



2018 Climate Action Plan

Redefining the possible in climate change solutions



SACRAMENTO STATE
Redefine the Possible



Table of Contents

Executive Summary...page 1

Introduction & Background – What is a Climate Action Plan?

Campus Master Plan

Leadership Support...page 2

Message from the President

Message from the Vice President

Message from Associated Students, Incorporated

Goals & Framework...page 3

Carbon Neutrality

Milestone Dates

Mechanisms and Indicators for Tracking Progress

Financing

Carbon Commitment

Governing Ordinances for Change...page 4

State of California

California State University (CSU) System

Approach to Developing Our Climate Action Plan...page 5

Greenhouse Gas Emissions Inventory and Scopes Defined

Current Status...page 6

Energy

Electricity

Natural Gas

Clean/Renewable Energy

Waste

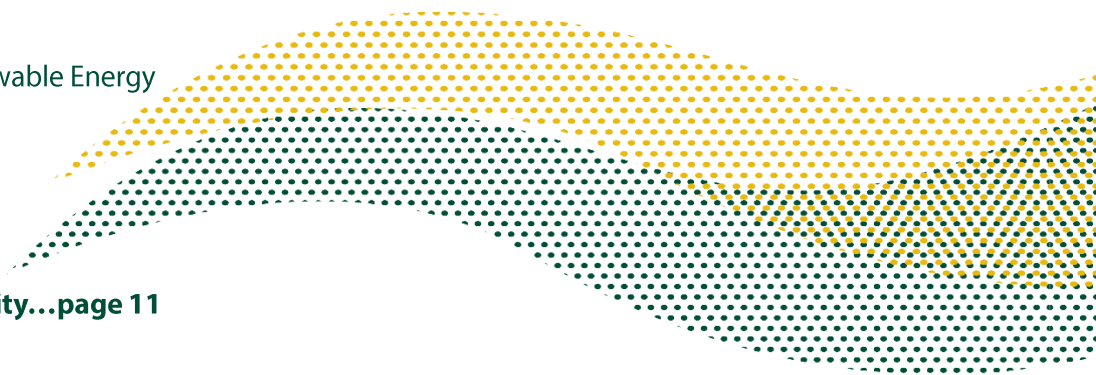
Water

Transportation

Achieving Carbon Neutrality...page 11

Energy

Existing Building & Infrastructure Improvements



New Construction

Renewable Energy

Student, Faculty, and Staff Behavioral Changes

Other

Waste

Waste Reduction and Diversion Strategies

Dining

Procurement

Water

Existing Building & Infrastructure Improvements

New Construction

Other

Transportation

Bicycle Circulation Plan

Parking

Commuting Reduction

Other Strategies

Additional Strategies...page 21

Academics...page 21

Curriculum

Tiny House, Big Accomplishment

Campus Carbon Sequestration Project

Solar Decathlon

Campus as a Living Lab 2015

Campus as a Living Lab 2016

Campus as a Living Lab 2017

Keep America Beautiful

Bees & Pollinators

Measuring Scope Emissions



Research

Arboretum Carbon Sequestration Study

Infrared Faucet Study

Sustainability Survey

Sustainable Engineering

Appendix...page 26

Works Cited

Acknowledgements



Executive Summary

Introduction & Background – What is a Climate Action Plan?

California State University, Sacramento (Sacramento State) presents a Climate Action Plan (CAP) as a climate change mitigation strategy to ensure the reduction of greenhouse gas emissions associated with campus operations leading to a carbon neutral campus by the year 2040. This report includes a baseline study of our campus carbon footprint; a target date for achieving carbon neutrality; interim target dates for meeting milestones; recommended changes to campus operations and facilities; mechanisms and indicators for tracking progress; actions to make carbon neutrality a part of the curriculum and other educational experiences for students, staff, and faculty; and actions to expand research in carbon neutrality and improve sustainability efforts on campus.

The following is a statement from California State University (CSU) Chancellor Timothy P. White:

"Climate change is a global challenge, but local decisions have a major impact. Our cumulative action is what will make the difference for current and future generations. California is currently and historically a leader on environmental stewardship, and the California State University plays a significant role in our state's work" (White, 2017).

In order to adequately address the threats of climate change it is imperative to develop and maintain collaborative efforts between students, faculty, staff, and the community. We must remain vigilant in our efforts to integrate innovative technologies that both reduce greenhouse gas emissions (GHG) and employ mitigation efforts.

We must also encourage environmental stewardship on campus as well as in our daily lives. We will do this by regularly conducting research, monitoring, assessing, and implementing strategies to reduce emissions from all on-campus operations. Sacramento State will also continue to support and encourage hands-on sustainability learning through the collaboration between students, staff, and faculty in the form of coursework, internships, research, and programs. In order to provide tangible outcomes, we will track our progress and remember that climate change is constantly evolving, and we must adapt to its dynamic nature by evaluating and modifying our plans as needed. As a university, we believe that our collaborative efforts will help in the fight against climate change.

Campus Master Plan

As summarized in the 2015 Master Plan, Sacramento State serves the capital region of California, the nation's leading center for the development of sustainability policy. It also champions the highest standards in environmental stewardship, respect for cultural diversity, and responsibility for the careful investment of public and student dollars. This 'Triple Bottom Line' of sustainability defines success for a broad set of perspectives from the University's many stakeholders including students, faculty, biologists, policy makers, regional planners, and the University's neighboring communities (California State University, Sacramento, 2015).

The 2015 Master Plan is an opportunity for Sacramento State to implement and further develop its sustainability policies and practices within the contexts of both the physical campus and the University's academic program. The Plan sets forth a series of practical ways that campus programs, departments and physical infrastructure can continue to move the campus and all its users further

toward environmental sustainability in all of its manifestations (California State University, Sacramento, 2015). Therefore, many of the recommendations described in this report will lean on the research and projections already laid out in the Master Plan.

Leadership Support

Message from the President

At Sacramento State, we hold ourselves accountable to the highest standards of environmental stewardship. Our University serves the capital region of California and is a national leader in the development of sustainability policies. In our pursuit of sustainability, we are dedicated to exploring opportunities and new initiatives for innovation and collaboration.

I believe that we, as a University and as citizens of the world, have to take responsibility for our actions today to ensure we are creating a better world tomorrow. Institutions of higher education are places where scientific advancements are made and solutions to global problems are realized. Climate change is one of the greatest issues facing our planet. Therefore, as one of the largest campuses within the California State University system, we have an obligation to not only reduce our environmental impact, but also to create an environment where sustainability becomes so engrained in our culture that it is not just what we do, but who we are.

Dr. Robert S. Nelsen

Message from the Vice President

As the California capital region's University, we offer a perfect stage to collaborate with students, faculty, and the community to achieve innovative and progressive sustainability strategies. Sacramento State has led and fostered these partnerships by bridging both operational and financial prudence, with academic and research efforts to harbor a true sustainable culture throughout the campus and local community.

The main driving force of this culture is our campus' mission, vision, and values; creating an innovative learning experience and supporting student success. We contribute to our mission by creating a campus-as-a-living-lab for students to participate in sustainability initiatives. These practices contribute to their educational experience as tangible real-life skills, while preparing them to be leaders in their community with a focus on being responsible stewards of this planet. This innovative environment ensures our students are ready to take on the challenge of not only reducing our environmental impact, but also inspiring older and future generations to take on this challenge as well. Our staff, faculty, and community partners work hand-in-hand with students to affect that change.

In recent years, Sacramento State has become a leader in sustainability and with that leadership comes an obligation to share both our successes and failures with those following in our path. Our partnerships with local K-12 schools, non-profits, and other community agencies allow us to bring ideas that have taken root and flourished at Sacramento State out into the local community. The sharing of these ideas is both crucial in our fight against climate change and critical to our role as the California capital region's University.

The following Climate Action Plan not only outlines Sacramento State's path to carbon neutrality, but details how we will continue to be a leader in this space. Ideas detailed in this document will not be limited to our campus, but shared as best practices so they can be replicated throughout the Sacramento region and beyond. Climate change is not a local problem and for that reason, solutions should not remain local.

Dr. Ming-Tung "Mike" Lee

Message from Associated Students, Incorporated

On behalf of Associated Students, Inc. at Sacramento State, we are committed to amplifying sustainability efforts such as Second Nature's Climate Leadership Carbon Commitment on campus and globally through student engagement with the Climate Action Plan. Our campus declaration to achieve carbon neutrality by 2040 and complete transparent reporting regarding annual greenhouse gas emissions inventories are crucial in mitigating the consequences of global climate change. It pushes our campus faculty, staff, and students to consider their parts in protecting and preserving those parts of the world our daily behaviors affect, and engages us all in deliberate consideration of our actions, and possible innovations.

Associated Students, Inc. at Sacramento State is committed to supporting the Climate Action plan on behalf of the student body, and will continually work to promote sustainability on campus, as well as in the comportment of the campus community.

Goals & Framework

Carbon Neutrality

This CAP details how Sacramento State will move the campus towards net zero carbon emissions (carbon neutrality) by 2040.

Milestone Dates

Reduce total GHG emissions levels by 50% by 2030

Reduce total GHG emissions levels by 80% by 2035

Reduce total GHG emissions to net zero by 2040

Mechanisms and Indicators for Tracking Progress

A campus greenhouse gas emissions inventory will continue to be completed annually and will serve as the basis for tracking regular progress towards carbon neutrality. Sacramento State also intends to continue to participate in the Association for the Advancement of Sustainability in Higher Education's Sustainability Tracking, Assessment and Rating System (STARS). Both of these reporting systems will allow Sacramento State to continually monitor campus progress toward carbon neutrality in a variety of areas.

Financing

Actions identified in this plan will be funded through a variety of existing internal funding sources and external opportunities such as grants as part of implementation.

Carbon Commitment

On April 14, 2016, Sacramento State President, Robert S. Nelsen, signed Second Nature's Carbon Commitment requiring Sacramento State to set a carbon neutrality target date along with a path to neutrality. In order to achieve the goals of the Carbon Commitment, Sacramento State completed a greenhouse gas emissions inventory in May of 2017, created this Climate Action Plan, and will continue annual monitoring and reporting of all campus greenhouse gas emissions. This Climate Action Plan outlines benchmarks and goals to be reached on our path to carbon neutrality, and highlights opportunities to engage in education and research regarding climate change. The goal of carbon neutrality will require a significant effort to reduce campus energy consumption and increase our use of clean energy. It will also require substantial efforts to reduce indirect emissions from commuting and travel by students, faculty, and staff.

Governing Ordinances for Change

This plan calls for an ambitious but achievable reduction in Sacramento State's carbon footprint. The solutions proposed will be guided by governing ordinances we are mandated to adhere to from local, state, and CSU policies. The following highlights the policies Sacramento State follows as guiding principles in all sustainability decisions and will shape our steps toward campus carbon neutrality.

State of California

As a global leader in combating climate change, the State of California has established and integrated an ambitious plan for addressing climate change and establishing statewide sustainability goals.

Key mandates are listed below and have a direct impact on the decisions made on the Sacramento State campus:

- Assembly Bill (AB) 32 requires California to reduce its GHG emissions to 1990 levels by 2020.
- Senate Bill (SB) requires a reduction in GHG emissions to 40% below 1990 levels by 2030.
- Executive Order (EO) S-3-05 requires that California's GHG emissions be reduced to 80% below 1990 levels by the year 2050.
- In 2002 under SB 1078, which was later accelerated in 2006 under SB 107, and expanded in 2011 under SB 2 (California's Renewables Portfolio Standard program), requires investor-owned utilities, electric service providers, and community choice aggregators to increase procurement from eligible renewable energy resources to 33% of total procurement by 2020.
- SB 350 seeks to increase energy efficiency in buildings by 50% by 2030, and gives California's energy agencies the authority to review and revise our state's energy efficiency programs to organize the funds and regulatory actions necessary to reach this target.
- AB 341 established that no less than 75% of solid waste generated be source reduced, recycled, or composted by the year 2020.

- AB 1826 requires businesses to recycle their organic waste after April 1, 2016, based on the amount of waste they generate per week.

California State University (CSU) System

As of May 2014, the CSU Board of Trustees adopted and revised its Sustainability Policy to include policies “broader than prior policies and more inclusive of all areas of the university community. The policy aims not only to reduce the university’s impact on the environment and educate our students, faculty, and staff on sustainable practices, but also to incorporate sustainability principles and climate science in our educational offerings” (California State University, 2014). CSU Sustainability Policy requires an intermediate goal of reducing GHG emission to 60% below 1990 levels by 2040.

Highlights of several policy goals include:

- Reduction of direct (Scope 1 and 2) greenhouse gas emissions to 1990 levels or below by 2020. This primarily consists of electricity and natural gas usage.
- Reduction of direct (Scope 1 and 2) greenhouse gas emissions 60% below 1990 levels by 2040.
- Exceed the State of California Public Utilities Commission Renewable Portfolio Standard (RPS) goal of 33% of electricity needs from renewable sources by 2020.
- Encourage and promote the use of alternative transportation and/or alternative fuels to reduce GHG emissions related to university associated transportation, including commuter and business travel.
- Pursue water resource conservation by 20% by 2020.
- Reduce solid waste disposal rate by 50%.
- Strive to increase sustainable food purchases to 20% of total food budget by 2020.
- Design/build all new buildings and renovations to meet a minimum of Leadership in Energy and Environmental Design (LEED) Silver standards. LEED Gold or Platinum standards are encouraged.

Since most of the policy goals have 2020 sunset dates, new iterations of this policy are underway with system-wide campus participation.

Approach to Developing Our Climate Action Plan

The three pillars of sustainability—social, environmental, economic—are not only universally-recognized as the main areas of interconnectivity when discussing sustainability, but are the foundation of our Climate Action Plan. We will address our approach to becoming a carbon neutral campus by considering solutions that positively impact the people who attend campus every day for education and work. We will illustrate methods to sustain campus operations that have a minimal impact to the surrounding eco-system. Our plan will detail steps to decrease our environmental impact through identifying cost-effective opportunities to reduce GHG emissions that are relevant to our campus environment. In preparation for creating this Climate Action Plan, we consulted with campus content matter experts in the areas of energy, waste, procurement, dining, water, transportation, and academia.

Greenhouse Gas Emissions Inventory and Scopes Defined

Sacramento State conducted an initial inventory of greenhouse gas emissions during the 2016-2017 school year. Thanks to a collaboration between faculty, staff, and students and by utilizing Second Nature's Greenhouse Gas Calculator, we were able to determine that the majority of campus emissions were considered Scopes 1 and 2. As stated by Second Nature, Scope 1 emissions are "direct emissions produced through campus activities" which include, use of natural gas, propane, renewable energy generated through solar electric and thermal systems, and direct transportation. Campus Scope 1 emissions accounted for 25% of our total emissions. Scope 2 emissions, which were the largest contributor and accounted for 56%, are "indirect emissions from purchased energy" and include purchased electricity, steam, and chilled water. Lastly, Scope 3 emissions (19%) are "indirect emissions from student, faculty, and staff commuting and institution-funded air travel, solid waste, water and waste water." Recommendations in this Climate Action Plan will address areas of change that will directly impact Scopes 1, 2, & 3 emissions leading to an overall decrease in total emissions and an increase in carbon offsets, therefore leading to carbon neutrality.

Current Status

Before outlining steps toward reaching carbon neutrality, it is important to outline the major areas of strengths in our campus sustainability program that directly impact Scopes 1, 2 & 3 greenhouse gas emissions. Significant progress can be made toward our neutrality goal by relying on existing technologies and building on the strengths of our past successes. A number of solutions proposed will be unconventional and forward-thinking, but creativity and thinking outside the box are how solutions to climate change are created. Additionally, it is important to note that this report will have a great deal of fluidity due to unforeseen advances in technology and various elements of change affecting the physical campus leading to potential deviations and modifications in our path to neutrality.

We have identified energy, waste, water, and transportation as having the greatest impacts on Scopes 1, 2 & 3 emissions, therefore these are the areas we have focused on when highlighting current achievements and outlining recommended actions and solutions. Other significant categories such as Procurement and Dining Services are not being highlighted as stand-alone categories because their functions are captured in the other four operational categories.

Energy

Electricity:

- Smart Grid Project: This project was funded through a Department of Energy grant and implemented by Sacramento Municipal Utility District (SMUD). Sacramento State partnered with SMUD in the application and was awarded \$4,272,500. The University was required to match the awarded amount.
 - The project goals, strategies, and funding requirements were to test the newly commercialized Smart Grid technology in an active environment. This new technology was to be implemented on all aspects of the project, addressing interconnectivity as a

major feature. The strategy was to work with SMUD using the latest technologies to create a real-world Smart Grid example with two-way flow of electric power and information between SMUD and Sacramento State.

- Demand response is another feature from the Smart Grid project. Demand response controls building equipment so that in the event of a stressed electrical grid, the local provider can issue an automated response signal reducing the University's electrical demand.
- The four major parts to the project are as follows:
 - Energy Management Control System (EMCS)
 - Electronic Metering and Reporting Software
 - Electric Vehicle Supply Equipment (EVSE)
 - Electric Grid Reliability
- The Smart Grid project energy saving are as follows:
 - Electrical Savings:
 - 3,130,262 kilowatt hours per year (kWh/year)
 - \$ 276K/year
 - 969 Metric Tons of carbon dioxide (CO₂) reduction/year
 - Natural Gas Savings:
 - 214,562 Therm/year
 - \$168K/year
 - 1,136 Metric Tons of CO₂ reduction/year
- Sleep mode is standard on computers & copy/printers campus-wide
- Tahoe Hall Lighting: Installed in 2017, the building's perimeter received state-of-the-art light-emitting diode (LED) outdoor lighting with two-stage sensors allowing the lights to react to motion, and turn on only when needed.
- Induction Pathway Lighting: The pathway induction lighting throughout campus produces 42% energy savings and lasts approximately 100,000 hours. The project removed 100 watt and 150 watt lamps and replaced them with 85 watt lamps throughout campus.
- New LED bi-level lighting was recently installed in Lot 7
- Campus street lights were retrofitted with LED lighting over a two year period.
- Occupancy sensors installed in classrooms and offices throughout campus keep lights off when they are not needed
- Calories to Kilowatts program at The WELL: The WELL has 19 Precor elliptical fitness cross-trainers with small circuit boards to convert human workouts into energy that is fed directly to the building's electrical grid. A typical 30-minute workout can produce 50 watt-hours, which would be enough clean, carbon-free electricity to power a laptop for an hour or a desktop computer for 30 minutes. WELL members can track their energy production over time.
- Mendocino lighting project: An impressive lighting retrofit project, completed in 2017, makes Mendocino Hall one of the most energy efficient buildings on campus. Advanced controls, dimming and daylight harvesting, occupancy sensors, and LED fixtures are just some of the highlights of the pilot project that achieved an energy reduction of 85%.
- Energy reduction competitions in student housing

Natural Gas:

- Central Plant boiler upgrade project: Replaced two steam boilers with new energy efficient units and added new high turn-down burners and controls for all three high pressure steam boilers
- A recent steam trap replacement project reduced natural gas usage and increase system efficiency

Clean/Renewable Energy:

- Sacramento State has two solar arrays on campus. There are 952 solar panels located on top of the WELL, producing approximately 16% of the building's total energy. There are 1134 panels atop the Library which generates 40% of the building's total energy.
- Sacramento State partners with the Western Area Power Authority (WAPA) to receive hydroelectric power. This federal program enables the campus to utilize hydroelectric power to reduce GHG emissions and energy consumption from the grid
- Sacramento State has a total of four solar hot water heaters on campus located at the American River Courtyard, Riverfront Center, and Yosemite Hall

Waste

- Creation of the Bio-Conversion & Agricultural Collaborative (BAC) Yard
 - On-campus composting of campus green waste (such as grass clippings and fallen leaves)
 - On-campus composting of some of the campus' pre-consumer food waste and used coffee grounds via windrow, hot, and vermicomposting methods.
 - 100 tons of organic material are diverted from the landfill each year from on-campus composting
 - 65 cubic yards of compost is generated at the BAC Yard annually
 - \$5,000 is saved annually in waste hauling fees and compost purchasing
 - Compost is used throughout campus in landscaping and various gardens
- Comprehensive receptacle bin signage program located on waste, recycling, and composting bins throughout campus denote proper disposal methods via imagery
- Responsible disposal of prescription and over-the-counter medications via our Don't Rush to Flush bin, located in the Pharmacy in Student Health Services at The WELL. This program was possible via a grant from the Rose Foundation. Sacramento State was one of the first in the Sacramento region to obtain one of these receptacles.
- During Department Recycling Days, the Recycling department collects materials from campus offices and even some personal items brought from home for recycling. The event allows for departments to de-clutter their work environment.
- Sacramento State participates in a take-back program via several campus departments to divert various waste streams from the landfill for items such as batteries, light bulbs, car batteries, toner cartridges, and electronic waste.

- Water bottle refill stations are continuously being installed throughout campus to encourage the use of refillable containers. To date there are 33 refill stations installed on campus. Every future drinking fountain replaced on campus will receive a refill station
- Several locations on campus, including the Union Store, no longer offer plastic bags to customers
- Every incoming student at Housing and Residential Life receives a reusable to-go container for food, a reusable cup, and a reusable shopping bag upon move-in
- Peak Adventures offers refillable 1lb propane tank rentals as part of the Refuel Your Fun campaign to keep harmful propane cylinders out of landfills

Water

- Low Impact Development (LID): In 2015, Sacramento State's Office of Water Programs (OWP) and Facilities Management partnered with the City of Sacramento to install new stormwater management devices on campus. The \$3 million grant-funded project removed large areas of turf and included the construction of 25 LID stormwater capture and treatment devices on campus. The devices included bio-retention planters, bioswales, rain gardens, rooftop disconnects, porous pavement, and a green street. The devices are designed to capture and treat over 13 acre-feet of stormwater runoff every year and increase ground water used for campus irrigation. As a result of the implementation of Sacramento State's stormwater management system, 3.2 million gallons of rainwater were harvested by the University in 2015. There are currently 7 bioretention devices that treat stormwater runoff throughout campus.
- Drought-Tolerant Landscaping: Sacramento State has a continuing effort to identify areas of the campus in which grass can be replaced with drought tolerant landscaping such as California native plants, decomposed granite or rocks which require minimal to no water.
- Bathroom Fixture Replacements: In 2014, Facilities Management replaced Sacramento State's pre-1992 restroom plumbing fixtures with water efficient fixtures in all older buildings. The new toilets use only 1.28 gallons per flush compared to the older models which use 4-6 gallons. The new model urinals use only 0.5 gallons per flush while the older models used 3-4 gallons. Additionally, campus plumbers updated many faucet aerators on Sacramento State's bathroom sinks to use just 0.5 gallons per minute (gpm) compared to 2 gallons per minute.
- Infrared (IR) Faucet Study: In early 2016, Sac State Sustainability conducted a study on campus to test if automatic infrared water faucets conserve water. The study found that infrared faucets combined with a 0.35 gpm aerator resulted in a reduction of approximately 54% of water use compared to manual faucets using 0.5 gpm aerators. These findings served as the basis for seeking infrared faucets with lower gpm aerators for restrooms throughout campus. Since our current manual faucets are not equipped to be retrofitted with a 0.35 aerator, infrared faucets were chosen to include a 0.35 aerator as a standard option. A grant proposal based on this premise was submitted through the Department of Water Resources in 2016, and Sacramento State was awarded over \$600k. With the addition of the infrared faucets, we will also have the ability to track our water consumption per faucet, improving future opportunities for increased domestic water and energy reduction. The grant award will not only pay for the replacement of nearly 500 campus faucets to infrared fixtures, but will also replace more than 200 showerheads and a variety of kitchen appliances in Dining Services.

- Upgraded irrigation control system: Campus installed an updated version of Maxicom irrigation control system, including an upgraded computer and the purchase of the annual factory technical support to optimize system operation. The program also connects with a campus weather station and incorporates evapotranspiration, adjusting irrigation needs automatically.

Transportation

- Real-time bus schedule for Regional Transit
- Covered transit shelters
- Direct outreach in classroom and orientation including films about alternative transportation and parking
- 'Bike to ----' Events to promote bicycling
- Sacramento State Mobile commute highlights
- Heat mapping allows drivers to know where parking is available on campus, reducing unnecessary circling and idling
- Bike Friendly Campus designation, Silver rating, achieved in Fall of 2017
- Walkable campus: There are several excellent pedestrian pathways throughout the campus. There is also easy access to campus by way of the Guy West Bridge and the Hornet Tunnel. All major public transportation is within walking distance of campus.
- Campus-wide bike expansion: In Spring 2014 a Bicycle Task Force comprised of members of Facilities Management and University Transportation and Parking Services created a plan to transform Sacramento State into a more bicycle-friendly campus. These changes included three new bicycle compounds with over 400 new parking spots; two new skateboard towers capable of holding up to 40 skateboards and scooters; and new bicycle traffic lanes throughout campus consisting of designated "Pedestrians Only" zones to ensure the safe passage of both pedestrian and bicyclist. Public Safety Officers are also on duty at all campus bike compounds.
- Hornet Shuttles powered by Bio-Compacted Natural Gas (Bio-CNG) created from food waste
- Hornet Express Shuttle tracking: Real-time GPS coordinates for all Hornet Shuttles
- Parksmart certified parking structure
- Car sharing via Zip Car: Zipcars are available around the Residence Halls. Zipcar vehicles are available 24 hours a day with gas, insurance, parking, maintenance, and up to 180 miles of driving per day included in the membership. Participants sign up online and pay an annual fee.
- 74 electric vehicle charging stations
- 135 fully electric vehicles charged by solar
- Three hybrid campus vehicles
- Peak Adventures Bike Shop and educational outreach programs
- Eight secure bike locker compounds with 112 individual bike lockers for rent per semester
- Showers available for bicyclists
- Student Commuter Sleeve: Sacramento State students may ride all Sacramento Regional Transit (RT) fixed-route transit services, including the light rail, by presenting a valid Sacramento State OneCard and the student commuter sleeve. Students pay a nominal fee for this service as part of their student fees.

- Employee Commuter Sleeve: Sacramento State employees may ride all Sacramento Regional Transit (RT) fixed-route transit services, including the light rail, by presenting a valid Sacramento State OneCard and the employee commuter sleeve available for purchase at a discounted rate.
- Carpool program: Carpool parking permits are offered at a reduced cost. Preferential covered carpool parking is available in two of the campus parking structures. Another benefit available to employees who rideshare at least 60% of the time is the Guaranteed Ride Home (GRH) Program. All campus employees who employ some method of ridesharing at least 3 days per week now have the opportunity to participate in this program. This benefit is offered by the Sacramento Transportation Management Association (SacTMA) and is a no-cost, non-taxable benefit available to ridesharing employees as a ridesharing commuter. Campus employees must be registered in Commuter Club, through the SacTMA website to take advantage of this benefit.
- Telecommuting program: Sacramento State approved a telecommuting policy effective January 1, 1994. With the approval of the appropriate supervisor and department head, telecommuting allows an individual to work one or more days each work week from their home or from a telecommuting center close to their home. Individuals stay in touch through the use of electronic devices.
- Transportation survey: Two transportation surveys were recently conducted to collect information about commuting and transportation trends for campus.

Achieving Carbon Neutrality

Achieving carbon neutrality requires everyone to be part of the journey. Many solutions across many disciplines will play an integral part in reaching carbon neutrality. At Sacramento State we believe that one person can make a difference, and many people can solve the problem. The following areas were identified as major contributors to Scope 1, 2, and 3 emissions and as such, will detail both broad and in-depth efforts to help reduce and offset those emissions. These plans are ever-changing and with technological advancements, funding opportunities, and new ideas, these plans may evolve over time. Regardless of the path, the primary goal of reducing our campus' carbon footprint remains.

Energy

Existing Building & Infrastructure Improvements

- LEED Gold certification for Major Existing Building Remodels and Renovations
- Use campus and building energy metering to quantify current use baseline and set reduction targets
- Augment Thermal Energy Storage (TES) capacity to offset peak demands
- Implement energy efficiency projects to lower building tonnage requirements
- Capture waste energy and heat energy from various systems for useful purposes establishing processes to capture this otherwise wasted resource
- Use of energy efficient LED lighting coupled with effective occupancy and automatic daylight control strategies and demand control system
- Use of Energy Star rated equipment to minimize energy consumption

- Use of Energy Management Systems
- Upgraded heating, heating ventilation and air conditioning (HVAC) for efficiency
- Consider adding an additional chilled water thermal energy storage (TES) tank to reduce electrical demand
- Migrate from natural gas heating to solar thermal, which could be used for radiant flooring and radiators, as well as domestic water heating needs
- Install high efficiency heat pumps for supplemental heating and cooling
- Reduce natural gas usage by installing all electric heating where possible
- Consider hot water TES tank
- Add water meters to all buildings
- Add British thermal unit (BTU) meters to chilled water and hot water/steam for all buildings connected to Central Plant
- Add sub-meters to all buildings
- Install new high-efficiency outdoor lighting which will satisfy three sustainability goals: reduced light pollution of the night sky (with the use of cut-off lighting hoods), reduced energy use, and reduced maintenance costs
- Re-lamp outdoor lighting to reduce energy and include cut-off fixtures to reduce light pollution and protect the night sky
- Implement a monitoring based commissioning (MBCx) system on all existing buildings

New Construction

- LEED Gold certification for all new buildings on campus
- Achieve net zero energy consumption for all new or renovated state buildings beginning design after 2025
- Target an average energy use intensity (EUI) of up to 40k BTU/square feet/year for new and renovated buildings
- All new buildings will have EUI targets that decrease over time
- Install ground-source heat-exchange technology
- New construction should incorporate water-saving fixtures to reduce potable water use by at least 30% and sewage conveyance by 50% below the baseline
- Implement ultra-low energy strategies
- Install ventilation with Dedicated Outdoor Air Systems and Demand Control Ventilation
- Install radiant heating/cooling, chilled beams
- Use earth tubes to precondition outside air on variable air volume (VAV) air handling systems
- Provide highly-efficient thermal and daylighting envelope
- Consider building orientation and glazing ratio
- Consider seasonal solar access and shading to reduce interior heating and cooling loads
- Install daylighting access and control systems
- Use skylights and solar tubes to minimize electric lighting
- Use phase change material on inside walls that will store 30 BTU/ft² at 73°F phase change
- Use air speed (ceiling fans) to expand thermal comfort ranges
- Use energy efficient LED lighting coupled with effective occupancy and automatic daylight control strategies and demand control systems

- Promote task lighting in spaces to reduce overhead lighting power densities (e.g. laboratory buildings)
- Use Energy Star rated equipment to minimize energy consumption
- Use Energy Management Systems
- Use indirect/direct evaporative cooling systems
- Install Ground source heat pumps
- Use wind driven natural ventilation such as operable windows with automatic HVAC shut-off and ventilation through operable skylights
- Consider seasonal solar access and shading to reduce interior heating and cooling loads
- Use radiant flooring for heating and cooling
- Use Triple pane low-emissivity windows on the South side of buildings
- Use sun shading for direct South facing windows
- Use Cool/green roofs
- Use Demand controlled ventilation
- Consider Living Building Challenge certification for all new buildings
- Build a Living Building Challenge certified demonstration project in the campus Arboretum to test new sustainable technology
- Provide photovoltaic (PV) systems on new buildings when applicable
- Extend chilled water piping to serve new buildings

Renewable Energy

- Increase on site renewable power generation with solar photovoltaics and solar hot water systems
- Move toward net zero energy where 100% of campus energy use is met by renewable energy generation on a net annual basis
- Install 13,990,300 kWh/year of solar photovoltaic and solar thermal power generation capacity
- Install battery storage to offset campus peak energy demand and improve resilience
- Purchase off-site generated renewable power
- Consider Fuel Cell technologies
- Install PV systems on existing facilities
 - Potential estimated production for PV systems on existing facilities is as follows:

University Union	490 kW
Parking Structure 1 [PS1]	= 930 Kw
Parking Structure 2 [PS2]	= 707 kW
Parking Structure 3 [PS3]	= 1.26 MW kW
Parking Structure 5 [PS5]	= 825 kW
Lot 9 & 10	= 2 MW to 3.6 MW
American River Courtyard	= 400 kW
Folsom Hall	= 814 kW
	9,026 kW

Annual production is estimated at 13,990,300 kWh/year, representing approximately 28.84% of our annual total.

Student, Faculty, and Staff Behavioral Changes

- Implement energy conservation strategies as a way of reducing loads on existing and future central plants, electrical service, and other energy generation equipment
- Achieve plug load reductions through promoting occupancy control power strips to shut off monitors and other plug loads when not in use
- Promote task lighting in spaces to reduce overhead lighting power densities (e.g. laboratory buildings)
- Maintain building dashboards; promoting metering with central display to monitor energy generation and consumption
- Continue annual energy reduction competitions at student housing and expand to additional areas of campus

Other

- Consolidate building use on off-season and after-hours
- Purchase carbon offsets
- Investigate excessive nighttime cooling usage
- Explore options for purchasing more hydropower
- Investigate Central Plant optimization opportunities

Waste

Waste Reduction and Diversion Strategies

- Increase campus auctions: The University's Property department has increased its participation in the auctioning of used state property each year to the point that it now generates a revenue of tens of thousands of dollars and diverts hundreds of thousands of tons annually.
- More hydration stations: The production of plastic products, particularly water bottles, is cheap enough that it rivals recycling efforts for plastic materials. Hydration stations and the use of reusable water bottles allows a user an alternative from repeatedly buying plastic water bottles.
- Re-use store to sell used products and clothing to students: A re-use store creates the opportunity to extend product life, negating all GHG emissions which would have been produced in the creation, shipping, and marketing of new items. A re-use store will help divert waste generated from the annual housing move-out event.
- Develop more accurate reporting for construction waste: Construction and Demolition waste (C&D) have the potential to increase our university's waste and diversion rates significantly. Standards currently exist for construction agencies to divert their waste, but the reporting process to the University can be improved significantly.
- Consolidate all campus waste accounts for improved waste, recycling, and compost tracking: While united under the banner of Sacramento State, the University is actually comprised of

several separate entities, nearly all of which contain their own waste-hauling contracts. If all accounts were monitored by a single waste diversion officer, diversion rates would be more accurately tracked.

- Require waste haulers to provide scales on trucks: Requiring waste-haulers to add scales to their trucks would allow the waste officer to better identify which campus entities are creating the greatest amount of waste. Without scales, there is no way to determine which of the many stops on campus is generating possible unnecessary waste.
- Establish back-up entity to compost post-consumer food waste: Currently, the agency to which the University's waste haulers have been taking food waste to for bio-conversion is unable to accept materials, while they conduct a facility clean-up. This temporary closure is estimated to last for another year. The University is searching for alternative means to keep organic materials from ending up in the landfill.
- Raise profile of buy recycled campaign: A state mandated program, the State Agency Buy Recycled Campaign (SABRC) stipulates that all state agencies make recycled content considerations in their purchasing and then requires annual progress reports. Promoting this campaign to the campus will 1) stress the importance of buying products with recycled content, but also 2) make more people aware that this aspect of their purchases should be reported.
- Improve data gathering for greenhouse gas emissions associated with waste, waste diversion, and recycled content: Historically, the primary data recorded for waste has been tonnages. Being able to accurately record other data sets such as the amount of offset carbon, will help determine which streams are creating GHG emissions and improve campus reporting in the reduction of GHG emissions.
- Increase waste diversion options for Athletics facilities: Most of the athletic facilities on the Sacramento State campus do not have adequate waste diversion infrastructure or rely on temporary infrastructure. Most waste from these events ends up in the landfill. Adding permanent waste, recycling, and composting bins and service to these events will increase the likelihood of diversion.
- Increased education about Epicure Eats: Epicure Eats is a program that allows for students to be notified when events have excess food and the location where students can come enjoy a meal. This program ensures that the prepared food would more likely be eaten rather than thrown away, contributing to an increase in GHG emissions. As with most of the initiatives on this list, promotion is paramount to program success.
- Replace Blue Books with Green Books: Green Books serve the exact same purpose as Blue Books and are alike in all ways except for the fact that they are composed of recycled content instead of virgin materials. Promoting the use of Green Books in course syllabi rather than generically referring to Blue Books as a testing document could reduce the amount of GHG emissions attributed to the University.
- Increase post-consumer food waste composting options: Organic materials in the landfill create methane, a potent GHG. Expanding post-consumer composting on campus, such as is done at the BAC Yard facility, greatly reduces the production of methane and other GHG emissions.
- Increase training for Custodial staff regarding compost, recycling, and landfill materials: Just as users must learn new processes, so should the personnel implementing the new processes.

This will ensure that the persons handling the waste know how to properly dispose of said waste.

- Increase training for Faculty and Students on tri-bin utilization: As indicated above, the users of the tri-bins are the starting portion for a process which ultimately end with the University decreasing its GHG output. This means signs, docents, and other means of training should be employed to ensure that new and continuing members of the campus community are engaging in post-food diversion.
- Improve Move-out day recycling: The annual exodus from Housing means that many items are left behind rather than taken back to students' permanent residences. This increases the opportunity for many recyclable materials to end up in the trash. Creating a more formalized recycling component to this event would help to ensure that items are properly disposed of.
- Eliminate stand-alone trash bins on campus: Since most items found on campus can either be recycled or composted, the presence of stand-alone trash cans increases the likelihood that an item will be thrown away rather than recycled or composted.
- Classroom bin recycling: Paper is one of the easiest items to recycle on a college campus, yet so much of it ends up in the landfill because it is either thrown away or contaminated by compostable materials. Having recycle bins in all classrooms would help ensure this material is recycled.
- Increase the use of paperless systems: Paperless systems solve several problems: 1) fewer virgin resources would be needed to create paper products and 2) the process to recycle paper would not be as necessary and time can be diverted to other recycling efforts.
- Color code bins including bags for stream separation: This simple act could help custodial staff better self-audit their efforts in separating different materials into separate streams. Having certain colored bags or liners for recycled and compostable waste ensures that those products will end up in their proper streams.

Because we recognize that reducing our waste output means making smarter and “greener” decisions at the time of purchase, Dining and Procurement solutions are directly linked to our overall waste reduction strategies.

Dining

- Require all vendors to reach certified Green Restaurants standards
- Use campus gardens and aquaponics systems to grow food for eateries
- Increase number of Zero Waste events
- Increase promotion of Zero Waste events during move-ins and other campus events
- Offer more plant-based foods
- Create more visible signage to educate users on what happens to their food when it leaves campus (such as in Riverfront Center, on the wall behind waste bins)
- Create displays of geographical distance maps of where campus food travels from
- Create display images of the people and places where campus food comes from
- Increase percentage of local and/or organic food (within 150 mile radius)
- Implement tracking measures for local purchasing practices
- Reduce pre- and post-consumer food waste
- Ensure all to-go containers are eco-friendly

- Increase use of reusable to go containers at Dining Commons
- Use Green Seal certified green cleaning products
- Provide straws only upon request
- Provide bags only upon request
- Post signage about bag and straw policies
- Increase use of reusable clamshells and cups in eateries (trade-in system)
- Provide a reusable tumbler and bag during Housing residents move-ins
- Public grading system for eateries based on their sustainable practices
- Offer discounts for reusable cups at beverage locations
- Offer Stinger's Up coffee blend campaign which offers a marginal donation of each purchase to the campus food pantry
- Expand on-site composting
- Replace Dining appliances with newer/energy-efficient options

Procurement

- All new contracts will be required to include recycled content minimums
- Include green requirements in all vendor contracts
- Require all vendor and contractor vehicles to be non-diesel, preferably natural gas, electric, hybrid, non-motorized, or smaller gas-powered vehicles
- All campus vehicles purchased must be hybrid or electric
- Preferred hybrid rental cars when traveling via Enterprise contract
- Require all delivery vehicles to deliver to Central Receiving, eliminating desk-top delivery (exceptions for food/beverage deliveries)
- Account for all greenhouse gas emissions associated with travel using Concur travel system
- Use of Concur travel system to implement carbon emissions travel taxes
- Eliminate all desktop printers
- Require office Xerox use for print management tracking and maximize green features such as power reduction (sleep mode), machines are made from 100% recycled content, machines use less toner, etc.)
- Require repurposing of all surplus property on campus
- All campus furniture purchased must be 100% recycled-content
- Advertise all used office furniture from remodels prior to deconstruction to encourage internal repurposing
- Require all uniform apparel purchases to contain renewable or recyclable content (i.e., bamboo)
- Increase number of buy-recycled products purchased
- Require all new electronics purchased must be at minimum Energy Star Certified or better
- Convert all forms to paperless

The following are currently promoted as 'Best Practices' through the Procurement office on how faculty and staff can contribute to improving the environment (Procurement & Contract Services, 2018). These will become mandatory practices as part of reaching our carbon neutrality goals:

- Consolidate orders: By increasing the number of items ordered in a single order, we will reduce the number of campus deliveries and packaging waste. By reducing the number of deliveries made to an office, we are reducing fuel use, carbon emissions, and traffic congestion
- Use of electronic catalogs: Saves paper, eliminates the need to dispose of bulky catalogs every year, and frees up valuable desk space for important things like pictures of the kids or a nice CO2 absorbing office plant.
- Buy items which contain recycled material: We are all aware that there is recycled paper available, but did you know that there are binders, pens, pencils, and notebooks that contain recycled material? There is also flooring and construction material, office furniture, and playground equipment that employ recycled material.
- Print double sided: When printing and copying documents print double sided this saves paper.
- Choose renewable resources: Lessen the demand for limited natural resources by making the renewable choice. Request vegetable based inks be used when printing your next brochure, or consider building materials obtained from sustainably harvested forests and are backed by the Forest Stewardship Council (FSC).
- Opt for the non-hazardous alternative: By purchasing alcohol thermometers as opposed to ones filled with mercury you can lessen disposal costs while removing the potential for a hazardous chemical spill. Likewise the purchase and use of non-toxic cleaning supplies.
- Use the most energy efficient model: The US Environmental Protection Agency Energy Star program rates and certifies hundreds of energy efficient products. By choosing Energy Star you are helping prevent global warming and promote cleaner air without sacrificing the product quality and performance you expect.
- Buy locally: It takes fuel to transport goods. Proximity to production not only reduces the energy use required to bring the item to market, it also helps to support the local economy.
- Buy only what you need: While it may appear economical to purchase in quantity, the truth is that often the cost to dispose of unused supplies, especially chemicals, far exceeds the original price of purchase.
- Spread the word: Once you see how simple it is to "Buy Green" make sure that everyone else know too! Show the office next door how the 50% post-consumer recycled paper you are now using works just as well as the virgin forest paper they use.

Water

Existing Building & Infrastructure Improvements

- Install low-flow plumbing fixtures in all existing buildings
- Install water meters on all existing campus buildings
- Install dual-flushing toilets in all existing campus buildings
- Use rain water capture to reduce water usage in restrooms
- Use of decorative fountains should continue to be minimized
- Audit water fixtures in existing buildings and prioritize replacement of inefficient fixtures over time to reduce potable water use in existing buildings by at least 30%

New Construction

- Sacramento State will reduce individual building water consumption by 20% in new buildings, using LEED criteria and by auditing existing buildings
- New construction will not connect to old storm sewer systems; they will divert water to local sources such as LID
- Include Thermal Water Heating on new buildings
- Use water-saving fixtures to reduce potable water use in new construction by at least 30% and sewage conveyance by 50%
- Install low-flow plumbing fixtures in all new buildings
- Install water meters on all new campus buildings
- Install dual-flushing toilets in all new buildings

Other

- All new construction includes low impact devices
- Develop an outdoor water use policy
- Evaluate options for on-site water sources
- Increase usage of permeable surface ground cover
- Develop campus policy for irrigation and CA native plant palette guidelines
- Test soil amendments for water retention, carbon sequestration capacity, and nutrient content
- Explore feasibility of waste water treatment plant on campus

Transportation

The Transportation Demand Management initiative described in Chapter 4 of the current Campus Master Plan encourages and supports the use of alternative transportation modes in order to reduce greenhouse gas emissions that contribute to climate change, reduce other air and noise pollution, and increase opportunities for physical exercise through diversifying modes of transport used on campus (California State University, Sacramento, 2015).

Bicycle Circulation Plan

- Close Moraga Way and convert it to biking and pedestrian-only boulevard
- Install four bike share stations throughout campus in partnership with Sacramento Area Council of Governments (SACOG) and the City of Sacramento through Social Bikes. Each charging station can hold up to 10 bikes.
- Purchase of 50 new bike racks as part of a bike rack replacement program in compound one, located adjacent to Guy West Bridge.
- Bike compound expansion for Mendocino Hall
- Host pop-up tabling events to promote biking on campus
- Partner with Peak Adventures' Bike Shop for more bike education events for campus community
- Hire active transportation/marketing coordinator to enhance active transportation such as walking and biking on campus
- Partner with City of Sacramento to improve egress at Hornet Tunnel exiting at Elvas Avenue to create a safer and more convenient pass-through.
- Expand additional on-campus bike parking
- Build new bike compound at PS 5, including an inflation station at no additional charge

- Install bike repair stations at each bike compound
- Increase number of bike lockers

Parking

- Increase permit fees
- Reduce price of staff commuter sleeves
- Improve transit access for pedestrians—make it easier to get to transit station
- Expand transit schedule until 10pm
- Incorporate a 27-passenger trolley, all-electric that will run from PS 3 to PS 5, with stops in between such as at The WELL
- Increase marketing to staff-bicyclists for access to campus showers located in Yosemite Hall, aimed to increase biking among staff
- Improve campus access for pedestrians
- Increase the amount of housing and amenities provided on campus
- Work with Zipcar or other car-sharing providers to increase car sharing opportunities on campus including at non-residential locations
- Provide reduced memberships for car-sharing
- Setup Sacramento State-specific ride-matching program using service such as Zimride
- Provide reduced-cost parking permits for carpooling/vanpooling
- Provide more service (increased service hours, frequency, etc.) on Hornet Shuttle
- Enhance service between 65th Street Light Rail station and campus
- Expand parking options for Housing & Residential Life
- Install Parking Guidance System with assigned parking zones to reduce idling
- Enhance automation to increase count accuracy
- Replace all Bio-CNG-ran shuttles to all-electric
- Include clean air vehicles parking spaces in PS 5, and expanded carpool parking

Commuting Reduction

- Additional campus housing at the South Housing Village
- Expand Ramona Avenue Extension opening up additional housing opportunities for students

Other Strategies

- Require Sophomores and Freshmen to live on campus
- Increase telecommuting options for all university staff to drive to campus 1 less day a week (also including more webinar and teleconferencing to reduce visitors to campus)
- Relocate bus and rail stations closer to campus
- Implement no-Idle policy for campus and visiting vehicles
- Implement no-linger in your cars policy
- Host monthly events to promote active transportation
- Create no-vehicle zones on campus
- Promote car free events – such as bike-up movies, instead of drive-in movies
- Increase clean-air parking spaces
- Implement Trip Planner phone app

- Expand senior projects, class projects, or senior capstone projects dedicated to solving transportation/parking problems
- Launch app such as Green Mile for campus community to track commuting GHG
- Limit the number of parking permits issued annually
- Mandate that contractors must comply with state idling laws

Additional Strategies

- Ensure all travel is accounted for to calculate GHG
- Implement carbon fee for business travel
- Purchase carbon offsets
- Eliminate gas or diesel powered vehicles for on-campus personnel transportation; elimination of gas or diesel powered vehicles for maintenance work where size and type of vehicle is not needed
- Replace campus vehicles with clean air versions
- Replace Grounds equipment with battery-powered
- Increase online and hybrid classes (distance learning)
- Expand faculty and staff housing
- Require Parksmart Gold cert for all new parking structures

Academics

Curriculum

As an institute of higher education, it is imperative to integrate climate change mitigation strategies into academia and research. The added benefit of this is the cross collaborative efforts from our campus' collective intelligence of students, professors, scientists, administrators, researchers, staff, and experts. By engaging the entire campus and community in our efforts, we will seek out new policies, technology, and best practices to realize carbon neutrality and to advance teaching and research in climate change and sustainability. The following section details current and past efforts to integrate carbon neutrality and sustainability into the curriculum at Sacramento state.

Tiny House, Big Accomplishment

Led by Assistant Professor Dr. Rustin Vogt, engineering students in Project Engineering I (ME 190) and Materials Selection in Engineering Design (ME 196F) worked with alumni from the Mechanical Engineering, Civil Engineering, and Construction Management departments to build a sustainable Tiny House. The home was built on campus over the course of three months, and won Best Mechanical Layout and Best Bathroom honors at a local SMUD tiny house competition.

The 184 square-foot, net zero structure spans a mere 20 feet and boasts many sustainable features including wood décor from reclaimed pallets, a recycled kitchen sink, and an innovative vacuum-tube solar system for plenty of hot running water.

Campus Carbon Sequestration Project

In partnership with Sac State Sustainability, Dr. Michelle Stevens led her Spring 2018 class of Environmental Studies Field Methods (ENVS 121) students through a campus tree carbon sequestration study. The study occurred over the course of three class meetings and involved tree sampling and data analysis using diameter breast height (DBH) and tree height measurements to calculate an estimated amount of carbon sequestered in our campus trees.

The students split up into 6 groups of 2 to 3 students per group. Sampling took place on February 23, 2018 and March 2, 2018. Students measured diameter breast height and used a pre-determined equation to calculate carbon sequestration. Collectively the 6 groups measured 1,230 trees, amounting to a total of 3755.45kg of carbon sequestered. This project is not only a step Sacramento State is taking to integrate carbon neutrality into academic curriculum, but is also part of our efforts to expand research in carbon neutrality (Arreola, L.; Becha, K.S.; Burroughs, D., 2018).

Solar Decathlon

Led by Construction Management Assistant Professor Gareth Figgess and Mechanical Engineering Assistant Professor Dr. Rustin Vogt, a team of 80 Mechanical Engineering, Construction Management and Design students and alumni built a 1,500 square foot net zero Reflect Home. The team brought Sac State and world-class skills in sustainable technology onto a global stage at the U.S. Energy Department's Solar Decathlon 2015, finishing 10th from among the 140 schools that applied to take part in the competition.

The state-of-the-art, two-bedroom Reflect Home, built on campus and transported to the decathlon in Irvine, CA, Sacramento State was competing in its first Solar Decathlon against a number of universities with more contest experience and deeper pockets. The results of Team Solar NEST's determination was clear in a number of judging areas, with a perfect score for commuting (using an electric car) and very high marks for appliances, home life, affordability, and market appeal.

Campus as a Living Lab 2015

Assistant Professor Dr. Kelly Thompson of Family and Consumer Sciences was the recipient of the Campus as a Living Laboratory (CALL) Grant. With a \$12,000 award, Dr. Thompson was able to integrate sustainability concepts into her Food Production and Sustainability (FACS 110) course including water conservation, sustainable food practices, and composting. As part of the course redesign, students were also able to work with the Sustainable Technology Optimization Research Center (STORC) to sustainably grow food for the course.

Campus as a Living Lab 2016

The California State University (CSU) in 2015-16 awarded Sacramento State an \$82,000 CALL grant, which allowed the University to integrate sustainability concepts and theories into academics.

Sacramento State created a hands-on, student-learning environment called the BAC (Bio-Conversion and Agricultural Collaborative) Yard, which is home to on-site composting for campus green waste and much of the campus' pre-consumer food waste. Additionally, campus coffee shops now divert their coffee grounds for composting at the BAC Yard.

Environmental Studies Assistant Professor Dr. Sara Kross led the efforts through ENVS 147 her course in immersive urban agricultural methods.

Campus as a Living Lab 2017

The 2017 CSU Chancellor's Office's Campus as a Living Lab Grant awarded \$60k to Sacramento State to help fund the Living Building Challenge (LBC) project. Submitted in collaboration with Sac State Sustainability, Sacramento State Mechanical Engineering Assistant Professor Rustin Vogt and Construction Management Assistant Professor Gareth Figgess, the team aims to renovate the Solar Decathlon House into an LBC certified building. Following project completion Sacramento State will be one of the first Universities in the country to hold the LBC certification. The LBC program is a green building certification program and sustainable design framework that visualizes the ideal for the built environment.

Keep America Beautiful

Environmental Studies Lecturer Christine Flowers regularly incorporates topics of climate change, assessing carbon footprints, and waste diversion into her Introduction to Environmental Science (ENVS 10) course curriculum, which all support Sacramento State's Keep America Beautiful (KAB) campus affiliation and carbon reduction strategies. Guided by the leadership of Professor Flowers, Sacramento State was the first university in the nation to earn the title of KAB Affiliate, which provides partnerships and opportunities for student internships, community outreach and engagement, and other local and national environmental resources. A few examples of the hands-on engagement Professor Flowers has engaged her students in as part of their curriculum are:

- Game Day waste educators for the annual Game Day Challenge, a component of Recycle Mania, educating game attendees and tailgaters on proper waste and recycling disposal.
- Campus waste docents for the newly installed waste tri-bins in Riverfront Center to educate diners on the importance of proper stream diversion of recyclables, organics, and landfill bins.
- Sustainability ambassadors for the California International Marathon in Sacramento, one of the state's largest events—student volunteers helped direct marathon event attendees on correct use of various disposal bins and where the different streams would go to after the event.

Bees & Pollinators

Because trees and plants sequester carbon and we have over 3,000 trees here at Sacramento State, the role of bees and other pollinators play a significant role in the health of our campus green space. With our recent addition to four beehives on campus at our BAC Yard, the incorporation of bee care and honey extraction into class curriculum is our newest classroom integration for reaching our carbon neutrality goals. Assistant Professor Dr. Kelly Thompson with her Food Production and Sustainability (FACS 110) students will assist with implementation, maintenance, and honey production of the proposed honey bee habitat. The students will also be available to facilitate training and oversight of the bee program. Students will also learn about locally sourcing food to reduce GHG emissions through various activities at the BAC Yard such as planting and maintaining gardens, learning about the benefits of composting and bio-conversion, and gain a better understanding of the complete food production cycle.

Measuring Scope Emissions

Assistant Professor of Environmental Studies Dr. Julian Fulton, recently worked with his In Energy, Society and the Environment (ENVS 140) students to estimate student commuter emissions for the Sacramento State campus. Each student created simple quantitative models for at least three different transportation modes, using various assumptions about mode choice, commute frequency and distance, and emissions intensity of different transportation technologies. Results varied greatly, but the median estimate of 750 metric tons of CO₂ per week indicated that commuter emissions (Scope 3) may actually be greater than emissions associated with on-campus combustion (Scope 1) and purchased electricity (Scope 2) combined. Students also proposed innovations for lowering emissions from their commutes, including long-distance shuttles (e.g. from Roseville), more strategic shuttle routing, free parking for carpools, cheaper housing around campus, and more online classes (Fulton, 2018).

Research

Arboretum Carbon Sequestration Study

The previously mentioned Campus Carbon Sequestration Project for Dr. Stevens' Field Studies class builds on a carbon sequestration research project led by Sacramento State Environmental Studies students Reshmi Prasad and Mariah Ponce and supervised by Sac State Sustainability in the spring of 2017. The project, summarized in the paper titled *Carbon Sequestration of the Sac State Arboretum*, written by Prasad, details the background of the project and the methodology used, as well as the project's relevancy to our campus Carbon Commitment. Trees in the University Arboretum were randomly selected using a grid correspondence map and a random number generator. The primary methodology used for the calculations was measuring DBH and then converting the findings into carbon sequestration levels realized based on previous research done at Furman University (Prasad, 2017). The total carbon sequestered in the trees sampled in the arboretum was used as an off-set in our greenhouse gas emissions inventory. Dr. Stevens' class project builds off of this project, therefore increases the known amount of carbon sequestered in our campus trees that can be reported as a carbon off-set.

Infrared Faucet Study

Another research project led by Sacramento State Biology student Alyssa Harmon and supervised by Sac State Sustainability, was the Infrared Faucet Study leading to a grant award of over \$600k from the CA Department of Water Resources for faucet replacements. We designed a study to comparatively evaluate the water usage of manual faucets and automatic faucets in a public campus setting. We implemented three phases across a four month period of time to compare a manual and automatic faucet with 0.5 gpm aerators, and an automatic faucet with a 0.35 gpm aerator in both men's and women's restrooms. It was determined that the automatic faucets with a 0.5 and 0.35 gpm aerator resulted in an average water reduction of 32% and 54% respectively, in comparison to the manual faucet. From this study, we determined that the most sustainable faucet is the automatic water faucet with a 0.35 gpm aerator (Harmon, 2016). Further research regarding estimated water reduction achieved by replacing manual with automatic faucets also indicate reductions in greenhouse gas emissions due to reduced campus-wide water pump usage.

Sustainability Survey

Led by the expert direction of Environmental Studies Assistant Professor Ajay S. Singh during his Sustainability in the Tropics (ENVS 144) course in fall of 2017, students developed survey questions that were based on both the questions and methodology used by the Social Sustainability Lab at Ohio State University during Professor Singh's tenure there, as well as the consultative feedback provided by the Sac State Sustainability team. The survey was sent out to a random sample of 8,480 students, of which 1,011 responded. The goal of the survey was to gauge the student body's sustainability knowledge, attitudes, and behaviors that emphasized carbon emission and neutrality (Agostinho, C.; Berrios, S.; Burrows, C., 2017). Results were detailed and varied over an array of sustainability topics. Results will help Sacramento State Sustainability better understand how to engage and communicate with the student body and tailor carbon neutrality efforts and goals to their level of understanding and engagement.

Sustainable Engineering

Dr. Farshid Zabihian, Assistant Professor with the Department of Mechanical Engineering is working on a number of engineering-based research projects that address the ever-changing technology of renewable energy. One example of his research is a proposal for the repurpose of Sacramento Municipal Utility District (SMUD)'s solar irradiance measurement systems to collect solar irradiance data for residential applications. A team of Mechanical Engineering students has already begun to design the system. A team of Computer Engineering students has already evaluated the exiting irradiance measurement systems and the report containing suggestions to refurbish them has been already submitted to SMUD. After completion of this system, the results will be compared with those of the existing solar panel-powered outdoor lights installed on campus. Plans to test this technology on the Sacramento State campus are in progress (Zabihian, 2018).

Appendix

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