1.0 Introduction

UCLA is a leader in sustainability and climate research and education. The university has conducted comprehensive assessments of academic programs and identified over 400 faculty and thousands of students from every corner of campus engaged in sustainability related research and training through 58 degree and certificate programs, 32 interdisciplinary institutes and centers and almost 600 courses. The Leaders in Sustainability graduate certificate has been recognized as a groundbreaking interdisciplinary program, and the undergraduate Sustainability Action Research Program been recognized nationwide as a model for creating a living laboratory where students collaborate with staff and faculty on applied sustainability research on campus.

UCLA launched the Sustainable LA Grand Challenge campuswide research initiative in 2013 in response to the local effects of climate change in the region. Sustainable LA aligns faculty, researchers, students, partner institutions, policymakers, and community stakeholders around a research-based action plan to achieve three key goals in Los Angeles County by 2050. These goals are to power 100% of energy and transportation needs with renewable energy; obtain 100% of water supply from sources within LA County; and enhance ecosystem health together with human health and wellbeing. Recent notable achievements include 1) Release of the Five-Year Work Plan detailing over 100 research recommendations critical to delivering a Sustainable LA Implementation Plan by 2020; 2) Symposium to explore the challenges of sustainability and civic, open, and urban data where UCLA and external researchers and community leaders presented and discussed needs, contributions, and challenges; 3) Awarding of $1.2M to 11 research projects; topics include developing lightweight solar panels that double as batteries and exploring how to minimize imported water; 4) A California Conservation Genomics Workshop with the California Department of Fish and Wildlife that gathered scientists, resource managers, and policy leaders to discuss how conservation genomics, remote sensing, and climate modeling can better inform wildlife management and help assess energy, transportation, and regional impacts; and 5) A workshop on "Understanding Local Stormwater Capture Potential" as part of a series to evaluate "LA's Water Resource Future" that was attended by experts in stormwater management, capture, and infiltration in urban spaces, climate change, and ecosystems.

Across the UC, we practice what we teach on our university campuses. The physical campus serves as a living laboratory for sustainability where academics, operations, and engagement come together and we demonstrate solutions for our state, our nation, and the world. In June 2004, the University of California then-President, Robert Dynes, approved the Policy on Sustainable Practices guidelines for the UC system to minimize its impact on the environment and decrease its dependence on non-renewable energy. In 2006 Chancellor Albert Carnesale signed the charter for the Chancellor's Advisory Committee on Campus Sustainability, now called the Sustainability Committee- a high level group of administrators, staff, faculty, and students that coordinates sustainability across the university and recommends policies and programs. In 2007, then-President Robert Dynes and UCLA Chancellor Norm Abrams signed the American College and University Presidents' Climate Commitment (ACUPCC) and a section on Climate Protection Practices was added to the UC Policy that mandated each campus develop, by December 2008, a long-term plan for (1) achieving 2000 emissions levels by 2014, (2) achieving 1990 levels by 2020, and (3) eventual carbon neutrality. UCLA's initial Climate Action Plan was published in 2008 and addressed

the policy targets for achieving 2000 emissions levels by 2014, achieving 1990 levels by 2020, and eventual carbon neutrality.

With the long history of leadership in mind, UC President Janet Napolitano announced an initiative in 2013 to achieve complete carbon neutrality in University of California operations (Scope 1 and 2 greenhouse gas emissions) by 2025. The initiative is designed by the UC Office of the President to build on a history of climate leadership and enable the University of California to become the first major Research University in the world to achieve carbon neutrality and capitalizes upon the UC's historic standing as a sustainability leader.

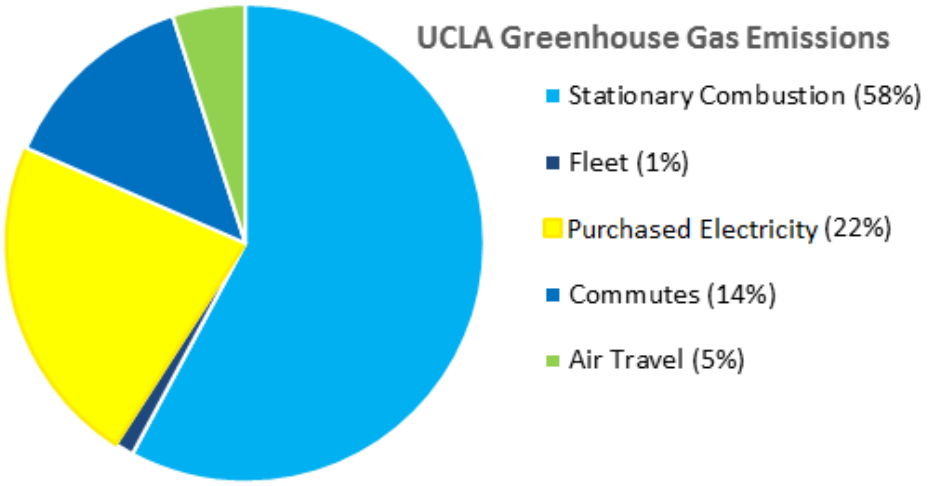
In December 2015 Chancellor Block signed an expanded Climate Leadership Commitment, building on the original Presidents' Climate Commitment. In 2016, a decade after the formation of the Sustainability Committee and in recognition of the growing scope of sustainability initiatives and the challenges ahead, an Executive Committee was created for the Sustainability Committee, engaging key Vice Chancellors and campus leadership (Charter in Appendix later) in planning around sustainability and climate. The development of this carbon neutrality plan involved engaging stakeholders across the university, including in a UC funded planning charrette in March of 2016. This updated CAP will replace the 2008 CAP, and focuses on the new target of carbon neutrality by 2025.

2.0 Greenhouse Gas Inventory

UCLA tracks greenhouse gas emissions, per UC policy, from the following main sources, as shown in Figure 1:

Scope 1 – Direct Emissions: on-site natural gas, diesel, and propane combustion; campus fleet emissions; and fugitive emissions
Scope 2 – Indirect Emissions: purchased electricity
Scope 3 – Indirect Emissions (Other): University-funded business air travel and student, staff, and faculty commuting

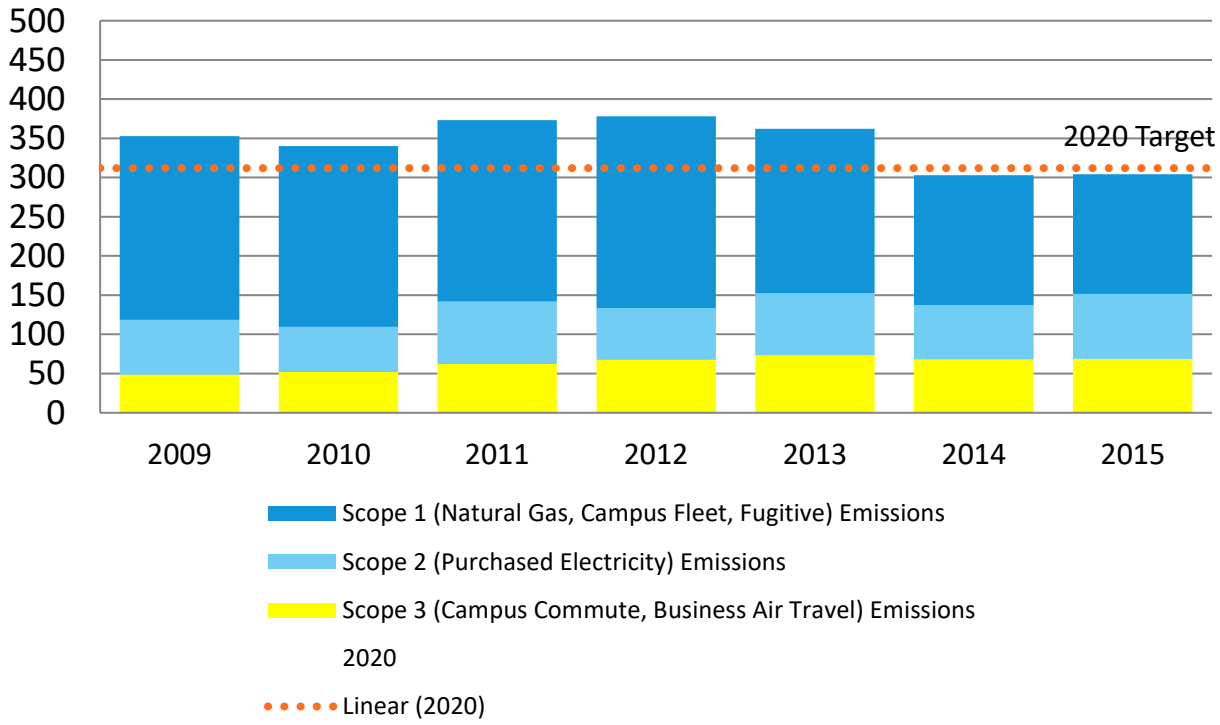
Figure 1



UCLA conducts greenhouse gas (GHG) emissions inventories under the California Air Resources Board (CARB) protocol for AB32/ Cap and Trade compliance (Scope 1 only), as well as under The Climate Registry (TCR) protocol for UCOP reporting and other external reporting such as Second Nature, Sierra Magazine, Princeton Review and the Association for the Advancement of Sustainability in Higher Education (AASHE) Sustainability Tracking Assessment and Reporting System (STARS). UCLA's emissions inventories under TCR are third party verified. Currently the 2014 and 2015 emissions inventories are in the process of being verified. Under TCR, UCLA currently reports under the Financial Control option- meaning that all the properties UCLA owns on the main campus and off campus are included (leased properties are not included).

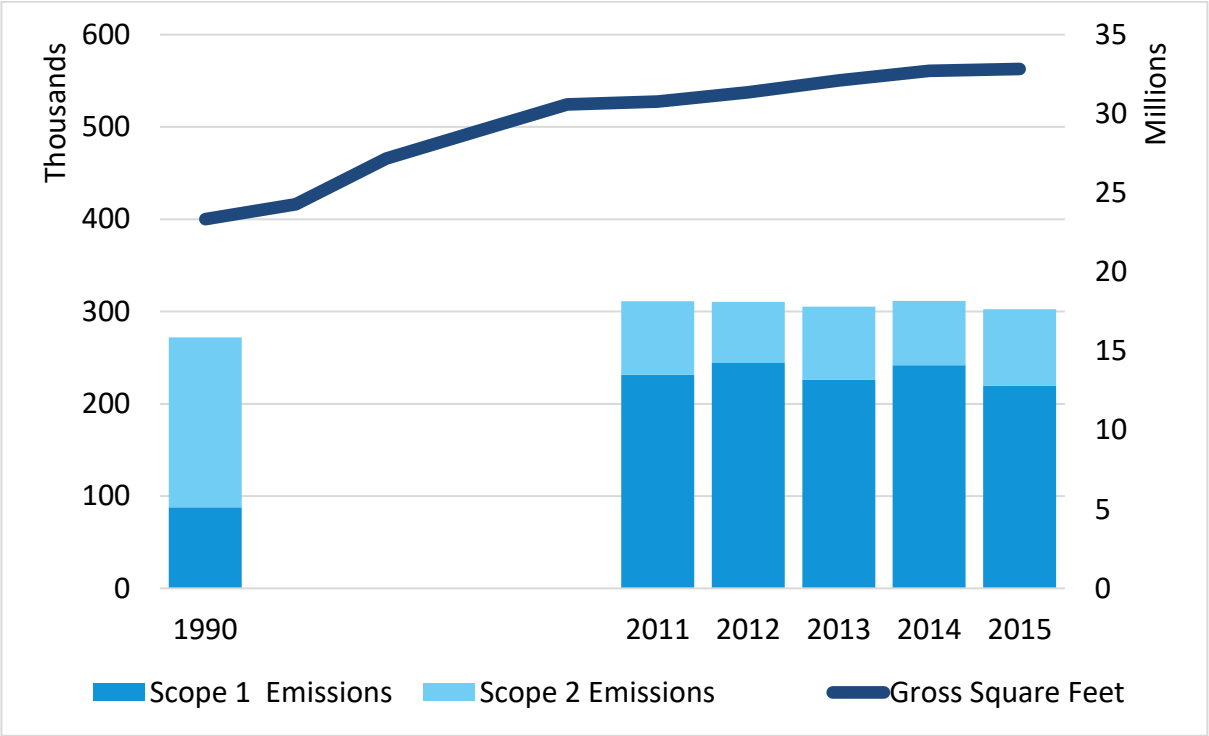
Under the original UC Sustainable Practices policy climate goals – year 2000 levels of emissions by 2014 and 1990 levels of emissions by 2020 – UCLA was in the unique position of having emissions levels in 2000 which were lower than those in 1990 due to the construction of a highly efficient campus cogeneration plant which came online in 1994. Because an interim target that is higher than the final target did not make sense, the targets were reversed and our 2014 target was set at 1990 levels of greenhouse gas emissions. In 2014, through a combination of efficiency and offsets UCLA lowered greenhouse gas emissions below 1990 levels, as shown in Figure 2.

Figure 2



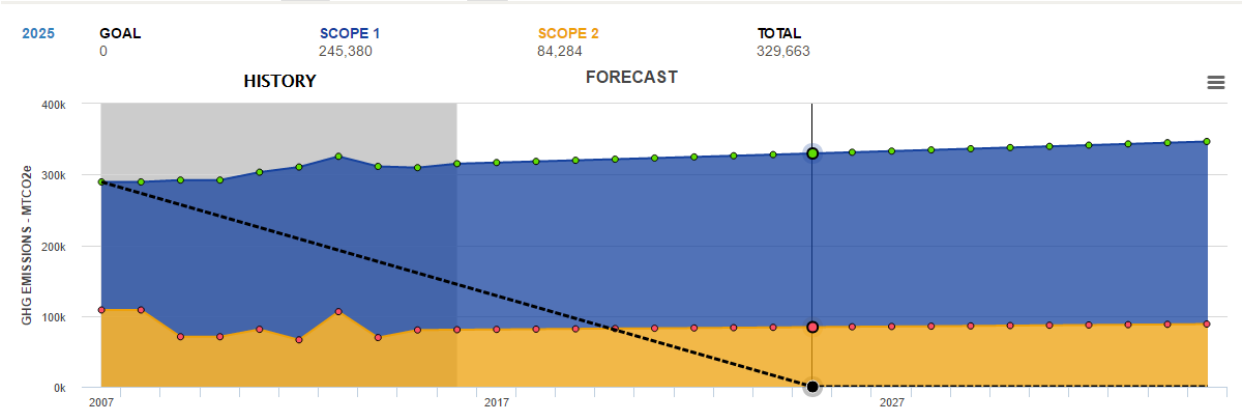
The newer 2025 carbon neutrality target under the President's Carbon Neutrality Initiative, now part of the UC Sustainable Practices policy, focuses on Scope 1 and 2 emissions. As a result of early investment in a large cogeneration plant and energy efficiency, the campus has been able to absorb significant square footage while keeping greenhouse gas emissions relatively level since 1990, as shown in Figure 3. The total reduction in GHG intensity since 1990 is a 20% reduction in emissions per square foot.

Figure 3



Despite managing energy and GHG efficiency, UCLA has continued to grow its campus square footage. Additionally, intensification of space usage in existing buildings is also likely to increase energy demand. The campus is currently evaluating its future development needs and will initiate an update to the Long Range Development Plan in Spring 2017. New projects under study include a hospital bed tower and 3,000-4,000 new beds to meet enrollment growth needs and increased demand for affordable housing proximate to campus. While more detailed energy projections are being developed for these projects, in this draft plan we assume a .5% growth rate in campus square footage, and a corresponding increase in energy demand.

Figure 4



3.0 Mitigation Strategies

3.1 Energy Efficiency

Energy conservation and efficiency are cornerstones of an effective carbon neutrality plan, and the most effective way to achieve carbon reductions. In July 2003, UCLA convened an Energy Task Force in response to the Chancellor's request to the campus community for cost reduction measures. Recommendations concerning the limitation of HVAC run-time hours were endorsed by the group. The following programs are now in place:

Winter Shutdown -This program curtails runtime hours continuously starting from the Christmas Eve holiday through the New Year's holiday. Currently, there are 42 state-funded buildings involved in the shutdown with varying levels of participation. In 2015/16, the winter shutdown reduced the campus' purchased utility expense $140K and reduced carbon footprint by 472 metric tons.

Weekend Shutdown – In 2015, Energy Services implemented a program to shut down and/or reduce air handling on weekends and holidays. There are currently thirty-two state- funded buildings in the program yielding a projected annual energy savings of $500K with a corresponding carbon footprint reduction of 1,600 metric tons. Additional savings will be achieved as participation is increased.

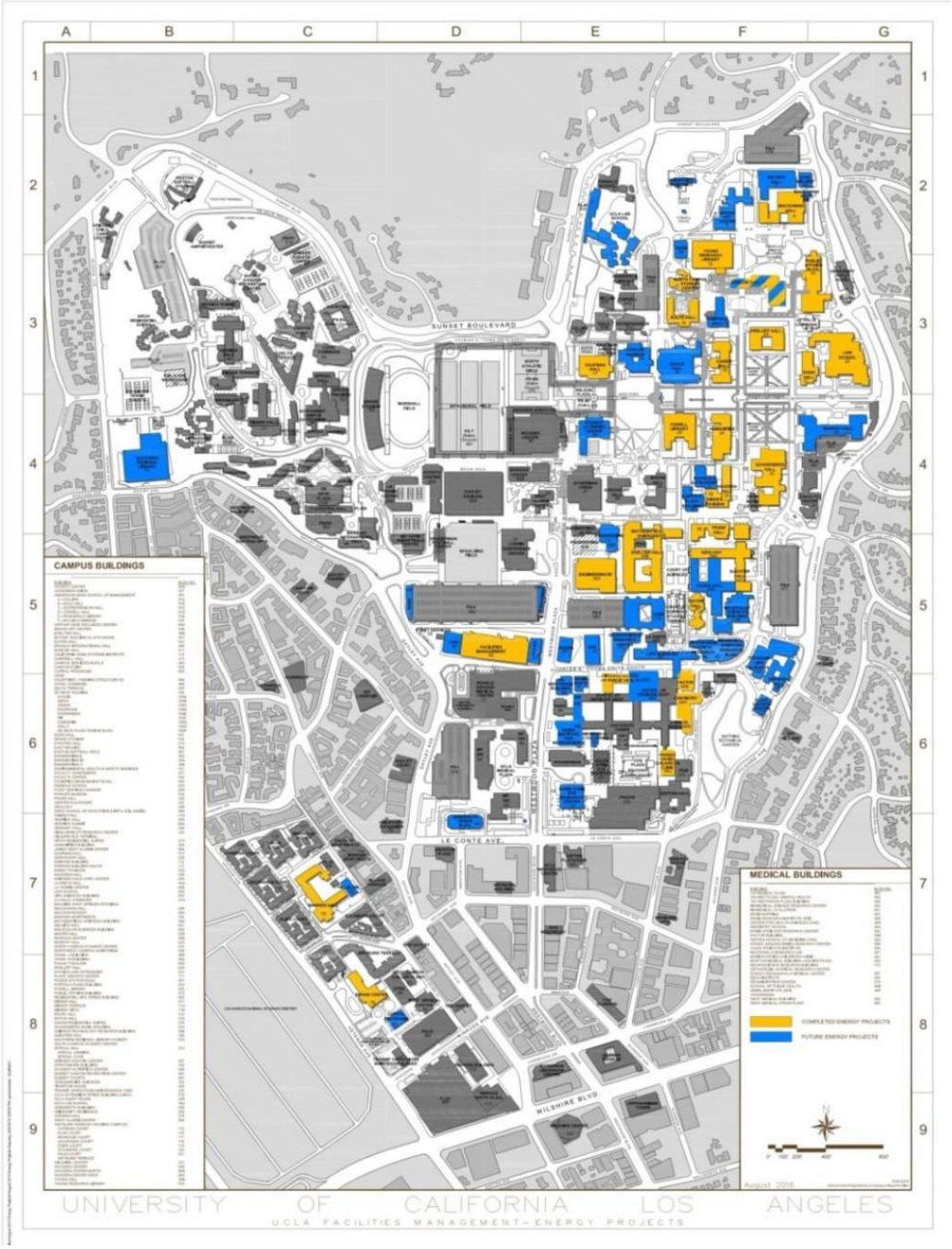
Since the 2008 UCLA Climate Action Plan, energy efficiency work has been executed in 32 of the 78 state owned buildings. Expenditures and savings thus far are as follows:

Building	Basic Gross Sq. Ft.	Annual Energy Cost	Project Budget	Annual Energy Savings	Annual CO2 Savings (metric tons)
Initial Audits /ECM's	4,937,633	$39,501,064	$20,918,467	$4,991,990	27,731

Lighting retrofits in all of the campus parking structures also contributed to additional savings beyond those tabled above.

In recognition of the importance and cost effectiveness of energy efficiency as a carbon neutrality strategy, President Napolitano called upon each UC campus to develop aggressive energy efficiency programs. The map labeled Figure 5 illustrates past progress for the state funded spaces and future plans. Energy conservation measures have been performed in 32 state buildings (gold) comprising of approximately 4.9 million gross square feet. These projects have reduced the campus annual carbon footprint by 27,700 metric tons. By 2025, Energy Services will perform comprehensive energy audits and retrofits in the remaining 46 state owned buildings (blue). These projects comprise 4.5 million gross square feet, and will yield an additional 50,000 or more metric ton reduction in annual carbon footprint.

Figure 5



In addition to the energy efficiency efforts in state funded spaces, additional efficiency efforts are planned for the Health System, Housing and Hospitality Services, ASUCLA and buildings managed by Real Estate and Asset Management.

3.1.1. Campus Opportunities and Challenges

The UCLA campus has significant deferred maintenance and aging buildings and infrastructure. In order to support the efficiency initiatives listed below and effective campus energy management, large investments in upgraded building controls and metering will also be necessary, in addition to energy project costs. The majority of campus buildings were designed in an era when energy efficiency was not a prevalent focus. In many cases occupancies and use of the buildings have changed over time. Corresponding building system modifications to reflect these changes ultimately had a cumulative negative impact on overall energy performance.

For the past decade the other campuses in the UC System have been part of a Statewide Energy Partnership (SEP). UCLA was not included because we have a municipal utility- LADWP, and later was marginally included through the participation of our gas provider, SoCal Gas. Despite this, the campus still debt financed $30 million in energy efficiency improvements and took advantage of utility rebates. For 2015 UCLA was honored in the first annual awards by our utility as the top large customer in energy efficiency, and third in water. In 2015 UCLA became the first UC to join the Billion Dollar Green Initiative, making a commitment to invest over $15 million in energy efficiency projects and reinvest half the resulting savings. To achieve this commitment, UCLA has secured over $25 million in debt financing for the next five years of energy efficiency projects.

This year UCLA was able to successfully work with our utility to bring them on board with the Statewide Energy Partnership. In 2016 LADWP officially joined the SEP, meaning that UCLA will receive a higher incentive rate of 24 cents per kWh for energy efficiency work, and technical support from both the utility and the partnership. Moving forward, UCLA will scale up its efforts by securing additional financing through the SEP program.

3.1.2. Potential projects through 2025 and beyond

UCLA Energy Services is leveraging current technologies to holistically analyze the energy efficiency of state funded buildings through comprehensive energy audits. The audits identify underperforming systems/ components, explore the implementation of energy-saving technologies and define operational strategies that will reduce overall energy consumption/ carbon footprint. Energy audits are performed using a combination of internal resources and consultants involving on-site surveys of building systems, energy modeling, and building operations. The audits produce performance data which is compared to baseline data (benchmarked) for similar systems and buildings. Variations between actual and baseline data indicate opportunities to implement energy conservation measures (ECM's).

The majority of ECM's focus on improvements to heating, ventilating and air conditioning (HVAC) systems and lighting. ECM's range in potential savings and complexity of execution, in some cases, yielding as much as a 50% reduction in energy use.

As energy audits are performed, a process to retro-commission the building systems will also be conducted. Similar to an automobile engine, building systems must be "tuned up" to maintain optimal performance and a minimized carbon footprint. The retro- commissioning process involves equipment repair as necessary to restore optimal functionality and systems modifications as necessary to accommodate deviations between original and current building usage.

To ensure initial energy savings and on-going optimal energy performance, a monitoring based commissioning/ energy management program (MBCx) will be developed. The program will continuously search for energy savings opportunities by monitoring data from building automation systems, and reporting (through an alert system), when building equipment drifts beyond normal operating parameters.

A separate, comprehensive lighting program is being implemented in all state funded buildings in parallel to the energy conservation initiative. In many cases, lighting levels in campus buildings are considerably higher than current recommended standards. The lighting program consists of measuring existing lighting levels and developing solutions that reduce levels as necessary. Lighting controls are installed which adjust light levels based on occupancy and/or daylight. When warranted, light fixtures are replaced with more energy efficient units.

In addition to these initiatives in general state buildings, Energy Services has also developed efficiency initiatives for lab buildings and similar research driven space, which typically have higher carbon footprints than the norm. These buildings consistently consume the most energy per square foot on campus, as much as three times more than classroom buildings.

Similar to non-laboratory buildings, comprehensive holistic energy audits will be conducted to identify energy conservation measures which should be executed. Retro-commissioning and lighting projects will also be implemented. In addition, significant emphasis will be placed on reducing air change rates in the laboratories from an average of 12 to 6 per hour. This reduction can reduce energy consumption by as much as 25%. In select buildings the air change rate will be reduced further with the assistance of sensors and lab demand control ventilation controls such as Aircuity. Building control systems will be installed and/or upgraded to sufficient levels to allow for centralized control and utilization of energy management software. In many cases, this will require converting existing pneumatic controls to direct digital controls.

Achieving energy efficiencies in lab buildings is often more involved and invasive than in office and classroom buildings, and will require significant coordination between occupants, consultants, and contractors. However, energy reduction for lab buildings can be in excess of 50% of current energy usage.

As with classroom and office buildings, a monitoring-based commissioning/ energy management program (MBCx) will be developed to ensure on-going optimal energy performance. Table 1 lists the total investment and kWh, steam and chilled water savings for these planned initiatives.

Table 1

Calendar Year	Total project costs	Project savings achieved by projects completed in this year	kWh/year savings achieved by projects completed in this year	Lbs of Steam/year savings achieved by projects completed in this year	Ton-hrs of cooling/year savings achieved by projects completed in this year
2017	$4,629,575	$906,788	4,412,212	13,976,065	1,967,801
2018	$11,261,380	$2,039,642	10,106,121	35,147,518	4,039,795
2019	$19,853,502	$3,478,387	17,388,275	63,072,901	6,563,268
2020	$19,238,879	$3,295,179	16,591,284	62,178,227	5,964,845
2021	$14,406,523	$2,429,873	8,915,222	46,811,336	3,710,315
2022	$10,567,589	$1,777,034	5,620,628	34,338,676	2,544,591
2023	$4,756,549	$822,310	4,282,225	15,015,018	1,324,167
2024	$263,514	$72,109	473,794	222,866	32,419
2025	$0	$0	-	-	-
Total	**$84,977,511**	**$14,821,322**	**67,789,761**	**270,762,607**	**26,147,201**

In addition to these initiatives led by UCLA Energy Services in state funded spaces on campus, additional energy efficiency initiatives will be undertaken by auxiliary units at UCLA, including the Health System and Housing and Hospitality Services as detailed in the sections following. Energy efficiency initiatives have also been undertaken by ASUCLA, including a pilot of an advanced building energy system called Building IQ, and by Real Estate and Asset Management in off campus buildings. UCLA Sustainability and Energy Services will work with these areas to further catalogue initiatives and develop plans.

Health System Energy Efficiency Initiatives

In recognition of the increasing need for energy and carbon management, UCLA Health System recently hired an Energy Manager and is developing an efficiency program. The following Table 2 is the current 5 year energy efficiency plan developed by UCLA Health System aligned with the 5 year plan requested by President Napolitano.

Table 2

Year	KWh/year savings achieved by projects completed during year	Therm/year savings achieved by projects completed during year	Total project costs
2017	2,430,297	214,961	$825,000
2018	4,460,967	139,242	$2,500,000
2019	9,061,338	430,308	$3,325,000
2020	4,600,372	0	$6,650,000
2021	1,301,115	0	$2,000,000
Total	21,854,089	784,511	$15,300,000

Strategies include air and water systems balancing, monitoring based commissioning, lighting retrofits, and chiller plant upgrades. The Health System will also pursue solar energy on some of the off campus properties.

Housing and Hospitality Services (H&HS) Energy Efficiency Initiatives

UCLA Housing and Hospitality Services is also undertaking a number of energy efficiency measures. Further analysis will be needed to provide quantitative planning metrics for these initiatives. H&HS will utilize the UC/CSU IOU Energy Efficiency Partnership program to obtain rebate funding for: mechanical equipment and lighting upgrades, advanced controls and sensors, 'smart' utility meters, and monitoring-based commissioning projects. As part of this, effort H&HS will continue LED lighting upgrades throughout H&HS properties, including On-Campus Housing, University Apartments, Lake Arrowhead Conference Center, Guest House, and the Luskin Conference Center. On-Campus Housing LED lighting replacements are 70% complete, with a goal to complete conversion by 2020.

H&HS will replace two major air handling units at Bradley Hall as well as eliminate pneumatic controls in 2017, as well as replace one of two chillers at De Neve in 2017, an investment of ~$250,000that will result in significant savings. Implement dry utility study recommendations and improve electrical service redundancy and enhance load distribution and conduct a wet utility documentation/survey study. Longer term, H&HS will continue evaluation of distributed power generation (e.g., fuel cell).

H&HS will also pursue LEED EBOM certification for two H&HS properties and evaluate costs vs. benefit of a retro-commissioning program (may be driven by LEED EBOM or a separate initiative). The department will provide training opportunities for facilities maintenance and project management team members, such as Building Operator Certificate and USGBC/Cal Green trainings.

The H&HS landscaping team will phase-out the gasoline powered mowers and blowers, and transition to electric-powered maintenance equipment.

3.2 New Construction Through 2025

Saxon Suites

GreenBuild 2016 tour of UCLA

3.2.1. Campus Opportunities and Challenges

Despite managing energy and GHG efficiency, UCLA has continued to grow its campus square footage. Additionally, intensification of space usage in existing buildings is also likely to increase energy demand. Throughout the UC, the project cost focused approach to building projects can lead to value engineering of features which have long term operational savings. In 2014, the UC Global Climate Leadership Council (GCLC) was formed by President Napolitano to advise UC leadership on achieving carbon neutrality by 2025 and in 2015, the GCLC approved 15 research and engagement projects to support the carbon neutrality goal. “These projects leverage UC faculty expertise and student creativity to make the University a global leader in climate change research, education, and business practices.” Projects include the UC’s purchase of 80 megawatts of solar capacity to supply the direct access campuses who get their electricity directly from UC. A special task force was also formed to accelerate reductions system-wide. The taskforce is currently looking at incorporating lifecycle cost assessments for new buildings. Recommendations made by this task force may be incorporated into future revisions of the climate action plan.

3.2.2. Potential projects through 2025

To factor energy consumption into planning efforts for individual buildings or the campus overall, a useful metric is Energy Use Intensity. EUI measures energy consumption per gross square foot per year (kBTU/GSF/yr). UCOP has

recently developed UC Energy Benchmarks for each utility type that place a cap on annual consumption by future projects, a maximum per-GSF design value that will be lowered every two years to help campuses to pursue Carbon Neutrality through new projects. The UC Benchmarks vary by building type: Academic/non-complex, Housing/Non-complex, and Lab/Complex, in order from least to most energy intensive. These units are directly measurable by meters and can easily compare actual consumption against projections for troubleshooting, verification, or goal-setting purposes. Electricity and natural gas consumption benchmarks can be combined to produce an EUI value. UCLA is in the process of considering utilizing these benchmarks. Recent projects, such as Hitch Suites, Geffen Hall, and Jules Stein are already outpacing the more aggressive 50% benchmark, and similar momentum is expected to continue.

As discussed in the introduction, the campus is currently evaluating its future development needs and will initiate an update to the Long Range Development Plan in Spring 2017. New projects under study include a hospital bed tower and 3,000-4,000 new beds to meet enrollment growth needs and increased demand for affordable housing proximate to campus. Some of these projects may be renovations of existing space and could decrease energy demand, while others may increase demand.

3.3 Renewable Energy

Delegation from Brazil visiting smart EV charging station at Parking Structure 9 solar installation

3.3.1. Campus Opportunities and Challenges

UCLA has a number of unique challenges due to the main campus being served by a municipal utility, The Los Angeles Department of Water and Power (LADWP) which is a monopoly power provider under the Charter of the City of Los Angeles. Because of the regulatory structure of LADWP, the main financing mechanism for on-site solar utilized by the majority of higher education campuses- a Power Purchase Agreement (PPA)- has been unavailable to UCLA. In addition, LADWP is not part of the CAISO (main California Grid) which means that the large scale renewables purchased by UCOP as a wholesale electricity provider are not available to the UCLA campus.

In spite of the barriers to on-site renewable energy, UCLA has still found avenues for installing solar on campus. UCLA was an early actor in solar thermal. UCLA has solar water heating systems serving several different residence halls. Rieber Hall, Hedrick Hall and Sproul Hall all have 125 panel systems with 8,000 gallon storage. Dykstra Hall has 125 panel

system with only 5,000 gallon storage; however, rather than storing the extra heated water, surplus hot water is diverted to the DeNeve kitchen. De Neve Gardenia and Holly, Sproul Cove and Landing all have newer solar water heating systems that use an evaporated tube technology. The first solar PV installation on campus was 36KW at Ackerman Student Union funded by The Green Initiative Fund, a student fee fund for sustainability projects. A second phase of this project will be completed in February 2017 adding an additional 20-30KW, also student funded. Solar has also been added to new some new building projects like Engineering VI. The first carport solar was constructed in 2016 on Parking Structure 9, funded by UCLA Transportation and connected to a living laboratory project with the Smart Grid Energy Research Center. These panels will power smart EV charging stations.

UCLA also uses landfill gas from Mountaingate landfill in our cogeneration plant that is piped directly in from a nearby landfill. This biomethane meets approximately 4% of the gas demand for the main campus and is a diminishing supply.

3.3.2. Potential Projects Through 2025 and Beyond

2016 has been a significant year for UCLA making progress in developing a greater partnership with LADWP and solving some of the challenges around renewable energy. Recent meetings between LADWP and UCLA have led to developing potential solutions for on-site and off site solar. It is an encouraging development for UCLA. Early in 2017 the campus will engage in further study as follow up to these proposals and at that time we will have additional details on size and approach for renewable energy on-site and off-site. To address the portion of campus energy that remains natural gas, biogas will be purchased through the UCOP biogas development program. The current scenario addressed in this plan assumes 50% of natural gas will be replaced with biomethane in 2025, the amount that UC has currently committed to. We are evaluating the possibility of increasing that percentage.

3.4 Fleet

New fully electric Bruin Bus

Electric fleet vehicles at UCLA

3.3.1. Campus Opportunities and challenges

UCLA Fleet milestones include the creation of the Alternative Fuel Vehicle Program (1998), the transition to CNG powered buses (1998) and the first electric buses purchased (2016). The UCLA Fleet currently has several hundred alternative fuel vehicles (AFV) in its 1,081 vehicle inventory, reaching 44% of the total vehicle number. Previous policy directives aimed at surrogating AFV deployment within the fleet to reduce GHG emissions, along with right-sizing efforts intended to reduce the number of vehicles on campus, and this fit in well with efforts that were already underway. UCLA has long had an AFV Program, and will continue to prioritize the purchase of ZEVs by campus departments and the medical center.

3.5.1 Opportunities and Challenges

One of the recent highlights for UCLA Fleet was the purchase of two electric buses, which have been added into the BruinBus fleet and serve the campus daily. The balance of the BruinBus fleet (14 vehicles) will be converted to electric buses as the existing CNG buses are phased out once they reach their end of life.

The plan to electrify the bus fleet beckons for associated provision of renewable electricity to power the electric buses. Efforts are underway to assess the viability (from a cost standpoint) of implementing a project to address that, however, buses use a significant amount of electricity to charge their batteries, and solar power via photovoltaic cells, at that scale, remains cost-prohibitive.

Another significant challenge is the fiscal climate that many departments face. AFVs still have a cost premium as compared to the typical Internal Combustion Engine (ICE) vehicle, and many departments are unable or unwilling to dedicate the additional funding necessary to procure an AFV. Efforts are underway to address this, and to find opportunities to educate Fleet customers about the lifecycle maintenance costs associated with owning an ICE vs. the lower maintenance costs of owning an EV. Also, it has been determined that Fleet is not fully charging the cost of ICE maintenance to campus departments, effectively decreasing the apparent cost savings of clean fuel vehicle ownership. This will soon be rectified.

The Sustainable Practices Policy only requires that AFV light-duty vehicles be procured at a 50% rate in 2025; this is tacit acknowledgment that specialized applications—often heavy-duty vehicles—are not frequently available in AFV form. This is changing as more specialized applications are seeing AFV options, however, because of the limited production of these vehicle types, the cost deltas between an ICE version and AFV version are still significant, and generally more than the cost deltas seen for light-duty vehicles.

Because of the research capabilities at UCLA, there is opportunity to partner with the academic departments regarding research related to alternative fuel infrastructure, namely in electric vehicle charging and its impact on the energy grid. And there is also opportunity related to autonomous vehicle (AV) research, as there should be one AV on campus sometime in 2017. A network of autonomous, electric vehicles on campus is a possible future.

Additionally, the challenging (poor) air quality environment in Los Angeles provides incentive to the state (California Air Resources Board, California Energy Commission) and regional (South Coast Air Quality Management District) entities to prioritize emission-reducing grant funding for fleets within the L.A. Basin. UCLA is at the nexus of geographic need and research capability in this regard, and is well-positioned to pull in grant funding to address air quality and renewable energy.

Lastly, UCLA Transit has recently inked an agreement to purchase renewable CNG for its CNG-powered BruinBuses until such time that they are replaced by electric buses.

3.5.2 Projected Fleet Through 2025

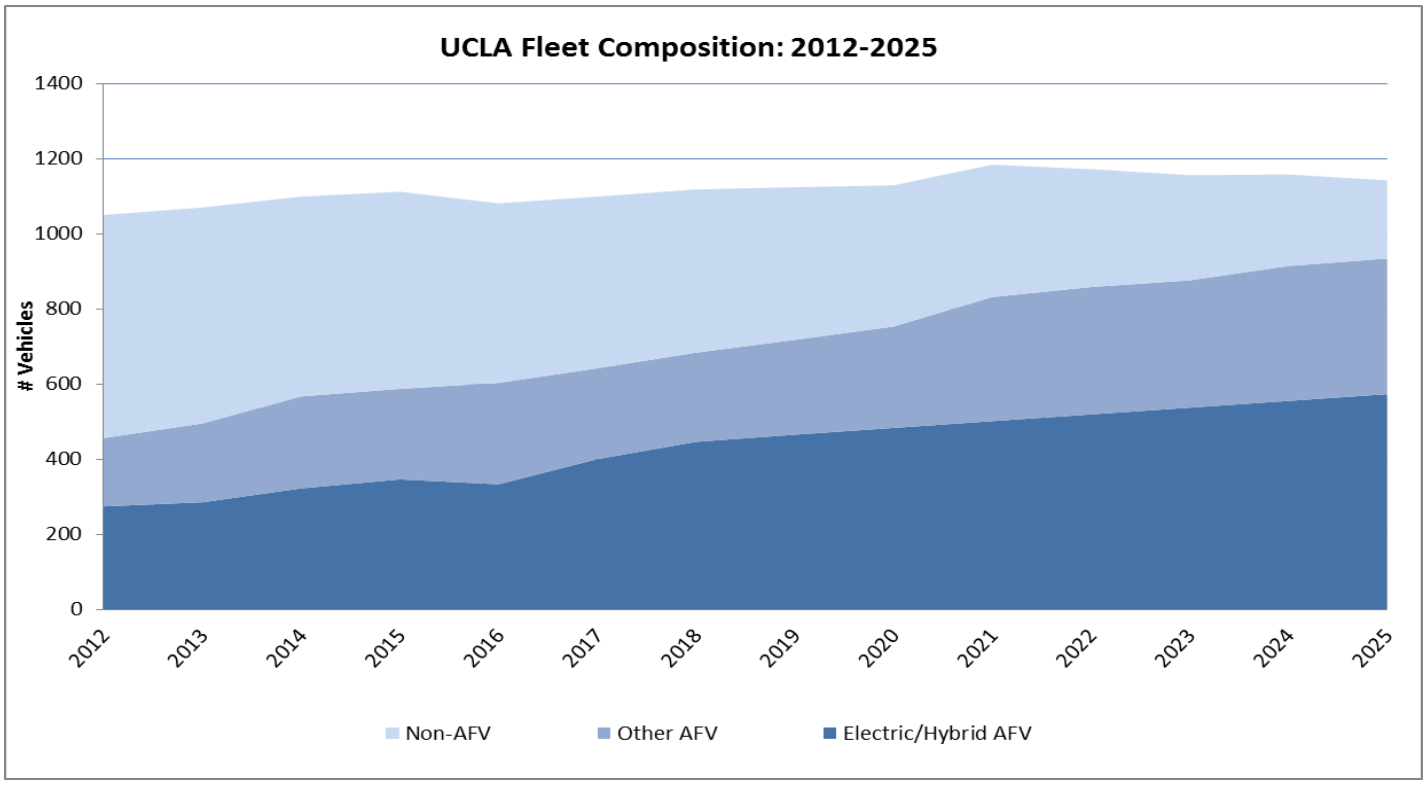
By 2025, fleet projections suggest that ICE vehicles will drop to approximately 18% of the vehicle inventory; while this is a BAU extrapolation, the recent, rapid pace of AFV acquisitions is expected to continue, putting UCLA in good stead regarding the Sustainable Practices Policy directive that: by 2025, 50% of all new light-duty vehicle acquisitions shall be ZEVs. That policy will be met and likely exceeded at UCLA. See below for fleet composition details, and the projection through 2025 of AFVs and Non-AFVs.

	Total Number of Alt. Fuel Vehicles	Total Number of Electric Vehicles	Total Number of EV Charging Stations
2016	607	337	16
2025	942	573	28

Table 3

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	% in 2025
Electric/Hybrid AFV	274	285	322	346	333	400	446	465	483	501	519	537	555	573	**50.2%**
Other AFV	182	210	245	241	270	242	237	253	270	330	339	339	359	361	**31.6%**
Non-AFV	594	575	532	525	478	457	435	406	376	353	314	280	244	208	**18.2%**
TOTAL	1050	1070	1099	1112	1081	1099	1118	1124	1129	1184	1172	1156	1158	1142	

Figure 6



3.5 Commute

Each weekday during the academic year, there are approximately 73,000 people on the UCLA campus. Besides the almost 13,000 students that reside on campus, there are approximately 60,000 commuters traveling to and from the UCLA campus in Westwood each weekday. The campus has almost 23,000 parking spaces and nearly 18 million square feet of gross developed space, including a large medical center with its attendant, high activity level. Because of the relatively long history of air quality concerns and subsequent regulations within the L.A. Basin, UCLA has for many years provided transportation demand management programs. Also, in 1990, the City of Los Angeles pressed the campus to mitigate traffic resulting from additional development, and UCLA agreed to a vehicle trip cap and parking space cap. These caps ensured TDM program efforts would continue to be a focal point for the campus, and by 2015, the campus built square footage had increased by ~%33, yet daily traffic into and out of campus had dropped by 18%. This achievement comes with a hefty price tag, as UCLA spends approximately $7 million per year on TDM subsidies and program management; however the campus has been able to grow without regard to limitations from traffic generation and this is expected to continue, as public transit service, in particular, continues to improve in the West Los Angeles area that Westwood sits within.

The current, broad palette of TDM programs runs the gamut from the Bruin Bikes program, to carpool discounts, to public transit pass subsidies (~50% for all agencies and lines) and vanpool routes across Southern California. The widespread footprint of UCLA employee residential locations means that almost no rock has been unturned as far as commute options for Bruins to reach the UCLA campus. Over the years, the UCLA employee drive-alone rate has decreased from approximately 69% in 1990 to 53% in 2016, well below the regional average of 74%, despite growth in campus population during the same period. The recent evolution of the UC Sustainable Practices Policy's transportation section includes a new goal to improve/lower the campus employees' drive-alone rate to, "10% below the 2015 SOV rate", which for UCLA was 53.9%. Therefore, the UCLA goal is a 48.5% drive-alone rate (53.9% - 5.39%).

While many commuters can be reasonably shifted away from drive-alone commutes, many others will continue to drive, no matter what. For this population cohort, efforts are underway to incentivize and serve commuters who switch from traditional, internal combustion engine vehicles to zero emission vehicles (ZEV), such as electric vehicles and fuel cell vehicles. In 2016, after several years of serving both visitors and employees with the same system of networked, Level 2 electric vehicle chargers, the campus switched to an approach that provides Level 1 charging to parking permit holders. With this approach, the cost-prohibitive nature of installing Level 2 chargers (which require 240v and thicker, dedicated conduit and a direct connection run to a nearby electrical panel) was avoided and a plethora of regular, 110v outlets have been installed to enable and allow all-day trickle charging for permit holders. A new EV parking permit was created, which allows charging at any of these Level 1 outlets.

3.5.1 Opportunities and Challenges

Much of the 'low-hanging fruit' has been reaped, so to speak, regarding switching prospective alternative mode commuters over from drive-alone vehicle commutes, and the balance of the employee population remaining is more reticent to switch from driving to an alternative mode. That being said, it is therefore important to focus upon new employees—who have yet to set their commute pattern in stone—as targets for shifting their mode away from driving

UCLA Transportation advocates regularly with area transit agencies for improved connections to campus, and has successfully fought to ensure bus service to campus was not curtailed in both the recent economic downturn (Great Recession) and during extensive system make-overs of Big Blue Bus and Culver CityBus in response to an expansion of Metro's rail service. Fortunately, public transit options at UCLA continue to improve, as local and regional transit providers expand and enhance their routes and service to the campus. Of note are the 2016 opening of L.A. County's Metro Exposition Rail Line (Expo) that runs east-west 2 ½ miles south of campus, connecting Santa Monica to downtown Los Angeles and the passage of Measure M, an L.A. County ballot measure, which establishes a half-cent sales tax to fund transportation projects across the county. This ensures that Metro's Purple Line Subway Extension is on track to be expedited and a subway station to be built at UCLA's Parking Lot 36, located along Wilshire Blvd., within seven to ten years. Construction is well underway on the east end of the line, and its eventual connection to Westwood will shrink travel times to points east and downtown, and is expected to further reduce single rider vehicle trips to campus.

The City of Los Angeles approved and adopted a new Mobility Element 2035 within its General Plan. This Element includes many of the tenets of new urbanism and focuses upon streets as public space to be shared and used by all modes and users, rather than act as conduits to move traffic as fast as possible. This evolution aids TDM program efforts, as streets become friendlier for transit users as they walk to and from bus stops and rail stations and for bicyclists commuting to campus, who should experience a gradual transition to a roadway network that includes more bike lanes and bike accoutrements.

While the City has been changing its General Plan, UCLA has been changing its on-campus mobility infrastructure, namely improving the safety and comfort of bicyclists and pedestrians as they move about the campus. This includes traffic calming treatments to slow vehicle traffic, bicycle facilities such as protected bike lanes, bike boxes, bike stairway channels, and pedestrian improvements like scramble, all-way crosswalks, enhanced crosswalks, and a dedicated shared-use pathway that used to be a roadway (Tiverton Dr., adjacent to the new Geffen Hall, is now a shared-use path sans vehicles). All of these improvements add to the safety and comfort of commuters who either walk, bike, or walk in connection to a vanpool or public transit route, and they all make it that much more palatable and likely that commuters will use the alternative modes.

Commuters have a greater penchant today than ever before to shift modes regularly, to use multiple modes to get to and from campus, and this multimodalism is an opportunity to gain traction regarding reducing drive-alone commutes. Recent parking policy changes have better enabled commuters to mix modes, and even park on days—via discounted parking made available to alternative commute mode users—when they, e.g., cannot take the bus or ride their bike.

Lastly, inexpensive gasoline prices, and the unchanging, low federal gas tax—still untied to the consumer price index and unchanged since 1993—continue to hamper the shift from driving to alternative modes

3.5.2 Projected Efforts Through 2025

Efforts are underway to build up UCLA's alternative mode incentive offerings and information provision to educate new hires about the campus' TDM programs and alternative mode offerings. This includes the establishment of a new employee commute 0ptions web page, an effort to connect to new graduate students and transfer students as soon as possible, and targeted, geo-based marketing to specific areas to steer new employees to the best commute solution for them and the campus. A 2016 policy change bore a new approach to serving new employees, graduate and undergraduate commute students, namely the creation of the New Bruin Transit Benefit, which provides one academic

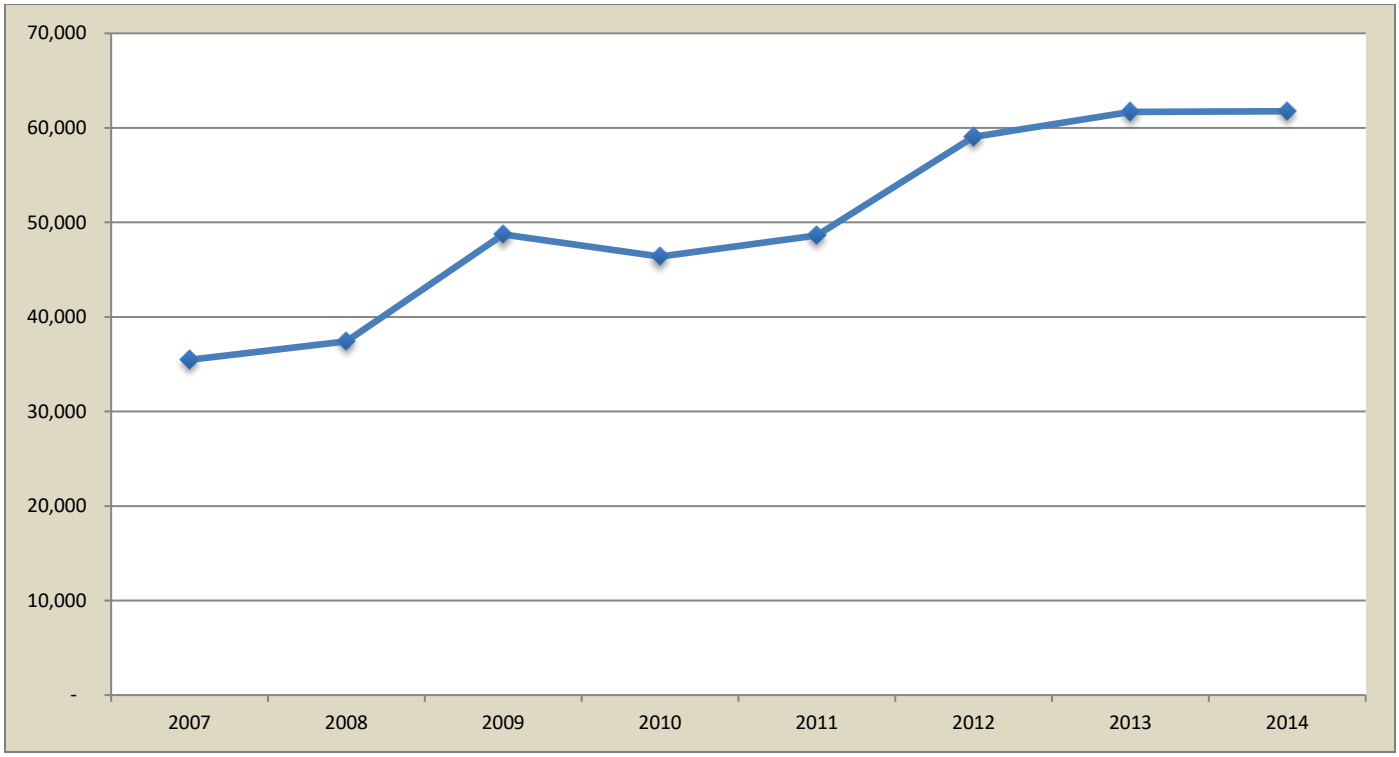
quarter of fully-subsidized transit to each new Bruin of the aforementioned types. This program intends to set commute patterns by getting new Bruins to use public transit from the get go.

Lastly, the transformation from car-centric to a people-centric campus will continue, with scheduled improvements to add more bike lanes, a bike share system, and other such features onto the campus.

3.6 Air Travel

In the 2008 UCLA Climate Action Plan, a goal to reduce business-related air travel was created, hoping to reduce such travel by 5% by 2020. The economic downturn briefly hinted that this might be possible, however once the economy recovered, air travel at UCLA increased precipitously, growing from just over 35,000 flights in 2007 to over 60,000 flights in 2014, an almost 75% increase.

Figure 7



While total miles flown increased by only 34%, a still substantial increase, both of these data points prove that efforts to reduce air travel at UCLA were unsuccessful and, given the high growth, not a fruitful pathway to reduce the GHG emissions impact of air travel. Further, it was recognized that air travel by faculty and staff is necessary for the University to pursue and fulfill its mission. Instead, the lack of progress shifted efforts towards the more productive labor of setting up carbon offsets to mitigate the emissions—if UCLA employees were going to fly, then the campus should at least work to reduce the impact of the emissions. Air travel is, after all, a larger portion (~ 5%) of the campus' GHG footprint than the campus' vehicle fleet.

In 2015, UCLA worked with a team from the Presidio Graduate School to analyze and construct a pilot approach to setting up a business-related air travel pilot program at UCLA. Flight patterns were reviewed, destinations categorized, and some groupings became evident. GHG emission calculation methodologies from flying were analyzed, and it led to the decoupling of the exact flight mileage from the fee charged. Also, the campus community, by and large, preferred local, even visible, projects to reduce emissions (paid for via the program's fees). The program approach therefore changed from a carbon offset program to a carbon mitigation program. Efforts are also are underway to add the air travel mitigation fee into the Express system, and appropriately charge the correct fee, depending upon which of the three tiers the flight falls into (CA, domestic other, or international). Once the programming is done, the Pilot can then commence and the fees can start being collected.

3.7.1 Opportunities and Challenges

The FAA reports that fuel efficiency for commercial aircraft is on the rise, showing an approximate 1% increase in fuel economy per year over the foreseeable near future

3.7.2 Projected Efforts Through 2025

The Pilot will be launched in January 2018. Results will be reviewed before 2019, and the decision to institutionalize the Pilot will then occur, with a permanent program up and running by 2020.

3.7 Education and Engagement

Changes to UCLA buildings and equipment can have a significant impact on energy use and GHG emissions, however there is always a portion of energy use that is controlled by building occupants. UCLA Energy Services is developing an Energy Information System (EIS) which is a campus-wide, web-based program that will provide near real-time information on campus and building level energy consumption. The goal of the EIS will be to stimulate awareness and to evaluate how occupancy, weather and programmatic changes can all affect the energy consumption within a building. Web-based applications and building lobby interactive displays will be used to target messages about the importance of saving energy on a daily basis. The EIS will include brief messaging built around: 1) how the campus is changing to respond to the challenges of carbon neutrality; 2) educational videos on climate change; and 3) how climate change affects the community, as well as interactive challenges that test knowledge of energy conservation.

A related initiative, The Customer Information System (CIS), is a campus-wide, web-based tool that will provide department heads and building coordinators with utility usage, cost and GHG emission information at the building-level or departmental perspective. The goal of CIS is to provide utility-level detail so that each department can understand its ongoing contribution to UCLA's overall carbon emissions. The format of the reports will mimic that of a utility bill to aid in understanding the content, but will include additional information such as benchmarking metrics, as well as current progress toward carbon neutrality and water reduction targets.

To enhance staff education, UCLA has also partnered with the City of Los Angeles Green Business Certification program to pursue staff education on sustainability and energy efficiency. To date, 45 offices have been certified under the program. A UCLA Green Champions program is being developed to involve UCLA departments in sustainable practices. Similar to the Green Business Certification, the UCLA Green Champions program will require participation across a broad spectrum of operations. In 2017, UCLA Sustainability is working with a Professional Development Program (PDP) team to

update the UCLA Staff and Faculty Sustainability Handbook and develop additional outreach recommendations for staff and faculty. UCLA's Sustainability office is working with UCLA Environment Health and Safety to further develop energy and sustainability programs for laboratories.

To engage students on carbon neutrality, UCLA undergraduate Carbon Neutrality Initiative Fellows, funded by the Carbon Neutrality Initiative, have developed social media and outreach programs. In 2016 fellows worked with UCLA Sustainability to do outreach for the system wide UC Cool Campus Challenge. UCLA placed third in the challenge, which involved faculty, staff, and students pledging carbon saving behavior change in an online and point based system. Over 3,000 people participated at UCLA. Fellows also tabled at events with interactive displays explaining climate change and the CNI. In 2017, fellows will continue to expand the Building Assessments for Sustainability and Efficiency (BASE) project, an effort to engage students directly in building energy audits that result in LEED certification.

The CNI Faculty Education and Engagement and Student Education and Engagement Committees have set the goal, across the UC system of ensuring that every UC graduate is literate in sustainability by 2025. With funding from CNI, UCLA hosted a faculty curriculum workshop in Spring 2016 that built connections between climate change education and teaching across disciplines throughout campus, including in areas such as race, ethnicity and gender, cultural history, chemistry, math, physics, psychology, medicine, engineering, media and communication, literature, the expressive arts, and public policy.

UCLA Presidential Carbon Neutrality Fellows with Sea Level Rise Display and Cool Campus Challenge Winners

The Sustainable LA Grand Challenge has provided opportunities through the Grand Challenges Undergraduate Research Scholars Program and fellowships. The Scholars program is a yearlong course for 2nd and 3rd year undergraduates that provides students with a traditional mentored research experience with faculty and an interdisciplinary research experience with peers to develop and implement an actionable sustainability project. The fellows have included two graduate students working in the LA Mayor's sustainability office on energy and water in municipal buildings and EV car sharing in underserved communities. In addition, 12 other fellows worked on sustainability projects ranging from a LA countywide renewable energy potential assessment, to evaluating the role of warming in the current and future California droughts.

In addition to these academic opportunities, students are also part of a wide variety of co-curricular education on climate and sustainability, from residence hall energy competitions to conferences and events--including Ecochella, a bicycle powered music festival and sustainability fair where students volunteer to pedal power the stage and can view the energy they produce on a live display. There are more than 40 different student organizations at UCLA focused on sustainability and climate. UCLA's Sustainable Theme Communities program, run by the Office of Residential Life, won a Best Practice Award in 2015.

Ecochella Bicycle Powered Concert

4.0 Adaptation and Resilience Planning

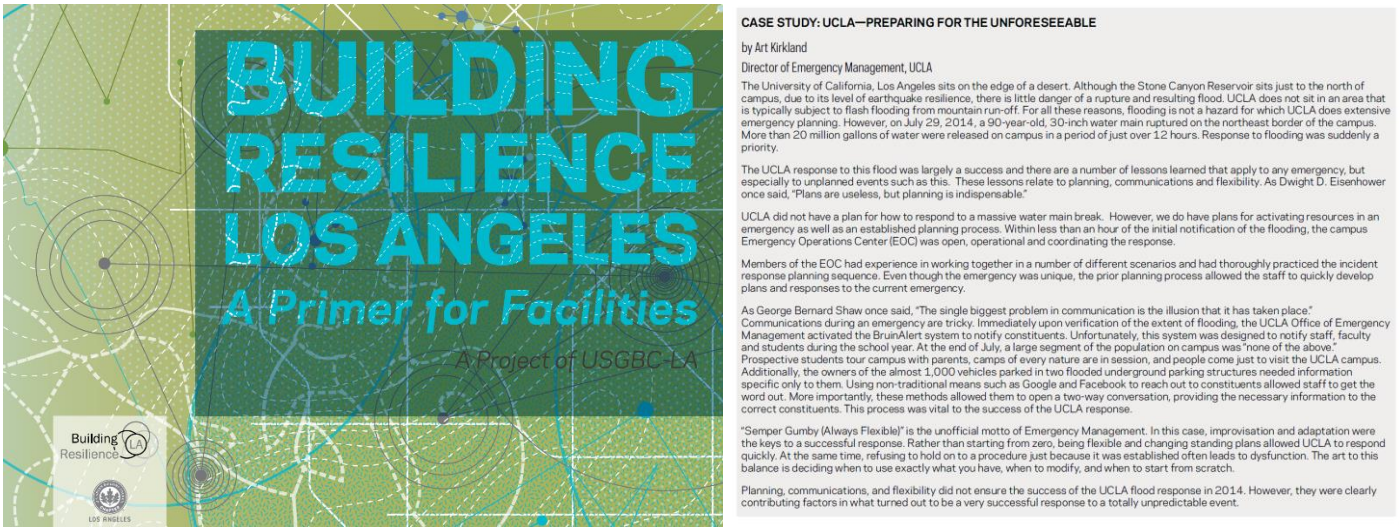
In December 2015, Chancellor Block signed the Climate Leadership Commitment under Second Nature, expanding on the original 2007 American College and University Presidents Climate Commitment (ACUPCC). The full text of the commitment can be found in Appendix X (to be added later). This commitment builds on the carbon neutrality initiative and expands it to include resilience planning. The commitment timeline requires a resilience plan for UCLA to be developed within three years, with interim milestones including forming a taskforce that includes a liaison to the community. UCLA was the first UC campus to sign the integrated commitment.

Resilience planning is a systems approach to developing an organization that is well prepared to respond to external shocks and stressors including climate change. It includes emergency management, business continuity, infrastructure planning, and community building. Adaptation planning is the intersection of resilience and sustainability/climate planning and refers to the part of resilience planning that focuses on climate adaptation- preparing for climate impacts such as heat, drought, and sea level rise. There is an Executive Order requiring State agencies to do adaptation planning, and the President's office is beginning to look into how campuses are addressing this issue, and what, if any, system wide commitments or actions should be considered.

UCLA is currently in the early stages of resilience planning. There have been some initial meetings between key stakeholders and UCLA undergraduate students have completed some initial best practice research through the Sustainability Action Research Program. Currently, a graduate student of urban and regional planning working with UCLA

Sustainability is evaluating frameworks to apply to university resilience planning, and will conduct an initial assessment, as well as make recommendations for the continuing planning process.

UCLA collaborated with USGBC's Building Resilience LA initiative to develop a guidebook for building owners on resilience. A case study on the major flood at UCLA in 2014 was featured in the guide, authored by UCLA's Director of Emergency Management. The guide was released at the national GreenBuild conference which was hosted in Los Angeles in October 2016.

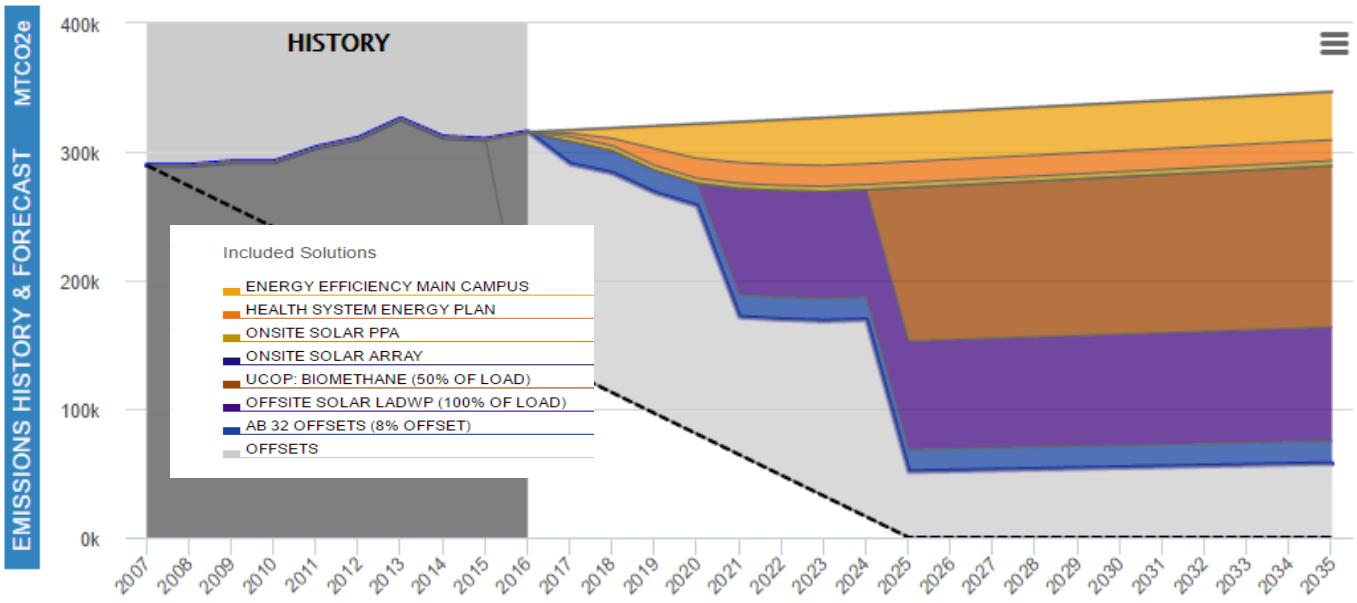


Building Resilience Los Angeles Cover and Case Study

5.0 Scenario Analysis and Next Steps

UCLA is in the process of refining scenarios for carbon neutrality in 2025. There are a number of technical studies underway or pending which will significantly impact the scenario analysis. UCLA is working with the Fovea tool developed by UCOP for reporting and analysis to develop scenarios and financial analysis. Two graduate CNI Fellows are assisting with the analysis. Figure 8 represents a scenario developed as a placeholder with the tool based on the current most likely path. The scenario includes the major strategies that UCLA is pursuing. It assumes 50% of methane demand will be met by UCOP biomethane starting in 2025, and the campus will procure 10MW of off site solar from LADWP, and that the campus will build 5 MW of solar on the campus. As additional financial analysis is conducted and details are developed for the renewable energy options the plan will evolve. We will examine the options of 100% biomethane as well as possibilities for further decarbonization.

Figure 8



There are a number of potential major energy infrastructure changes under consideration for UCLA, including a possible new central plant for the Health System and distributed heating and cooling resources to address current distribution and supply challenges. The campus is also investigating thermal exchange possibilities for different zones. Options evaluated for the medical center plant will include both gas and electric, and the study will look at life cycle costing for these options. If the campus pursues a separate plant for the Health System it would shift the steam load for the cogeneration plant significantly and would allow that steam to be used for additional electricity generation instead. Additional studies will be undertaken early in 2017 including an analysis for on-site and off-site solar and an infrastructure and integrated resource planning study. The results of these studies and the decisions that follow will have a significant impact on the energy demand profile for the campus, and on the solution scenarios for carbon neutrality and then UCLA should be able to refine these scenarios and cost analyses and will have a more robust scenario selection process and a more defined path to carbon neutrality. UCLA will also be undertaking a planning process for an overarching sustainability plan over the next couple years which will involve further developing the vision, and will tie together the carbon neutrality, water, zero waste, resilience and other planning processes.