CAL STATE LA

Climate Action Plan

Pushing Boundaries in a Changing Climate



2019



California State University, Los Angeles
5151 State University Drive
Los Angeles, CA 90032
(323) 343-3000

Executive Summary

In April 2016, Cal State LA became a signatory of Second Nature's Climate Commitment that integrates the goals of carbon neutrality with climate resilience planning.[1] This Climate Action Plan, with a roadmap to achieve carbon neutrality, an assessment of the campus's capacity to adapt to the impacts of climate change, and the direction to integrate these efforts into the University's physical plans, research and curriculum, is the fulfillment of the Second Nature Climate Commitment.

This Climate Action Plan takes an integrated approach to climate change by covering both mitigation and adaptation planning. The first objective is to provide a strategy by which Cal State LA can reduce its carbon footprint to achieve operational carbon neutrality by the end of 2040, and full carbon neutrality by the end of 2045. Thereafter, Cal State LA commits to remain carbon neutral in perpetuity.

Cal State LA defines operational carbon neutrality as the point at which net greenhouse gas (GHG) emissions from scopes 1 and 2 equal zero. Full carbon neutrality expands this definition to include scope 3 emissions. For reference, GHG emissions are commonly divided into three scopes:[2]

Scope 1: Direct GHG emissions from stationary fuel combustion, fleet vehicles, and fugitive emissions from refrigerants.

Scope 2: Indirect GHG emissions from purchased electricity.

Scope 3: Any other indirect GHG emissions, such as employee and student commuting, waste management, and business-related travel.

The second objective is for Cal State LA to achieve climate resilience by actively adapting to Los Angeles's changing climate. The major climate hazards Cal State LA is exposed to include extreme heat events, wildfires and reduced air quality, drought conditions, and heavier storms and flooding. The resilience assessment reviews Cal State LA's strengths and vulnerabilities in relation to these climate hazards, and how they connect to the University's strategic priorities.

Cal State LA plans to achieve climate resilience with the completion of its strategic adaptation priorities by 2040. The University also intends to develop its community partnerships, curriculum and research opportunities to better integrate concepts of carbon neutrality and climate resilience. While these ambitions goals will require significant effort, Cal State LA is committed to pushing boundaries to create a more just, sustainable and resilient future.

Table of Contents

1. Introduction 5
1.1. Background 5
1.2. Cal State LA 6
2. Greenhouse Gas Inventories 10
2.1. Fiscal Year GHG Emissions 10
2.2. Trends and Targets 11
3. Carbon Neutrality Targets 13
3.1. Neutrality 2040: Scopes 1 and 2 Strategies 13
3.2. Neutrality 2045: Scope 3 Strategies 18
4. Resilience Assessment 21
4.1. Climate Hazards 21
4.2. Strengths and Vulnerabilities 24
5. Resilience Goals 28
5.1. Resilience Strategies 28
5.2. Community Partnerships 32
6. Curriculum and Research Development 34
7. Management Plan 37
7.1. Responsibilities 37
7.2. Tracking 39
7.3. Communication 39
8. Additional Considerations 40
9. Conclusion 41

Introduction

There is indisputable evidence that the earth's climate is warming, with observed increases in average global air and ocean temperatures, snow and ice melting, and rising sea levels.[3] In its Fifth Assessment Report, the Intergovernmental Panel on Climate Change (IPCC), a group of 1,300 independent scientific experts under the auspices of the United Nations, concluded it is more than 95% likely that human activities have caused much of the observed temperature increases over the past 50 years.[4] Climate change has already effected many ecological processes around the world, and it is expected to intensify changes in social, political and economic systems in the near future.

Both mitigation and adaptation strategies are necessary to address the worst case scenarios of climate change. Mitigation includes any intervention to reduce GHG emissions, and adaptation involves any adjustment in response to the impacts of climate change. These two strategies form the basis of Cal State LA's commitment to help create a more sustainable and resilient society. By integrating a mitigation goal of carbon neutrality with an adaptation plan to achieve climate resilience, Cal State LA is pushing boundaries in a changing climate.

1.1. Background

Climate change is influenced by the concentration of greenhouse gases (GHGs) and aerosols in the atmosphere, changes in reflectance from the land surface, and variation in incoming solar radiation.[5] Human activities that increase the concentrations of atmospheric GHGs, which trap solar radiation within the Earth's atmosphere and warm the planet, include the use of fossil fuels, deforestation, and agricultural production.

Global concentrations of GHGs have increased significantly since the beginning of the industrial revolution.[6] The six major GHGs from fossil fuel combustion and industrial processes—carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6)—have increased by 78% in atmospheric concentration from 1970 to 2011.[7] The most abundant GHG, CO2, has increased by 90% during this time period.[8]

State of California

California is the most populous state in the United States with over 39.5 million residents, and the third most extensive by area. It also boasts the world's fifth largest economy, with a Gross State Product that has increased steadily as GHG emissions continue to fall. This is in large part due to California international leadership on climate change, with strong statewide policies and rapid growth of an increasingly low-carbon economy.

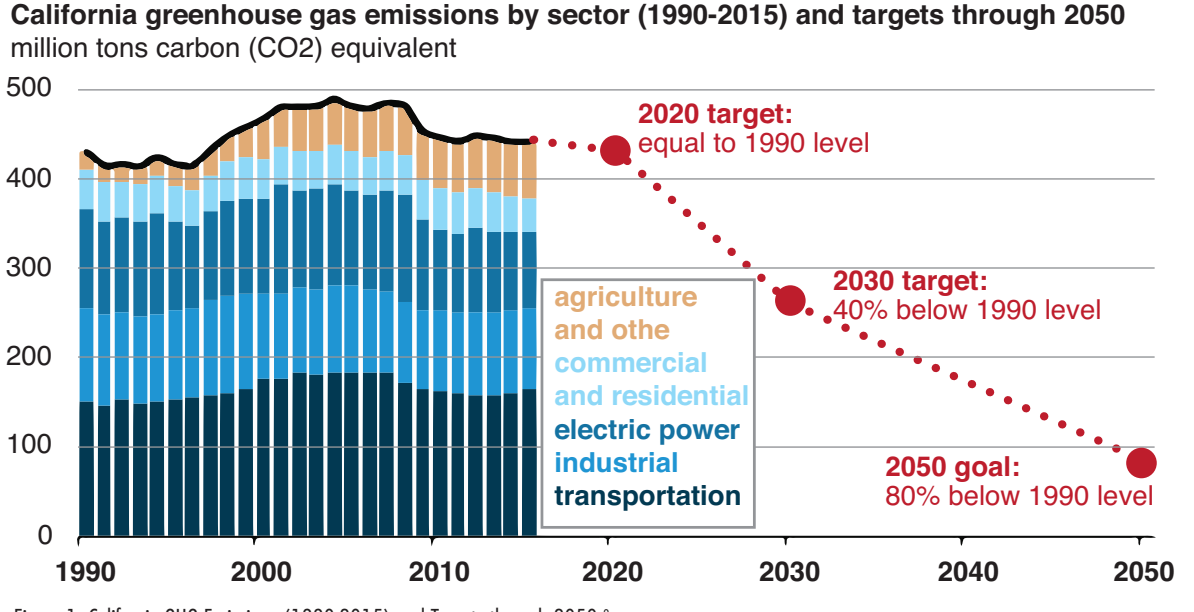


Figure 1: California GHG Emissions (1990-2015) and Targets through 2050 [9]

In 2006, Governor Schwarzenegger signed Assembly Bill 32 (AB 32) into law, establishing a commitment to reduce California's GHG emissions to 2000 levels by 2010, to 1990 levels by 2020, and to 80% below 1990 levels by 2050. California is ahead of schedule in meeting its 2020 goal.[10]

In 2016, Governor Jerry Brown signed Senate Bill 32 (SB 32), setting an intermediate goal of reducing GHGs to 40% below 1990 levels by 2030. In 2018, Brown signed Senate Bill (SB 100), committing California to 100% use of zero-carbon electricity by 2045, and Executive Order B-55-18, committing California to carbon neutrality by 2045 and to maintain net negative emissions thereafter.

City of Los Angeles

Los Angeles is the second-largest city in the country, covering 470 square miles and home to over 4 million people.[11] In May 2007, Los Angeles released "Green LA: An Action Plan to Lead the Nation in Fighting Global Warming" with a goal to reduce GHG emissions to 35% below 1990 levels by 2030. At the time of publication, Los Angeles had already reduced emissions to 7% below 1990 levels.

In 2013, Los Angeles became a partner of 100 Resilient Cities, a global program pioneered by the Rockefeller Foundation that helps cities integrate resilience planning into their approach to physical, social, and economic challenges.[12] In 2015, Mayor Garcetti released LA's "Sustainable City pLAn", a roadmap to achieve a more environmentally healthy, economically prosperous, and equitable city over the next 20 years.[13] In 2017, the Mayor's Office published "Resilient Los Angeles" with a goal of becoming better prepared for natural disasters, economic insecurity, aging infrastructure, and the threats of climate change.[14]

The Los Angeles Regional Collaborative for Climate Action and Sustainability (LARC), in partnership with LA County Metro and the California Strategic Growth Council, has also recently published "A Greater LA: A Framework for Climate Action."[15] The Framework presents an overview of the climate change hazards facing the Los Angeles region, with regionally specific recommendations across five impact areas: Energy, Transportation and Land Use, Ocean and Coastal Resources, Water, and Public Health.

California State University System

The California State University (CSU) is the nation's largest, most inclusive and most affordable university system, with 23 campuses and eight off-campus centers.[16] The CSU educates approximately 484,300 students, with more than 3.4 million living alumni, and employs over 52,000 individuals. It works to promote student success through opportunity and a high-quality education, and is an engine for social mobility throughout the State of California.

In 2014, the CSU Board of Trustees approved the first systemwide Sustainability Policy.[17] This policy seeks to integrate sustainability across all areas of the 23 universities, including academics, facilities operations, the built environment, and student life. In 2015, the CSU joined the White House American Campuses Act on Climate Pledge, agreeing to reduce carbon emissions to 80% below 1990 levels by 2040, install 80 MW of renewable and clean on-site generation by 2020, and reduce GHG emissions from transportation. In 2017, the CSU joined the We Are Still In Climate Declaration, pledging to uphold the climate goals of the Paris Agreement. To date, fifteen CSU campus presidents have signed one of the three Second Nature Climate Leadership Commitments.[18]

1.2. Cal State LA

Located just five miles from downtown Los Angeles, Cal State LA has one of the most diverse student populations of any college or university in the country.[19] In 2017, Cal State LA was ranked number one in the nation based on the upward mobility of its students, according to a study by The Equality of Opportunity Project and published by The New York Times. The study showed that Cal State LA has propelled a higher percentage of students from the bottom fifth into the top fifth of U.S. income earners than over 2,000 other colleges and universities.[20]

On April 4, 2016, Cal State LA's President Covino signed the most comprehensive of Second Nature's three Climate Leadership Commitments, the Climate Commitment. This commitment includes the publication of annual greenhouse gas (GHG) emissions inventories, a campus-community resilience assessment, active support of a joint campus-community resilience task force, development of a comprehensive Climate Action Plan, and the annual evaluation of progress toward carbon neutrality and climate resilience goals.

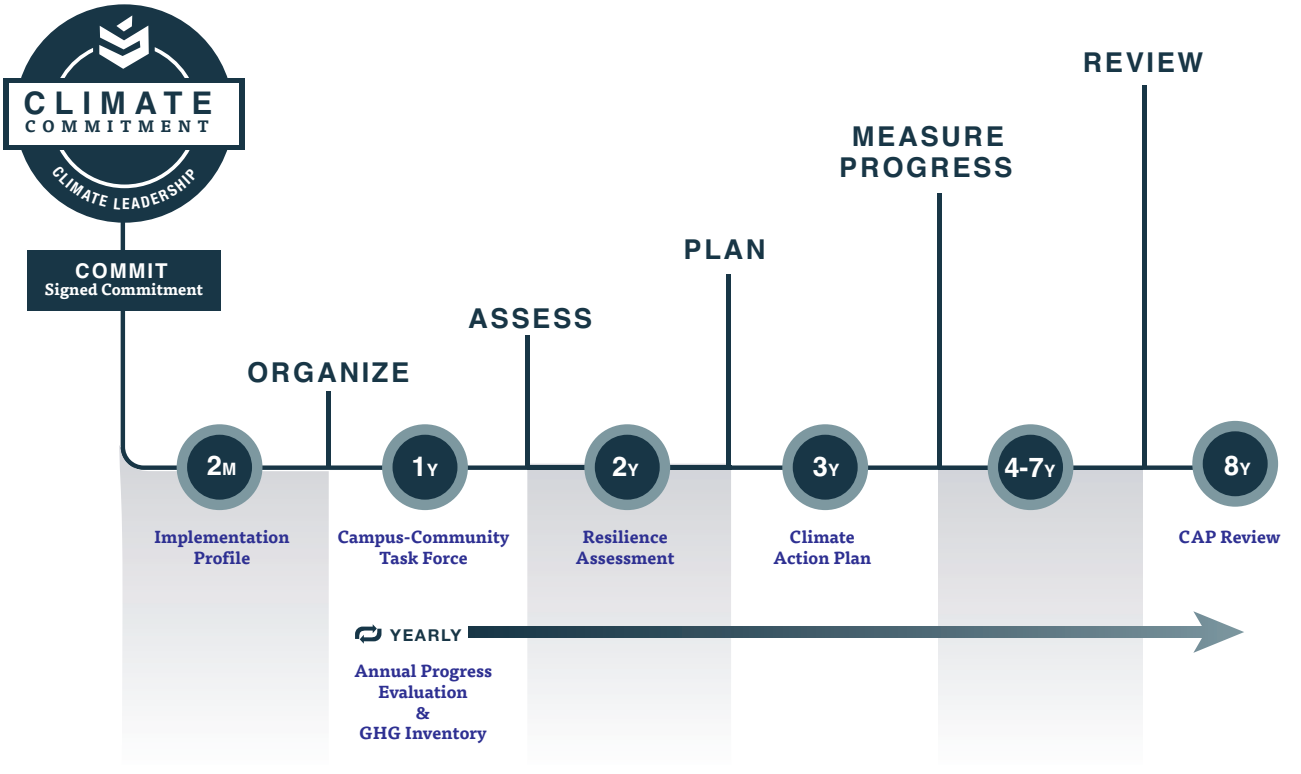


Figure 2: Second Nature Climate Commitment Timeline [21]

Campus Profile

Cal State LA is a 175 acre campus located in middle of Los Angeles's University Hills District. The campus borders the residential neighborhoods of Alhambra, South Pasadena and El Sereno in the northeast, with the City of Monterey Park in the southeast. Interstate 10, the San Bernardino Freeway, is located at the University's southern boundary, with Interstate 710, the Long Beach Freeway, along its eastern boundary. To the north and the west, the campus boundaries are defined by dramatic topography changes, with hillsides defining and limiting access to the campus.[22]

Cal State LA operates and maintains more than 4 million square feet of buildings and land, with close to 50 major buildings, and houses nearly 1,000 students on campus. The nine original campus buildings demonstrate passive solar building principles, including window overhangs on south-facing windows and cool roofs, helping to retain solar heat in the winter and reject solar heat in the summer.

Heating and Cooling Infrastructure

Cooling at Cal State LA is primarily provided by a central chilled water plant with a distribution system that serves a majority of buildings on campus. Developed in 1997, the Central Plant will soon be upgraded to have four 1,200 ton electric centrifugal chillers, providing chilled water to the campus buildings for space cooling. The plant also utilizes a thermal energy storage (TES) tank with a capacity of 2 million gallons. Several buildings, comprising 2.37 million gross square feet, are connected to the central plant cooling system.

The campus does not presently have a centralized system for providing heating hot water to the campus buildings. Heating hot water is provided by an array of in-building boilers located throughout campus. The actual installed capacity of in-building boilers at the campus is over 75 MMBtuh (input), with a total of 71 boilers in 15 buildings.

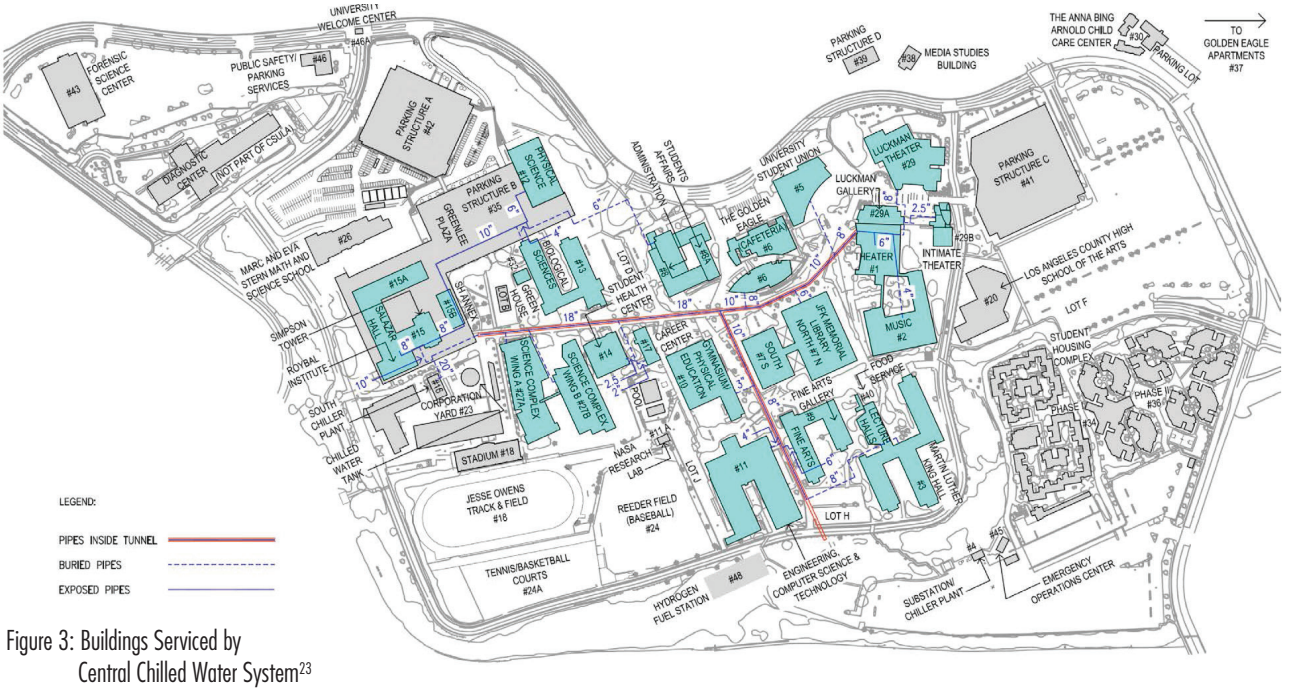


Figure 3: Buildings Serviced by Central Chilled Water System[23]

Campus Sustainability Committee

In 2015, the Cal State LA Campus Sustainability Committee (CSC) was created with Administrative Procedure 428. The purpose of this committee is to promote collaboration among faculty, students and staff in the adoption of best practices, policies, projects and technologies to improve the environmental, social and economic sustainability of the campus community. The CSC is charged with educating and engaging campus stakeholders and external partners on sustainability issues, integrating sustainability into campus policies and procedures, and facilitating communication of initiatives, strategic plans, assessments, and updates on campus sustainability efforts, both internally and externally.[24]

The CSC has four subcommittees: 1) Climate Action and Adaptation Planning, 2) Sustainability Policies and Reporting, 3) Green Revolving Fund Administration, and 4) Zero Waste Planning. The subcommittee on Climate Action and Adaptation Planning is responsible for ensuring Cal State LA fulfills the obligations of its Second Nature Climate Commitment. Representatives from different areas on campus participate in this subcommittee, including Administration, Environmental Health & Safety, Transportation, Facilities, Planning, Design & Construction, and representatives from faculty members and students. Feedback on this Climate Action Plan was received through an iterative process from the campus community, including administration, staff, faculty and students.

Campus-Community Partnership

Cal State LA, with the support of CSU Northridge and UCLA, helped establish a campus-community task force with the City of Los Angeles to ensure University's resilience planning efforts align with the city's broader strategies. As a result, the City of Los Angeles agreed to partner with local academic institutions to develop and launch a Campus Resilience Challenge to promote and encourage innovative actions that advance physical resilience and social cohesion by engaging local institutional partners.

The Campus Resilience Challenge is listed as action item 23 in the "Resilient Los Angeles," with a description to "participate in a Campus Resilience advisory group, share training and resilience planning and implementation resources, and receive recognition from the City. Many of these institutions have already signed Second Nature's Climate Commitment to carbon neutrality and resilience. The Challenge will first be offered to universities and colleges and then be extended to other academic institutions and private sector campuses. By convening major institutions and promoting idea-sharing, the Campus Resilience Challenge will encourage innovations in community resilience-building while establishing a network of institutions that can communicate resilience awareness to surrounding neighborhoods."[25]

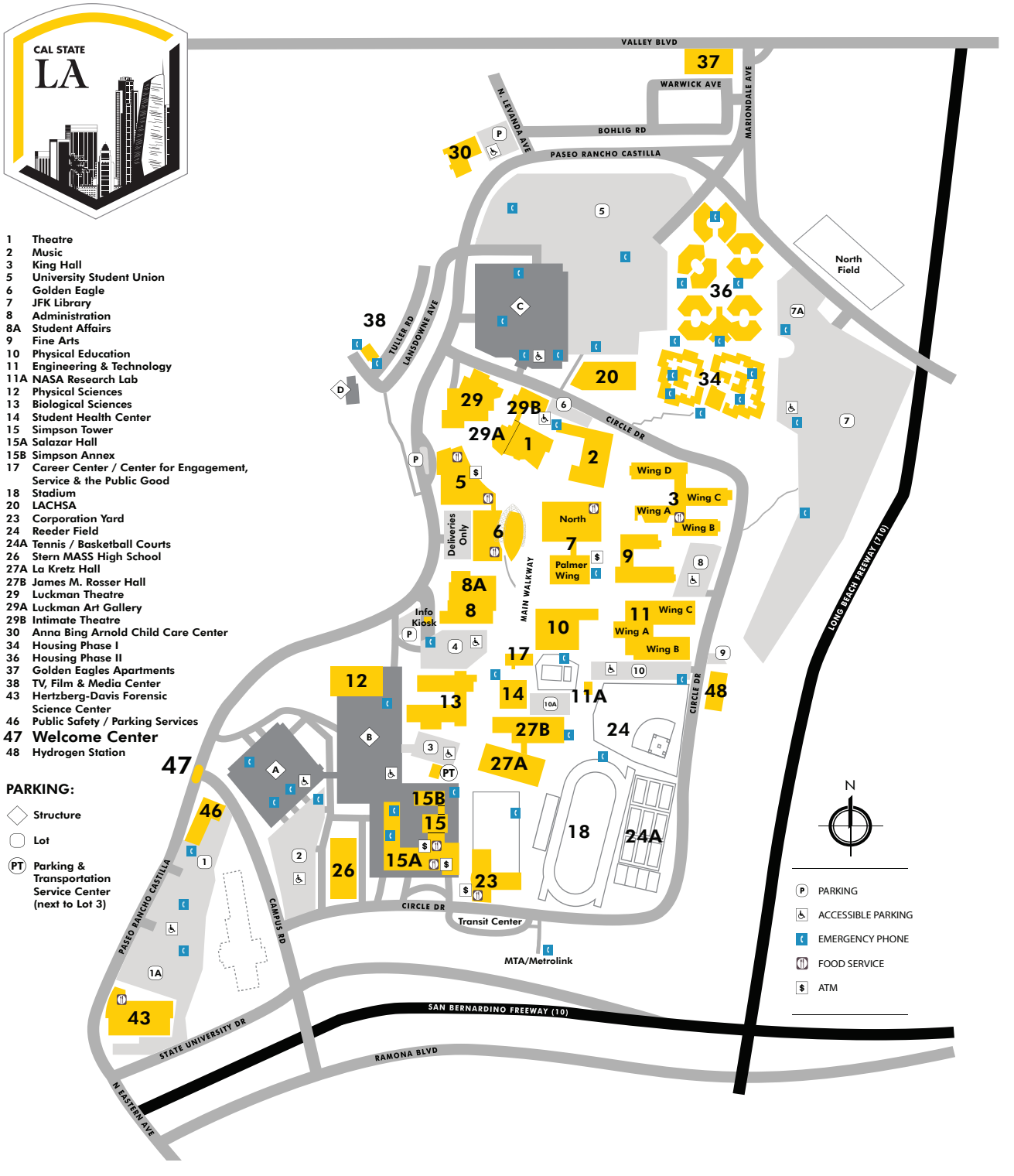


Figure 4: Campus Map of Cal State LA

Greenhouse Gas Inventories

Cal State LA uses GHG emission inventories to measure its annual carbon footprint, develop effective strategies for reducing GHG emissions, and to track progress against its 2040 and 2045 carbon neutrality goals. These inventories are divided into 3 scopes, per the internationally recognized Greenhouse Gas Protocol, as follows:

Starting with fiscal year (FY) 2015-16, which runs from July 1 to June 30, Cal State LA began conducting comprehensive GHG inventories that include all major GHG emissions under scope 3. In April 2016, Cal State LA completed its first annual Student Commute Survey to quantify the number of students traveling to and from campus, the frequency of their commutes, and their modes of transportation. This

Table 1

Scope 1	Scope 2	Scope 3
Stationary Fuels (Oil, Natural Gas, Propane) Transport Fuels (Gasoline, Diesel, Hydrogen) Refrigerants & Chemicals	Purchased Electricity from LADWP Renewable Energy Credits (RECs)	Commuting (Faculty, Staff, Student) Business Travel (Personal Mileage, Air Travel) Solid Waste Disposal

Since GHGs vary in their ability to warm the planet, GHG inventories also use global warming potential (GWP) values to combine emissions of various GHGs into a single weighted value of emissions. For example, methane has 25 times the impact on climate change than an equivalent amount of CO_2.[26] This common metric is based on carbon dioxide, and referenced as metric tons of carbon dioxide equivalent or $MTCO_2e$.[27]

2.1. Fiscal Year GHG Emissions

Cal State LA burns natural gas on campus for heating, cooking, and maintenance. The University also maintains fossil fuel use for its transportation fleet and other facility operations, and uses in-house building services engineers (BSEs) to service the on-campus chillers and refrigeration units that result in fugitive emissions. These direct GHG emissions are accounted for under scope 1.

Cal State LA generates some electricity on-site through solar photovoltaics (PV) panels, but the majority of electricity is purchased from Los Angeles Department of Water and Power (LADWP). As of 2017, 31% of LADWP's power resources were renewable, with the remaining power derived from coal (19%), natural gas (35%), nuclear (11%) and large hydro (4%).[28] Using LADWP's historical electricity CO_2 intensity metrics, consumption in MWh was multiplied by emissions factors for annual scope 2 emissions.[29] Renewable Energy Credits (RECs) are purchased to offset the carbon emissions from Cal State LA's Hydrogen Station. GHG emissions related to purchased electricity falls within scope 2.

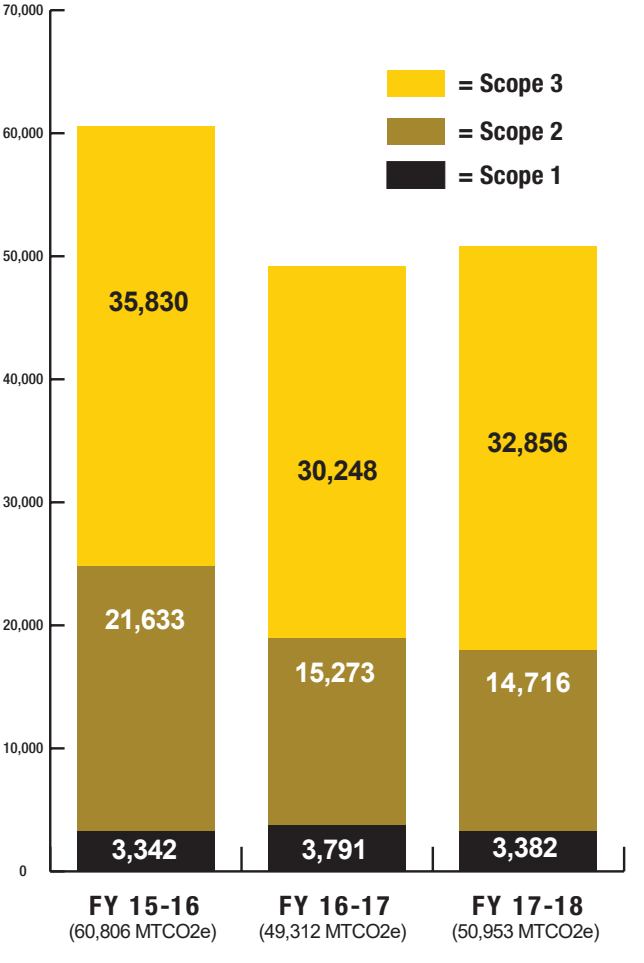


Figure 5: GHG Emissions by Scope

information was used to help estimate scope 3 emissions and gather suggestions to improve campus transportation options.

Cal State LA employees participate in a similar Commuter Transportation Survey provided annually by the Los Angeles County Metropolitan Transportation Authority. Business travel expenses, including both personal mileage and air travel, is maintained by Business Financial Services. Solid waste tonnage sent to landfill is reported by diversion reports provided by the University's waste hauler.

The most significant decrease in total GHG emissions in any category between FY 2015-16 and FY 2017-18 is from electricity. This is largely due to LADWP's recent selling of its share in the Navajo Generating Station (NGS), the largest coal-fired power plant operating in the western United States.[30] The other most significant decrease in GHG emissions comes from employee and student commuting. This is largely attributable to Cal State LA's recent conversion from a quarter to semester schedule, resulting in a reduced number of school days per year. Student commuting is also the largest category contributing to the University's carbon footprint, accounting for approximately 48% of total emissions, followed by purchased electricity with between 29-35% of total emissions.

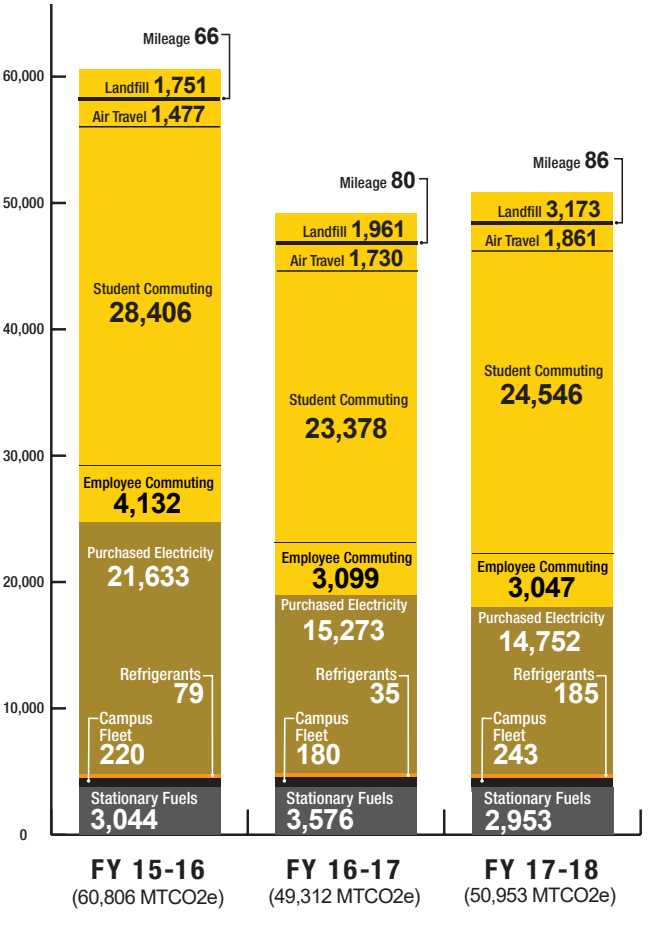


Figure 6: GHG Emissions by Category

While approximately 35% of total campus GHG emissions are within scopes 1 and 2, over 60% are found within scope 3. These indirect emissions are mostly outside of the University's direct control, representing both significant challenges and the biggest opportunity to reduce Cal State LA's overall carbon footprint.

2.2. Trends and Targets

Cal State LA's 1990 GHG inventory baseline for scopes 1 and 2 emission totals 28,712 MTCO2e. Based on the CSU Chancellor's Office system-wide greenhouse gas (GHG) emissions inventory, it is estimated Cal State LA used approximately 35.5 million kWh/year of electricity and 660,777 therms of natural gas in 1990. Since energy use data is not available until FY 1993-94, GHG emissions data from the CSU Chancellor's Office was similarly used for 1991 and 1992. Starting in FY 2007-08, scope 1 data was expanded beyond natural gas, diesel, and gasoline to include propane use. In FY 2014-15, scope 1 data was further expanded to include refrigerants and chemicals.

In order to decide what blend of strategies Cal State LA needs to implement to become carbon neutral, these emission trends were projected through 2040 for scopes 1 and 2 if business as usual (BAU) operations were to continue in the absence of additional mitigation efforts. Annual carbon neutrality targets were also developed for scopes 1 and 2 (2040) and scope 3 (2045). Cal State LA has an interim target to reduce scopes 1 and 2 emissions to 40% below 1990 levels by 2030, consistent with SB 32.

Cal State LA has already successfully reduced its GHG emissions to below 1990 levels, an AB 32 goal which was originally set for 2020. Scopes 1 and 2 GHG emissions calculated for FY 2017-18 are approximately 37% lower than the FY 1990-91 baseline, and 55% lower per full-time equivalent (FTE) student. During this time, Cal State LA has also increased from 2.4 million gross square feet (GSF) to 3.1 million GSF, a 29% increase since FY 1990-91, while reducing site energy use index from 80.6 kBtu/GSF/year to 66.6 kBtu/SFT/year, a reduction of approximately 17%.[31]

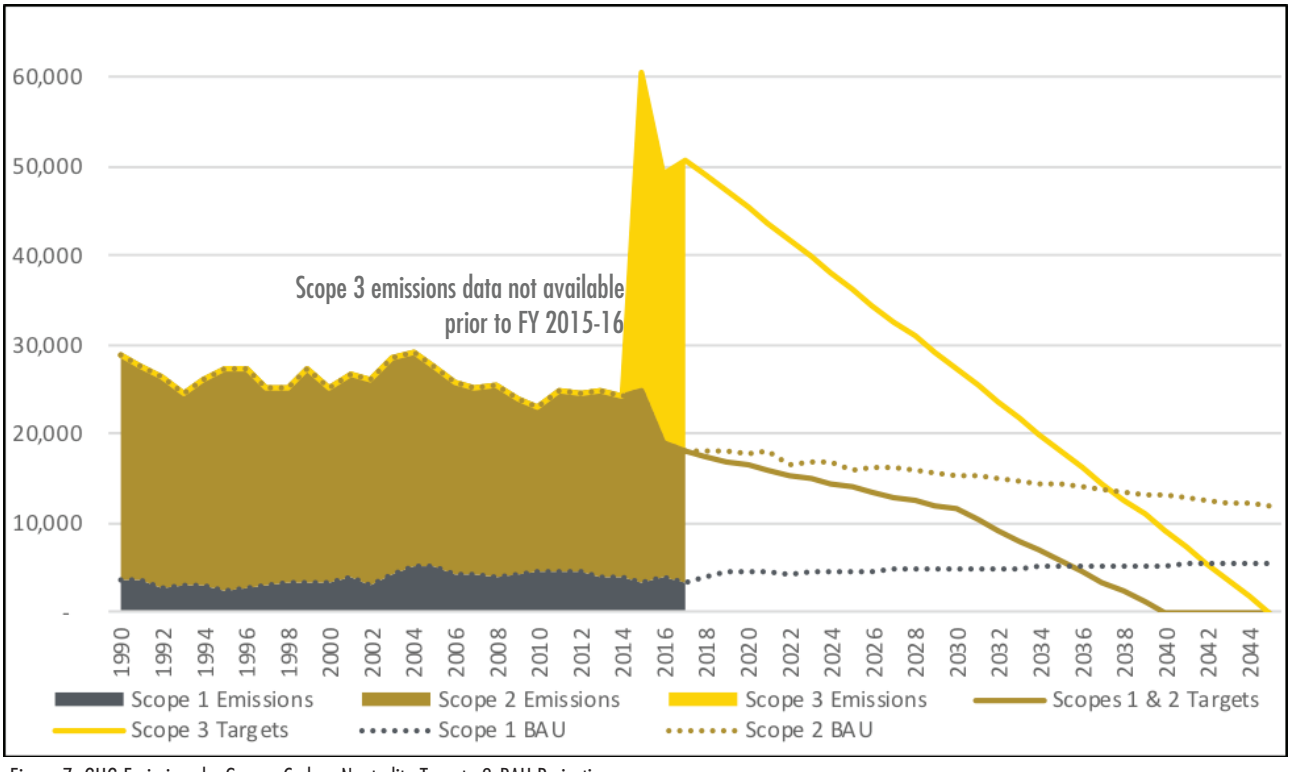


Figure 7: GHG Emissions by Scope, Carbon Neutrality Targets & BAU Projections

Although Cal State LA has achieved its first target, near term building growth during the next five to ten years to support the academic mission of the campus is likely to negatively impact these downward trends. Proposed new construction includes Rongxiang Xu Bioscience Innovation Center, Parking Structure E, Rosie Casals/Pancho Gonzales Tennis Center, and Student Housing East. These buildings are estimated to add another 1,496 MTCO2e to scopes 1 and 2 emissions.

Carbon Neutrality Targets

Cal State LA's definition of operational carbon neutrality includes GHG emissions from scopes 1 and 2 only, with scope 3 included in its definition of full carbon neutrality. The following sections outline a list of necessary emissions reduction strategies to drive Cal State LA toward an operational neutrality target date of 2040 and a full neutrality target date of 2045.

These emission reduction strategies represent the first priority of Cal State LA's carbon management hierarchy.[32] This hierarchy prioritizes internal GHG mitigation measures that replace sources of emissions, reduce existing emissions, and avoid new emissions. However, it is unlikely that these strategies alone will allow Cal State LA to achieve carbon neutrality. If there are any remaining GHG emissions beyond the operational and full neutrality target dates, Cal State LA is committed to purchasing carbon offsets on the open market, as necessary, in perpetuity.

Cal State LA approaches carbon offsets as a last resort under its carbon management hierarchy. Offsets will only be purchased to account for remaining GHG emissions at the end of each neutrality target date while continuing to pursue emissions reduction strategies. Each year, as further internal reductions are made, fewer annual offsets will be purchased to maintain operational and full neutrality.

Cal State LA is also committed to only purchase offsets that represent real emissions reductions with corollary social benefits. Purchased offsets should add value to Cal State LA's academic mission, support systemwide initiatives in Academic and Student Affairs, or contribute to climate resilience efforts to create a healthy, just, and sustainable society.



Figure 8: Electric Grounds Equipment Demonstration

3.1. Neutrality 2040: Scopes 1 and 2 Strategies

Cal State LA commits to operational carbon neutrality by the year 2040. The University has intermediate goals to reduce GHG emissions to 60% below 1990 levels by 2030, surpassing the goal of SB 32, and 80% below 1990 levels by 2035.

The following list of strategies will facilitate Cal State LA's goal to achieve operational carbon neutrality by the year 2040. Achieving operational carbon neutrality economically requires aggressive adoption of the below energy efficiency and renewable energy measures to reduce current electricity and natural gas use by at least 50%. It is estimated that these efforts will cost Cal State LA some $200-300 million in building side improvements with a net positive return on investment.[33]

Each of the following mitigation strategies include a group that is responsible for completing the necessary measures on campus. These groups include Facilities Services (**FS**), Planning, Design & Construction (**PDC**), Purchasing and Contracts Services (**PCS**), Housing and Residential Life (**HRL**), Human Resources (**HR**), and the Office of the Vice Provost for Planning & Budget (**PB**).

1. Electric Grounds Equipment (FS)

In January 2016, Facilities Services participated in SCAQMD's lawn mower exchange program and subsequently purchased a zero-emission lawn mower and 12 cordless blowers with plans to upgrade to 100% zero-emissions grounds equipment.

2. Update Campus Fleet (FS)

Replace all gas and diesel powered campus vehicles with hydrogen or electric alternatives. Eliminate gas or diesel powered vehicles for maintenance work where size and type of vehicle is not needed. The University has already acquired four hydrogen fuel cell vehicles, and recently acquired one of two hydrogen shuttles to transport students to the University's downtown campus.

3. Upgrade Air Handler Units (FS)

Replace existing constant volume air handlers with new variable air volume (VAV) air handlers, with variable frequency drives (VFDs) to modulate fan speed, air-side economizers for free cooling, and high delta-T water coils to improve central plant efficiency.

4. HVAC Controls (FS)

Replace existing pneumatic controls with state-of-the-art DDC controls to allow maintenance technicians to remotely monitor room temperature conditions, maintain setpoint schedules, and detect potential problems in advance. Link existing occupancy sensors to the Metasys system so zone temperatures can be reset when no occupancy is detected. When there are no occupants, the energy management system (EMS) will automatically set back zone temperatures to a more efficient setting. Use real-time weather data to automatically regulate HVAC set-points. Learn occupancy patterns of spaces and adjust occupied schedules accordingly.

5. Demand Controlled Ventilation (FS)

Install CO2 sensors to control outside air volume at all zones with variable occupancy for Demand Controlled Ventilation (DCV) HVAC controls. Reducing the fresh airflow at lower occupancy conditions enables a reduction in heating energy and cooling energy.

6. High Efficiency Glazing and Windows (FS)

Replace existing single-pane windows with double- and triple-pane windows at south-facing and west-facing conditioned rooms throughout campus. Retrofit of existing building glazing with high-efficiency glazing material that provides the best combination of low U-value, high visible transmittance for daylight and low space heat gain coefficient to minimize solar heat gain. Replace additional building exposures as necessary. Facilities Services has started sealing all windows to prevent the loss of conditioned air in buildings and other facilities across campus.

7. Exterior LED and Solar Lighting (FS)

Complete conversion of all high pressure sodium, metal halide, halogen/incandescent, and compact fluorescent exterior lighting with LED fixtures and multilevel lighting control system. This includes installing “smart sensors” at each fixture to allow for occupancy sensing, daylight harvesting, light level scheduling, and demand response controls. The University has retrofitted approximately 600 exterior light fixtures to LED technology, including roadway pole fixtures along Circle Drive, parking lot pole fixtures at Lots 1 and 5, Parking Structures B and D, and various building wall packs and flood fixtures.

8. Interior LED Lighting (FS)

Complete replacement of all linear fluorescent and compact fluorescent interior lighting, including all incandescent or compact-fluorescent exit signs, to light-emitting diode (LED) technology. LED lighting can reduce existing lighting load by as much as 50% and allows for more efficient controls, such as dimming and daylight harvesting. Interior LED lighting upgrades have been employed in the Welcome Center, Salazar Hall, Simpson Tower, JFK Library, BioScience, King Hall, Golden Eagle and the Wallis-Annenberg Science Complex, with occupancy sensors located in approximately 90% of all classrooms throughout campus.

9. Advanced Lighting Controls (FS)

Install networked wireless system to allow time scheduling, daylight harvesting, occupancy sensing, and demand response. Use occupancy sensors to shut off lighting in unoccupied spaces and photocells to dim lighting to maximize use of daylight. Install new bi-level LED fixtures integrated with an ultra-sonic motion sensor at all stairwells to step-down to a fraction of full load when the space is unoccupied. While most campus buildings utilize occupancy sensors in key areas like classrooms and offices, there are many spaces like hallways, restrooms, and storage areas that lack such controls.

Most buildings also have an abundant amount of daylight, creating a significant opportunity to eliminate 60% or more of the wasted lighting energy while enhancing occupant comfort and productivity.[34] Based on real-time data collected, better decisions to control lighting, HVAC, and plug loads can be made. Advanced controls can also be used to track occupancy to determine how spaces are being used, turn off selected plug loads if spaces are not being used, and integrate with space reservation systems for HVAC scheduling in multi-use buildings.

10. Adjust Custodial Hours (FS)

Change custodial working hours from early morning to day shifts to reduce energy usage. Building ventilation and lighting systems will not be operated any more or longer than what is required under health and safety codes during the low load custodial occupancy periods.

11. Continuous Commissioning (FS)

Continuous commissioning is an ongoing process used to resolve operating problems, improve comfort, and reduce energy use by utilizing automated data from the building management system. Monitoring tools such as Johnson Controls Metasys BAS, SkySpark Analytics Software, and a comprehensive utility metering program will all play a critical role in the success of future building performance. Additional staffing, including a Controls Specialist, will be needed for an in-house MBCx team to implement recommendations from SkySpark's fault-detection diagnostic system.

In 2018, commissioning was completed at Salazar Hall with major lighting, mechanical equipment and automation system programming upgrades using SkySpark analytics. These improvements are estimated to reduce the building's GHG footprint by over 950 MTCO2e annually. By demonstrating significant financial and environmental benefits, along with numerous building occupant improvements, the Salazar Hall project won the CSU Facilities Management Conference Best Practice Award for Energy Retrofit. The success of this project will be used as a model for subsequent projects to be conducted on all major buildings across Cal State LA.



Figure 9: Solar Panels and Wind Turbine on E&T

12. Expand Central Chilled Water Loop (PDC)

Tie the Corporation Yard, and Student Housing East, and potentially both the MASS Stern and LACHSA buildings, to the campus central CHW loop. Existing HVAC systems at these buildings are chilled water based and use their own air-cooled chiller located in the building. Tying to the central CHW loop will result in higher efficiencies through the water-cooled chiller system and electric load shifting through the TES system. The University recently replaced one of the two existing central plant chillers with a high-efficiency chiller utilizing variable frequency drives (VFDs) and frictionless compressors. The installation of two new 1,200 ton electric chillers to supplement existing chiller capacity will help maintain redundancy while satisfying the growing cooling demands of the campus.

13. Develop Central Hot Water Loop (PDC)

Heating hot water for buildings is generated by a multitude of boilers spread across various buildings. While a centralized plant conversion is capital intensive, a centralized system would reduce the total installed system capacity while reducing maintenance labor and associated costs. If a central hot water loop proves infeasible, the University will implement a boiler replacement program whereby all end-of-life gas boilers are replaced with water loop heat pump (WLHP) systems.

14. Superinsulation of Building Envelopes (PDC)

Superinsulation dramatically reduces heat loss and gain by using very high levels of insulation, typically R-40 walls and R-60 roof, and airtight construction, especially around doors and windows to prevent air infiltration. Presently there is minimal insulation in most campus buildings, particularly in some of the older concrete buildings. Choice of building materials used for walls and roofs during a building renovation effort, and heat recovery ventilation systems to provide fresh air, would help to achieve higher building performance.

15. DC Power Systems (PDC)

Direct DC power in buildings avoid traditional AC power conversion losses. Other benefits include higher efficiency energy storage, enhanced system reliability through use of



Figure 10: Proposed Solar on ZNE Parking Structure E

multiple small networks, and enhanced electric vehicle integration. The University can explore DC power system opportunities not only in new building applications, but also in existing buildings. This can be achieved by creating interconnected scalable DC microgrid networks as small as a single room or building floor.

16. Renewable Energy (PDC)

Cal State LA installed a 77-panel solar photovoltaic (PV) system atop the Engineering and Technology building in July 2011 that produces approximately 11,000 to 12,000 kWh annually. The University needs to dramatically increase its commitment to solar energy with the placement of up to 16.1 MW (DC) of PV capacity (or 24.7 million kWh /year of annual renewable energy generation).[35] This can be achieved either at an off-campus property or on several existing campus buildings, such as Fine Arts, Physical Education, University Student Union, Parking Structure A, C and E, Salazar Hall, and the Corp Yard.

17. Battery Storage (PDC)

A battery energy storage system (BESS) stores electrical energy in a reversible chemical reaction. In application, a renewable energy source like PV will generate electricity and the battery stores it for times that it is needed. Battery storage can be installed to offset high peak load charges from the utility. By shifting to stored energy when demand costs are highest, Cal State LA will be able to significantly reduce LADWP electricity charges without disrupting building operations or requiring additional demands on staff.

18. Utility Infrastructure Upgrades (PDC)

Over $28M was allocated in the Five-Year Capital Improvement Program 2013-18 to upgrade and expand critical components, including a central chiller plant upgrade, expansion and replacement of campus-wide chilled water coils, replacement of electrical switchgear, and the upgrade of the medium voltage distribution feeder system currently serving the University. These critical assets will require ongoing maintenance and continual improvements.

19. Establish Building Energy Use Benchmarks (PDC)

Whole- building energy performance targets are one of the best practice for designing zero net energy buildings.[36] Energy performance targets use of static baselines to compare against similar building types. This would allow Cal State LA to evaluate the energy use for all building loads beyond those regulated by the California Building Code energy-efficiency standards (Title 24). It also eliminates the limitations of trying to achieve a percentage energy savings relative to a moving baseline, as the code is regularly updated per statute.

20. LEED Gold Minimum Certification Standard (PDC)

All new buildings and renovations of major existing major buildings on campus will receive a LEED Gold certification or higher. The upcoming Rosie Casals/Pancho Gonzalez Tennis Center and Student Housing East new construction projects, along with the Physical Sciences renovation, are currently tracking to achieve LEED Gold certifications.

21. Zero Net Energy Buildings (PDC)

A net zero energy (ZNE) building is an energy-efficient building where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy.[37] Some best practices for ZNE buildings include strategic building orientation, heating and cooling with electrically driven air-source heat pumps, and heat-recovery ventilation.[38]

The University embraces the goals set forth by the California Public Utilities Commission (CPUC) in their "Big Bold Energy Efficiency Strategies" (BBEES) which state the following:

- all new residential construction will be Zero Net Energy (ZNE) by 2020,
- all new commercial construction will be ZNE by 2030, and
- 50% of the existing commercial buildings will be retrofit to ZNE by 2030

Cal State LA commits that all new construction beginning design after 2025 will be Zero Energy Ready (ZER), and all new construction will be ZNE by 2030. ZER buildings meet the same high efficiency standards as ZNE Buildings, but lack on-site renewables. To support these goals, the University is constructing a ZNE Parking Structure E with close to 1MW of solar power generation.



Figure 11: Cal State LA's Transportation Hub

Making new buildings all-electric will effectively reduce Cal State LA's carbon footprint without the complications of decarbonizing natural gas consumption through purchasing either carbon offsets or directed biogas.[39] Buildings that are all-electric, the only delivered energy type that can be effectively offset with renewable energy, have shown to be comparable or slightly less expensive than combined gas and electric buildings from a 20-year life cycle cost perspective, factoring in both capital and energy costs.[40]

22. Upgrade Housing HVAC Systems (HRL)

Replace aging HVAC systems at Housing Phase 1 (all-electric single-zone split-type heat pumps) and Housing 2 (single-zone split-type A/C systems with indoor gas-fired furnaces) with high-efficiency units of the same capacity. Replace existing programmable thermostats by installing network thermostats and occupancy sensors, allowing maintenance staff to monitor, diagnose, and control HVAC systems from a central location.

23. Annual Energy Challenge (HRL)

Implement network metering and real time energy use information systems to support an energy conservation competitions among Housing residents. This program would allow Housing to educate, motivate, and empower their building occupants to conserve energy and water as they compete to achieve the highest percent reduction in utilities compared to a baseline period. An effective competition incentivizes students to change their behavior with public commitments, outreach campaigns, and a user-friendly web interfaces to allow participants to track competition standings. Energy cost savings attributable to the Energy Challenge could be used to help fund Housing's other sustainability efforts, as well as being expanded across campus.

24. Electronics Purchasing Policy (PCS)

Create an electronics purchasing and management program that prioritizes the purchase of Energy Star, and/or EPEAT Bronze rating level certified products. Energy Star is a standard

for energy efficient consumer products administered by the U.S. Environmental Protection Agency and the U.S. Department of Energy. EPEAT (Electronic Product Environmental Assessment Tool) evaluates the effect of a product on the environment and ranks products as gold, silver or bronze based on a set of environmental performance criteria.

25. Alternative Workweek Schedule (HR):

Offer staff employees an optional summer time compressed workweek, such as a 4-day workweek with 10-hour days. A staff telecommuting option would additionally support the reduction of scope 3 emissions associated with traditional commuting. With changes in technology, many jobs are capable of being done remotely. Flexible work schedules would lower campus energy costs, increase energy efficiency, and decrease the number of days employees commute to work. They have also been shown to improve efficiency if work schedules match employees' most productive hours, and improve morale by giving employees more control over scheduling personal responsibilities.

26. Adjust Academic Scheduling (PB)

Summertime courses should be scheduled in classrooms with consideration to building occupancy. If classes were consolidated in areas to match HVAC zones then heating and cooling resources would be reduced. The University should also consider the pushing back the start of its Fall semester to late September to avoid cooling demand on extreme heat days.



Figure 12: Cal State LA's U-Pass Card

3.2. Neutrality 2045: Scope 3 Strategies

Cal State LA commits to campus-wide carbon neutrality by the year 2045. This target includes the elimination of all indirect emissions under scope 3 related to student, faculty and staff commuting, business-related air travel and personal mileage, and solid waste disposal. This ambitious goal is compounded by the fact that scope 3 accounts for more than 60% of the University's total annual GHG inventories. Scope 3 emissions are double the size of scope 2 emissions, and nearly 10 times the amount of the University's scope 1 emissions.

The following list of scope 3 strategies, in addition to the Neutrality 2040 strategies provided in the previous section, would dramatically increase the University's goal to reach full carbon neutrality by the year 2045.

Each of the following scope 3 mitigation strategies include a group that is responsible for completing the necessary measures on campus. These groups include Parking & Transportation Services (**PTS**), Housing and Residential Life (**HRL**), the Office of the Vice Provost for Planning & Budget (**PB**), Business Financial Services (**BFS**), University Auxiliary Services (**UAS**), and Facilities Services (**FS**).

27. Promote Active Transportation (PTS)

Place Metro bike docking stations at 3 strategic campus locations frequented by students, with access to safe route zones to and from the campus transit center. The identified locations will provide secured parking for bike stations, and will be operated via a Metro TAP card that can be used for both transit and bike share systems. This bike sharing program will help to reduce reliance on car ownership with a viable "first-last mile" solution to close the gap between transit options.

28. Expand Bike Infrastructure (PTS)

Commuter Services provides secured bike lockers located at 4 different locations around the campus. Additional bike racks, along with a bike repair station, should be installed on campus. The University should also establish bike lanes on the main campus road, Paseo Rancho Castilla, to help improve traffic safety. Bike lanes promote safety by establishing protective boundaries between bicyclists and vehicle traffic.

29. Expand Public Transportation Routes to Campus (PTS):

The Cal State LA Transit Center hosts bus lines operated by both the Metropolitan Transportation Authority (Metro) and Foothill Transit, various community-based shuttles, such as the Alhambra Community Transit (ACT), East Los Angeles Shuttle (El Sol), Edelman's Children's Court Shuttle and the Monterey Park Shuttle (Spirit), along with a Metrolink train station. The Transit Center serves approximately 750 passengers daily and provides direct service to more than 35 communities in the San Gabriel Valley and other nearby communities.[41] Despite these options, most commuters arrive to campus by car, thereby creating the need to expand public transportation services and limit the number of parking permits issued annually.

30. Carpool Program (PTS):

The Commuter Services office provides match lists to University members who are looking for potential rideshare partners. In January 2017, the University launched Ride Amigos!, a ride-sharing platform enabling the campus community to find carpool buddies, new bike routes, transit options, and vanpools. Cal State LA employees who carpool and arrive at work before 11:00 am are eligible to receive preferred parking on campus. This program should be expanded to all faculty, staff and students.

31. EV Charging Stations (PTS):

The campus currently hosts 11 electric vehicle (EV) charging stations with 19 level 2 ports. Parking Structure E will add an additional 30 EV chargers to the campus, with several more being planned at various locations throughout campus. The number of EV charging stations will need to be continually increased to meet the growing demand of zero emissions electric vehicles.

32. Metro U-Pass Program (PTS):

Cal State LA currently offers over 3,000 students unlimited rides on any Metro system in LA County that accepts TAP at a 45% discounted price. The Metro U-Pass program is subsidized by Metro, the Student Success Fee and Parking & Transportation Services. The University should work with Metro to gradually increase the subsidy rates as the program continues grow with a goal of providing free TAP cards for all full time students.

33. Car Sharing (PTS):

Cal State LA has partnered with Zipcar and WaiveCar to bring shared mobility programs to the University. WaiveCar offers hydrogen fuel cell vehicles for all faculty, staff and students age 18 years and older with a driver's license. There is no cost to drive WaiveCar vehicles for the first 2 hours of every rental, although additional time is charged by the hour.

34. Freshman On-Campus Housing Requirement (HRL):

All admitted first-time freshmen who graduated from a high school outside a 30 mile radius of Cal State LA will be required to live on campus for their first year. Students who live on-campus are more likely to stay enrolled, have better grades, graduate on time, participate in extracurricular activities, and experience a higher overall satisfaction with their college experience.

35. Distance Learning and Compressed Schedules (PB):

Cal State LA will increase the number of online and hybrid class offerings. Online courses meet completely online, whereas hybrid courses have one or more class meetings on campus, such as a lab, orientation or proctored test. The Office of the Vice Provost for Planning & Budget will also work to schedule longer classes that meet less often to reduce the need for unnecessary commuting.

36. Carbon Fee for Business-Related Air Travel (BFS):

Create a program modeled after UCLA's Air Travel Mitigation Fund, which imposes a $9 or $25 fee to each domestic and international round-trip, respectively. Air travel mitigation fees will be assessed to the traveler's department, collected and placed into a fund. This fund will then be made available to finance on-campus projects that make a measurable reduction in greenhouse gas emissions.

37. Organics Composting System (UAS):

Conventional waste disposal systems that send food and other organic materials to landfills produce methane, an extremely potent greenhouse gas. Composting source separate organic waste allows aerobic decomposition to limit the production and release of methane into

the atmosphere. Applying organic compost to soils is an effective way of diverting these GHG emissions from the atmosphere and converting it into stable carbon that remains bound in the soil for long periods of time. It also reduces the need for fossil fuels based fertilizers.

38. Zero Waste Coordinator (FS):

In 2016, Cal State LA developed a Zero Waste Plan to achieve the policy goals of the California State University Sustainability Policy, which are:

- Reduce solid waste disposal by 50% by 2016
- Reduce solid waste disposal by 80% by 2020
- Move to Zero Waste

Cal State LA currently diverts approximately 63% of its discarded materials from landfills through source-separated recycling and mixed waste processing. In order to increase Cal State LA's diversion rate, a Zero Waste Coordinator will need to be hired to pursue the following actions: expand existing reuse programs, prepare additional signage and recycling guides, develop Environmentally Preferable Purchasing Policies, raise profile of buy recycled campaign, improve move-out day program, recruit Recycling Champions throughout campus, eliminate stand-alone trash bins on campus, implement an on-site organics composting system, and provide ongoing trainings to students, faculty and staff. The Zero Waste Coordinator will also be responsible for compliance with California laws and regulations, including AB 1826 (Mandatory Commercial Organics Recycling) and SB 1383 (Short-Lived Climate Pollutants).[42]

Ultimately, Cal State LA will always have a certain portion of irreducible net GHG emissions, especially with regards to scope 3 emissions. Scope 3 emissions are by definition outside of Cal State LA's ability to manage through internal operational decisions. They are also not able to be precisely calculated, and can only be roughly estimated based on best available data. While this offers an opportunity to leverage the University's research capacity to develop new and innovative offsetting approaches, it is likely that the University will have to commit to the purchase of carbon offsets indefinitely.

Resilience Assessment

Cal State LA's resilience assessment addresses the University's need to actively adapt to Los Angeles's changing climate. Second Nature defines resilience as increasing the ability to survive disruption and to anticipate, adapt, and flourish in the face of change.[43] The following assessment and list of strategies provides a roadmap to enhance Cal State LA's capacity to adapt to a changing climate and create a more resilient campus community.

4.1. Climate Hazards

A climate hazard is defined as a physical process or event that can harm human health, livelihoods or natural resources.[44] The Los Angeles region is exposed to three direct climate change hazards: changes in average temperature, altered precipitation, and sea level rise.[45] Since Cal State LA is located approximately 18 miles away from the Pacific Ocean, the campus will not directly experience the effects of sea level rise.

However, the campus will experience more severe extreme heat events, as well as more intense storms that may result in flooding on campus or surrounding neighborhoods. Overall drier and warmer conditions throughout the region will also result in a less predictable water supply, increased air pollution, and more frequent and severe wildfires.[46]

Extreme events, such as droughts, storms, floods, wildfires, heat waves, landslides, sea level rise, and the spread of vector borne diseases, are problems many communities already face. Climate change raises the stakes in managing these problems with an increase in their frequency, intensity, extent, and magnitude. The following section is a review of the major climate hazards Cal State LA faces in the near future: extreme heat, wildfires and reduced air quality, drought conditions, and heavier storms and flooding.

Extreme Heat

The Los Angeles region is projected to be 3°F to 4°F warmer by mid-century.[47] By 2100, if temperatures rise to the higher warming range, there could be up to 100 more days per year with temperatures above 90°F.[48] These higher average temperatures and more frequent heat waves will put stress on conventional building technologies, resulting in higher cooling demand, and may lead to periodic energy shortages.[49] Warmer temperatures will also cause an increase in ground-level concentrations of ozone, resulting in unhealthy levels that cause harm to people, animals and agricultural crops.[50]

The health and well-being of campus populations will be impaired by extreme heat events. Outside workers, athletes, children, elderly and people with chronic medical diseases are some of the populations most vulnerable to extreme heat.[51] Dehydration, heat exhaustion, heat stroke, and several other conditions caused by extreme heat can result in premature death. In 2006, California saw deadly heatwaves sweep across the state, resulting in an estimated 650 deaths and an excess of 16,000 cases emergency room visits.[52]

There is also the risk of increased exposure to vector-borne diseases transmitted by mosquitoes, which feed and breed more frequently in warmer weather. Different kinds of species are increasingly causing concern in the Los Angeles region. For example, the Asian tiger mosquito was recently identified in

<table>
<tr><th colspan="5">Los Angeles Climate Hazards</th></tr>
<tr><th colspan="2">Direct Hazards</th><th colspan="3">Indirect Hazards</th></tr>
<tr><td rowspan="2">Changes in Average Temperature</td><td>Extreme Heat</td><td rowspan="2">Wildfires</td><td rowspan="2">Reduced Air Quality</td><td rowspan="2">Vector Borne Disease</td></tr>
<tr><td>Warmer Conditions</td></tr>
<tr><td rowspan="2">Altered Precipitation</td><td>Reduced Average Precipitation</td><td colspan="3">Drought Conditions</td></tr>
<tr><td>Heavier Storms</td><td colspan="3">Flooding</td></tr>
<tr><td colspan="2">Sea Level Rise</td><td colspan="3">Coastal Flooding</td></tr>
</table>

Table 2

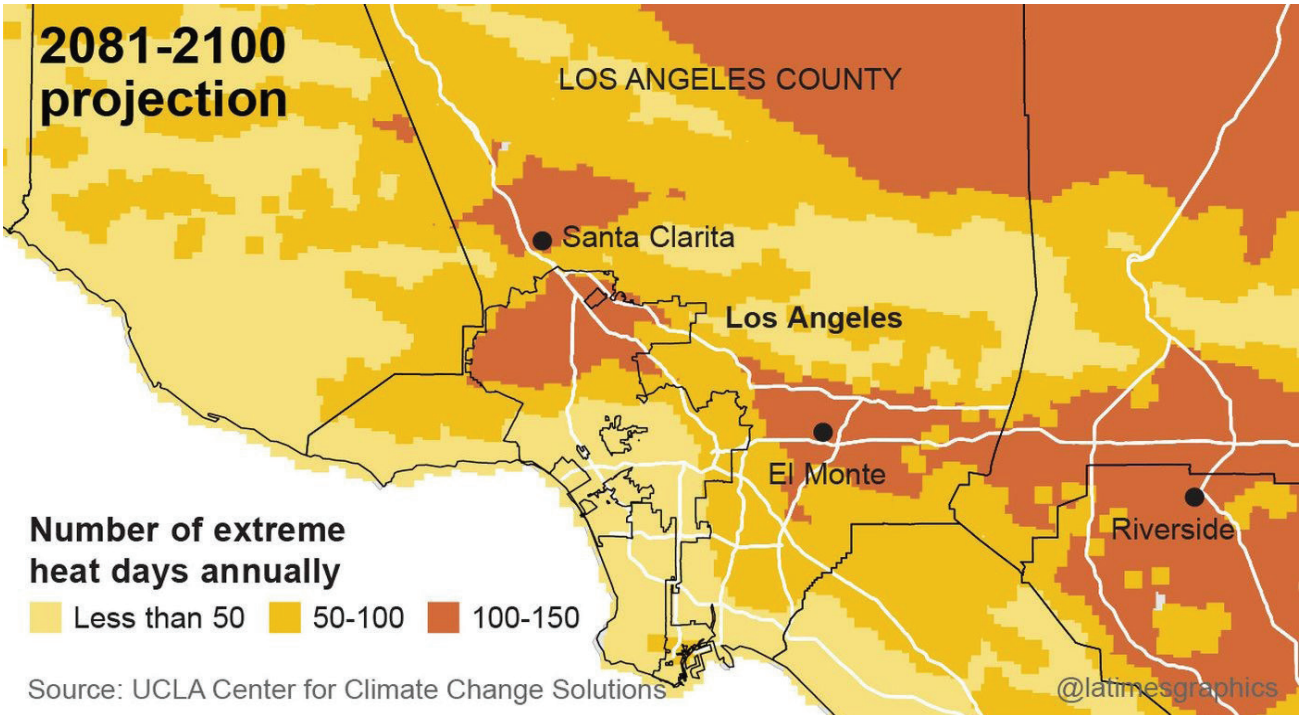


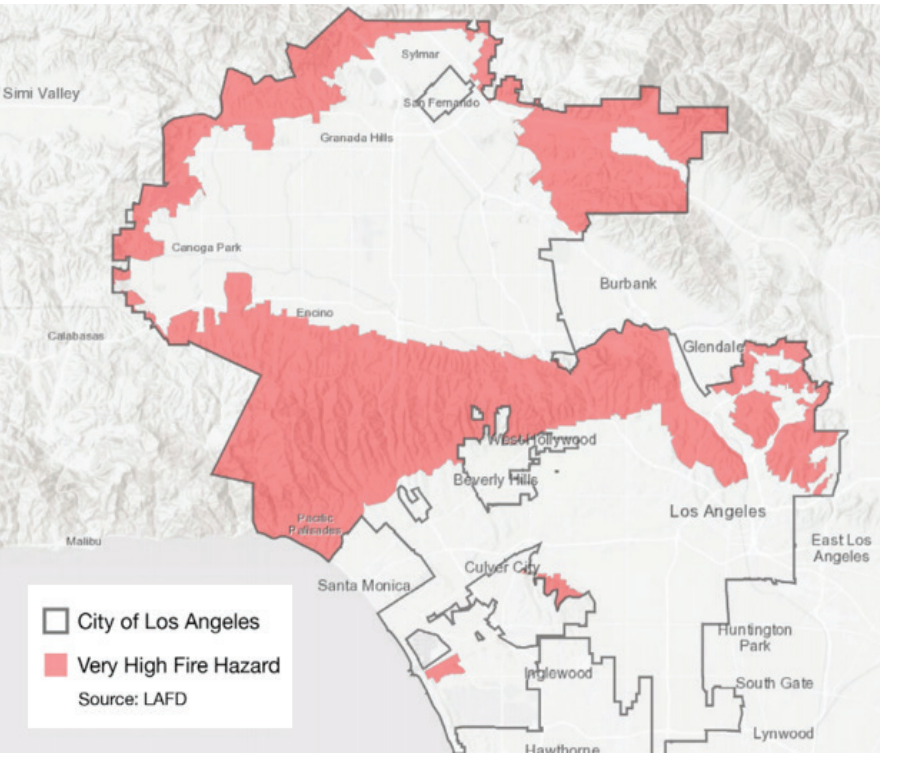
Figure 13: Annual Extreme Heat Days Projection (2081-2100)[53]

Texas. In 2013, the Asian tiger mosquito and other species that carry the West Nile virus contributed to 9 deaths and 265 infections in Los Angeles County.[54] The built environment of Cal State LA's campus, including buildings, parking lots and surrounding transportation corridors, is also susceptible to the urban heat island effect (UHIE). Urban heat islands occur where natural land cover is replaced with dense con-centrations of pavement, buildings, and other heat absorbing surfaces.[55] As an urban campus, Cal State LA has many dark surfaces that absorb and retain solar energy, leading to even warmer conditions.

Wildfires and Reduced Air Quality

By 2050, the Los Angeles wildfire season is projected to last three weeks longer, be up to twice as smoky, and be 20-30% more destructive.[56] Wildfires will further reduce local air quality and increase the health risk of nearby residents who are vulnerable to asthma, bronchitis, and other respiratory ailments.[57] Other risks associated with wildfires include damage to property and natural systems, loss of soil nutrients, and soil erosion.[58]

Figure 14: City of LA Fire Hazard Map[59]



Fifteen of the 20 largest fires in California's past century have taken place between 2002 and 2018.[60] The 2003 southern California fires were widely considered a 100-year event at the time, the 2007 fires were responsible for billions of dollars in damages, and the 2009 Station Fire is the largest and most destructive to ever occur in Los Angeles County.[61]

Although Cal State LA is at a safe distance from the San Gabriel Mountains where wildfires frequently occur, the campus community remains at risk to the reduced air quality that results from nearby wildfires. High winds propagate smoke and ash, causing health concerns among more vulnerable groups with pre-existing heart and respiratory health conditions. Ash and debris can also contaminate drinking water resources, posing a challenge for water treatment systems.[62]

Rising ambient levels of carbon dioxide will also make it more difficult to maintain acceptable levels of indoor air quality. Poorly ventilated buildings can contribute to symptoms of CO2 poisoning, which includes labored breathing, headaches, rapid pulse rate, hyperventilation, sweating, and fatigue.[63] This decrease in human cognitive performance is likely to affect productivity as higher indoor CO2 levels make it harder to think and work effectively.

Drought Conditions

While drought conditions are already common in the State of California, water shortages are expected to become more frequent, intense, and longer lasting. Less total annual rainfall, less snowpack in the mountains, and earlier snowmelt will result in a reduced water supply, especially during summer months when demand in the Los Angeles region is highest.[64]

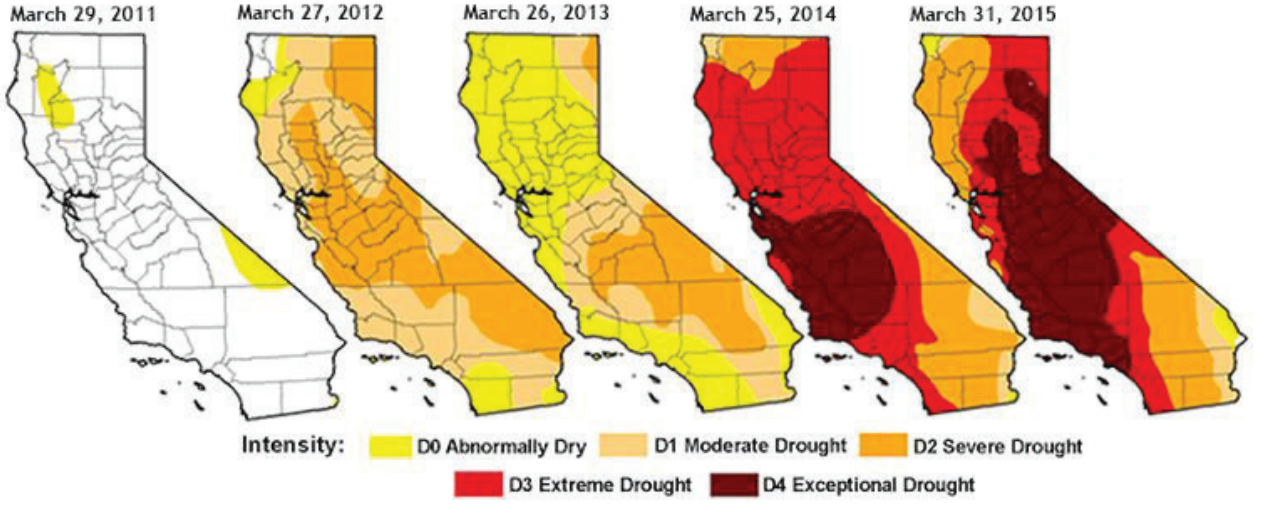
Meteorological data shows that the four years between 2011 and 2015 was the driest period in California since record keeping began in 1895.[65] In 2014, California Governor Jerry Brown declared a state of emergency as a result of the prolonged drought. In 2015, Executive Order B-29-15 called for a statewide 25% reduction in potable urban water use. Cal State LA was able to surpass the 25% goal by reducing water consumption by over 31% through the implementation of a wide range of water saving practices.

Heavier Storms and Flooding

Changes to mean precipitation are expected to be small in the Los Angeles region. However, extreme precipitation events are expected to increase, and extremely wet years are likely to increase by a factor of three by the end of the century.[67] This will amplify the risk of floods, erosion, and non-point source pollution. Heavier downpours in Los Angeles would increase the amount of urban run-off into rivers and lakes, washing sediment, nutrients, pollutants, trash, animal waste, and other materials into the local water supply.

In 2017, Los Angeles experienced a series of downpours that resulted in disruptions throughout the region.[68] Downtown Los Angeles received more than 18 inches of rain in the last four months of 2017, three inches more than its total annual average, resulting in floods, mudslides, railroad service interruptions, power outages, and several deaths throughout the region.[69]

Figure 15: California Drought Map (2011-2015)[66]



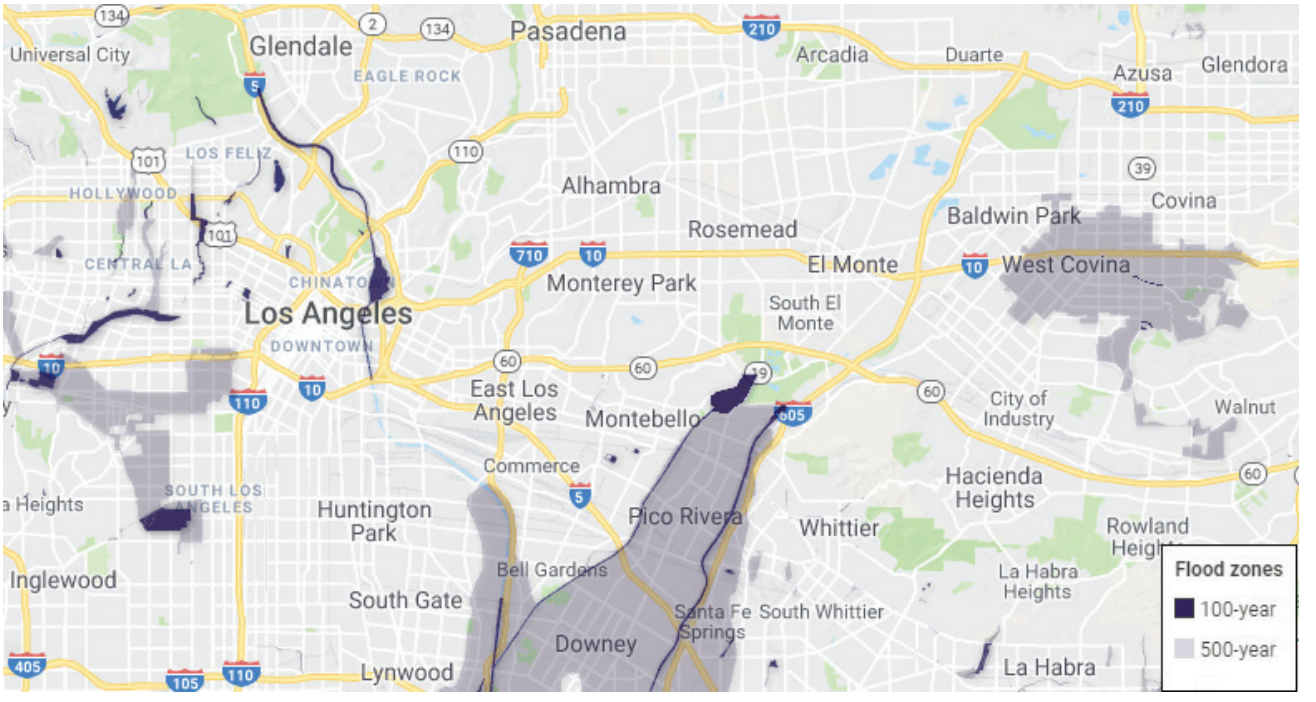


Figure 16: Flood Zones in East Los Angeles[70]

Due to its hillside location, with a concrete lined channel running along its eastern border, Cal State LA is well situated to minimize campus flooding during a major rain storm.[71] However, the impact of floods throughout the county are likely to affect the campus community and nearby neighborhoods. Potential damages to roads, reduced water quality, degraded waste management systems, and compromised sanitation systems will put all local populations at an increased risk of illness.[72]

4.2. Strengths and Vulnerabilities

To understand how Cal State LA is being impacted by climate change, it is important to first understand its mission and strategic priorities.[73] In October 2015, Cal State LA embarked on a strategic planning initiative to articulate a vision for Cal State LA's future. The following mission statement is a result of this collaborative process:

Cal State LA's Mission Statement:

Cal State LA transforms lives and fosters thriving communities across greater Los Angeles. We cultivate and amplify our students' unique talents, diverse life experiences, and intellect through engaged teaching, learning, scholarship, research, and public service that support their overall success, well-being, and the greater good.

The Strategic Planning Coordinating Committee, composed of faculty, staff, students, and administrative representatives, also developed four strategic priorities for the University. These strategic priorities have notable synergies with the four key dimensions used by the City Resilience Index, a resilience framework used by more than a hundred cities committed to resilience.[74]

Table 3

Cal State LA Strategic Priorities	City Resilience Index Dimensions
Engagement, Service, and the Public Good: Graduate civic-minded students equipped for and committed to engagement, service, and the public good	**Organization:** the social and economic systems that enable urban populations to live peacefully, and act collectively
Welcoming and Inclusive Campus: Nurture a welcoming and inclusive campus where students, faculty, and staff thrive and community is honored and cultivated	**Place:** the quality of infrastructure and ecosystems that protects, provide and connect us
Student Success: Create a positive, holistic student experience with a clear and timely path to a high quality degree	**People:** the health and well-being of everyone living and working in the city
Academic Distinction: Provide high-quality undergraduate and graduate programs and investment in faculty who are uniquely committed to educating a diverse student body	**Knowledge:** the capacity to learn from the past and take appropriate action based on evidence and active participation, including business and civil society

Since the four strategic priorities shown above are in basic alignment with City Resilience Index's four resilience dimensions, the following section will use Cal State LA's Strategic Priorities as the impact categories for the review of campus assets that are current strengths and potential vulnerabilities as Cal State LA adapts to a changing climate.

Engagement, Service, and the Public Good:

In order to graduate civic-minded students equipped for and committed to engagement, service, and the public good, Cal State LA will need to remain a leader in climate change mitigation and adaptation.

Organization:

the social and economic systems that enable urban populations to live peacefully, and act collectively.

Strengths	Vulnerabilities
• Strategic mission is well known and integrated across campus • CSU systemwide commitment to sustainability • Civic engagement through volunteer activities and community partnerships • Scholarships available for low-income students • Implementing strategic energy plan • Long-term hazard mitigation and emergency response plans	• Lack of plans to address water scarcity • Current purchasing policy neglects sustainability issues • Insufficient staff capacity to manage sustainability programs • Limited collaboration with local municipal departments • Unreliable operating budget and fundraising • Faculty and staff turnover • Students with insecure housing

Table 4

Welcoming and Inclusive Campus:

In order to nurture a welcoming and inclusive campus where students, faculty, and staff thrive and community is honored and cultivated, Cal State LA needs to maintain and invest in its physical infrastructure.

Place:

the quality of infrastructure and ecosystems that protects, provide and connect us.

Strengths	Vulnerabilities
• Consistent inclusion of land use and accessibility in long-term plans • Emergency drinking water supply in case of disaster • Limited landscaping and water intensive plants around campus • Periodic testing of backup generators • Public transportation options on campus are reliable and affordable • Working to improve outdated infrastructure • Safe roads and adequate stormwater systems on campus	• Inadequate renewable energy technologies on campus • Insufficient tree canopy and minimal shaded areas on campus • Lack of food waste composting options • Lack of water capture and storage systems on campus • Limited bicycle infrastructure • Majority of students commute to campus in single occupancy vehicles • Potential landslides along slopes during heavy rain seasons • Some inefficient HVAC systems

Table 5

Student Success:

In order to create a positive, holistic student experience with a clear and timely path to a high quality degree, Cal State LA needs to ensure the health, safety, and general wellbeing of its campus constituents.

People:

the health and well-being of everyone living and working in the city.

Strengths	Vulnerabilities
• Affordable food offerings with three communal dining spaces • Filtered water filling stations throughout campus • Monthly farmers market offering locally grown produce • On-campus food pantry • Student health care services on campus • Wide range of emotional/mental health services and programs • Nutrition & wellness curriculum	• Limited Student Health Center capacity • Drinking water quality and less dependable water supply • Emotional distress and demand for mental health services • Increase in food insecure students • Individuals with special needs requiring assistance in emergencies • Food desert in neighboring communities • Lower air quality on campus and surrounding communities

Table 6

Academic Distinction:

In order to provide high-quality undergraduate and graduate programs and investment in faculty who are uniquely committed to educating a diverse student body, Cal State LA will need to support innovative curricula and research opportunities in resilience and sustainability.

Knowledge:

the capacity to learn from the past and take appropriate action based on evidence and active participation, including business and civil society

Strengths	Vulnerabilities
• Nationally recognized engine of social mobility • Various programs that transcend disciplinary boundaries • Associated Students Inc. (ASI) is integrated into campus decision-making • Low tension among racial, gender, sexual preference and cultural identities • Many cultural diversity and inclusivity celebrations, activities and groups	• Inadequate student engagement with natural areas and outdoor recreation • Insufficient curriculum and research addressing climate change • Long-term ability to recruit students and employees in warmer climate • Scarce environmental studies and sustainability course offerings • Financial support for faculty research and scholarship

Table 7

Resilience Goals

As Los Angeles's climate continues to change, causing more frequent and stressful weather events, Cal State LA will be forced to develop its capacity to adapt and recover. In this context, the capacity to adapt is the ability to adjust to climate change while minimizing damages, seizing opportunities, and coping with the consequences.[75] A resilient campus is one that is not only able to sustain its core educational mission, but thrives in the face of uncertainty, disturbances and disruptions.

The following adaptation priorities support Cal State LA's mission, values and strategic priorities. The University has a goal to complete more than 50% of these adaptation priorities by 2030, more than 75% by 2035, and 100% by 2040.

5.1. Resilience Strategies

To improve Cal State LA's resilience, this section outlines a list of adaptation priorities to address the climate hazards described above. Each priority includes the climate hazard it is intended to address with a color coded icon:

- Extreme Heat
- Heavier Storms and Flooding
- Drought Conditions
- Wildfires and Reduced Air Quality

1. Integrate Resilience and Sustainability into Master Planning

Cal State LA will incorporate resilience and sustainability as guiding principles in planning documents that inform land use and development decisions. This includes updating the Campus Master Plan with considerations of climate adaptation, hazard mitigation and recovery, and efforts to increase equity and long-range planning for capital improvements.

2. We Are LA Fundraising Campaign

The goal of the We Are LA campaign is to raise $75 million to support the University's strategic plan and academic distinction.[76] The campaign will also help the University to upgrade critical utility infrastructure and address deferred maintenance issues. Cal State LA has experienced a steady aging of buildings and infrastructure over the last several decades, along with a backlog of deferred maintenance projects awaiting funding. The single biggest challenge that campuses face today relates to supporting the visionary academic mission with a reliable infrastructure that students and staff can depend upon on a day-to-day basis.[77]

3. Campus Resilience Challenge

Cal State LA is collaborating with the City of Los Angeles in a campus resilience advisory group to promote and encourage innovative actions that advance physical resilience and social cohesion. Cal State LA can further support the Campus Resilience Challenge by developing strategies that align with, and help strengthen, the actions outlined in the City's *Resilient Los Angeles*.

4. STARS Program

Cal State LA participates in the Sustainability Tracking, Assessment & Rating System (STARS) program, and achieved a STARS Silver rating in June 2016. This system was developed by the Association for the Advancement of Sustainability in Higher Education (AASHE), and is designed to provide a framework to measure current sustainability performance in all aspects of higher education, including curriculum, research, operations, administration and engagement.

5. Green Revolving Fund

In 2016, Cal State LA established its Green Revolving Fund (GRF) to provide seed capital to invest in energy efficiency, renewable energy, and other sustainable projects that generate cost savings, and to be reinvest those savings in similar future projects. The fund was created through a $1 million allocation from the University's utilities budget and is administered by the Campus Sustainability Committee. The fund is open to receive applications from across the campus community and should be used to fund the University's financially rewarding resilience programs.

6. Mind Matters

The Mind Matters initiative provides resources and programs to help Cal State LA students navigate the demands of academic excellence, family responsibilities, and jobs. The Mind Matters initiative will be expanded to address students experiencing high levels of stress related to climate change adaptation.

7. Health Center Programs

Cal State LA's Student Health Center provides high-quality, affordable health care and health education for the students of Cal State LA. The Student Health Center will leverage existing networks with hospitals, public health organizations, clinics, and health agencies to address health disparities, prepare for disasters, and increase community wellness.

8. Building Forward LA

This initiative aims to address LA's unique long-term challenges to design and build more sustainable and resilient buildings. Cal State LA commits to implementing recommended strategies for high-design, high-performance buildings that are capable of withstanding multiple hazards and that address sustainability goals around renewable energy, efficiency, and water.

9. Water Management Plan

Develop a holistic plan to manage stormwater, groundwater, and wastewater resources. Aspects to be considered include rainwater capture and storage, groundwater, greywater and blackwater treatment and reuse, sustainable drainage systems, and stormdrain maintenance.

10. Cooling Center Program

Establish location and goals for a cooling center program that prioritize populations vulnerable to heatwave. Cooling centers offer a cool place to stay and access services and programs during extreme heat events. Additional consideration should be given to facility amenities, proximity to transit, and the identification of public-private partnerships.

11. Add 10,000 Ton-Hour TES System

The campus uses a 2,400 Ton central chilled plant with a thermal energy storage (TES) tank to offset peak electric loads. In operation since 1997, the TES tank is unable to completely offset the cooling loads during LADWP's low peak periods, causing the University bring one or two chiller online to satisfy campus cooling demands. As a utility cost reduction measure, additional TES capacity will help to minimize electric demand charges for high and low peak periods, especially considering the expected long term growth of the campus.

12. Combined Solar and Energy Storage Projects

Identify opportunities to pilot a solar PV and battery storage project to ensure critical facilities are accessible and operational in times of emergency. This action will also ensure that first responders will be able to continue operations when the electric grid is impacted, and is a critical first step in the development of a microgrid infrastructure that is reliable in the face of future climate impacts and hazards.

13. Tree Campus USA

Cal State LA will grow and maintain a healthy urban forest on campus, and meet the five standards of Tree Campus USA program. There are numerous resources available to support this endeavor, such as free shade trees offered through City Plants and CalFire grant programs. A robust tree canopy provides critical shade and evaporative cooling benefits, and also improves air quality, stormwater management, energy efficiency, and overall public health benefits.



Figure 17: Tree Planting at Housing

14. Hydration Stations

Cal State LA will continue to install dual-hi-lo hydration stations as a means of providing safe drinking water to the campus community. These filtered water bottle filling stations offer an effective alternative to plastic water bottles by encouraging the drinking of tap water. They also have built in water bottle counters at each station to track the number of avoided plastic water bottles.

15. Test Pilot Cooling Strategies

Work with the City of Los Angeles to test heat-adaptation strategies that will inform future citywide implementation efforts, including increased vegetation cover, reflectivity, and community empowerment tools. Cal State LA will engage community members in creating retrofit designs that are neighborhood-appropriate, and offer educational classes and workshops to support simple strategies, such as cool roof and cool pavement technology to offset the urban heat island effect.

16. High Efficiency Bathroom Appliances

Water consumption at Cal State LA has been reduced by over 31% over the past few years.



Figure 18: Xeriscaping at BioScience

The University is committed to making further reductions in water use by replacing all bathroom appliances with high efficiency alternatives, including toilets, urinals, faucet aerators and low flow showerheads. Recent bathroom fixture replacements are estimated to save over 10 million gallons per year.

17. Reduce Grass Turf

In 2016-17, Cal State LA discontinued the watering of over 20,000 square feet of grass turf and re-landscaped these areas with xeriscape and climate appropriate plants to save an additional 1 million gallons annually. The University will continue to evaluate additional grass turf areas on campus that should be removed.

18. Drip Irrigation and Weather-Based Controllers

A majority of Cal State LA's irrigation has been converted to a drip system, and the University plans to convert the entire campus to a smart, low-flow drip irrigation system. Smart irrigation systems automatically tailor watering schedules and run times to on-site conditions of the site. The University will continue to reduce watering all campus lawns from 3 to 1 times per week, and reduce the amount of watering time from 20 to 8 minutes, until all irrigation systems across campus have been updated.

19. Clear Brush to Reduce Wildfire Risk

The University will partner with the Los Angeles Fire Department (LAFD) and campus Fire Marshall to ensure hillside vegetation along Paseo Rancho Castilla and Circle Drive is maintained in accordance with Fire Code.

20. Green Walls

Living walls of grass, climbing ivy and other plants that grow along the sides of buildings can deliver substantial reductions in air pollution in urban areas. It is estimated that careful placement of greenery could reduce concentrations of nitrogen dioxide and microscopic particulate matter levels by up to 40% and 60% respectively.[78]

21. Student Farm

By implementing sustainable agriculture practices on campus, a student farm would increase student food security, reduce food waste, and help increase community awareness about


Figure 19: Cal State LA's Monthly Farmers Market

eating healthy and locally produced foods. This program would also provide students an opportunity to engage in hands-on, experiential learning on a range of topics related to gardening, food, health and nutrition.

22. Expand Food Pantry

Started in 2017, Cal State LA's Food Pantry provides more than 100 students per week with free food regardless of verified need as a means of supporting their wellbeing.[79] Food pantry drive, where non-perishable food items are donated, should be held more frequently and with more public outreach to better support the overall health and food security of Cal State LA students.

23. Farmers Market

Associated Students, Inc. (ASI) actively engages local farmers from Southern California, and vendors from the Alhambra Farmer's Market, to highlight their locally grown, organic produce and artisanal products on the main campus walkway every month. ASI's Farmers Market also provides information about community services, organizations, and other campus resources.

24. City of Los Angeles Preparedness Campaign

Cal State LA commits to promoting public education messaging and resources provided by City departments, regional emergency management agencies, and preparedness organizations on staying prepared in advance of a crisis.

25. Emergency Operations Center

The EOC is located in the northeast side of the campus and functions as food and power storage in case of campus emergencies. This building, together with the Multi-hazard Emergency Plan, Business Continuity Plan, the Emergency Action Plan and the Community Emergency Response Team (CERT), encompass the emergency preparedness program. This program ensures the campus and surrounding community are prepared to respond to extraordinary emergencies such as earthquakes, floods or hazardous materials incidents. Improvements will be made to the EOC to ensure it can fulfill its mission to preserve life, protect property and continue campus operations.

26. Cal State LA CERT Team

The Community Emergency Response Team (CERT) provides trained volunteers to support Cal State LA in disaster preparedness, response, and recovery activities creating a self-sustaining community in the event of a natural or man-made disaster.[80] The University will work to increase active membership of the Cal State LA CERT Team.

27. Food Recovery Network

Join the largest student movement against food waste and hunger in America, the Food Recovery Network, by recovering perishable food that would otherwise go to waste and donating it to people in need.[81]

28. Real Food Challenge

Cal State LA will expand participation in the Real Food Challenge, and work to ensure that at least 20% of all food spending goes to farms and food businesses that are local and community-based, fair, ecologically sound, and/or humane by 2020.[82] Since Cal State LA is located within a food desert as defined by the USDA, a low-income census tract that is more than one mile from the nearest supermarket, it is important that UAS Food Services continues to serve the campus community with a large selection of healthy, sustainable, and culturally diverse dining options across campus.[83]

Local small business vendors from LA County currently account for a majority of food purchased at Cal State LA. Produce is purchased from minority-owned small business in downtown LA, all bread and pastries are made in downtown LA, and more than half of all produce is verified as grown locally. In addition, the University Club restaurant provides vegan options on its menu, and Housing Dining offers a daily vegan special available to all students.

29. Energize California

Launched in 2017, Energize California is an initiative of the Los Angeles Cleantech Incubator (LACI) and part of the California Energy Commission's statewide initiative to drive energy innovation. Cal State LA will expand its role as an Energize California partner to support California's clean energy goals by piloting technologies from promising clean energy startups.

30. LADWP's Demand Response Program

Cal State LA was the first participant to sign up for LADWP's pilot Demand Response Program. The University recently completed its fourth year of participation in the program, which is designed to help the University earn incentives for employing voluntary energy conservation behaviors on days of high when electric grid demand.

5.2. Community Partnerships

Cal State LA is committed to serving local and vulnerable populations. The University will continue to work with these communities to address their most prevalent challenges and opportunities, while striving to integrate neighborhood-scale resilience strategies into its various community engagement and service programs:

1. Los Angeles Regional Collaborative

LARC is a network of local and regional decision-makers ensuring Los Angeles is prepared for the impacts of climate change.[84] It is one of six regional collaboratives in California supporting climate change science, policy and planning efforts across sectors, including academia, cities, LA County, regional agencies, non-profits, and businesses.

2. Los Angeles Urban Cooling Collaborative

Cal State LA will join the LAUCC, a national partnership between nonprofit groups, universities, government agencies and other experts in urban heat with the aim of achieving cooler, more prosperous, and a healthier LA by addressing current and future challenges posed by urban heat.[85]

3. LA Better Buildings Challenge

Cal State LA belongs to the LA Better Buildings Challenge (LABBC), a leadership initiative funded by local utilities, LADWP and So Cal Gas, to reduce energy and water use intensity by 20% by the year 2020. As a program partner, Cal State LA gets access to free resources, energy and water efficiency technical advisors, marketing and PR support, rebate application support, and the So Cal Edge Program to pilot vetted emerging technologies in energy and water efficiency. The university will also continue to work with Savings By Design to receive financial incentives for exceeding Title 24 Energy Efficiency Standards by 10% or more in new construction.

4. Coalition of Urban Serving Universities

The Coalition of Urban Serving Universities (USU) is a president-led network of 34 public urban research universities committed to tackling urban challenges to increase prosperity and opportunity in U.S. cities.[86] Cal State LA will partner on USU projects addressing transformations in student success, encouraging campus-community partnerships, and ensuring greater diversity in professional employment.

5. Center for Engagement, Service, and the Public Good

The center was launched in 2014 with a vision to transform the University into a hub of civic engagement and public service that would generate positive change across Southern California. The Center for Engagement, Service, and the Public Good actualizes this goal by linking students with their community through service learning, applied research, and student success initiatives.



Figure 20: Cal State LA's Civic University Program[87]

6. Educational Participation in Communities

Established in the wake of the Watts Rebellion of 1965, the EPIC program aims to address critical community needs by placing student volunteers in local nonprofit organizations. EPIC inspires and enables university students to realize their full potential as productive, responsible and caring citizens by volunteering in a wide range of agencies serving a broad spectrum of communities throughout the Los Angeles area.

7. Civic University

A program offered by Cal State LA's College of Professional and Global Education, in partnership with the Mayor's Office and the Mayor's Youth Council, Civic U is a non-credit certificate program to educate members of the community on how their local government system works in support of building a well-informed and engaged civic society.

8. Pat Brown Institute for Public Affairs

Each year, the Pat Brown Institute (PBI) host conferences and offers programs that extend the University's engagement with the public on key issues, including sustainability and resilience. In 2015, PBI sponsored a conference on the Ports of Los Angeles and Long Beach and their sustainability efforts. In 2016, PBI hosted its 35th annual dinner with the conference theme "California Shows the Way: Leadership in the Face of Climate Change." PBI will continue to promote awareness and discussion around issues of sustainability and resilience.

9. Office of Service Learning

OSL links academic teaching, learning and community service by engaging students, faculty, and community partners in collaborative relationships that embrace diversity and social justice. OSL supports a campus-wide culture of community engagement that contributes to student success and prepares students to serve the changing needs of a global society.

#	Community Partnerships
1	Los Angeles Regional Collaborative
2	Los Angeles Urban Cooling Collaborative
3	LA Better Buildings Challenge
4	Coalition of Urban Serving Universities
5	Center for Engagement, Service, and the Public Good
6	Educational Participation in Communities
7	Civic University
8	Pat Brown Institute for Public Affairs
9	Office of Service Learning

Table 8

Curriculum and Research Development

Cal State LA is committed to expanding its faculty research and course offerings related to climate change and resilience. As part of Cal State LA's STARS submission, the University created a publicly-available inventory of all sustainability programs and courses covering issues of sustainability.[88] The inventory determined the following integration of sustainability into the academic curriculum:

- 48 academic departments offering at least one sustainability course
- 51 sustainability-focused undergraduate courses
- 13 sustainability-focused graduate courses
- 207 sustainability-included undergraduate courses
- 63 sustainability-included graduate courses

Cal State LA will continue to support and encourage hands-on sustainability learning by promoting the collaborative efforts between students, faculty, staff, and neighboring communities with the following academic programs:

1. Campus as a Living Lab

Cal State LA has participated in three rounds of the CSU Campus as a Living Lab (CALL) grant program, a unique opportunity to partner faculty and facilities management staff in using the campus as a forum for exploration of sustainable concepts and theories. In 2014-2015, a course on Global Climate Change was redesigned to use the Cal State LA Hydrogen Station in learning about alternative energy, and, in 2015-16, a course on Sustainable Energy and Transportation was redesigned to learn about the campus's central plant, solar PV system, and energy usage. In 2017-18, the Chancellor's Office awarded the CALL grant to Cal State LA to help redesign three courses with a focus to redesign campus landscapes as interactive learning environments.

2. Master of Science Degree in Environmental Science

This advanced degree offers three focus options: Environmental Biology, Environmental Engineering Science, and Environmental Hydrology. The Environmental Biology Option emphasizes basic research into such areas as conservation, pollution, and global change. The Environmental Engineering Science Option approaches air, soil, and water pollution from an engineering perspective. The Environmental Hydrology Option emphasizes fundamental problems of the hydrologic cycle, including water pollution issues, wetlands and watershed hydrology, and hydrologic modeling.



Figure 21: CALL Tour of Cal State LA's Central Plant

3. Sustainability Marketing

Both the Certificate and the Minor in Sustainability Marketing provide students the opportunity to broaden their understanding of mounting environmental and social issues that impact local and global communities. It also gives students the tools to transform the design, marketing, and consumption of products and services within an interdisciplinary framework of environmental and social sustainability.

4. Center for Energy and Sustainability

CEaS involves 13 faculty members from eight interdisciplinary departments to promote energy diversity, energy sustainability, and energy efficiency.[89] Its mission is to educate policymakers and the public about the value and applicability of alternative energy technologies, as well as about the environmental impacts of current energy technologies. It includes five research



Figure 22: Cal State LA Hydrogen Station

areas: Advanced Materials, Fuel Cells, Biofuels and Combustion, Carbon Sequestration, and Modeling.

5. NASA Data Intensive Research and Education Center in STEM

The NASA DIRECT-STEM Program has an overarching goal of recruiting highly competitive, historically under-represented students, giving them direct NASA research experience in scientific computing and data analysis, and inspiring them to become future leaders in STEM-related professions. Students of the program focus on collaborative research and training in areas of hydrology and climate change, computational physics, and cloud computing that directly contribute to NASA's mission.

6. Hydrogen Research and Fueling Facility

Cal State LA's Hydrogen Station serves as a commercial hydrogen fuel station as well as a sustainable technology research laboratory. Opened in 2014, the Hydrogen Station is a 60 kg/day production facility that provides hydrogen fuel for the surrounding community and the campus' fleet of fuel cell electric vehicles (FCEVs). On January 8, 2015, the H2 Station became the first station in the nation to sell hydrogen fuel by the kilogram to the public, a milestone in the commercialization of hydrogen fuel. The Hydrogen Station was funded by CARB, SCAQMD and MSRC, and provides key research data to the US DOE and National Laboratories, as well as to state agencies such as the CEC and CARB. Since Cal State LA's Hydrogen Station is one of a few stations internationally that is 100% renewable, its carbon-free fuel could potentially be used to enrich the natural gas used on campus, thereby reducing GHG emissions without changing the existing boiler infrastructure.[90]

7. EcoCAR3

EcoCAR3 is a 4-year Advanced Vehicle Technology Competition (AVTC) sponsored by the US Department of Energy in which 16 North American university teams are challenged to redesign a Chevrolet Camaro to reduce its environmental impact. This premiere automotive engineering competition helps to drive the development of new technologies for the automotive industry while providing a one of a kind educational experience.

8. Engineers for a Sustainable World

The mission of the ESW student group is to build a more sustainable world through sustainability-oriented design projects, educational programs, and volunteer activities.

9. Environmental Policy Committee

ASI's Environmental Policy Committee (EPC) helps formulate and encourage the adoption of policies to make the University more sustainable. The committee also collaborates with



Figure 23: Solar Canopy Senior Design Team

university administrators to educate the campus community on topics regarding sustainability and environmental justice.

10. ECST Professional Practices Program

The College of Engineering, Computer Science, and Technology (ECST) Professional Practice Program (PPP) establishes corporate and university partnerships with its Senior Design Projects.[91] The purpose of the Senior Design Project Program is to provide students with a capstone experience in which they apply their theoretical knowledge to real applications. The program encourages students to work with a real client to solve a client-defined problem.

The University has been a client on a number of recent student design projects, including the "Design of Energy Efficient Buildings" and the "Design of Palmer Wing HVAC" projects. Another group recently created a Solar Canopy Charging Station prototype. An innovative solution for charging mobile devices throughout the academic year, the project involved the reconfiguration of an existing shade structure with three ultrathin and flexible solar panels and a charging hub.

11. EPIC-Network

EPIC-N is an award-winning university-community partnership program that works at a large scale by engaging students on pressing community issues. The EPIC-N Model focuses a university campus in a single location over a defined time period to help advance a locally identified priority issues while training the next generation workforce and leadership. Cal State LA could partner with the City of Los Angeles to address a shared sustainability, resilience or livability initiative, while allowing students to learn through real-life problem solving and skills development.[92]

12. Climate Corps

The Environmental Defense Fund (EDF) Climate Corps is a fellowship program to help organizations to design customized solutions to challenges involving energy efficiency, renewable energy, energy management strategy and more. Hosting a fellow is a low-cost and low-risk way Cal State LA can save money while growing its sustainability program.

13. Sustainable LA Grand Challenge

Cal State LA could partner with UCLA and the City of L.A. to bring together cross-disciplinary faculty and researchers with the goal of transitioning the Los Angeles region to 100% renewable energy, 100% local water, and an enhanced ecosystem and human health by 2050.

#	Curriculum and Research Development
1	Campus as a Living Lab
2	Master of Science Degree in Environmental Science
3	Sustainability Marketing
4	Center for Energy and Sustainability
5	NASA Data Intensive Research and Education Center in STEM
6	Hydrogen Research and Fueling Facility
7	EcoCAR3
8	Engineers for a Sustainable World
9	Environmental Policy Committee
10	ECST Professional Practices Program
11	EPIC-Network (EPIC-N)
12	Climate Corps
13	Sustainable LA Grand Challenge

Table 9

Management Plan

This Climate Action Plan is intended to act as a living document. Second Nature's Climate Commitment requires an evaluation of progress to be made publicly available with the Cal State LA's annual submission to Second Nature's reporting system. This Climate Action Plan is also to be reviewed and updated no less frequently than every five years. This iterative process will be a key component to the plan's ultimate success.

7.1. Responsibilities

The following table lists the organizations responsible for all Resilience Strategies, along with the climate hazard each is intended to address: extreme heat (**EH**), heavier storms and flooding (**SF**), drought conditions (**DC**), and wildfires and reduced air quality (**WA**).

#	Resilience Strategies	Responsibility	EH	SF	DC	WA
1	Integrate Resilience and Sustainability into Master Plan	Administration	■	■	■	■
2	We Are LA Fundraising Campaign	Administration	■	■	■	■
3	Campus Resilience Challenge	Campus Sustainability Committee	■	■	■	■
4	STARS Program	Campus Sustainability Committee	■	■	■	■
5	Green Revolving Fund	Campus Sustainability Committee	■	■	■	■
6	Mind Matters	Student Health Center	■	■	■	■
7	Health Center Programs	Student Health Center	■	■		■
8	Building Forward LA	Planning, Design and Construction	■	■	■	■
9	Water Management Plan	Planning, Design and Construction		■	■	
10	Cooling Center Program	Planning, Design and Construction	■			
11	Add 10,000 Ton-Hour TES System	Planning, Design and Construction	■			
12	Combined Solar and Energy Storage Projects	Planning, Design and Construction	■			
13	Tree Campus USA	Facilities Services	■	■	■	■
14	Hydration Stations	Facilities Services	■		■	
15	Test Pilot Cooling Strategies	Facilities Services	■			■
16	High Efficiency Bathroom Appliances	Facilities Services			■	
17	Reduce Grass Turf	Facilities Services			■	
18	Drip Irrigation and Water-Based Controllers	Facilities Services			■	
19	Clear Brush to Reduce Wildfire Risk	Facilities Services				■
20	Green Walls	Facilities Services				■
21	Student Farm	Associated Students Inc. (ASI)	■	■	■	■
22	Expand Food Pantry	Associated Students Inc. (ASI)	■	■	■	
23	Farmer's Market	Associated Students Inc. (ASI)	■	■	■	
24	City of Los Angeles Preparedness Campaign	Environmental Health and Safety	■	■		■
25	Emergency Operations Center	Environmental Health and Safety	■	■		■
26	Cal State LA CERT Team	Environmental Health and Safety	■	■		■
27	Food Recovery Network	UAS Food Services	■	■	■	
28	Real Food Challenge	UAS Food Services	■	■	■	
29	Energize California	Energy & Sustainability Manager	■			
30	LADWP's Demand Response Program	Energy & Sustainability Manager	■			

Table 10

The following table lists the organizations responsible for all Carbon Neutrality Strategies:

#	Carbon Neutrality Strategies	Responsibility	Scopes
1	Electric Grounds Equipment	Facilities Services	1
2	Update Campus Fleet	Facilities Services	1
3	Upgrade Air Handler Units	Facilities Services	1
4	HVAC Controls	Facilities Services	1
5	Demand Controlled Ventilation	Facilities Services	1
6	High Efficiency Glazing and Windows	Facilities Services	1
7	Exterior LED and Solar Lighting	Facilities Services	2
8	Interior LED Lighting	Facilities Services	2
9	Advanced Lighting Controls	Facilities Services	2
10	Adjust Custodial Hours	Facilities Services	1 & 2
11	Continuous Commissioning	Facilities Services	1 & 2
12	Expand Central Chilled Water Loop	Planning, Design and Construction	1
13	Develop Central Hot Water Loop	Planning, Design and Construction	1
14	Superinsulation of Building Envelopes	Planning, Design and Construction	1
15	DC Power Systems	Planning, Design and Construction	2
16	Renewable Energy	Planning, Design and Construction	2
17	Battery Storage	Planning, Design and Construction	2
18	Utility Infrastructure Upgrades	Planning, Design and Construction	1 & 2
19	Establish Building Energy Use Benchmarks	Planning, Design and Construction	1 & 2
20	LEED Gold Minimum Certification Standard	Planning, Design and Construction	1 & 2
21	Zero Net Energy Buildings	Planning, Design and Construction	1 & 2
22	Upgrade Housing HVAC Systems	Housing and Residential Life	1
23	Annual Energy Challenge	Housing and Residential Life	1 & 2
24	Electronics Purchasing Policy	Purchasing and Contracts Services	2
25	Alternative Workweek Schedule	Human Resources	1 & 2
26	Adjust Academic Scheduling	University Registrar	1 & 2
27	Promote Active Transportation	Parking & Transportation Services	3
28	Expand Bike Infrastructure	Parking & Transportation Services	3
29	Expand Public Transportation Routes to Campus	Parking & Transportation Services	3
30	Carpool Program	Parking & Transportation Services	3
31	EV Charging Stations	Parking & Transportation Services	3
32	Metro U-Pass Program	Parking & Transportation Services	3
33	Car Sharing	Parking & Transportation Services	3
34	Freshman On-Campus Housing Requirement	Housing and Residential Life	3
35	Distance Learning and Compressed Schedules	University Registrar	3
36	Carbon Fee for Business-Related Air Travel	Business Financial Services	3
37	Organics Composting System	University Auxiliary Services	3
38	Zero Waste Coordinator	Facilities Services	3

Table 11

7.2. Tracking

Cal State LA is currently initiating an energy information system (EIS) that will leverage the University's building automation system, Johnson Controls Metasys, and SkySpark Analytics Software to benchmark, track and improve building performance. The EIS will also support a campus-wide continuous commissioning program and GHG emissions reporting for scopes 1 and 2. The University is also pursuing a comprehensive utility metering program for all major buildings. To further support the EIS program, the University has a goal to install metering systems for all utilities, including electricity, domestic water and natural gas.

Cal State LA's Energy & Sustainability Manager will continue to complete comprehensive annual GHG emissions inventories to track regular progress toward campus carbon neutrality goals. The Energy & Sustainability Manager will also ensure the University continues its triennial STARS updates to track resilience strategies and sustainability metrics more broadly.

7.3. Communication

Achieving carbon neutrality and climate resilience is a multifaceted challenge that requires widespread awareness and important behavioral changes across various groups on campus. To achieve this, an effective communication strategy is needed to better inform the campus community, encourage active involvement, and facilitate necessary change agents.

Community-based social marketing has proven to be an effective way to bring about behavior change, especially when compared against more conventional, information-intensive campaigns.[93] Its effectiveness is due to its pragmatic approach, which involves selecting the behavior to be promoted, identifying the barriers and benefits to its adoption, designing a strategy to address these barriers and benefits, piloting a behavior change program, and evaluating its impact once broadly implemented.

The use of terms and phrases is also critical to encouraging changes. Messaging must be tailored to different audiences on campus, identifying what motivates them, and involving faculty and professional staff experts in communications, public relations, art, design, and media. The most effective tools for creating behavioral changes include written commitments, prompts and reminders, norms, and incentives.

Future outreach initiatives should consider developing the following:

- Written commitments for all incoming first-year students
- Bulletins and posters highlighting positive social norms on campus
- Tabling events by student sustainability groups
- Social media prompts to encourage energy, water and waste reduction
- Non-monetary incentives for sustainable behaviors

Additional Considerations

Any long-term climate action plan also faces the challenge of future unknowns. Consequently, successful implementation of this plan requires a year-by-year review of strategies, progress toward goals, factors influencing proposed near-term actions, appropriate changes to planned projects, and the inclusion of emerging technologies.

Changes are to be expected in all areas effecting the University's GHG emissions, and some of the factors that may warrant amending this plan include the following:

- Technology advancements in building energy systems and renewable energy.
- New technologies becoming more viable as market competition drives costs down.
- Availability of funding for Zero Net Energy (ZNE) buildings and efficiency projects.
- Changes to utility rebate programs to implement energy projects.
- Building and energy code revisions may drive future capital improvement decisions.
- Impact of proposed new construction on green house gas emissions.
- Changes to LADWP's Time-of-Use (TOU) tariff structures

Cal State LA may also need to conduct additional studies affecting its road to a carbon neutral future. These may include:

- Assessment of electrical infrastructure for the allocation of large scale photovoltaics, battery storage or other microgrid energy systems with regard to the timing imbalance between peak demand and renewable energy production.
- Detailed investigation of LADWP's Feed-In-Tariff (FIT) program which allows customers to install solar power plants on-site and sell electricity generated directly to LADWP for distribution to the power grid.
- Focused study on off-site renewable energy options and the purchase of additional renewable energy credits.
- Potential impact of electric vehicle charging stations on the overall campus energy use and electrical infrastructure.
- Evaluation of losses from existing central heating and cooling systems that condition the entire space as opposed to the micro zone occupied by the occupant.
- Possible replacement of traditional central domestic hot water supplies with point of use instantaneous heaters to avoid recirculation losses.
- Use of natural ventilation, economizing and direct/indirect evaporative cooling to minimize use of refrigerant based cooling.
- Heat recovery systems (e.g., air-to-air heat exchangers, run-around coils, and thermal energy wheels) to pre-heat or pre-cool the ventilation air into the building using the energy from the building air exhaust.
- New choices of refrigerants and refrigeration processes to improve chiller or compressor efficiencies for providing cooling to buildings.
- Alternate Electric MEP Systems, including all-electric HVAC heating, cooling, ventilation, and distribution options, as well as all-electric domestic hot water options.

As Cal State LA strives to reach carbon neutrality and resilience, every aspect of building energy use, transportation and waste management needs to be closely tracked to determine where newer technologies and opportunities can be leveraged to make campus buildings, programs and processes more efficient and resilient.

Conclusion

Cal State LA has a unique role to play in climate change mitigation and adaptation. As an internationally recognized center of knowledge, innovation and research, the University has a responsibility to engage its local, regional and global communities on the topic of climate change. For this reason, Cal State LA is pushing boundaries to achieve operational carbon neutrality by 2040 and full carbon neutrality by 2045. The University will also complete all adaptation priorities by 2040, integrate resilience planning into a variety of its community partnerships, and expand educational offerings to include concepts of both carbon neutrality and resilience.

While these long-term goals may seem ambitious, it is certainly attainable with strategic planning, available funding, innovative decision making, and the flexibility to adapt to new technologies and behaviors. Cal State LA is committed to improving campus operations, developing its community partnerships, and expanding its cutting-edge academic programs to create a more just, sustainable and resilient world.

Endnotes

1 http://secondnature.org/what-we-do/climate-leadership/
2 https://ghgprotocol.org
3 https://www.ipcc.ch/pdf/assessment-report/ar5/syr/SYR_AR5_FINAL_full_wcover.pdf
4 https://climate.nasa.gov/causes/
5 https://www.ipcc.ch/pdf/assessment-report/ar5/syr/SYR_AR5_FINAL_full_wcover.pdf
6 https://www.epa.gov/climate-indicators/climate-change-indicators-atmospheric-concentrations-greenhouse-gases
7 https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data
8 https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data
9 https://www.eia.gov/todayinenergy/detail.php?id=34792
10 https://ww2.arb.ca.gov/news/climate-pollutants-fall-below-1990-levels-first-time
11 https://coolcalifornia.arb.ca.gov/story/city-of-los-angeles
12 https://www.rockefellerfoundation.org/our-work/initiatives/100-resilient-cities/
13 http://plan.lamayor.org/about-the-plan/
14 https://www.lamayor.org/sites/g/files/wph446/f/page/file/Resilient%20Los%20Angeles.pdf
15 http://climateaction.la/about/
16 https://www2.calstate.edu/csu-system/about-the-csu/facts-about-the-csu/Documents/facts2018.pdf
17 https://www2.calstate.edu/impact-of-the-csu/sustainability/Documents/2014-17-Sustainability.pdf
18 https://www2.calstate.edu/impact-of-the-csu/sustainability/Documents/2014-17-Sustainability.pdf
19 HOK. California State University, Los Angeles Master Plan. Draft for review 03.20.09, p. 2-9.
20 http://www.calstatela.edu/univ/ppa/publicat/cal-state-la-ranked-number-one-nation-upward-mobility
21 https://secondnature.org/signatory-handbook/commitments-implementation-handbook/
22 HOK. California State University, Los Angeles Master Plan. Draft for review 03.20.09
23 Digital Energy Inc. *Cal State LA Strategic Energy Plan. p. 25.*
24 http://www.calstatela.edu/sustainability
25 https://www.lamayor.org/sites/g/files/wph446/f/page/file/Resilient%20Los%20Angeles.pdf
26 https://www.arb.ca.gov/cc/inventory/background/gwp.htm
27 https://www.epa.gov/ghgemissions/understanding-global-warming-potentials
28 https://www.ladwp.com/cs/idcplg?IdcService=GET_FILE&dDocName=OPLADWPCCB655007&RevisionSelectionMethod=LatestReleased
29 https://www.ladwp.com/cs/idcplg?IdcService=GET_FILE&dDocName=OPLADWPCCB655007&RevisionSelectionMethod=LatestReleased
30 https://www.nrel.gov/docs/fy17osti/66506.pdf
31 Digital Energy Inc. *Cal State LA Strategic Energy Plan. p. 2.*
32 http://secondnature.org/wp-content/uploads/Second-Nature-Offset-Guidance_Draft.pdf
33 Digital Energy Inc. Cal State LA Strategic Energy Plan. p. 37.
34 http://lightingcontrolsassociation.org/2011/05/16/ashrae-releases-90-1-2010-part-2-lighting-controls/
35 Digital Energy Inc. *Cal State LA Strategic Energy Plan. p. 7.*
36 https://www.ucop.edu/sustainability/_files/whole-building-energy-performance-targets-for-uc-buildings-study.pdf
37 https://www.energy.gov/sites/prod/files/2015/09/f26/A%20Common%20Definition%20for%20Zero%20Energy%20Buildings.pdf
38 http://www.greenbuildingadvisor.com/blogs/dept/guest-blogs/best-practices-zero-net-energy-buildings
39 https://www.ucop.edu/sustainability/_files/Carbon%20Neutral%20New%20Building%20Cost%20Study%20FinalReport.pdf
40 https://www.ucop.edu/sustainability/_files/Carbon%20Neutral%20New%20Building%20Cost%20Study%20FinalReport.pdf
41 http://www.calstatela.edu/parking/transportation-services
42 https://www.lacitysan.org/cs/groups/public/documents/document/y250/mdiy/~edisp/cnt022745.pdf
43 http://secondnature.org/climate-guidance/sustainability-planning-and-climate-action-guide/building-blocks-for-sustainability-planning-and-climate-action/climate-resilience/
44 https://climatescreeningtools.worldbank.org/content/key-terms-0
45 https://www.epa.gov/sites/production/files/2016-09/documents/climate-change-ca.pdf
46 https://www.ucsusa.org/sites/default/files/legacy/assets/documents/global_warming/preparing-for-climate-change-impacts-in-los-angeles.pdf
47 http://climateaction.la/state-of-the-region/
48 https://www.ioes.ucla.edu/project/climate-change-in-the-los-angeles-region/
49 https://www.ucsusa.org/sites/default/files/legacy/assets/documents/global_warming/preparing-for-climate-change-impacts-in-los-angeles.pdf

50 https://airnow.gov/index.cfm?action=aqibasics.ozone
51 https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-human-health_.html
52 http://publichealth.lacounty.gov/eh/docs/YourHealthandClimateChange.Aug2014.pdf
53 https://www.lamayor.org/sites/g/files/wph446/f/page/file/Resilient%20Los%20Angeles.pdf
54 Los Angeles County Department of Public Health. *Your Health and Climate Change in Los Angeles County. Climate and Health Series. Report 1.* August 2014, p.8.
55 https://www.epa.gov/green-infrastructure/reduce-urban-heat-island-effect
56 https://www.seas.harvard.edu/news/2013/08/wildfires-projected-to-worsen-with-climate-change
57 http://publichealth.lacounty.gov/eh/docs/YourHealthandClimateChange.Aug2014.pdf
58 http://publichealth.lacounty.gov/eh/docs/YourHealthandClimateChange.Aug2014.pdf
59 https://www.lamayor.org/sites/g/files/wph446/f/page/file/Resilient%20Los%20Angeles.pdf
60 http://publichealth.lacounty.gov/eh/docs/YourHealthandClimateChange.Aug2014.pdf
61 http://senv.senate.ca.gov/sites/senv.senate.ca.gov/files/southern_ca_background_paper_final.pdf
62 http://publichealth.lacounty.gov/eh/docs/YourHealthandClimateChange.Aug2014.pdf
63 https://medium.com/s/futurehuman/how-climate-change-is-ruining-our-indoor-air-b73fc1627c1a
64 https://www.epa.gov/sites/production/files/2016-09/documents/climate-change-ca.pdf
65 http://www.ppic.org/publication/californias-latest-drought/
66 http://droughtmonitor.unl.edu/Maps/MapArchive.aspx
67 https://www.waterboards.ca.gov/losangeles/water_issues/programs/climate_change/docs/2015/Climatechange-frameworkforclimatechange adaptation-final7-20-2015.pdf
68 http://www.latimes.com/local/lanow/la-me-rain-record-la-20170123-story.html
69 http://www.reuters.com/article/us-usa-weather-idUSKBN15W1WZ
70 http://projects.scpr.org/maps/california-flood-zones/
71 Digital Energy Inc. *Drat Report Utility Infrastructure Systems Failure Analysis and Impact Assessment. p. 12.*
72 http://publichealth.lacounty.gov/eh/docs/YourHealthandClimateChange.Aug2014.pdf
73 http://www.calstatela.edu/strategicplan
74 https://www.rockefellerfoundation.org/blog/the-city-resilience-index-shaping-a-new-urban-agenda/
75 https://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_All_Topics.pdf
76 https://campaign.calstatela.edu
77 Digital Energy Inc. *Drat Report Utility Infrastructure Systems Failure Analysis and Impact Assessment.* California State University Los Angeles. September 2014, p. 3.
78 https://ehp.niehs.nih.gov/121-a14/
79 http://www.calstatela.edu/deanofstudents/food-pantry
80 http://www.calstatela.edu/sites/default/files/groups/Environmental%20Health%20and%20Safety/Disaster_Preparedness/csula_cert_sops_version_1.a_3-29-16.pdf
81 https://www.foodrecoverynetwork.org/aboutus/
82 http://www.realfoodchallenge.org/blog/csu-board-trustees-approves-state-wide-sustainable-food-policy
83 https://www.ers.usda.gov/data-products/food-access-research-atlas/go-to-the-atlas/
84 http://www.laregionalcollaborative.com/about/
85 https://globalcoolcities.org/los-angeles-urban-cooling-collaborative/
86 http://usucoalition.org/about/overview
87 https://www.lamayor.org/sites/g/files/wph446/f/page/file/Resilient%20Los%20Angeles.pdf
88 https://stars.aashe.org/institutions/california-state-university-los-angeles-ca/report/2016-06-06/
89 http://ceas.calstatela.edu/
90 https://interestingengineering.com/uk-could-replace-30-of-its-natural-gas-with-hydrogen-in-effort-to-curb-climate-change
91 https://www.calstatela.edu/ecst/ppp
92 http://www.epicn.org/
93 https://www.uwsp.edu/cnr-ap/UWEXLakes/Documents/ecology/shoreland/marketing/fostering_sustainable_behavior_dmm.pdf



California State University, Los Angeles
5151 State University Drive
Los Angeles, CA 90032
(323) 343-3000