can reduce existing lighting load by as much as 50%. LED lighting would also allow for more efficient controls such as dimming, occupancy sensing and daylight harvesting.

2. Task area lighting

For all areas such as offices, PC labs, and study areas, this measure would reduce the illumination from ceiling level light fixtures. To compensate, LED task lights should be added at all work areas. These can be incorporated with timers for automatic shutoff. Optimal design is for the workstations to have the recommended 50 foot-candles (per IES) with assistance from task lights; while the surrounding areas are to have 20 to 30 foot-candles.

3. Lighting occupancy sensors

Complete interior lighting controls upgrades to with the capability of sensing occupancy. Occupancy sensors allow lights to be automatically turned off when no motion is detected in a given space. These controls are ideal for areas such as classrooms, private offices, activity rooms, conference rooms, restrooms, and large public use areas which have variable occupancy. While the campus does have some use of occupancy sensors, this measure will install occupancy sensors in remaining areas.

4. Stairwell bi-level lighting

Stairwells typically offer energy saving opportunities in lighting because lights normally remain on 24-hours a day although the space is only occupied a fraction of the time. This project will require the installation of new bi-level LED fixtures integrated with an ultrasonic motion sensor. When the space is unoccupied, lights will step-down to a fraction of full load and ramp back up when occupancy is sensed.

5. Daylight harvesting at perimeter zones

Most buildings on the campus enjoy an abundant amount of daylight through glass windows at its perimeter or skylights at the roof. When daylight is present, there is an opportunity for energy savings by dimming the light fixtures, or in some cases, turning them off. This project will require the installation of photocells at interior day lit zones and controls to dim the light fixtures up and down so as to maintain constant illumination levels.

6. Occupancy-based book-stack lighting

The Oviatt Library book stack areas typically have a low occupancy level. Given the limited traffic, there’s a large energy savings opportunity for occupancy-based lighting controls. Unfortunately, the existing lighting systems design and book stack arrangement are not particularly suited for implementation of such controls thus a redesign of lighting would be required. The new lighting system would provide uniform light distribution across all stack areas with light levels per IES standards (i.e., IES suggests that stacks be maintained at an average of 30 FC). The system will also allow for individual isle-way occupancy controls.

7. LED lighting & bi-level controls for exterior

Various exterior areas throughout the campus are illuminated by high pressure sodium (HPS), metal halide (MH), compact fluorescent (CF), halogen, and incandescent lamp fixtures. These are located at building perimeters, walkways, parking structures, parking lots, and roadways. This project proposes replacement of all exterior fixtures (not already LED) with new LED-based fixtures. For enhanced energy savings and to meet Title 24's mandated controls compliance, this project also proposes multi-level lighting controls. The multi-level lighting control system generally consists of "smart sensors" at each fixture. Each luminaire with embedded control technology is designed with an intelligent microprocessor directly integrated into the LED fixture driver. This design eliminates the need for additional interfaces, enabling the fixture and controls to communicate directly with each other for instantaneous and seamless interoperability. The control system offers occupancy sensing, daylight harvesting, light level scheduling, and demand response controls.

8. New AHUs with economizers

Many buildings on campus have original HVAC equipment (+50 years) that is reaching or has passed the end of its useful life (i.e., 15 – 30 years). Specifically, this includes existing constant volume air handlers without existing variable frequency drives (VFDs) to control fans or air-side economizers to control outside air. This project proposes replacement of existing air handlers with new air handlers of the same capacity, VFDs to modulate fan speed, air-side economizers for free cooling, and high delta-T water coils to improve central plant efficiency. Also, in buildings with constant volume air distribution, zones shall be converted to variable air volume (VAV).

9. Pneumatic to DDC controls

Although most of the buildings on the campus utilize a Siemens Energy Management System (EMS) system with Direct Digital Control (DDC) controls, some building systems still depend on pneumatic HVAC controls. This project will require the replacement existing pneumatic controls with state-of-the-art DDC controls. Since HVAC energy use in any given building is significant, it takes the best tools available in the industry to make a positive impact on their use efficiency. DDC systems allows a maintenance technician to remotely monitor room temperature conditions, maintain and change set points, schedule equipment on/off periods, track energy use, and detect potential problems before the space users become uncomfortable. Because a majority of the university buildings will remain in operation for the foreseeable future, it makes sense to migrate subject building controls to the current technology for improved monitoring, maintenance, and energy efficiency. In addition to cooling and heating energy savings, there would be added savings from elimination of compressed air systems.

10. Demand controlled ventilation (DCV)

Install CO_2 sensors at all zones with variable occupancy for demand controlled ventilation (DCV) HVAC controls. Building ventilation rates are typically designed for 15 CFM per person, so as to maintain indoor CO_2 concentrations below 1000 PPM (or 700 PPM above the ambient level of 300-400 PPM). Fan systems are typically designed to provide a ventilation rate large enough to handle the peak occupancy conditions of a given space. Since no space is loaded to 100% capacity at all times, there is an opportunity to modulate the outside air dampers during partial occupancy periods while continually meeting the design intent of maintaining the CO_2 level under 1000 PPM. Reducing the outside airflow at lower occupancy conditions enables a reduction in heating energy and cooling energy. Under this measure, the CO_2 sensor would signal the need for more or less fresh outside air and controls would operate so that the OSA damper adjusts to maintain a healthy CO_2 level.

11. Occupancy-based HVAC

This measure would require the linkage of existing occupancy sensors to the EMS system for capability to reset zone temperatures when no occupancy is detected. This of course is reliant upon the fact that each zone is or will be equipped with lighting occupancy sensors. Under the proposed system, the existing occupancy sensor in each zone will relay a signal to the EMS when no occupancy is detected. When there are no occupants, the EMS shall automatically set back zone temperatures to a more efficient setting. This can be accomplished by simply providing low-voltage wiring from the sensor to the EMS controller input.

12. High-efficiency motors at elevators

Existing elevator motors throughout the campus range from 30 to 50 HP. For energy savings, this project proposes replacement of standard efficiency motors with new premium efficiency motors of matching capacity.

13. Computer shut-down management

A majority of computers on campus remain on after normal building operating hours. This measure would require the implementation of software to automatically shut off the computer at a specified time every day. This will eliminate energy consumption over extended periods like nighttime hours, weekends, and breaks. The computers will be given a set time in the off hours to accommodate for software updates and will subsequently be turned off.

14. Vending misers for vending machines

This measure would require the installation of a vending machine controllers at all campus vending machines to monitor occupancy and space temperature conditions in the vicinity and to power down the vending machines during periods when the surrounding areas are vacated. The controllers also re-power the cooling system at periodic intervals to ensure that the beverages remain cold.

15. High efficiency windows

Windows in buildings are typically responsible for a large part of the heat loss during winter and heat gain in the summer. Heat is transferred by direct conduction through the glass and through the frame around the window assembly. Although not fully eliminated, this heat loss can be reduced by various means including converting from single to multiple panes, specialty selective films or coatings, and high tech framing. This measure would require the replacement of existing single-pane windows with double-pane windows at south-facing and west-facing conditioned rooms throughout campus facilities.

16. Network Thermostats

Install network thermostats for all HVAC system in University Park Apartments 1 – 15. Existing HVAC control is done by programmable thermostats; however, it is difficult for campus to enforce schedules or temperature set-points. HVAC may operate for long periods of time without any occupancy in the space or with cooling set-points as low as 68 F. This project proposes replacement of existing programmable thermostats with new network thermostats, an alternative lower cost option to direct digital control (DDC) systems. Network thermostats can be connected via a secure wired Ethernet to a facility's data network. This allows for maintenance staff to monitor, diagnose, and control HVAC systems from a central location.

17. Central Plant Chiller Retrofit

Retrofitted in 1997, the Central Plant efficiency is measured at 0.74 kW/ton and is approaching the end of useful equipment life (i.e., 15+ years). This measure proposes the replacement of existing centrifugal compressors with the energy efficient compressors and variable speed drives, installing variable speed primary pumps, condenser pumps, and cooling tower fans. With this installation, the chiller is expected to operate at an efficiency of 0.54 kW/ton (full load) and 0.48 kW/ton (part load); resulting in savings of approximately 0.20 kW/ton at full load and 0.12 kW/ton at part load.

18. Central Plant Chiller Savings from Building Measures

This strategy captures the savings realized through the implementation of the above strategies related to the campus HVAC system. Because of the efficiencies gained at the building level, the Central Plant supplying the chilled and heated hot water for HVAC proposed will have a lower overall demand.

All of the above strategies were derived from the CSUN Strategic Energy Plan. This plan outlines each measure and breaks down the cost as well as the greenhouse gas emission reductions that are expected from each measure.

3.1.1 Refrigerants and Chemicals

Refrigerants and chemicals emissions primarily come from the use of refrigerants in a variety of equipment on campus. Some examples of this equipment are vehicles, air conditioning (both large and small), etc. Certain types of refrigerants, primarily chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs), are harmful to the environment and result in fugitive emissions directly introduced to the atmosphere through leakage and service/maintenance of equipment. CSUN's GHG Emissions Report revealed that the University's use of refrigerants and chemicals contributes only 374 tonnes eCO_2 annually, equivalent to 0.004% of the total campus emissions.

The data on refrigerants and chemical leakage and disposal at CSUN is only available between 2010 and 2013. Using these, the fugitive emissions were found to account for less than 0.5% of total emissions for the years in which they are available, and thus fall under the de minimis category (materially insignificant) used for small emission sources that collectively comprise less than 5% of the institution's total GHG emissions.

While these emissions may fall under the de minimis category, it is important that the university continue to track the leakage and disposal of these refrigerants and chemicals as they are significantly more potent GHGs than CO_2. In order to ensure that these emissions do not increase, the University has identified the following strategies for implementation.

Strategies

Strategy	Potential GHG Savings	Estimated Project cost (one-time and ongoing)
1. Leak prevention and Repair	21 lbs. R-22 (16 tonnes eCO_2)	current practice- no additional cost
2. Phase out and replace all equipment using HCFC's (R22)	318,673 kWh & 413 lbs. R-22 (318 tonnes eCO_2)	$1,926,750

1. Leak prevention & repair

The refrigeration equipment on campus is managed and maintain by the University's Physical Plant Management Engineering Services Department. This strategy will have the department develop a strategic plan to find and monitor/track leaks on refrigeration equipment as well as refill and repair these units.

2. Retrofit, phase out and replace all equipment using HCFC's

The University has identified over 63 individual packaged units spread throughout 12 buildings on campus that are still using HCFC's, particularly R22 refrigerant. This strategy will be to replace all of these units with more efficient SEER 14 units that do not use HCFC refrigerants. The replacement of these units will be done in a phased approach, as funding permits.

3.2 Power Mix

CSUN generates approximately 18% of its electricity on site utilizing a 1 MW fuel cell, 692 kW of solar PV panels installed over parking lots B2 and E6 in the early 2000s, a 90 kW solar rooftop installation over the Student Recreation Center, and 61 kW of potential PV from pilot technology developed with Boeing. Over 80% of electricity used on campus is purchased from the Los Angeles Department of Water and Power (LADWP), our local utility provider.

POWER CONTENT LABEL

Annual Report of Actual Electricity Purchases for LADWP
Calendar Year 2013

ENERGY RESOURCES	LADWP Power ACTUAL MIX	LADWP Green Power ACTUAL MIX	2013 CA POWER MIX** (for comparison)
Eligible Renewable***	23%	100%	19%
-- Biomass & waste	6%	98%	3%
-- Geothermal	1%	0%	4%
-- Small hydroelectric	1%	0%	1%
-- Solar	1%	0%	2%
-- Wind	14%	2%	9%
Coal	42%	0%	8%
Large Hydroelectric	4%	0%	8%
Natural Gas	17%	0%	44%
Nuclear	10%	0%	9%
Other	0%	0%	0%
Unspecified sources of power*	4%	0%	12%
TOTAL	100%	100%	100%

* "Unspecified sources of power" means electricity from transactions that are not traceable to specific generation sources.

** Percentages are estimated annually by the California Energy Commission based on the electricity sold to California consumers during the previous year.

*** This is in accordance with LADWP's RPS Policy and Enforcement Program, amended December 6th 2013 Resolution No. 014119.

Figure 8. Fuel mix of power generated by LADWP in 2013 and compared to the CA average.

Much of LADWP's power is generated from coal (Figure 8), which has the highest GHG emissions per unit of energy generated of any fuel (300 g CO_2/kWh) compared to natural gas at 181 g CO_2/kWh and oil at 240 g CO_2/kWh, thus the carbon intensity of CSUN's electricity use is considerably higher than the statewide average.

According to the most recent (2013) data, the utility company's GHG emissions per unit of electricity generated were 1135 lbs CO_2 /MWh, and although improving by 20% since 1990 remain significantly higher than other generators in California (PG&E's emission factor is 427 lbs/MWh[14] and the statewide average is 650.31 lbs/MWh[15]). This emissions factor is a significant factor contributing to CSUN's carbon footprint.

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

[14] http://www.pge.com/includes/docs/pdfs/shared/environment/calculator/pge_ghg_emission_factor_info_sheet.pdf
[15] http://www2.epa.gov/sites/production/files/2015-10/documents/egrid2012_summarytables_0.pdf

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	13,829,395	28,041,998	1,151
2010	13,771,166	12,844,288	27,490,878	1,104
2011	14,169,324	13,631,178	27,025,925	1,156
2012	13,968,172	13,329,797	28,145,679	1,094
2013	14,314,083	13,813,895	27,792,649	1,135
Table from: Los Angeles Department of Water and Power 2014 Integrated Resource Plan, Appendix C: Environmental Issues, Table C-1.				

Under California's Renewables Portfolio Standard (RPS) utility companies must increase procurement from eligible renewable energy resources to 33% of total procurement by 2020[16]. In October 2015, Governor Brown extended clean energy generation requirements by signing SB 350, which now sets a goal of 50% of CA utilities' power coming from renewable energy by 2030. In addition this law establishes a requirement for a 50% increase in the energy efficiency in buildings. In complying with current GHG state regulations and in anticipation of President Obama's Clean Power Plan, LADWP is working to reduce its GHG emissions through a number of strategies, the primary of which is early replacement of coal-fired generation. Coal energy delivered to LADWP comes from two coal-fired generating stations: the Intermountain Power Project (IPP) in Utah, and the Navajo Generating Station (NGS) in Arizona. The NGS's operating agreement and land lease expires in December 2019 and IPP's Power Purchase Agreement (PPA) contract is in effect until June 2027. Under LADWP's 2014 Integrated Resource Plan (IRP)[17], the recommended strategic case incorporates early Navajo coal divestiture in 2015, and early IPP coal replacement in 2025. In addition LADWP plans a large investment in renewable technologies with solar leading the way. Their recommended generation mix for 2014-2034 is shown below.

[16] http://www.cpuc.ca.gov/PUC/energy/Renewables/

[17] https://www.ladwp.com/ladwp/faces/wcnav_externalId/a-p-doc?_adf.ctrl-state=r1wlftn8v_4&_afrLoop=43721225950530

Table ES-5. 2014 IRP RECOMMENDED CASE

	2030	SB 1368 Compliance Date		New Renewables Installed (MW) 2014-2020				New Renewables Installed (MW) 2014-2034				
Case ID	RPS Target	Navajo	IPP	Geo/ Biomass	Wind	Non-DG Solar	Dist. Solar	Geo/ Biomass	Wind	Non-DG Solar	Dist. Solar[2]	Generic
Case 4 w/ 800 MW Local Solar	40%[1]	12/31/2015	7/1/2025	76	70	1,059	579	216	270	1,305	704	723

[1]33% RPS by 2020

[2]Incremental to current 100 MW installed

The IRP exhibits a significant transition to renewables, and solar in particular, over the next few years (Figure 9). This transition will likely be expanded further as the recommended strategic case was based on a 40% RPS by 2030 and the new standard calls for a 50% RPS.

The accompanying GHG emission reductions are presented in Figure 10. (Case #4 is the recommended case utilized in our projections.)

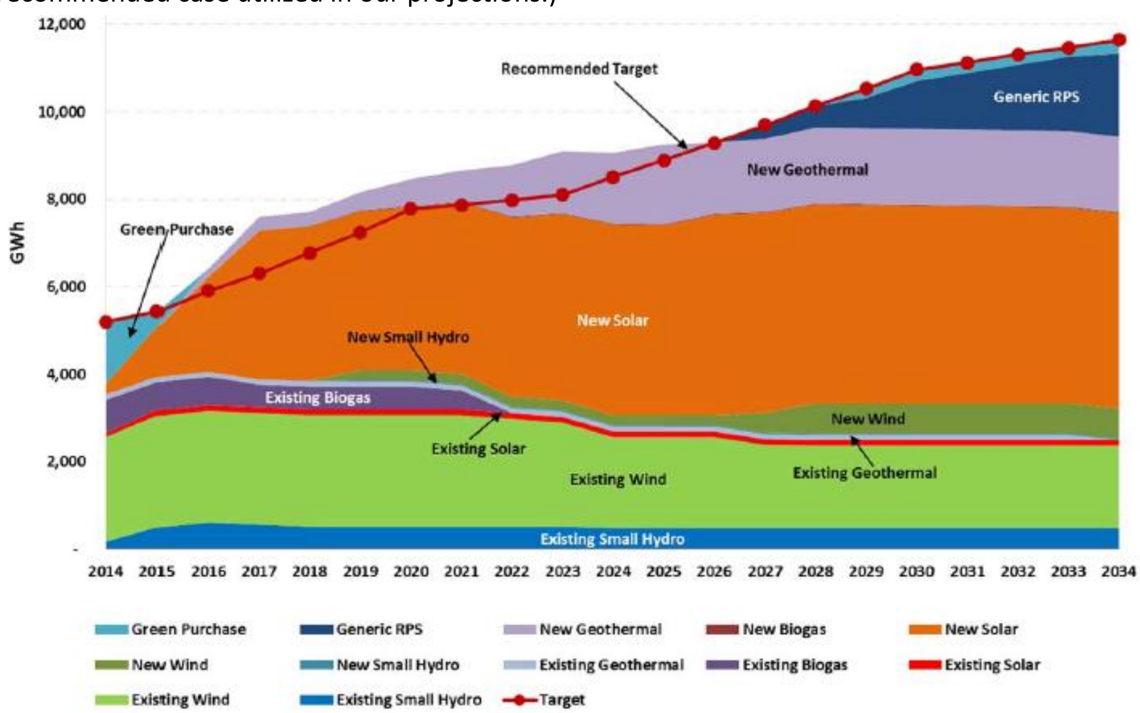


Figure 9. LADWP's power generation mix, 2014 – 2034.Taken from the IRP[18] Figure 5-2.

[18] See 17

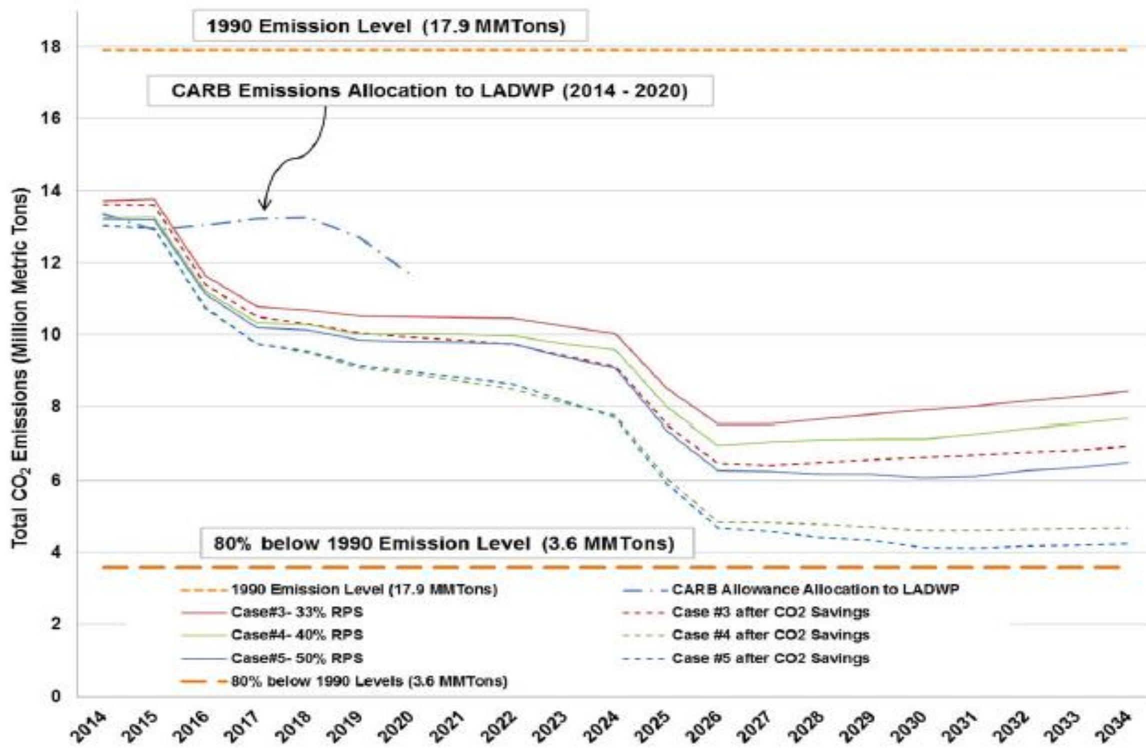


Figure 10. From LADWP's IRP Figure ES-5. The recommended case (above) is case #4.

Emissions under various scenarios would be reduced from 14.3 million tonnes in 2013 to 6.5 – 8.5 million tonnes in 2034. The recommended case (#4) results in a reduction in total emissions to approximately 7.7 million tonnes per year by 2034. Case #5 which meets the 50% RPS lowers carbon emissions to about 6.5 million tonnes annually. Given the 2013 GHG emissions intensity of 1,135 lbs CO_2/MWh corresponding to a total generation emissions of 14.3 million tonnes, the recommended strategic case would reduce the emissions factor down to approx. 611 lbs CO_2/MWh or 516 lbs CO_2/MWh for the 50% RPS case by 2034. (These calculations assume no increase in power production.) LADWP's projected emission factors based on their own calculations which include expected demand increase, increased energy efficiency of buildings, and significant electrification of the transportation sector are shown in Figure 10. These are important in generating CSUN's CAP because they strongly affect CSUN's projected emissions from electricity use (see BAU projections in Section 2.2).

3.3 Renewables

Although a number of different options are now available for renewable energy production on a utility scale, the most viable options for the CSUN campus are limited to solar PV and wind. For a number of reasons, including primarily the low average wind speed on campus (2.8 mph or 1.25 m/s for 2010-2013[19]), wind is not considered here.

[19] based on data from the CSUN weather station

The campus has high potential for expanding its solar PV capacity, both on rooftops and using ground-mounted structures over surface parking lots. Using data recorded by the CSUN weather station, the campus receives an annual average of 5.06 kWh of sunlight per m^2 per day (data for 2009 – 2013). The campus is located in one of the highest solar potential regions in the country, surpassed only by the southeastern-most part of the state and the southern part of Arizona[20]. The efficiency of solar cells in converting sunlight into electricity is limited by the electrical properties of semiconductor materials, so only a fraction of this can be converted to electricity. Most commercially-available solar panels have average efficiencies between 14 and 20%. The calculations used in this CAP assume an efficiency (sunlight to DC) of 15% and an inverter efficiency of 95% for an overall sunlight to AC efficiency of 14.25%. Given the available sunlight, this yields an AC electrical output of 24 kWh of electricity per year for every square foot of panel area installed. (Note that the actual output will depend on the panel type and mounting angle and will be decreased by any shading.)

Using a GIS, the surface parking lot areas were analyzed and total areas computed. The thirty-three lots included in this analysis have a combined surface area of 2,168,505 sq ft (201,461 m^2), or 49.8 acres, and are shown in Figure 11 below (areas in sq ft).

[20] http://www.nrel.gov/gis/images/eere_pv/national_photovoltaic_2012-01.jpg

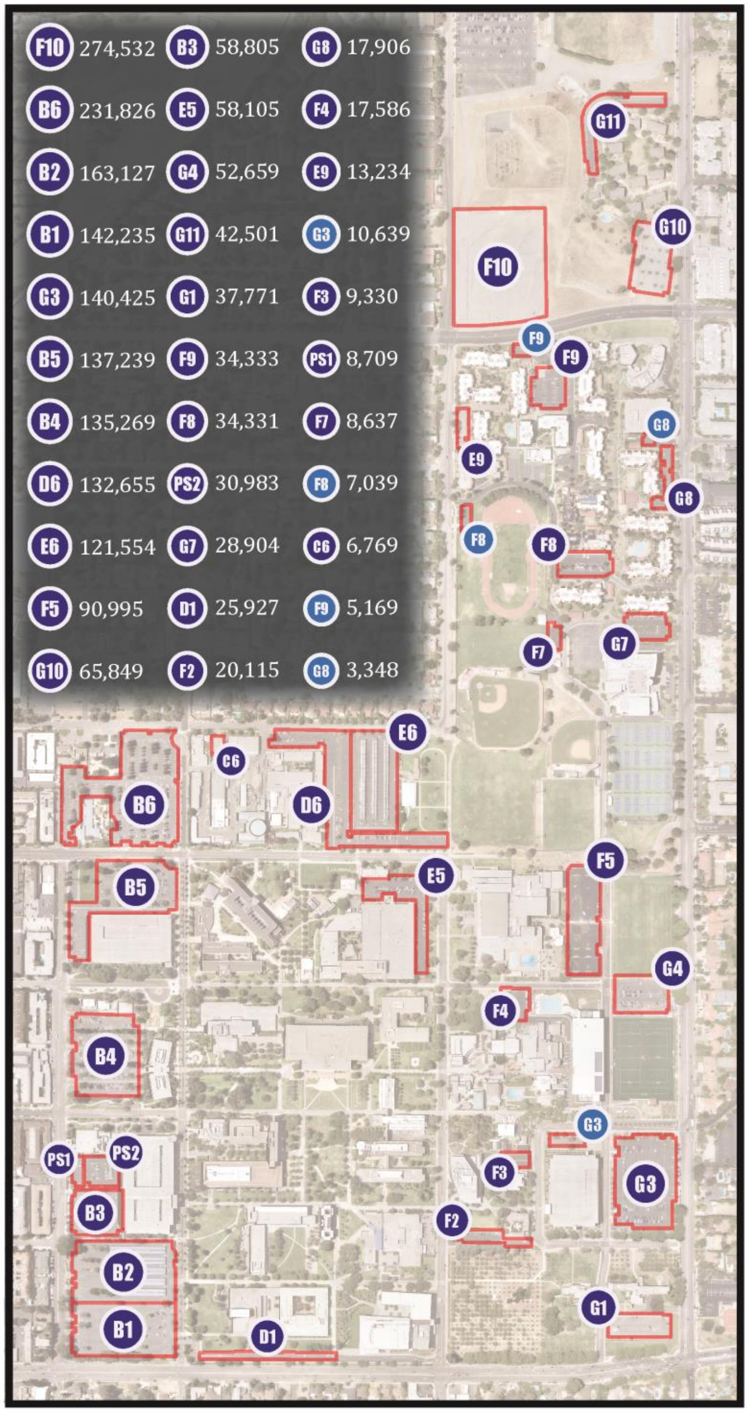


Figure 11. Areas (ft^2) of the 33 surface parking lots on the CSUN

Assuming 70% coverage of these parking areas with solar panels, there is potential to generate approximately 37.1 million kWh of electricity for the campus annually using carport structures over surface lots. With an average annual electricity purchase (2011 – 2013 data) of 51.7 million kWh, these structures could replace approx. 72% of the power purchased from LADWP. The total electricity use on campus, including that currently generated from the fuel cell and existing solar panels, amounted to 57,277,245 kWh so this amount of solar would provide 65% of current use. With an average panel size of 18 sq ft and panel nameplate capacity of 250W/panel, this area of panels would accommodate approximately 21 MW of installed solar.

At CSUN's current average utility rate of $0.13/kWh (which takes advantage of lower off peak rates), this potential generated power would result in savings of $4.8 million per year. As utility rates increase (a rate increase of 6-7% per year is projected for the next five years), the potential savings become even more attractive.

In addition to surface parking lots, the campus houses some large building rooftop areas which could serve as potential sites for solar PV. Potential sites include the rooftops of the Oviatt Library, Redwood Hall, the Bookstore complex, Jacaranda Hall, Sierra Hall and Tower, and University Hall. Although installation costs for rooftop systems are approximately 15% cheaper than carport canopy structures, there are other factors that make rooftop systems less attractive. For the most part, building roofs on campus house HVAC and other infrastructure that reduces and interferes with rooftop availability; in addition rooftop penetrations are undesirable due to potential leakage issues (although solar PV ballasted systems are now available that avoid this). Carport structures have the added benefit of providing desirable vehicle shade from the hot sun. Although carport structures are prioritized in this plan for these reasons, it should be noted that the combination of building roof and surface lot areas have the potential to provide for, and exceed the current electricity needs of the campus.

There are three primary mechanisms by which solar power can be secured for CSUN. One is a purchase, which requires the campus to fund the project upfront through a capital investment or by borrowing funds via bond issuance. The other is through a power purchase agreement (PPA) or lease. Under this arrangement a third party owns the associated infrastructure and agrees to sell power to the campus for a period of time (normally 20 years) at a discounted rate (relative to utility rates). Because of LADWP's charter, which declares that entity as the only one permitted to sell power within the municipality, PPAs are not allowed in DWP territory. There are alternative leasing options however, which could be arranged so that CSUN is leasing equipment rather than buying power from a third party which could avoid the need to finance the total cost upfront. Two potential financing options include a third party equipment lease and the use of CREBS bonds[21]. There is also a Feed-In-Tariff program[22] operated by LADWP in which the campus could participate for a portion of the installation (up to 1 MW/year and a site maximum of 5 MW). Under this

[21] http://energy.gov/savings/clean-renewable-energy-bonds-crebs
[22] https://www.ladwp.com/ladwp/faces/ladwp/partners/p-gogreen/p-gg-localrenewableenergyprogram?_afrLoop=413602254252248&_afrWindowMode=0&_afrWindowId=null#%40%3F_afrWindowId%3Dnull%26_afrLoop%3D413602254252248%26_afrWindowMode%3D0%26_adf.ctrl-state%3D1azswrlgum_4

arrangement CSUN would develop the project and sell the generated power to LADWP at a contracted rate. The campus would continue to buy its power from LADWP.

Although the exact financing mechanism to be utilized remains undetermined at this time, some viable options exist which allow costs to be estimated. The CSU system, through the Chancellor's Office will release a system-wide RFP/RFQ in 2016 that will facilitate solar procurement at CSUN and other CSU campuses. This will greatly aid in moving the campus forward on a solar path beginning in 2016-17.

Although recent (2015) commercial-scale procurement data suggest that costs as low as $0.085/kWh for rooftop installations and $0.10/kWh for carport structures through 20 year fixed rate leasing contracts may be available, and $3.00/W purchase pricing[23], cost estimates here utilize more conservative pricing. In the projections presented here, it is assumed that solar (carport structures) can be installed at $4.00/W or leased at $0.12/kWh. Most leases are over a 20-yr period, but with an outright purchase, the panels can continue to be utilized for longer, potentially generating power for up to 40 years, although efficiency will diminish by a few percent as the panels become older. Most existing panels are sold with performance guarantees of 25 years. At these (carport) costs, the panels have a payback period of 17.5 years and a simple rate of return (at current utility rates) of 5.7%. However, with projected utility rate increases the payback period is much lower.

Strategy	**Annual energy savings (kWh) per MW installed solar**	**Estimated Project cost (per MW carport structure)**	**Project lifetime**	**Payback time (years – simple payback)**
Solar PV (assuming 25 year lifetime)	1,760,437	4,000,000	25 years	17.48

The financial benefits of going solar depend on the price of power purchased from LADWP. Under the new investments LADWP will be making in power generation there will be a rate increase of between 6 and 7 percent annually from 2014 through 2019. This upward trend is expected to gradually reduce and stabilize in the 2 to 3 percent range after 2021. Based on these statements taken from LADWP's IRP, and CSUN's current average rate, rates are projected for the next twenty five years as shown in Figure 12.

[23] Personal communication with CSU CO (Aaron Klemm/Helen Cox) and Borrego Solar proposal.

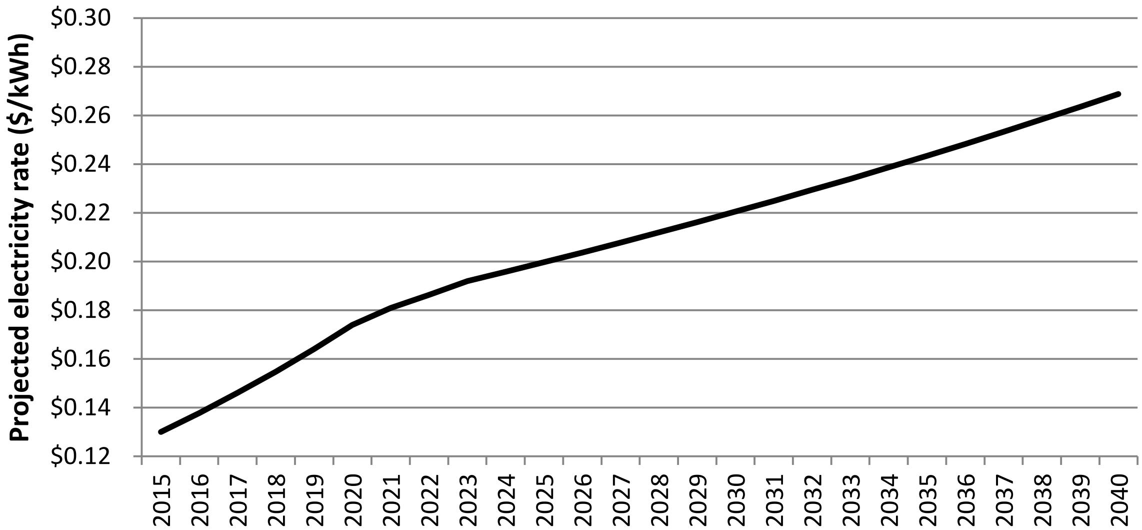


Figure 12. Projected average electric rate for CSUN based on current average of $0.13/kWh, a 6% increase per year until 2020, diminishing rate increases in 2020 – 2022, and an increase of 2% per year thereafter.

At CSUN's current average rate, the cost of purchasing the 1,760,437 kWh of electricity generated by a 1MW solar array is $228,857. At the (conservative) projected rate increases shown above, the cost of purchasing this same amount of power will have increased to $473,155 by 2040. On the other hand, if the campus enters into a fixed price lease agreement for solar power or finances solar installation through a 20-yr amortized loan, its payments remain fixed. Both these options provide significant financial benefits to the campus as shown in Figure 13.

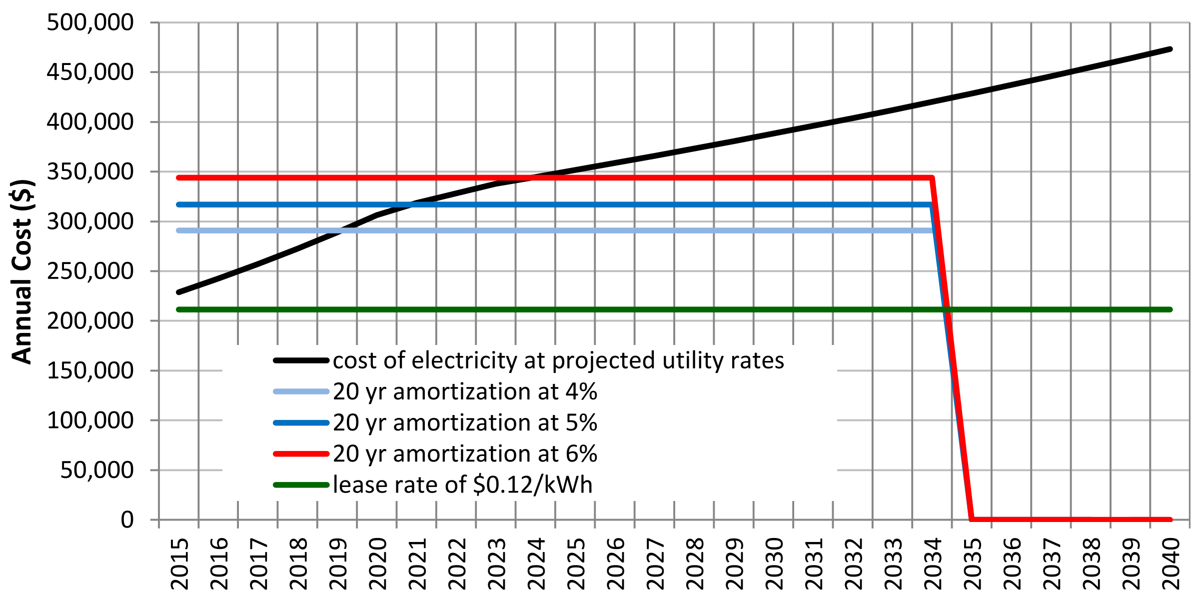


Figure 13. Projected annual cost of equivalent power produced by a 1MW array purchased through the utility provider and by various solar financing options.

The net savings generated based on these projections increase over time, amounting to about $200,000 per year in 20 years and to the full cost of the equivalent retail value of the power generated (almost half a million dollars) thereafter (Figure 14). Note that calculations presented here are based on a 1MW system, whereas the potential system size for the campus based on surface lot availability exceeds 20 MW with accompanying savings twenty times as great.

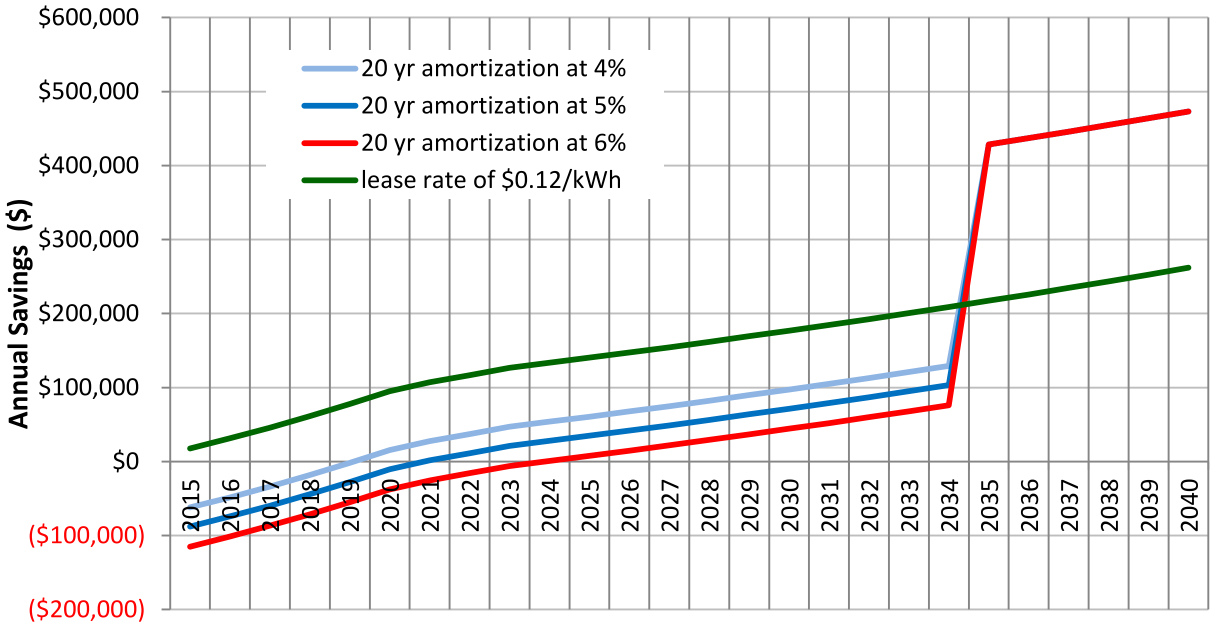


Figure 14. Projected annual savings to campus on a 1 MW system based on various solar financing options and projected utility rates.

There are a number of challenges which must be addressed before large scale solar integration. The campus houses 4 sub-stations each with a 1MW maximum cap on power export. LADWP requires a VISTA switch for system protection at each of these, at a cost of approx. $300,000 apiece. One possibility to be investigated is a “no export” agreement with the utility company, requiring all generated power to be used internally. In this case one must be sure that at the lowest demand times (Sundays) power production does not exceed use. An additional possibility is the development of a “smart-grid” with storage that could be potentially attractive to the utility company if it was made available for their use during high demand or emergency situations to avoid construction of new peaker plants.

Besides technical considerations, financing is challenging due to the PPA restrictions. Clean Renewable Energy Bonds (CREBs[24]) available through the Federal government are an attractive financing option for public sector organizations such as CSUN. These allow the bondholder to take

[24] http://energy.gov/savings/clean-renewable-energy-bonds-crebs

advantage of the tax credit available for renewable energy projects, which CSUN itself cannot. The bondholder receives federal tax credits in lieu of a portion of the traditional bond interest, resulting in a lower effective interest rate for the borrower. This may mean that loans at lower than the 4%, 5% and 6% rates shown in the projections above may be available. The current tax credit of 30%, which was due to expire at the end of 2016, has just been extended.

The CAP developed here will rely heavily on extensive solar deployment on campus; the exact mechanism by which the system is developed and financed will be decided over the next year after the release of the CSU-wide RFP/RFQ, discussions with LADWP, and further exploration of financing options.

3.4 Mobile emissions

CSUN operates and maintains a fleet of vehicles. These vehicles help support the general maintenance of campus as well various academic programs. CSUN's Greenhouse Gas Emissions Report revealed that the University's fleet (including cars, trucks, carts, equipment, etc.) contributes 461 tonnes eCO_2 annually, equivalent to 0.5% of the total campus emissions.

The university owns and operates a fleet of 235 vehicles belonging to over 30 different departments. A majority of these vehicles, 58%, are electric carts and are used for the transportation of people, goods and services. These carts serve as the primary mode of transportation for most of the physical plant management campus maintenance staff, from the grounds shop to electricians. The next most used vehicles on campus are traditional gasoline internal combustion engine powered vehicles. These make up 39% of our campus fleet and consist of primarily cars and trucks mainly used for heavier duty work or transportation off campus. While there are some carts included in the 39% powered by traditional gasoline, these are legacy carts and will be phased out in time. The university has four hybrid vehicles that make up just under 2% of the fleet with diesel (1%) and E85 capable vehicles (0.4%) making up the remainder of the fleet.

CSUN has an extensive collection of equipment and special purpose vehicles that are powered by either gasoline or diesel combustion engines. These include backup generators, grounds equipment, boom and scissor lifts, tractors, forklifts, etc. Many of these equipment types are not used on a daily basis and contribute very little towards our greenhouse gas footprint, while others are part of everyday operations. The equipment that is used on a daily basis includes most of the grounds equipment such as weed whackers, mowers (push and ride on), edgers, etc.

The university has seen a 25% increase in the emissions related to fleet vehicles and equipment since 2010. In order to reduce the GHG emissions related to this emission source, the University has identified the following strategies.

Strategies

Strategy	Potential Energy Savings	Estimated Project cost (one-time and ongoing)
1. "Right Size" Vehicle Fleet	470 gallons of fuel	n/a
2. Department Bike Share Programs	11,747 gallons of fuel	$10,000
3. Migrate fleet to PZEV, ZEV, ATPZEV and other alternative fuel technology vehicles	15,976 gallons of fuel	$1,710,000
4. Implement a No-Idling Policy	235 gallons of fuel	$2,000
5. Migrate Grounds Equipment to Battery Powered	1,560 gallons of fuel	$27,000

1. "Right Size" Vehicle Fleet

Right sizing our vehicle fleet would greatly help reduce unnecessary emissions. This strategy will target the types of vehicles are used for what type of work.

Key strategies:

- Eliminate the use of gasoline/diesel powered vehicles for on campus personnel transportation and utilize electric carts, bicycles, or walking.
- Eliminate the use of gasoline/diesel powered vehicles for maintenance work where that size and type of vehicle is not needed and utilize electric carts instead.

2. Faculty/Staff Bike Share Programs

This strategy is tied with the previous strategy of “Right Sizing” our vehicle fleet. Eliminating the use of gasoline/diesel powered vehicles for on campus personnel transportation will require providing alternative ways to move across campus. This strategy will provide a bike share program for each department on campus as a way to mitigate the elimination of gasoline/diesel powered vehicles and promote a healthier carbon neutral alternative to an electric cart.

3. Migrate fleet to PZEV, ZEV, ATPZEV and other alternative fuel technology vehicles

This strategy will aim to change over 40% of our fleet that is currently powered by traditional fossil fuels including diesel and gasoline internal combustion engines. PZEV’s are defined as Partially Zero Emission Vehicles that must meet both the requirements of Super Ultra Low Emission Vehicles (SULEV) exhaust emissions and zero evaporative emissions. While PZEV’s are still fossil fuel powered, they are a better alternative to the traditional fossil fuel vehicles. ATPZEV are defined as Advanced Technology Partial Zero Emission Vehicle and are comprised of vehicles that are either powered by one of the following technologies: hybrid (gasoline/electric), compressed natural gas or methanol fuel cell. ZEV are defined as Zero Emission Vehicles and are either battery electric or hydrogen fuel cell powered.

- Eliminate unnecessary trucks, vans, suv’s and cars from the fleet

- Replace necessary light duty trucks and vans with PZEV's
- Replace/convert necessary heavy duty diesel trucks and vans with biodiesel versions
- Replace necessary cars to ZEV or PZEV vehicles

4. Implement a No-Idling Policy

Idling vehicles produces greenhouse gas emissions that are not only harmful to the environment, but are also unnecessary. This strategy will allow the University to eliminate unnecessary idling on campus in state vehicles and help CSUN lead by example.

5. Migrate Grounds Equipment to Battery Powered

CSUN has a grounds department that is in charge of maintaining 356 acres of landscaping. The grounds department uses a variety of tools and equipment on a daily basis to complete their tasks. Many of these items are powered by traditional gasoline. This strategy will target these types of equipment and replace them with comparable electric battery powered versions.

Strategies:

- Evaluate all gas powered weed whackers, edgers, blowers and push mowers for replacement with electric battery powered versions.
- Evaluate the feasibility of an electric ride on mower

3.5 Scope 3 Emissions

3.5.1 Commuting

Automobile travel is credited as the major contributor of greenhouse gas (GHG) emissions, accounting for about 28% of GHG emissions in the United States and 36% in California (Rodier 2009). The State of California has been a leader in climate change legislation with the passage of the Global Warming Solutions Act of 2006, AB 32, which sets GHG reduction targets to 1990 levels by the year 2020. Reducing per capita Vehicle Miles Traveled (VMT) is one of the most effective methods for reducing GHG emissions. The relationship between GHG and per capita VMT has prompted further legislative actions and policies in California, such as SB 375, the Sustainable Communities and Climate Protection Act of 2008, which seek to reduce per capita VMT through sustainable development strategies at the regional planning level. Yet, the lack of adequate public transport in the Los Angeles region and the predominance of motor vehicles as the primary means of commuting contribute greatly to carbon dioxide emissions and air pollution in this region. California State University, Northridge (CSUN), a large urban school in the region is confronted with these challenges. CSUN employs about 4,000 faculty and staff and has a student enrollment of over 40,000, the majority of whom commute to campus.

For the last several years, CSUN has implemented numerous infrastructure improvements to curb the high dependency on automobile use. These infrastructures include extension of bike lanes, increasing the number of secure bike and skateboard racks on campus, building on-campus student housing units, carpool and rideshare programs, electric car charging stations, mass transportation subsidies, and an on-campus transit center. To understand the effects of these transportation and housing initiatives, commuter surveys were conducted in Spring 2010 and Spring 2015. The purpose of the surveys is to understand the carbon footprint of current commuting, to determine the change in commuting behavior between 2010 and 2015, to examine responsiveness to more sustainable options for the future, and to study CSUN commuting patterns.

The 2015 survey recipients were asked their one-way travel distance from home to the CSUN campus. As portrayed in Figure 15 below, this was measured in increments of 5 miles up to 40+ miles, with individuals beyond 40 miles being grouped together. The results show that the majority of respondents indicated that they live within 5 miles of the CSUN campus, with the percentages steadily decreasing for each increment until 40+ miles, where numbers pick up once again.

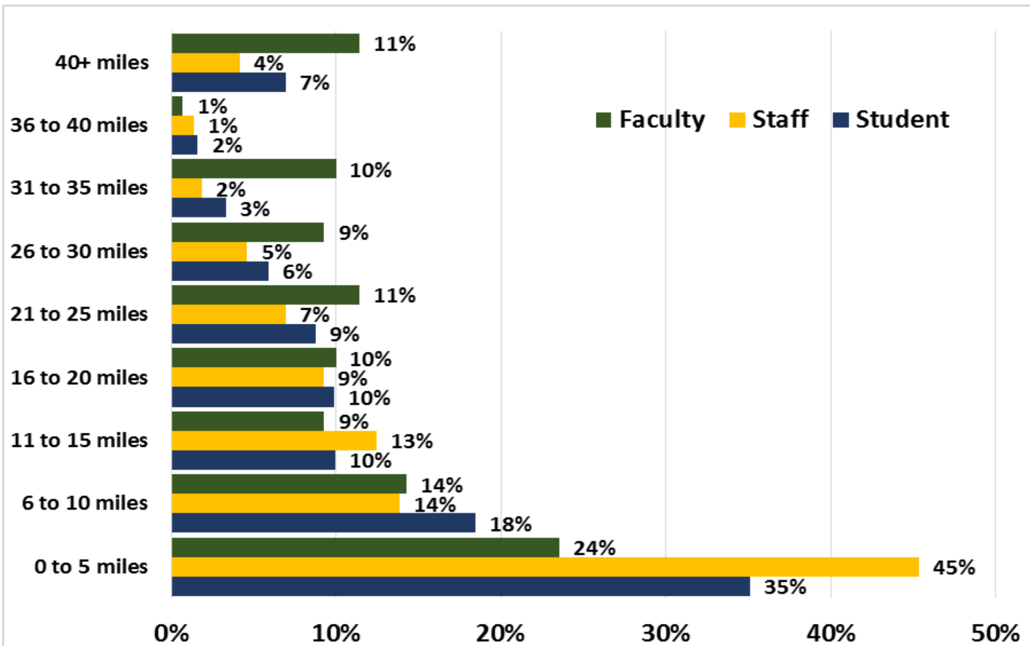


Figure 15. Campus commuting distance

The number of days in a week that individuals typically come to campus was also assessed, with Figure 16 showing that students typically come four days (29%), most staff come five days (83%), and most faculty come three days (26%). Overall CSUN students, staff and faculty come to campus an average of 3.77, 4.88 and 3.10 days a week respectively. This information is relevant to computing the per capita CO_2 emissions.

As displayed in Figure 17, data on primary mode of transportation was gathered from the 2015 survey and compared with data from the 2010 survey, with respondents choosing from a list of modes they generally take to campus.

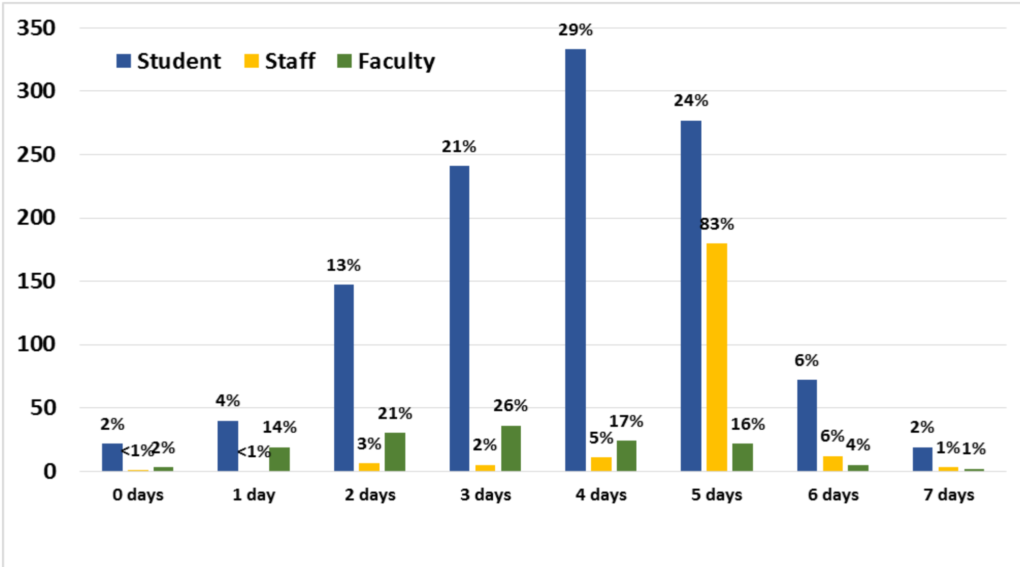


Figure 16. Number of days on campus

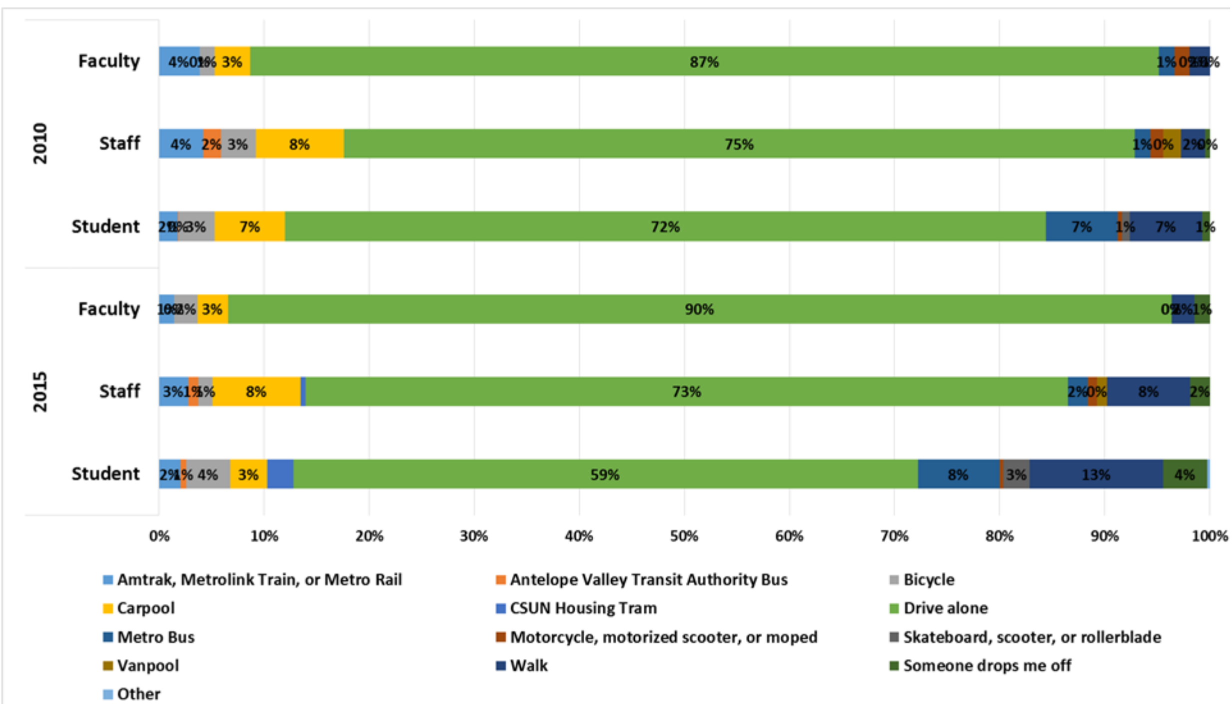


Figure 17. Primary Mode of Travel: Comparison 2010 vs. 2015

Just as in 2010, results for all groups indicate that the private automobile is still the primary mode choice, with all other options lagging behind. Even so, there are signs of improvement in 2015 over 2010. In terms of single occupancy vehicles, 59% of students in 2015 indicate they use it whereas in 2010, 72% of students used it, marking a fairly substantial change in usage. And while a smaller percentage of students appear to carpool in 2015 (~6% vs. ~3%), there is a higher percentage of people using modes such as bicycles, the CSUN Housing Tram, and walking. For students and staff, the biggest change since 2010 is in the percentage of people walking to the campus. For faculty, the only noticeable improvements are in the percentage that are dropped off or who use a bicycle. Usage of all other categories inclusive of vanpooling has gone down, and car usage has gone up.

In projecting out emissions from commuting, improvements in mode choice like those demonstrated above for single occupancy vehicle use by students will reduce our carbon footprint further as strategies are put into place to further incentivize mode shifts to cleaner and more sustainable choices of transportation.

Strategies

Strategy	**Comments**	**Estimated Project cost (one-time and 20 years of annual costs)**
EXPANDING BICYCLING INFRASTRUCTURE	**Expanding bicycle infrastructure will aid in moving more of the CSUN community towards a zero emission mode of commuting.**	**$580,000**
1. Bicycle rental for dorm residents	Costs include bicycle purchase plus annual program costs	$260,000 ($20,000 + $12,000/year)
2. Improve bicycle infrastructure within campus	One-time construction costs	$200,000
3. Work with the city to improve the quality and connectivity of bike lanes around campus	Costs for staff time	$40,000 ($2,000/year)
4. Expand bicycle theft prevention strategy	Costs for Duo guards, signage, education, U-locks	$80,000
EXPANDING PUBLIC TRANSIT SERVICES	**Expanding the public transit available to the campus community will aid in reducing the number of single occupancy vehicles.**	**$3,920,000**
5. Partner with Metro and other agencies to bring major bus lines to the CSUN Transit Station	Costs for staff time	$40,000 ($2,000/year)
6. Increase the subsidy of transit passes for students and staff members, potentially providing a free transit pass program to students.	20 years of ongoing costs	$3,840,000
7. Partner with Metro, LADOT and the City to solve connectivity issues between CSUN and major transit hubs	Costs for staff time	$40,000 ($2,000/year)

8. Priority class enrollment for students travelling by public transit		
EXPANDING RIDESHARE PROGRAMS	**Expanding rideshare programs offered will aid in reducing total vehicle miles traveled and the number of single occupancy vehicles.**	**$215,000**
9. Implement Zimride – ridesharing	Annual program costs for 20 years	$140,000 ($7,000/year)
10. Implement special parking zones to incentivize ridesharing	$1,000 per space converted includes costs of signage, passes etc.	$40,000
11. Auto-enroll students in the rideshare program upon class enrolment through SOLAR	One-time staff costs	$35,000
PARKING MANAGEMENT	**Managing parking and limiting the number of vehicles permitted to park on campus will incentivize a transition to other modes of travel.**	**$505,000**
12. Limit number of housing parking permits to current housing parking capacity		
13. Install real-time information system that tells drivers where parking is available, reducing the need to circle in search of parking.	Costs for installation of license plate readers and associated software for four structures.	$500,000
14. Do not allow use of housing parking permits for parking on campus.	Staff and signage cost	$5,000
PROVIDE SHUTTLE SERVICES	**Repurposing the housing shuttle to service off campus dwellers will reduce vehicle traffic to campus.**	**$10,200,000**
15. Replace housing shuttle with shuttle providing service within three miles of campus	Annual program cost over twenty years	$10,200,000 ($510,000/year)
EXPANDING ELECTRIC CAR CHARGING STATIONS	**Expanding CSUN's EV charging stations will promote the use of electric vehicles, reducing CO_2 emissions.**	**$42,000**
16. Add electric car charging stations on campus	Costs for twenty chargers at an installation cost of $2,100 each.	$42,000
OTHER INTERVENTIONS	**These strategies support our goal by reducing total commuting miles to campus.**	**$257,960**
17. Expand student housing (with a no-car policy, bike rental and		$237,960

rideshare programs)		
18. Increase online and hybrid classes		
19. Expand telecommuting and compressed work schedules for staff		
20. Develop an outreach plan to increase knowledge about transportation options	Staff time	$20,000 ($1,000/year)
21. Expand faculty and staff housing to reduce commuting		
TOTAL		**$15,719,960**

EXPANDING BICYCLING INFRASTRUCTURE

One way of reducing the carbon footprint of CSUN campus is encouraging bicycle use for commuting to and from campus. Expanding the bicycle infrastructure within and around CSUN campus is very important. Introducing bicycle rental and bike clinic programs, improving and extending the bicycle infrastructure and expanding bicycle theft prevention programs are among the strategies to reach the goal of reducing CO_2 and energy use.

1. **Bicycle rentals for dorm residents**

   Provide free or low-cost bicycle rentals for all dorm residents. Campus bicycles could be purchased for students living in housing and rented for a semester or a year. Bicycles would be provided with U-locks and students would leave a credit card as deposit. Charge would be calculated to cover cost of the program. The program could be coupled with an expanded ZipCar program serving housing to discourage housing students from bringing a car to campus.
2. **Improve bicycle infrastructure within campus**

   More visibility and support for bicycles on campus will encourage their use. This strategy includes adding bicycle lanes, providing designated bike paths, creating an on-campus bicycle repair shop, and painting streets with bicycle traffic signs.
3. **Work with the city to improve the quality and connectivity of bike lanes around campus**

   Most of the bicycle trips don't begin and end within campus. Therefore, working with the city to provide better bike lanes and bike paths on major roads around campus is important. The connectivity of bike lanes needs to be improved to encourage more bike usage.
4. **Expand bicycle theft prevention strategy**

   Expand installation of improved bicycle racks that permit front and rear wheels to be locked and allow for easier use of U-locks. Add signage to bicycle racks showing the best way to secure the bike. Provide training with the bicycle rental program. Also, add surveillance cameras at bike parking locations.

EXPANDING PUBLIC TRANSIT SERVICES

Expanding public transit services will have a significant impact in reducing CSUN's transportation-related carbon impact. While expanding university-level transit services, it is important to work with

LA Metro and other agencies to promote the expansion of public transit service to the CSUN campus. Direct connections between CSUN and major residential centers, frequent service, after hour services, and transit subsidies are some of the strategies that encourage the campus community, especially students, to use public transportation.

5. **Partner with Metro and other agencies to bring major bus lines to the CSUN Transit Station**
   With the CSUN Transit Center up and running, having major transit lines connect to CSUN encourage the use of buses by the CSUN community. Work to bring LADOT's DASH bus service to the campus transportation center.
6. **Increase the subsidy of transit passes for students and staff members, potentially providing a free transit pass program to students.**
   Incentives have proven very effective in increasing public transportation use and decreasing single occupancy vehicle commutes to campus. Therefore, providing a transit subsidy or a universal pass could provide students, faculty, and staff with access to unrestricted local transit service.
7. **Partner with Metro, LADOT and the City to solve connectivity issues between CSUN and major transit hubs**
   Direct links or minimal transfers are important in encouraging the use of public transportation. Under this strategy, identifying transit routes with multiple transfers and indirect links to the CSUN campus and providing direct transit service from areas where a large number of CSUN students live is important.
8. **Priority class enrollment for students travelling by public transit**
   In order to encourage the use of transit, introduce a system that allows students to register early if they commit themselves to use transit through the semester, or if they used transit for the significant portion of their trips in a prior semester.

EXPANDING RIDESHARE PROGRAMS

Data show that existing rideshare programs are successful and the demand is increasing. Expanding ridesharing programs will expand the use of the service and reduce single occupancy vehicle commutes to the campus. Strategies such as implementing the Zimride program and creating special parking zones for those who share a ride would encourage people to rideshare more.

9. **Implement Zimride – ridesharing**
   Zimride is a commercial online and mobile ridesharing application which connects rides and riders. Create a system for students to enroll in the ridesharing program and encourage the use of the program through marketing techniques.
10. **Implement special parking zones to incentivize ridesharing**
    Three or more riders in a vehicle get a parking pass for priority parking zones at the most desirable parking areas. These spaces would be reserved for those who drive to campus with others. The spaces should be located where they are convenient for students and employees to reward them for sharing their ride.
11. **Auto-enroll students in the rideshare program upon class enrolment through SOLAR**

Create a system for students to auto-enroll in the rideshare program. This creates awareness about the service and encourages its use.

PARKING MANAGEMENT

Managing parking spaces is important in reducing the use of single occupancy vehicles. Providing real-time information about the availability of parking spaces, limiting the number of parking spaces for housing residents, and restricting students living in student housing from bringing their car to campus are just some of the strategies under parking management.

12. **Limit number of housing parking permits to current housing parking capacity**
    Under this strategy, CSUN would limit the number of permits sold for parking at campus housing. This would eliminate the need to construct additional parking structures at campus housing in the future and incentivize residents to use alternative low or no-emission transport.
13. **Install a real-time informational system that tells drivers where parking is available reducing the need to circle in search of parking.**
    Provide real-time parking information to help drivers not only save time and money by finding the closest parking spaces on campus but also reduce congestion, pollution, and gas consumption. Real-time parking availability information should be considered as an important component of campus parking management.
14. **Do not allow the use of housing parking permit for parking on campus.**
    This strategy may discourage freshman students who are living on campus from bringing their vehicle to campus

PROVIDE SHUTTLE SERVICES

There are several apartments and student housing around CSUN campus. Providing a shuttle service that runs within a three mile radius of the campus will reduce the use of single occupancy vehicle for short trips.

15. **Replace housing shuttle with shuttle providing service within three miles of campus**
    Provide shuttles that service local high density student apartments and student housing around the CSUN campus. A frequent shuttle service would reduce the use of cars by students that live within a 3 mile radius of the campus, but the community impact of this measure would need to be thoroughly investigated to ensure it is a sound traffic reduction measure before implementation.

EXPANDING ELECTRIC CAR CHARGING STATIONS

The current electric car charging stations are providing services to those who drive EVs to campus. With the increased popularity of EVs and Plug-in Hybrid cars, adding the charging stations would encourage a shift to environmentally friendly vehicles.

16. **Add electric car charging stations on campus**
    Adding Electric Vehicle (EV) charging stations can encourage the use of low-emission vehicles by providing the necessary support infrastructure.

OTHER INTERVENTIONS

There are also several strategies that help to curb CO_2 emissions and energy used. Among them are the expansion of student housing, increasing telecommuting and online/hybrid instruction, and most importantly, the development and implementation of an outreach plan to increase knowledge about transportation options in and around campus.

17. **Expand student housing (with no car policy, bike rental and rideshare programs)**
    Expanding student housing has a significant impact on reducing student commuting by reducing number of trips and total vehicle miles traveled by students to commute to the CSUN campus.
18. **Increase online and hybrid classes**
    Work with Academic Affairs and Extended Learning to increase the capacity for and promotion of distance learning and online courses. Such alternative instruction technologies offer the potential to reduce total number of weekly commutes by students.
19. **Expand telecommuting and compressed work schedules for staff**
    Allowing employees to work ten hours each day, four days a week reduces trips to campus, ultimately reducing CO_2 emissions and gasoline used.
20. **Develop an outreach plan to increase knowledge about transportation options**
    Distribute campus transportation maps highlighting the locations of large bike parking installments, covered/secure parking, services such as showers and lockers, electric car charging stations, the transit center, etc. Targeted marketing of transportation options, resources and education through social media, websites and by installing sustainable transportation kiosks that provide information and services.
21. **Expand faculty and staff housing to reduce commuting**
    Construct additional housing on or close to campus to reduce commuting from staff and faculty. Although construction would be a costly upfront, this could be cost-neutral or even generate revenue over the long term.

3.5.2 Business travel

Staff and faculty of the higher education community at times, need to travel for university sponsored business. University sponsored travel often relates to professional development as well as sharing accomplishments and research through conferences, meetings and outreach. CSUN's GHG Emissions Report revealed that university sponsored business travel contributes between 3,000 and 4,000 tonnes eCO_2 annually, equivalent to 4-5% of the total campus emissions.

While CSUN has maintained records of travel costs which include the destination of the sponsored travel, the method of transport is not part of those records. Emissions were estimated making the assumption that any travel within 200 miles of CSUN is by car, and travel beyond that distance is by plane. Based upon destination, driving and flight distances were recorded in a GHG calculator in which energy consumption and accompanying emissions were computed based on national energy efficiency data for vehicles and planes from the U.S. Department of Transportation, Bureau of Transportation Statistics. These calculations were performed for years 2010-2013.

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) for the four years of record (2010 – 2013) were utilized. These were 1,125 miles for the average distance flown per employee per year, and 111 miles driven. These data were used to extrapolate years 1990 – 2009 using the actual number of employees (faculty + staff) for each year. For additional information on these calculations see *CSUN Greenhouse Gas Emissions Report, 1990-2013*.

In order to reduce the GHG emissions related to business travel, the University has identified the following strategies.

Strategies

Strategy	Potential GHG Savings (tonnes)	Estimated Project cost (one-time and ongoing)
1. Utilize virtual meeting technologies	210	$10,000
2. EV/Hybrid vehicles	141	n/a
3. Shared EV for local travel	80	$150,000
4. Carbon Fund for unavoidable business travel	-	$23/MTe$CO_2$ avoided

1. Utilize virtual meeting technologies

The most effective way to reduce emissions related to business travel is to eliminate physical travel completely. While we recognize that this would not be feasible in all cases, in many cases virtual meeting technologies could be used with very little impact. With the current state of the technology, virtual meeting software is very suitable for meetings, trainings as well as initial interviews for positions. Many of the technologies available today allow for screen sharing, recording, and video as well as voice communication.

2. EV/Hybrid vehicles

In the event business travel is required and unavoidable, the university will set a preference for EV or Hybrid vehicles. This could be done through our rental car agreement with Enterprise as well as through a policy if needed or determined more effective. While EV's and Hybrids may not meet the needs of every traveler, especially if carpooling in larger groups, there would need to be exceptions to this. This policy is expected to be implemented by 2017/18 FY and once implement, full compliance should be seen.

3. Shared EV for Local Travel

The shared EV concept would allow the campus to house several (5) EV's for use by departments for travel from the university to a destination. This concept would eliminate employees using their personal vehicles as well as any vehicles that the departments may already have which would likely be fossil fuel powered and not as efficient as these EV's.

4. Carbon Fund for unavoidable business travel

While not all business travel is avoidable, carbon offsets will help reduce these additional emissions. The university requires employees to fill out travel authorization forms for any university sponsored business travel. This is the same system that is used to track travel mileage, reimbursements, etc. By adding a required carbon offset field to this online travel authorization process, each traveler/department would make contributions towards offsetting their travel emissions. Funds from this could be used towards internal carbon offset and reduction strategies, for example solar installations, energy efficiency, etc.

3.5.3 Transmission and Distribution Losses (T&D)

Electricity transmission and distribution losses are a function of amount of electricity pulled from the utility company's grid and the distance that power travels from the power generating station to the campus. The nominal energy loss rate applied here is that 9% of delivered electricity has been lost in T&D. As the campus migrates to an increasing amount of self-generation and reduces its demand on the grid, these losses will lessen proportionally, and ultimately fall to zero.

4. Model Projections and Strategies to Reach Carbon Neutrality

A number of energy and carbon reduction strategies have been identified in Section 3 above. The impact of these on emissions has been evaluated through comparison with the BAU case presented in Section 2.2. Most Scope 1 and 2 energy reduction estimates were taken from a recent Strategic Energy Plan (SEP) commissioned by the campus, mobile energy reductions were estimated based on current and projected vehicle composition and use, and Scope 3 reductions were estimated based on mode mix changes resulting from the employment of strategies identified in Section 3.5.1. Although the timeline of energy and emissions savings will ultimately be sensitive to project timing, projections here are based on an even deployment of strategies over time. Actual implementation schedules will be based on resources, opportunities for funding and incentives, and the cost-benefit of each project.

Based on BAU (with associated growth) as described in Section 2.2 and the projected energy savings of each strategy identified above, solar energy generation was adjusted to achieve net zero GHG emissions from Scope 1 and 2 sources by 2040. This requires 38 MW of solar power to be installed. Approximately half of this, 19 MW, is required to achieve zero Scope 2 (electricity) emissions, and the remaining 19 MW is required to offset emissions from gas use. The associated energy use projections are shown in Figure 18.

Even without the installation of solar PV, electricity consumption is significantly (approx. 45%) reduced by the energy conservation projects outlined earlier, whereas natural gas consumption only shows a small (approx. 9%) reduction. This is because many of the projects reduce lighting and other electrical loads and only a few projects save on heating costs.

The resulting emissions based on BAU energy use, implementation of all projects, and utilizing the projected emissions factor for purchased electricity are shown in Figure 19. In terms of eCO_2 emissions, savings are dominated by reductions in electricity demand from the grid.

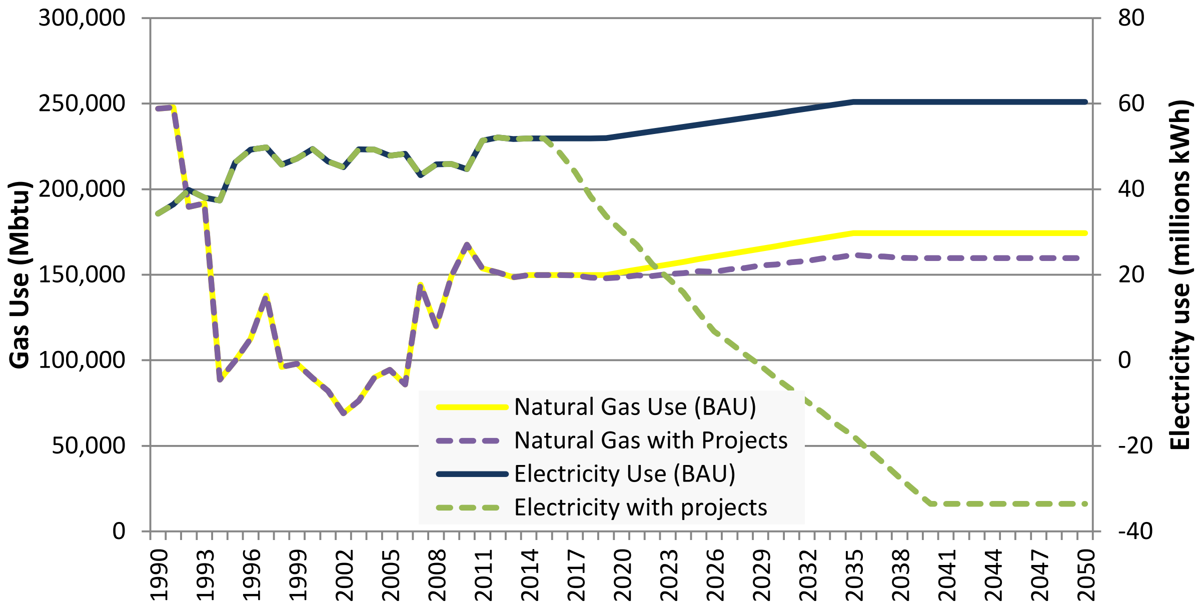


Figure 18. Projected energy use (BAU and with all energy-saving strategies employed)

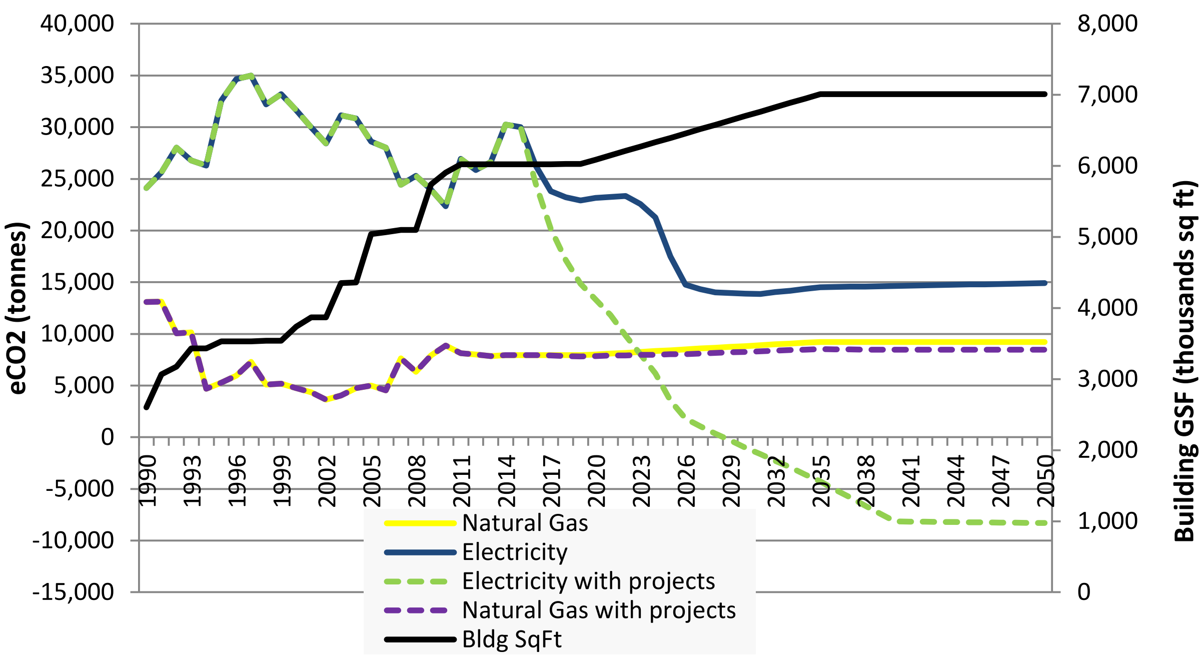


Figure 19. eCO_2 emissions (tonnes) resulting from natural gas and electricity use (BAU) and with project implementation. Also shown is building gross area (GSF).

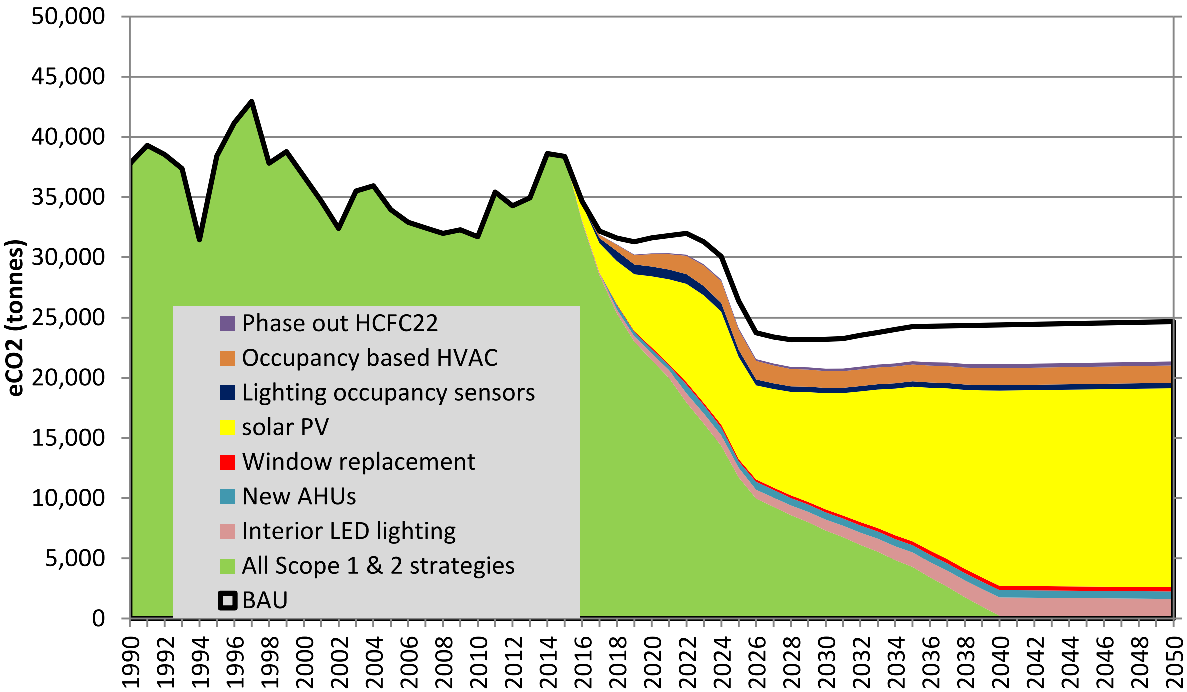


Figure 20. Projected Scope 1 and 2 GHG emissions for BAU, for some individual projects, and for the sum of all projects. (Gap between BAU and project wedges represents sum of all other projects.) Chart shows path to zero emissions by 2040.

Contributions to GHG savings from individual projects are compared in Figure 20, which shows the BAU projection, the contributions from major projects individually, and the sum of all project contributions to Scope 1 and 2 emissions. It is clear that with the exception of large scale solar, overall savings are accomplished by the combination of a significant number of individual strategies.

Scope 3 emissions arise primarily from commuting. In addition there are roughly equal but small contributions from business travel, and T&D losses from utility supplied electricity. In modelling emissions reductions due to business travel, the BAU exhibits a small increase due to an increasing number of faculty and staff. By implementing the strategies identified in Section 3.5.2, reductions of 1% per year in emissions associated with air miles beginning in 2017 for five years are projected, and reductions associated with vehicle miles at 5% per year for seven years are assumed. The use of EVs and hybrid vehicles, coupled with the increasing fuel efficiency of vehicles, will generate these reductions.

T&D losses from electricity distribution are modelled based on changes to grid-supplied electricity resulting from project implementation. As the campus moves towards more self-generation using renewables, T&D emissions decrease, and eventually reach zero when electricity is no longer purchased from the grid.

Commuting is the largest single contributor to GHG emissions and is anticipated to remain so in a BAU scenario, although it is anticipated that these emissions will start to fall as a result of improvements in vehicle fuel economy. As the efficiency of new vehicles improves and older vehicles are retired, and as EVs and hybrids gain increased market penetration the average mpg of vehicles driven by CSUN's community will rise. These expected changes are reflected in the BAU case presented. Over and above these changes, there are a large number of strategies that the campus will employ to reduce emissions from commuting. Most of these are designed to promote a mode mix shift from single occupancy vehicles to more sustainable forms of transportation such as walking, bicycling, ridesharing, and use of public transit. In order to understand the impact of these strategies on carbon emissions, a mode shift was modelled. The BAU case shown is based on the mode mix determined from the 2010 commuting survey; future projections are modelled based on a steady transition to a cleaner mode mix by 2040. The future mix, accomplished through implementation of the strategies outline in Section 3.5.1, assumes that by 2040 three times as many faculty, staff and students will be using public transit (bus and rail) as now, three times as many faculty and staff will be carpooling/ridesharing and five times as many students will be ridesharing.

The impact of these Scope 3 strategies on GHG emissions is shown in Figure 21. With all strategies implemented, net zero emissions are projected for Scope 1 and 2, but there are remaining emissions of a little under 20,000 tonnes in the Scope 3 category from commuting and business travel. In Figure 22 a comparison is made between the BAU scenario and one predicated on the implementation of the proposed strategies.

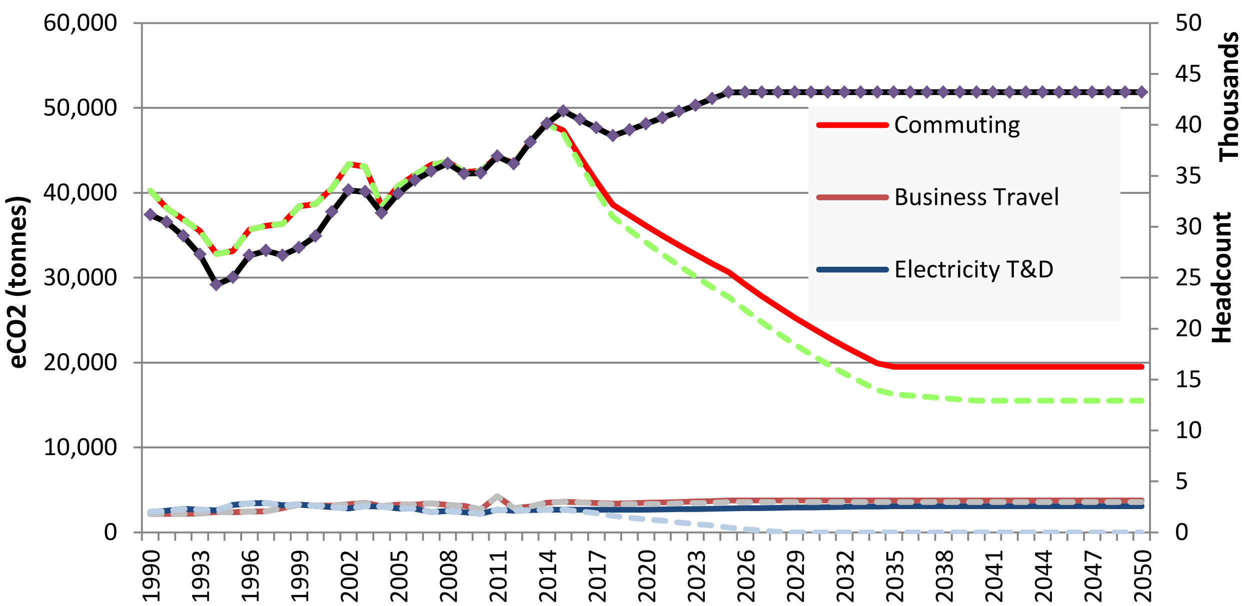


Figure 21. Impact of proposed emission reduction strategies on GHG Scope 3 emissions.

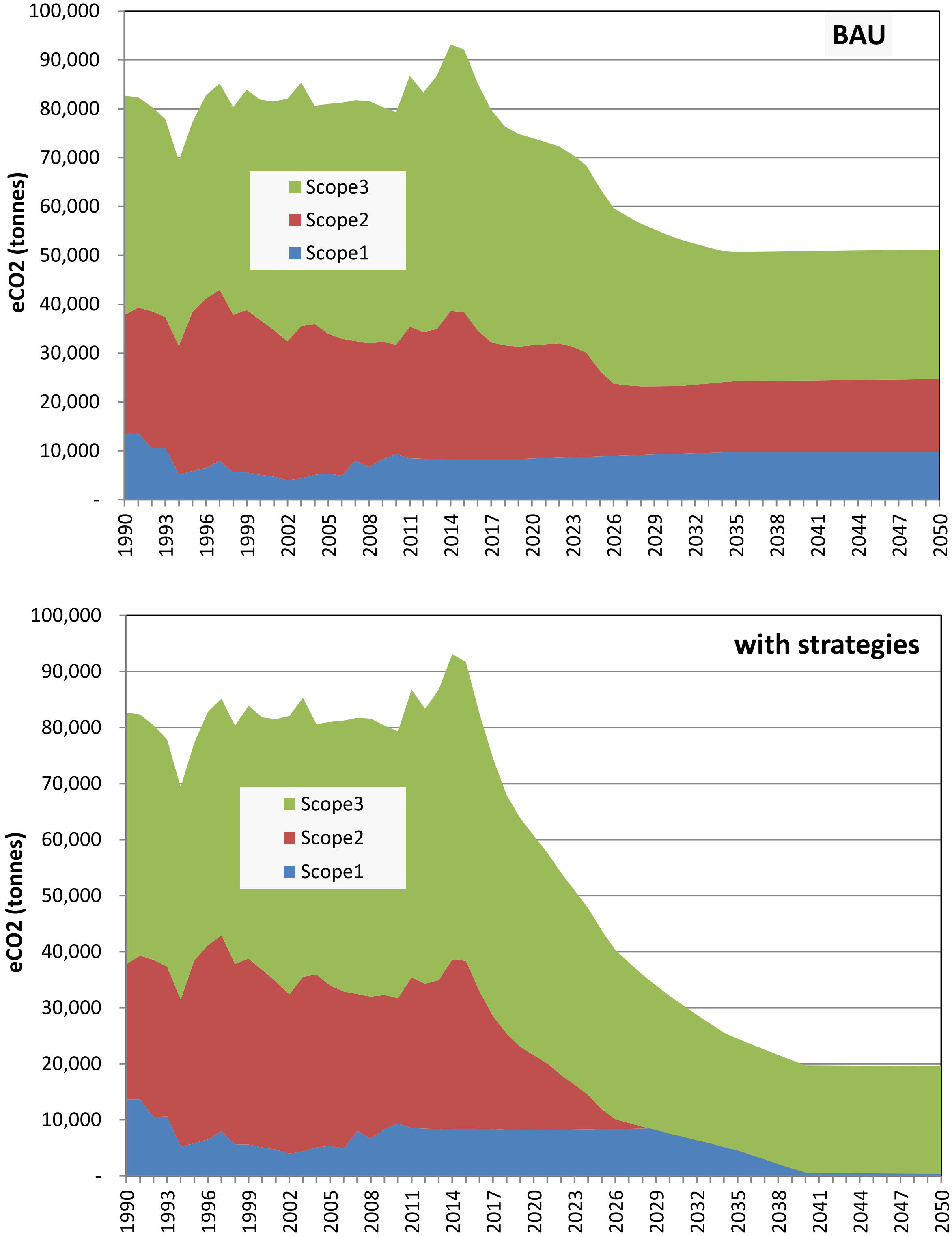


Figure 22. Comparison between projected BAU and BAU with implementation of strategies.

As 2040 approaches carbon offsets will be purchased to offset any emissions that remain. Regional transportation is an area with great uncertainty and one where CSUN has little control. Future transportation may look very different to current, particularly with the advent of zero-emission cars, the promise of zero and low emission electric and hybrid buses in the near future and the impending arrival of driverless vehicles. Driverless vehicles could virtually eliminate the need for local mass transit if deployed on a massive scale with smart technology used to connect riders to vehicles. In addition new light rail may reach CSUN in the future and drive significant shifts to more sustainable modes of transport.

5. Implementation Plan

5.1 Cost-Benefit Analysis

The priority given to each strategy in this plan depends on their cost-benefit, available resources and a number of external factors. To aid in decision-making the net cost-savings was modelled for each project based on the following:

- cost estimates are in 2015 dollars
- carbon emission savings are estimated for each project based on implementation at 2015 emission factors
- the value of energy savings is computed at current energy costs
- project lifetimes are assumed to be 25 years

The results of this analysis are shown in Figure 23.

Of note is that the majority of projects have a net financial as well as carbon benefit. Thus the challenge becomes primarily one of securing funds for implementation with the understanding that they will pay for themselves over time. The role of solar in meeting these goals is clear.

Although project timing will affect costs, savings and carbon benefits, calculations performed for future implementation yielded similar savings, thus the timing is not critical. The carbon benefits from electricity savings will diminish over time as the utility company migrates to a cleaner fuel mix. However, although costs will rise due to inflation, utility rates are projected to rise at higher rates. Thus there are financial benefits (as well as environmental benefits) to starting sooner rather than later.

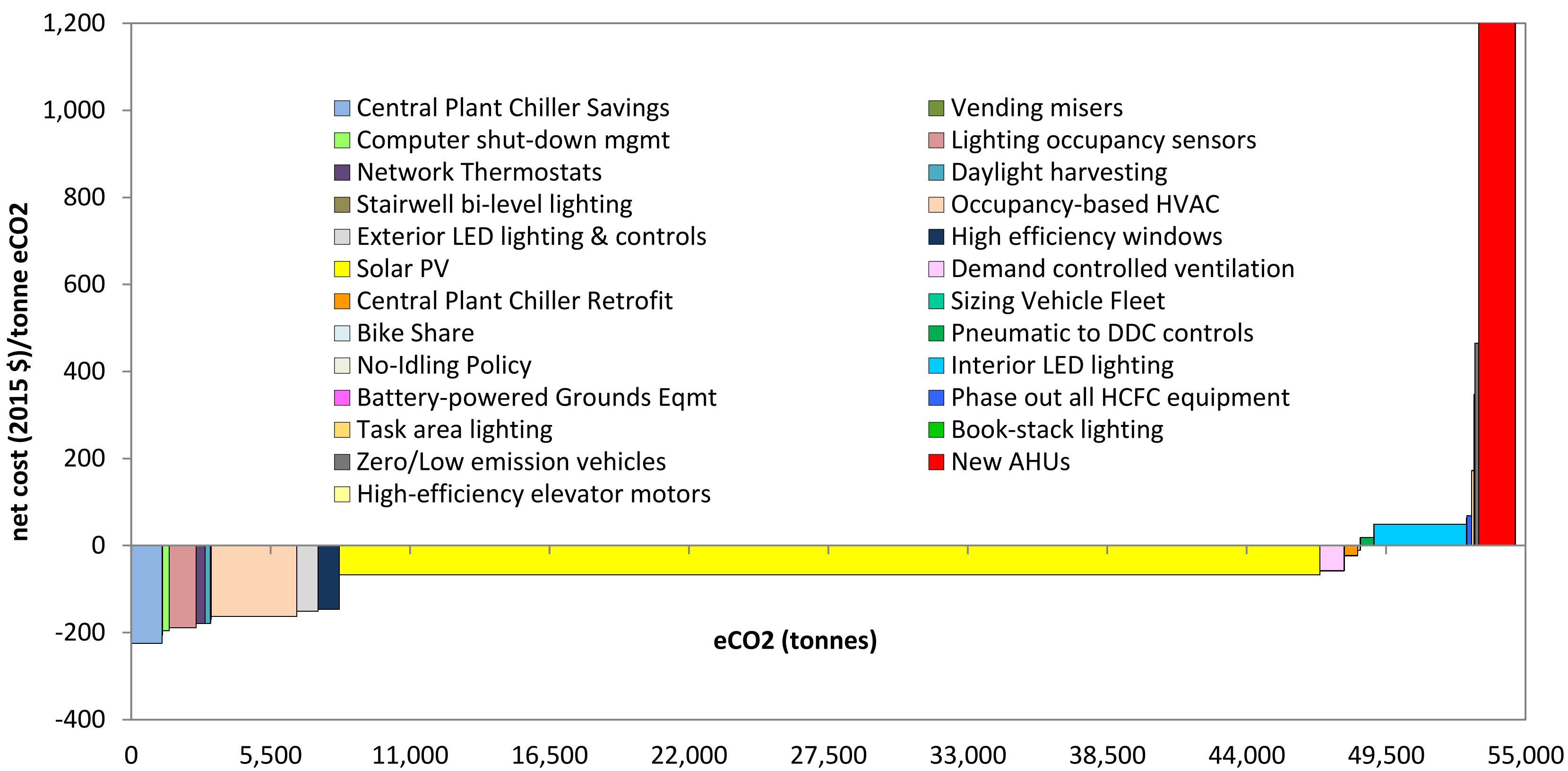


Figure 23. Net cost (cost minus energy savings) per annual tonne of eCO_2 emissions saved for proposed Scope 1 and 2 projects. Column width represents total annual emissions savings for each project. (To match colored blocks from left to right, the legend should be read *row by row* left to right.)

5.2 Schedule and Tracking

The implementation of a Climate Action Plan of the breadth, size and scale proposed must be a University wide movement and inclusive of personnel from all departments. CSUN's Facilities Planning department is developing an implementation schedule for each project with the assistance of the stakeholders primarily responsible for each. The overall cost of implementing this Climate Action Plan will require an investment of approximately $291 million of which approx. half is attributed to solar installations, and almost a third is from one large project to replace a significant component of building HVAC systems. While the CAP schedule that was created is an ideal rollout of these initiatives, at this point in time no funds have been specifically set aside to fund the strategies in the CAP. While some of these strategies have the potential to receive funding through annual operational budgets, a vast majority of these initiatives will need to secure special funding through alternative sources. While the University is committed to executing this CAP, funding restraints will likely cause rearrangement of these initiatives over time

Having developed a Climate Action Plan it is critical to ensure that progress is made. Tracking CSUN's progress towards carbon neutrality will ultimately be achieved through evaluation of our greenhouse gas inventory annually. Staff responsible for sustainability at CSUN will update the University's GHG Inventory and provide progress reports on the Sustainability and Climate Action Plans on an annual basis. These will be reviewed by our Climate Leadership Task Force and our sustainability Working Groups, who will also help to secure funding for initiatives, promote the programs identified here, and develop any required policy changes.

6. Incorporating Climate Neutrality and Sustainability into the Educational Experience

CSUN strives to reduce its own footprint on the environment and to educate its students and the broader campus population on sustainable practices. The campus is a living-learning community where students can gain knowledge in sustainability and put that knowledge into practice. CSUN's education plan in sustainability incorporates both informal education, which includes events, signage and employee training, and formal education, which includes sustainability courses and embedded content within the curriculum. The university will expand partnerships to provide additional opportunities for students to actively participate in sustainability practices whilst helping the campus achieve its own sustainability goals.

6.1 Goals and Objectives

In 2012 the university developed a campus sustainability plan which includes goals and objectives for sustainability education. They are listed below.

Goals

1. Expand education on sustainability principles and practices to entire campus population

2. Increase formal educational offerings in sustainability
3. Increase opportunities for hands-on student learning in sustainability

Objectives

- Participation in sustainability office program by all campus offices/units by 2015-16
- Implement university-wide sustainability education for all students by 2018-19
- Offer M.A. degree in sustainability practices by 2018-19
- Expand service learning and internship opportunities in sustainability
- Expand network of faculty engaging in sustainability-related research

6.2 Curriculum

In June 2009, a university Sustainability Curriculum Committee was formed and tasked with infusing sustainability concepts into the university curriculum. Beginning in Fall 2009, CSUN began to expand its climate change and sustainability curriculum offerings with the introduction of a new course, "Interdisciplinary Perspectives on Sustainability" team-taught by six faculty from different departments. This course, in which students are introduced to the concept of sustainability and the interconnectedness of systems, has now become the lynchpin of our undergraduate sustainability program. Our sustainability program has grown since this time and continues to expand. Currently CSUN offers:

- Three core courses in sustainability:
  - SUST 300: Interdisciplinary Perspectives in Sustainability (team-taught by faculty from six different disciplines, satisfies General Education requirements in Social Sciences, currently offering four sections per year)
  - SUST 310: Best Practices in Sustainability (Satisfies General Education requirements in Lifelong learning, currently offering six sections per year)
  - SUST 401: Applied Sustainability (Includes a service-learning component, currently offering one to two sections per year)
- Minor in Sustainability (began Fall 2011) includes three core courses listed above plus three others chosen from list of approved sustainability-focused courses from eighteen different departments.
- 42 students have graduated with a Sustainability Minor since the program started in Fall 2011, and 90 current students have declared the minor (Spring 2015).
- A specialization track in Sustainability was added to the Interdisciplinary Studies degree to provide a sustainability focus for students interested in a broad liberal arts education.
- A General Education Path in Principles of Sustainability, which offers students a connected path through their general education requirements with courses addressing sustainability principles and practices. Students take 4 lower division GE courses (12 units) and 2 upper division GE courses (6 units) associated with the path to obtain a GE Path Certificate in Sustainability.
- A Climate Science Program, created with funding from NASA and with support from CSUN's Interdisciplinary Research Institute for the Sciences (IRIS) and the Institute for Sustainability. Qualified students from all disciplines are encouraged to enroll in climate science courses

offered through this program, which is housed within the Departments of Mathematics, Physics and Astronomy, and Geography.

- An interdisciplinary Certificate in Sustainable Engineering, offered through the College of Engineering and Computer Science, which includes courses in environmental engineering, alternative energy, product design, waste and environmental policy.
- A new freshman-level course in “Understanding Climate Change”, developed and team-taught in Spring 2015. Approved for General Education credit in Natural Sciences.

Our plan is to expand formal education offerings in climate change and sustainability through a number of mechanisms, with the objective of greatly increasing the number of students receiving sustainability education, and a goal of reaching all students by 2025.

1. Develop a new undergraduate internship course in Sustainability, SUST 494, to be available for 1, 2 or 3 units of credit. This course will allow students to earn credit for carrying out campus or off campus work which provides hands-on experience in sustainability practices. (Target dates: Course development and curriculum review process: 2015-16. Implementation: Fall 2017)
2. Develop a new 1-unit General Education (Social Science) course in Sustainability Awareness/Introduction to Sustainability to be available at the 100-level to all students. (Target dates: Course development and curriculum review process: 2015-16. Implementation: Fall 2017)
3. Develop a new 1-unit General Education laboratory in Natural Sciences, Introduction to Sustainability Practices, to be available at the 100-level to all students. (Target dates: Course development and curriculum review process: 2016-17. Implementation: Fall 2018)
4. Incorporate sustainability education into specific existing General Education classes that are required of all students. Oral communications classes (COMS 151 and equivalent) will be targeted for initial consideration. (Target dates: Course development and curriculum review process: 2016-17. Implementation: Spring 2018)
5. Increase the number of sustainability-content courses identified as electives for the Sustainability Minor through a complete catalog review, beginning with those courses in the GE Principles of Sustainability path. (Target dates: Course review 2015-16, curriculum review process 2016-17. Implementation: Fall 2017)
6. Increase the number of sustainability-content courses included in the GE Principles of Sustainability path. (Ongoing)
7. Identify and flag all Sustainability-content courses in CSUN catalog and require all students to take a Sustainability overlay within G.E. (No target date. Will be employed as a strategy if #s 1-5 prove insufficient to meet our objectives.)
8. Develop an MA in Sustainability Practices that utilizes the sustainability graduate core courses already on the books. (Target dates: Course development and curriculum review process: 2015-16. Implementation: Fall 2018)
    - SUST 500: Foundations of Sustainable Systems
    - SUST 510: Resource Use and Management
    - SUST 520: Regulatory Framework for Sustainability

- SUST 540: Sustainable Business Practices

These courses are included in the MBA Sustainability Option.

6.3 Informal Education in Sustainability and Climate Change

In addition to formal curriculum offerings, there exist many opportunities for students to learn about sustainability through informal programs. The Institute for Sustainability, Associated Students, and other campus programs such as the Office of Research and Graduate Studies Distinguished Visiting Speakers Program provide informal education in sustainability by hosting campus-wide educational events and opportunities during the year. Regular events include:

- Campus Sustainability Day (every Fall)
- Orange Pick (every Fall and Spring)
- Water Day (every Spring)
- Earth Day (every Spring)
- America Recycles Day (every Fall)
- Recyclemania (annually)
- Documentary film screenings with panel discussions
- California Renewable Energy and Storage Technology Conference (every Spring)

In addition students take part in active-learning through service-learning and internship programs with the Institute for Sustainability including:

- development of the organic campus food garden
- organic waste reduction and composting program
- resource use analysis and carbon foot-printing
- resource mapping using Geographic Information Systems
- development of sustainability guides, student resources and newsletter
- campus-wide exterior and interior lighting surveys
- participation and research associated with the Real Food Challenge
- assessment of sustainability practices in employee offices through the Sustainable Office Program
- analysis of commuting practices through campus-wide survey and analysis
- event coordination
- participation in university's Farmers' Market
- participation in Climate Action Planning

Students manage the university's Sustainable Office Program (SOP), which was developed to educate campus employees about sustainable practices in the workplace and to assess practices in campus offices. Students are trained as educators and assessors, and manage the program through Associated Students. Students host the university's weekly Farmers' Market and conduct sustainability outreach at these events. In 2014-15 a new sustainability themed housing community was established, the Matasphere, where freshman interested in sustainability can live together and organize activities. In 2014-15 students in the 17 buildings comprising campus housing competed in the Campus Conservation Nationals.

The programs listed above continue to engage students across campus in sustainability education. Additional programs will be offered to expand opportunities for students to gain knowledge and experience in sustainability. These include an expansion of service learning and volunteer opportunities within the Institute for Sustainability and Facilities Management, where students can work directly with our Sustainability Program Manager. In addition students will be engaged in working directly with the local community in sustainability practices in our new resiliency efforts described in Section 8 as part of the President's Climate Leadership Commitment.

7. Expanding Research Efforts to Achieve Climate Neutrality and Advance Sustainability

Seventeen faculty are engaged in teaching sustainability-specific courses. In addition these faculty and many others conduct sustainability-related research. Areas of research include the following: production of value-added compounds (including biofuel and biodiesel) in plants and algae, and the production of biofuel and biodiesel; the "greening" of American religion; sustainable tourism; permaculture; attitudes and policy preferences related to global climate change and energy issues; food choices; public transportation policies and its impact on the environment; the impact of carbon emissions on coral reefs; water policy; renewable energy; smart grid; atmospheric pollution and greenhouse gas monitoring; remote sensing of the atmosphere; carbon sequestration and many others too numerous to list.

CSUN has recently made significant investments in clean technology research. In 2014 the university entered into a partnership with the Los Angeles Cleantech Incubator (LACI), a non-profit organization fostering the creation and support of new clean technology businesses in Los Angeles. The partnership is designed to help startups from CSUN and the surrounding communities discover new opportunities, create outstanding enterprises and connect with a global network of businesses and investors. The investment that CSUN made has stimulated and expanded research efforts by faculty and students in green and clean technologies designed to mitigate climate change, advance sustainability and develop resilience to the impacts of climate change.

CSUN houses an Energy Research Center which promotes research and development projects in new or alternative energy sources as well as conservation and sustainability practices at CSUN. Many engineering faculty and students are engaged in R&D projects such as solar charging stations, solar powered water treatment, and concentrated photovoltaic systems.

The number of faculty and students engaged in sustainability teaching and research will be counted and tracked beginning in 2016 as part of the university's STARS[25] reporting.

8. Engagement of Community in Climate Action and Resiliency Planning

8.1 Community Engagement in Sustainability

In many undergraduate classes, students complete service learning hours or internships which allow them to gain experience in applying knowledge and practices in the community; through sustainability-focused courses many such activities engage the community in advancing sustainability. In particular our Sustainability Minor capstone course is an applied sustainability project to be conducted in partnership with the community. Through these opportunities students have worked with a number of community partners including non-profit organizations, local agencies, schools, neighborhood councils, small businesses, and homeowners. Examples include orange picking, processing and distribution through non-profit groups who glean fresh local produce that would otherwise be wasted and distribute it to the hungry; design, data collection, advocacy and recommendations for alternative regional transportation including shuttles, buses, rail, bikes and an electric streetcar through various non-profits and public agencies; solar PV installation assessments and recommendations for local businesses and community groups; design and development of educational and sustainable gardens at schools; development of urban food gardens for community groups and schools; energy and water assessments for homeowners and local businesses; energy and equipment recommendations for local restaurants; siting of an urban aquaponics and hydroponics farm facility for a clean technology company.

The Institute for Sustainability conducts regular workshops in the community in partnership with local cities on how to go solar. These cover everything residents need to know to make a decision about solar, project sizing, components of the system, permitting, the costs and financing options, and how to go about the process. Through one of our alumni and partners we offer a free web-based cost-benefit analysis and consultation service. In 2014-15 we offered twelve workshops, with plans to expand the program in 2015-16.

The Institute also regularly hosts food garden and composting workshops for the campus and community in which participants engage in gardening activities, learn the fundamentals of growing food organically, and share resources and ideas.

The university works closely with LA Metro and the local councilmember's office on increasing public transportation options to the campus in an effort to provide reduced-emission alternatives to single vehicle occupancy commuting. The University has worked closely with our local power supplier, to help finance the 23 EV charging stations installed on campus in 2014-15.

[25] Sustainability Tracking and Rating System (https://stars.aashe.org/)

To further campus-community engagement and collaboration a number of new initiatives will begin in 2015-16. These include the introduction of a sustainability internship program, the establishment of new community service learning partners, the hosting of additional workshops on energy and water conservation and efficiencies in the community, including region-appropriate landscaping practices, an expanded public outreach program through a newsletter and social media, and a new campus-community resiliency network.

8.2 Climate Action and Resilience Planning

Under a new ACUPCC initiative which integrates the Presidents' Climate Commitment and the Alliance for Resilient Campuses into a new Climate Leadership Commitment, our campus will work closely with the community on developing joint climate mitigation, adaptation and resilience strategies.

We broadly define resilience as our ability to respond to stressors within an environmental, social and economic context and ensure the preservation of society's health and wellbeing, social and financial systems, leadership and decision-making capabilities, and critical infrastructure[26]. Challenges come from a number of sources – climate change, drought, food shortages and other resource limitations, natural disasters, violence, epidemics, and a host of others, both predictable and unexpected. The most resilient communities are ones that have not only a healthy environment and strong technical systems, but also vibrant social networks.

We will focus on resilience in particular as it relates to the impacts of climate change. The effects of climate change are no longer just a concern for future generations; they are already present now and are projected to become more severe and damaging in the decades to come. For our community the impact of increased prolonged heat waves, increased pollution levels and drought are of particular concern.

Initial efforts will focus on the completion of a campus-community resilience assessment including the identification of indicators and vulnerability measures. We will engage community members in defining targets for resiliency thresholds and carbon emissions, and establish a work plan for reaching these targets. Community leaders and organizations will join in the planning and execution of the work plan, and identify the needs of community members that can benefit from collaboration with our faculty and students.

Our plan for taking on this challenge includes building and developing relationships with local community organizations, identifying a specific focus community for project implementation, creating a campus-community task force to guide the resilience plan, and replicating efforts in other communities within the region through the establishment of an Urban Resilience Network in

[26] http://www.100resilientcities.org

partnership with other regional universities (the "CSU5"). The following are specific steps which will be taken to engage the community in climate and resiliency planning:

1. Build an internal team focused on generating ideas for working in and with the community on climate action and resilience. This team will be built around our existing Green Core Team, which was instrumental in developing the CSUN Sustainability Plan. (Completed Fall 2015.)
2. Identify one or two focus communities to engage in our initial efforts. Communities should be local, disadvantaged and with an interest and willingness to work closely with the campus on these issues. (Completed Fall 2015.)
    - Engage in activities and planning with a specific community will allow us to gather information, collect and analyze data, and do due diligence in understanding community needs and vulnerabilities. The groundwork laid in working with a focus community will inform our larger Resiliency Network picture in working with the CSU5.
3. Work closely with focus community/ies to identify specific projects where faculty and students can engage with the community to address specific needs. (2015-16)
4. Implement at least six faculty-student community-based projects focused on climate adaptation and resilience. (2016)
5. Create a joint campus-community resiliency task force to align the Climate Action and Resilience Plan with community goals and to facilitate joint action. (2015 - 2016)
6. Convene task force (Beginning Spring 2016 and twice annually thereafter)
7. Conduct campus-community resilience assessment (2016)
8. Develop and revise campus-community Climate Action and Resilience Plan with guidance from task force and alignment with ongoing regional efforts. (Fall 2016 – Spring 2018)

We propose to create an "Urban Resilience Network" to connect higher education institutions in the greater Los Angeles region with community partners to address community needs and help build resilience through education, research, the collection and dissemination of data and information, the development and sharing of best-practices, and partnerships and collaborative projects. Community partners can range from informal neighborhood groups to public agencies, from NGOs to small businesses. Of particular focus will be engagements with disadvantaged communities facing environmental or social injustices including poverty, pollution, lack of access to resources such as affordable fresh foods, clean energy, green spaces, quality water, etc.

By leveraging the resources of five California State University campuses with over 140,000 students and 12,000 faculty and staff, the potential impact on the region is vast. We propose to:

1. identify existing efforts in which our universities are working closely with communities in resiliency-related work
2. identify collaborative opportunities in which our universities can work together to expand these efforts and initiate new ones

3. link existing efforts in a network in which both faculty and communities can share best practices and resources
4. expand these efforts particularly in focus and disadvantaged communities in which we will concentrate our resources initially
5. plan for expansion of resiliency efforts into new communities

The Urban Resilience Network will integrate the work of our campus, community partnerships and the campus-community task force with those of other regional universities and provide a structure for building climate adaptation and resilience throughout the region.

9. Milestones and Future

This Climate Action Plan will serve as a guiding document for California State University, Northridge to reach a goal of becoming carbon neutral by 2040. Cost, funding, incentives and resource availability together with external factors including technology will dictate the timing of project implementation. Many of these factors are out of our direct control; thus this plan is intended to be a living document and will be adapted as necessary.

In meeting the goal to become carbon neutral by 2040, the following intermediate milestones have been established.

- Reduce commuting carbon footprint to below 1990 levels by 2020
- Reduce total GHG emissions to below 1990 levels by 2020
- Reduce Scope 1 and 2 GHG emission levels to 50% below 1990 levels by 2030
- Reduce Scope 1 and 2 GHG emission levels to 80% below 1990 levels by 2035
- Reduce Scope 3 GHG emission levels to 50% below 1990 levels by 2035

Appendix A: Planning Personnel

This plan was prepared by the CSUN Institute for Sustainability.

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