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Office of the President

TO THE REGENTS OF THE UNIVERSITY OF CALIFORNIA:

DISCUSSION ITEM

For Meeting of September 14, 2017

CARBON NEUTRALITY AT THE UNIVERSITY OF CALIFORNIA

EXECUTIVE SUMMARY

This report provides a review of UC's leadership in addressing climate change and recent progress towards the goal to become carbon neutral by 2025. The University of California is a global model for sustainability practices, research, and innovation, and its work to advance the Carbon Neutrality Initiative is helping to make that standing broadly known, understood, and appreciated. UC's sustainability efforts are becoming a signature trait of the University – on the same footing as access, affordability, and excellence.

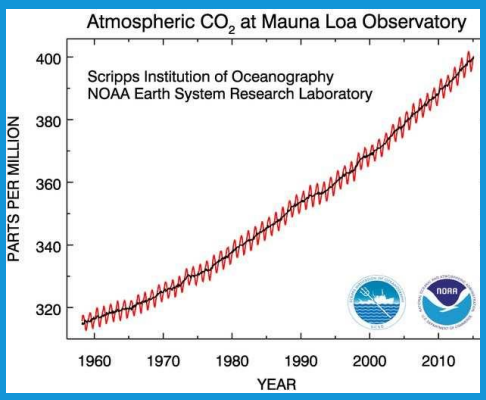
BACKGROUND

Global climate disruption poses serious and urgent environmental, social, and economic challenges. The University of California, with its vast intellectual resources on ten campuses, five medical centers and three national laboratories, is uniquely positioned to play a leading role in this critically important endeavor. These include research, innovation, ongoing campus campaigns, and overall stewardship of resources. Ultimately, UC's sustainability work also will lead to financial advantages, for both the University and the emerging green economy.

The Prompt for Action: Climate Change Science

The evidence of climate change is irrefutable. Since 1750, the dawn of the Industrial Revolution, human activity has generated two trillion metric tons of carbon dioxide (CO2) and other greenhouse gases. These emissions have helped warm the planet by 0.9 degrees Celsius. Continued or accelerated rates of warming may increase the frequency and intensity of weather disasters, cause loss of coastal land areas due to sea

The Keeling Curve



Charles David Keeling of the Scripps Institution of Oceanography at UC San Diego first established the linkages between fossil fuel combustion and global climate change due to the greenhouse effect. His work is a cornerstone of modern climate science, and the Keeling Curve has become a powerful symbol of the role of fossil fuels in climate change.

level rise, and destabilize current climate patterns. Rapid warming may contribute to the spread of infectious diseases, local increases in air pollution, and the scarcity of fresh water in some locations. The risk of significant climate-induced losses to society requires that the University make a comprehensive effort to reduce those risks.

UC's Commitment to Carbon Neutrality

Reversing these emissions trends requires a global effort, and the University of California has made a commitment to lead. Students first initiated the call for UC to reduce its own emissions, and in 2007 the chancellors of all ten campuses signed commitments to achieve carbon-neutral operations on several different timelines. In November 2013, President Napolitano launched the Carbon Neutrality Initiative, which commits UC to emitting net-zero greenhouse gases from its buildings and vehicle fleets by 2025. This would make the University of California the first major university system to reach net-zero emissions.

The pursuit of carbon neutrality is central to the UC mission. As a unifying goal, it harnesses the University's depth in climate research, using its own campuses as living laboratories. It engages students and faculty in advancing climate solutions of statewide, national, and global impact. Moreover, it exemplifies the University's commitment to public service by demonstrating that carbon neutrality is possible. UC's successes will encourage other universities, industry, and the public to use what UC has learned so that they can also take similar paths towards carbon neutrality.

UC's bold goal has galvanized many faculty, students, and staff around an issue of enormous societal importance, driving new multicampus, multidisciplinary research and collaboration, and enriching the curriculum. By focusing on what UC must do to decarbonize, the UC system becomes a large set of living laboratories, each an active learning environment exploring solutions that have the potential to advance carbon neutrality worldwide.

"In the face of the existential challenge posed by climate change in our students' lifetimes, intergenerational equity and climate justice align with the common core of the UC's mission toward our students — the future leaders of California's communities — and should therefore be placed at the center of the goals of the Carbon Neutrality Initiative. This initiative, like the UC itself, is a commitment to foster the leadership potential of this generation in service of future generations."

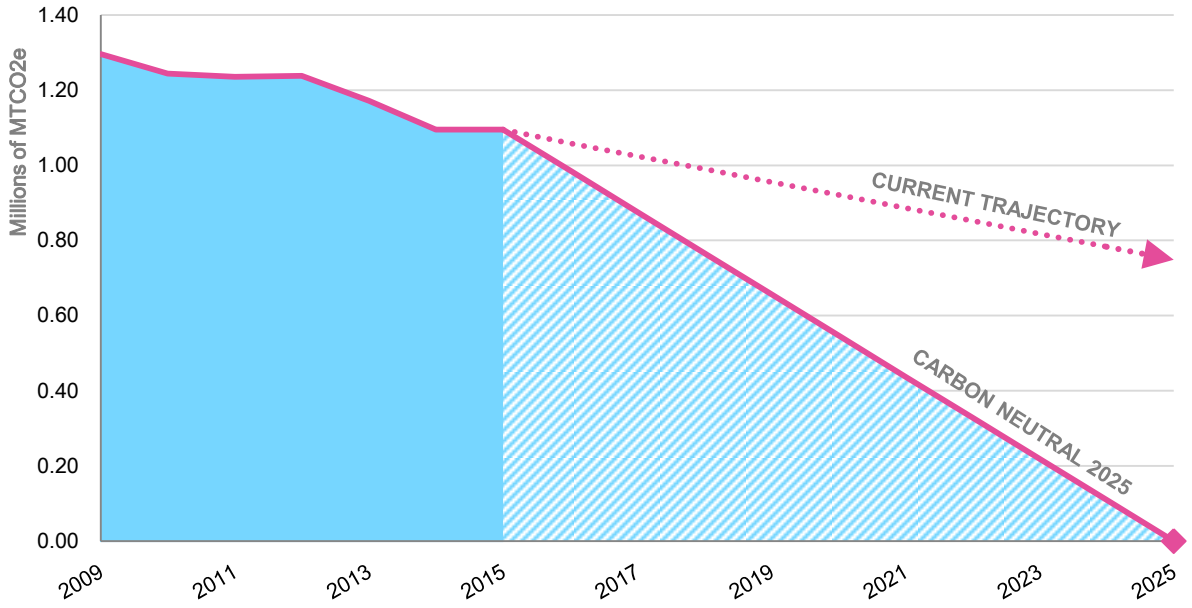
John Foran, professor of sociology, UC Santa Barbara

To provide oversight, research and recommendations for the Carbon Neutrality Initiative, President Napolitano has convened experts from across the University, including faculty, students, administrative leaders, and operations staff, with expertise in energy and sustainability, environmental law, climate science, social science, budget and finance, facilities construction and operations, administrative services, capital planning, and communication. The primary oversight group is the Global Climate Leadership Council (GCLC), formed in 2014.

PROGRESS TO DATE

The 2025 goal has also driven significant progress toward reducing carbon through efficient and innovative campus operations. UC's current emissions are three percent below its emissions in 2000, even with the addition of new space totaling more than 36 million square feet and general campus enrollment growth of more than 66,000 students. Many campuses are exceeding their own goals as well as California standards for carbon reduction. A combination of energy efficiency incentive programs, renewable energy procurement strategies, aggressive green building standards, and other measures have set the University on a steady trajectory toward net zero carbon, but this trajectory would put UC there in 2040, not 2025, as shown in Figure 1 below. The Carbon Neutrality Initiative calls on UC to accelerate its progress by implementing further operational and budgetary strategies to move the University to carbon neutrality in just eight years.

Figure 1: UC Scope 1 and 2 Greenhouse Gas Emissions: Current Emissions and Trajectory Necessary to Reach Carbon Neutrality by 2025



This graph illustrates UC's current rate of progress toward eliminating carbon from its operations. UC is on track for 2040, but needs to gain sufficient momentum to achieve carbon neutrality by 2025.

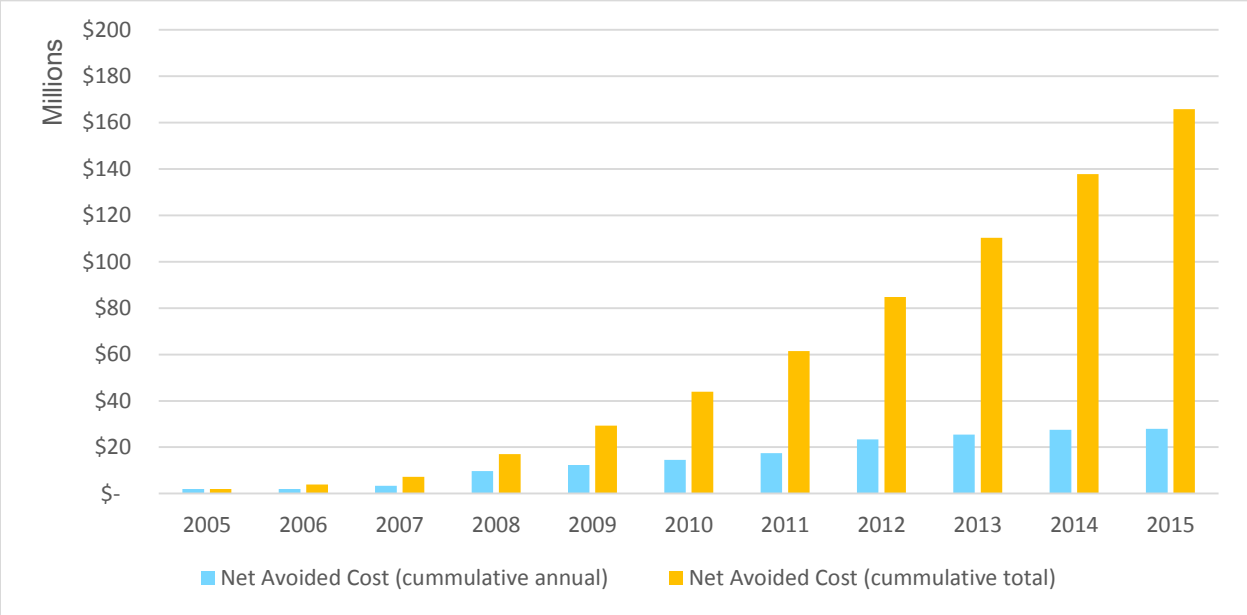
Statewide Energy Partnership

The primary funding mechanism for energy efficiency programs since 2004 has been the Statewide Energy Partnership (SEP), formed by the UC system, the California State University system, and California's four investor-owned utilities. Municipal systems serving Los Angeles and Riverside have recently joined the partnership, and all campuses are now eligible to receive SEP incentives. The SEP program provides financing for projects based on projected first-year energy savings. It funds equipment retrofits and monitoring-based commissioning, as well as staff training and education on the importance of energy efficiency. Utility company incentives

are provided for qualifying projects to reduce project expenses and widen the range of projects that can be implemented with acceptable paybacks.

Since the SEP launched, UC campuses have registered more than 1,000 projects with the program. These projects have received more than $80 million in incentive payments and avoided $28 million in annual energy costs. Systemwide, the SEP program has enabled the University to invest in energy efficiency projects that have saved 170,000 metric tons of greenhouse gas emissions while avoiding $166 million in energy costs, net of debt service, systemwide. Figure 2 illustrates the dramatic rise in both annual and cumulative cost avoidance since 2004. Important co-benefits are reductions in deferred maintenance backlogs and avoided capital costs that would have otherwise been spent to expand the capacity of UC's infrastructure systems.

Figure 2: Avoided Costs from Energy Efficiency Projects, 2004-2015



Wholesale Power Program

The University has established a Wholesale Power Program to improve the campuses' abilities to directly manage their energy supplies and lower the cost of carbon-free electricity. In 2014, the University became a registered Electric Service Provider (ESP), which allows it to procure or produce electricity and provide it to campuses that have "Direct Access" rights authorized by the California Public Utilities Commission. Direct Access service allows retail electric service customers to purchase electricity from an ESP instead of from a regulated electric utility. Their electricity is delivered through the utility's distribution system. Direct Access customers are billed by their ESP for electricity and by the utility company for transmission and distribution of the electricity. Direct Access was introduced in the late 1990s as part of the deregulation of California's utility industry. Seven UC campuses and three UC medical centers have full or partial direct access rights. (The campuses served by municipal utilities are not eligible.)

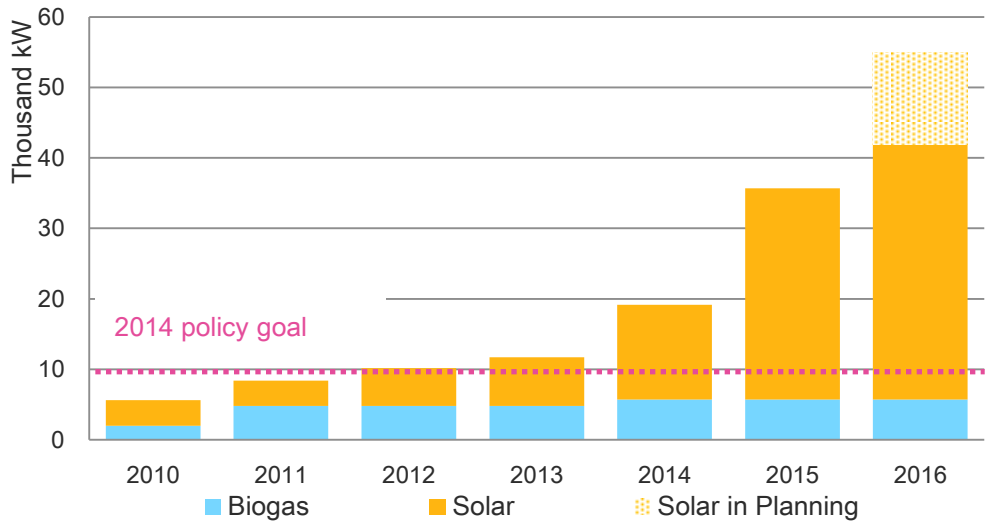
Approximately 25 to 30 percent of the University's purchased electricity is now served by the Wholesale Power Program. Participating campuses have decreased their carbon emissions while paying less than they did under past programs. As part of the Wholesale Power Program, UC now receives renewable energy from two solar projects in Fresno County: Five Points Solar Park, a 60-megawatt (MW) solar photovoltaic (PV) project, and the nearby Giffen Solar Park, a 20-MW solar PV project. Combined, these agreements are the largest solar purchase by any university in the country. The solar projects are now supplying approximately 14 percent of UC's total annual purchased electricity.

This program is overseen by UC's Energy Services Governing Board, which includes representatives from every campus and provides oversight for energy procurement decisions across the University. In practice, decisions about electricity use have been made by a subgroup that consists of the campuses and medical centers that participate in the Wholesale Power Program. The Office of the President establishes and maintains all third-party contracts for procurement and passes through transaction costs to the individual campuses. Because the program maintains its own working reserves, it does not require any additional funding to function properly. The Wholesale Power Program has proven effective and popular with the participating campuses.

On-site Renewable Energy Generation

Generating renewable energy on campus land or buildings, most commonly from solar photovoltaic systems, is often a cost-effective way to reduce greenhouse gas emissions. As illustrated in Figure 3, dozens of projects are now in place on UC campuses, totaling more than 36 MW of generation capacity. Many more projects are planned to come online before 2025. Through their climate action and energy master planning efforts, campuses are evaluating the physical, financial, and alignment-with-mission factors that dictate when larger on-site renewable projects can be implemented.

Figure 3: On-Campus Renewable Energy Capacity Exceeds Goal (MW)



The University has increased its renewable energy capacity by four times its 2014 policy goal.

Cap-and-Trade

California's cap-and-trade regulation went into effect on January 1, 2012, and established an enforceable compliance obligation beginning with 2013 greenhouse gas emissions. UC campuses joined together to take strategic actions to reduce the cost of this new regulation. UC invested in purchased allowances during the first few auctions, and the value of those allowances has steadily increased since then. California subsequently granted free allowances to UC in recognition that its campuses were already devoting considerable effort to directly reduce their emissions.

Administration of the program is coordinated by a cap-and-trade steering committee, made up of representatives from nine campuses and one medical center. Campuses individually retain verifiers and report emissions to the State's Air Resources Board, while the Office of the President maintains account holdings and documentations, and ensures regulatory compliance. This structure allows campuses to make cap-and-trade purchase decisions independently with advice from the Office of the President and consultants.

Thanks to the sequestration of funds earmarked for compliance and returns on those early investments, UC's current cap-and-trade program is now fully funded through about 2025. Thus, the program has been an effective strategy to cost-effectively administer UC's regulatory compliance obligations regarding greenhouse gas emissions.

Green Buildings

With more than 250 total certifications for green building design and operations, UC boasts the most Leadership in Energy and Environmental Design (LEED) certifications of any university in the country. Almost 20 percent of UC's building space is LEED certified, and UC Merced is the only campus in the nation where every building, including every residence hall, is LEED certified. Most important for achieving carbon neutrality, UC policy requires that all new buildings are at least 20 percent more energy efficient than required by California's already strict building energy code.

Vehicle Fleet Emissions

Although they represent only a tiny portion of total emissions, greenhouse gas emissions from UC's fleet vehicles are reflected in the carbon neutrality goal. The University has been reducing these emissions as well. In 2016, electric and hybrid vehicles accounted for 29 percent of all new fleet vehicle acquisitions. UCLA recently purchased three electric buses, and UC Irvine became the first campus in the nation to deploy an all-electric bus fleet in 2017.

Central Heating and Cooling Plants

Currently, 65 percent of UC's greenhouse gas emissions come from the on-campus combustion of natural gas, mostly from large central heating and cooling plants. Seven campuses operate combined heat and power plants (CHPs) that burn natural gas to generate electricity and provide heating (and cooling at some sites) for campus buildings.

Historically, these plants have supported several University goals. They have been cost-effective in meeting campus energy needs and have been environmentally superior choices relative to other options available when they were built. They generate fewer pollutants and greenhouse gas emissions than some other systems. Some provide important business continuity benefits by producing electricity when the surrounding utility grid is down. This was an important consideration for construction of UC's newest CHP at UC Santa Cruz, which previously experienced many PG&E power outages.

Figure 4: Combined Heat and Power Plant at UCLA

Although CHPs have been a tremendous asset for UC, the burning of natural gas presents a significant challenge to reaching carbon neutrality. Even UC's campuses without CHPs are highly invested in gas-fired heating equipment, such as large boilers that produce steam or hot water for campus buildings. The challenge of decarbonizing these assets is similar to decarbonizing CHPs. One method for decarbonizing is to develop and purchase biomethane.

Biomethane Program

Biomethane is used as a substitute for natural gas to reduce emissions from campuses' heating and cooling plants and other gas-fired equipment. UC has procured biomethane through two long-term arrangements that will eventually supply about ten percent of UC's natural gas to all campuses and medical centers. These projects are expected to come on line in the summer 2018. UC is researching related environmental benefits associated with its development of biomethane projects, such as the reduction of fugitive methane emissions resulting from better landfill gas collection systems.

Strategies are in place to minimize the cost impacts of switching to biomethane. However, for a host of reasons biomethane is not considered a complete solution to transition away from natural gas. Some stakeholders would prefer that UC stop combusting fossil fuels entirely. The recently completed TomKat Carbon Neutrality Project addressed these issues in detail. (See summary on Page 11.)

CARBON NEUTRALITY FINANCE AND ADMINSTRATIVE TASK FORCE

President Napolitano formed the Global Climate Leadership Council (GCLC) in 2014 to advise her about how to achieve carbon neutrality and to guide the campuses in advancing other sustainability goals. GCLC members include faculty, administrators, students, and experts from inside and outside UC. The GCLC engages a broad cross-section of the University community in seeking out best practices, policies, and technologies to achieve carbon neutrality while advancing teaching and research in climate change and sustainability.

Although the University has made significant progress since the Carbon Neutrality Initiative was announced, it is not yet on a path to reach carbon neutrality by 2025. Several closely related efforts are underway to support strategic actions to achieve this goal. Most importantly, all of UC's campuses have developed and recently updated Climate Action Plans that outline strategies to reduce greenhouse gas emissions. The information in these plans forms the basis for a systemwide strategic plan to achieve carbon neutrality. Although these documents define the key strategies, implementing many of them has proven difficult.

In response, through its Applied Research Working Group, the GCLC formed the Task Force on Carbon Neutrality Financing and Management (the Task Force) in the spring of 2016. The Task Force included faculty, staff, and students with expertise in energy and sustainability, construction, environmental law, budget and finance, facilities operations, administrative services, and capital planning. President Napolitano asked the Task Force to identify and prioritize the organizational barriers to achieving carbon neutrality by 2025 and to recommend ways to overcome these barriers.

Engaging Stakeholders in the Process

Leadership and participation by students, faculty, and staff are essential in steering the University to carbon neutrality. Therefore, in evaluating how to achieve the 2025 goal, the Task Force's primary strategy has been to engage the larger University community in identifying challenges and potential solutions. It conducted considerable research and fact-finding efforts among campus-based subject matter experts and its outreach has included UC's Council of Vice Chancellors for Administration, its Council of Vice Chancellors for Planning and Budget, and its Energy Services Unit Governing Board. In total, more than 200 individuals have provided guidance to the Task Force through their participation in interviews, formal surveys, and workshops, and by reviewing drafts of this report. The Task Force noted that involving those who will be responsible for implementing their recommendations and tapping their deep understanding of the challenges unique to their campuses and operating units, is critical to creating a sense of ownership in the Task Force's recommendations and in the Carbon Neutrality Initiative itself.

Task Force Recommendations

The Task Force focused its efforts in five broad areas that pertain to campuses and medical centers: funding and financing, energy efficiency and conservation, new buildings,

communication and change management, and energy supplies. A sixth area addresses barriers specific to medical centers.

The Task Force did not attempt to provide a definitive path to carbon neutrality by 2025. Instead, the report presents a set of strategies that can be implemented based on the unique needs of each location. The report includes flexibility for campuses to determine how to implement the recommendations based on campus-specific feasibility. The Task Force recommends centralized approaches only where they offer significant economies of scale or will be necessary to achieve meaningful carbon reductions.

The Task Force recommendations cover several key subjects and strategies:

- **Funding and financing.** Account for the cost of carbon and integrate carbon management with utility budgets.
- **Energy efficiency and conservation.** Invest in deeper energy efficiency and develop staff to operate finely tuned building systems.
- **New buildings.** Design new buildings to carbon-neutral standards.
- **Communication and change management.** Engage faculty, students, and staff in the commitment to achieve carbon neutrality.
- **Energy supplies.** Procure as much renewable energy as possible.
- **Medical centers.** Address the barriers unique to hospitals, including regulatory requirements and the primacy of patient care and safety.

These recommendations are now moving forward through several channels. The Office of the President is actively planning and tracking progress.

TOMKAT CARBON NEUTRALITY PROJECT

In early 2016, the TomKat Foundation, established by Tom Steyer and Kathryn Taylor, made a generous grant to the UC Santa Barbara Institute for Energy Efficiency to establish the TomKat UC Carbon Neutrality Project, a research effort to develop solutions to two of the most challenging aspects of achieving carbon neutrality. The TomKat Strategic Communication Working Group is researching ways to foster broad-based attitudinal and behavioral change in support of carbon neutrality. The TomKat Natural Gas Exit Strategies Working Group explored how to eliminate campus reliance on natural gas, the main source of campus emissions, as described below.

The UC Santa Barbara Institute for Energy Efficiency, in partnership with the National Center for Ecological Analysis and Synthesis, convened a team of UC experts to study options for reducing the use of natural gas. The 25-member team included academic researchers having a wide range of expertise, students, and energy managers from five UC campuses and the Lawrence Berkeley National Laboratory, as well as a key representative of the Office of the President, who helped coordinate this work with other activities of the UC Carbon Neutrality Project.

Recommended "Exit Strategies" for Natural Gas

For UC, the central challenge to deep decarbonization lies in reducing and, perhaps, ultimately eliminating the use of natural gas, a fossil fuel consisting primarily of methane. Approximately 65 percent of UC's operational CO2 emissions come from the direct combustion of natural gas in central plants. Therefore, a cost-effective exit strategy for natural gas is vital to achieving the carbon neutrality goal.

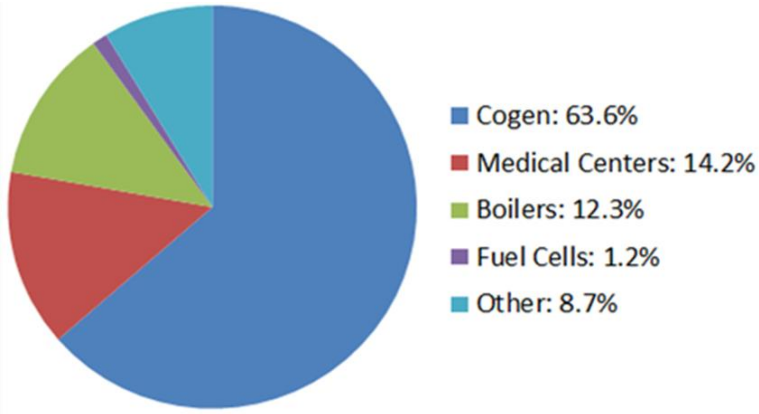


Figure 5: UC Natural Gas Use

The TomKat project was an independent academic effort that focused on how UC can translate its experience into replicable and scalable emission control strategies. The research team was designed to ensure that our analysis and proposals were rooted in the practical realities of implementation within one of the world's largest university complexes. The team used literature review and new benchmarking studies to reach its conclusions.

The TomKat report presents three complementary approaches for transitioning away from natural gas: (1) reducing energy demand via improved energy efficiency, (2) substitution of renewable gas (i.e., biogas and hydrogen produced without GHG emissions) for natural gas, and (3) electrification of end uses. The report identifies a promising short-term path and explains that the most transformative options are burdened with technical, economic, and administrative challenges. The report authors conclude with a vision of a strategy that builds on successes, documents failures from experiments, puts a priority on retaining a diversity of options, and explicitly narrows uncertainties. The report's strategies, summarized below, are intended to help UC achieve its own carbon neutrality goals while also demonstrating how other large and complex institutions can set their own goals and implement the actions needed to achieve them.

The TomKat report noted that here is no universal or optimum strategy to achieve near zero emissions. Solutions will differ in their nature and efficacy, and strategies that achieve substantial emission reduction in one setting may well prove economically or environmentally inappropriate in another, or may prove institutionally infeasible. UC and other organizations must continue to experiment with decarbonization strategies and share findings. Three strategies identified in this report occupy a substantial part of the solution space available to large campuses. These three strategies are not mutually exclusive; indeed, they can and should complement one another if actuated with careful planning and execution. Federalist planning in the UC system can be a strength because it allows each campus to tailor its own solutions – provided that the UC system as a whole sets common goals, creates systems for sharing best practices, and facilitates collective efforts when necessary to create scale.

The TomKat authors concluded that energy efficiency, biogas, and electrification are complementary solutions. Deep energy efficiency is an essential option which must be pursued at scale to the limit of its cost effectiveness. It is a significant part of the solution on all campuses – one that can reduce utility costs and offset increased costs that may be associated with biogas or electrification. For many campuses, efficiency can fully offset the price premium of biogas by 2025 as ongoing efficiency and longer-term electrification strategies are pursued. For campuses with CHP plants, deep efficiency must be pursued with an eye to the impact on operations and cost. Clearly, these campuses as a group face distinct options and strategies from those that do not have CHP systems. In this context, the availability of biogas may be particularly important since that allows continued operation of CHP units at cost-effective levels while still decarbonizing energy services.

In tandem with deep efficiency and appropriate uses of biogas, the options around electrification are essential to deep and sustained decarbonization across the whole UC system. Electrification is relatively easy for new construction and relatively difficult for retrofit of existing building stock. For new construction, electrification offers substantial flexibility for decarbonization, and the costs appear to be within the uncertainty in cost estimation practices. For the existing building stock, more calculations are needed to assess the value of overhauls and retrofits. The UC system can help establish metrics and demonstrations for doing those calculations.

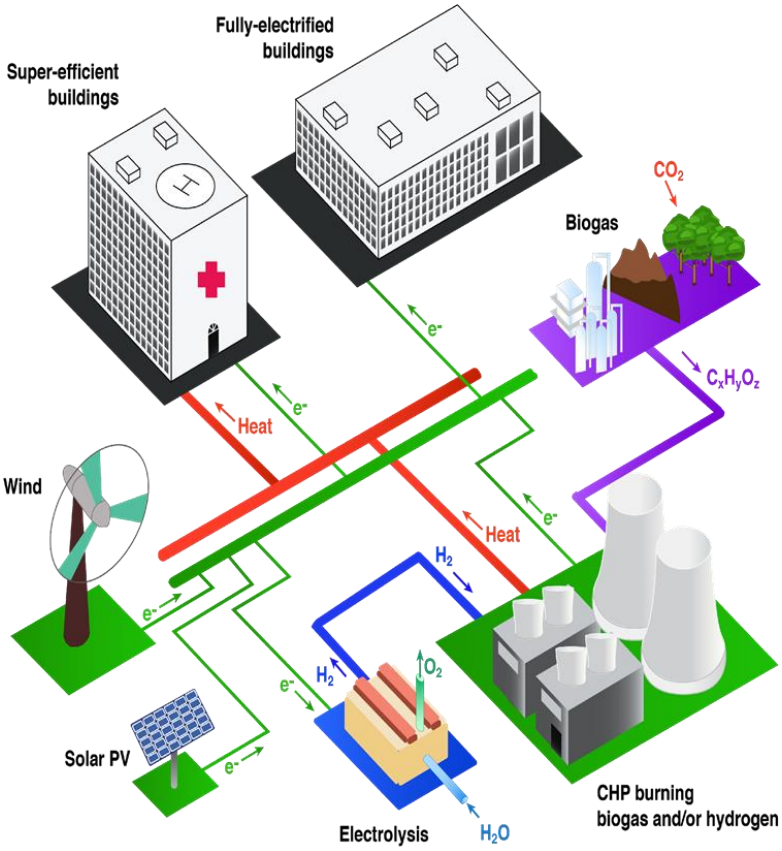


Figure 6: The TomKat Project's recommended approach to achieve carbon neutrality

CARBON NEUTRALITY INITIATIVE PROJECT FUNDING

In support of the Carbon Neutrality Initiative, the Office of the President has provided $3.67 million in project funding during fiscal years 2015-16 and 2016-17. These funds and their results have proven essential in advancing progress towards the 2025 goal. Ninety percent of the funds have been spent at the campus level. Some typical projects are described below. Funding for fiscal year 2017-18 is $1.5 million and will support similar work.

Carbon Neutrality Student Fellowships Program

In 2014, Carbon Neutrality Student Fellowship Program was initiated which included undergraduate and graduate students from the ten campuses, the Lawrence Berkeley National Laboratory, the Division of Agriculture and Natural Resources, and the Office of the President. The Program has continued to be funded each year. So far, there have been four cohorts, which include 164 CNI student fellows. The have worked on year-long projects addressing topics such as climate action plans, resiliency, carbon offsets, building efficiency data systems, and student engagement. In addition to their projects, CNI student fellows benefit from an orientation, leadership training, a symposium, and other learning opportunities.

Figure 7: Carbon Neutrality Student Fellows Program

Faculty Climate Action Champions

Expanding the best practice pioneered on the UC Santa Barbara campus, the GCLC funded the creation of a year-long climate action fellowship award for one faculty member on each campus for the 2015-16 academic year. The program promotes faculty leadership in scholarship and teaching about climate-action solutions. Faculty champions received a small grant to fund their proposals for activities that engage students and provide campus-wide leadership in carbon neutrality and sustainability issues.

Adapted from UC Santa Barbara's Faculty Sustainability Champion program, the Faculty Climate Action Champion awards on each campus in 2015-16 provided funding support for faculty to work with students on projects aimed at building community engagement and awareness. The inaugural group of champions includes physicists, engineers, biologists, atmospheric scientists, and others who have exhibited outstanding teaching, research and public service in the areas of climate change solutions, action, and broad engagement. The program is designed to help meet and focus students' interest in climate-action education, and to inspire other faculty members to help the University's goal of achieving carbon neutrality by 2025 through engaged research and education.

UC Santa Cruz's Climate Action Champion, Sue Carter, organized UC Carbon Slam to give students and faculty from all ten UC campuses the chance to present their research on climate impacts and climate solutions to industry leaders. Students also had an opportunity to pitch their ideas to a panel of expert judges looking for the ideas that held the greatest potential to have an impact on the fight against climate change. UC Berkeley's Alexis Shusterman won the climate impacts portion of the competition for her work with BEACON, which focuses on an

inexpensive way to help cities and counties assess the effectiveness of their policies. For climate change solutions, the judges awarded the first place prize to Eric Walters from UC Davis, who is working on developing biofuels using a novel fungal intermediary that could help bring the cost of manufacturing down to a level competitive with petroleum-based fuels.

Many of the Faculty Climate Action Champions played a key role in a series of curriculum building workshops, based on a model championed by the Association for the Advancement of Sustainability in Higher Education. Faculty from each campus interested in adding climate change and sustainability concepts to their existing courses participated in workshops to learn, share ideas and find the resources to make it happen. The attendees of the workshops came from every imaginable field, representing over 160 different academic units across the University. In all, 228 faculty members participated. With an average of 50 students per class, these courses could reach more than 11,000 students every year, many of whom would never have been exposed to this material otherwise.

UC San Diego's Scripps Institution of Oceanography Professor Ram Ramanathan initiated a pilot upper-division seminar on climate solutions in spring 2016. The course featured lecturers from five UC campuses from multiple disciplines, along with external lecturers from State government and international bodies. Lectures focused on pragmatic paths for achieving carbon neutrality and climate stability, inspired by UC's Carbon Neutrality Initiative and California's recent climate legislation. Professor Ramanathan and his faculty collaborators from across the UC system plan to build on the pilot Climate Solutions course by offering it on every undergraduate UC campus in 2017.

Cool Campus Challenge

In the fall of 2015, the Cool Campus Challenge (CCC) engaged nearly 20,000 staff, students and faculty at UC in an online pledge campaign aimed at reducing the University's carbon footprint and creating a culture of sustainability across campuses. From October 6 to December 10, 2015, all University faculty, staff, and students were invited to learn more about their carbon footprints on campus and at home, and then pledge to complete actions to prevent greenhouse gas emissions. Program participants will save an estimated 7,000 metric tons annually of greenhouse gas emissions from new actions and 15,000 metric tons from maintaining existing actions.

A participant survey revealed that the primary motivations of participants were to improve their campus, work toward common goals, and improve the environment. The program is one of the first systemwide engagement campaigns to involve staff, faculty, and students. Its success demonstrates the importance of building a lasting culture of sustainability as a key component of meeting an ambitious goal like carbon neutrality. Staff engagement in particular is critically important, and the challenge succeeded in engaging approximately eight percent of staff across the system.

CONCLUSIONS

Each of UC's ten campuses and five medical centers has its own culture, infrastructure, energy mix, competing priorities and budgetary constraints as well as local climatic and topographic features. A centralized, one-size-fits-all approach is both impossible and undesirable. Each campus will face unique tradeoffs and challenges in reaching carbon neutrality. There are many unknowns and uncertainties, since no institution of UC's size and scope has yet achieved carbon neutral operations.

Achieving carbon neutrality could increase operating expenses over the next five to ten years, but many of UC's subject matter experts are optimistic that UC can reach carbon neutrality without significant increase in energy expenditures. Moreover, many of the strategies recommended to achieve carbon neutrality provide the secondary benefit of increasing energy independence and providing a hedge that reduces financial risk and facilitates budget planning. For example, long-term contracts for solar power establish firm prices for 20- to 25-year terms. The UC system is actively working to evaluate all proposed solutions with financial rigor, and will continually refine carbon neutrality strategies accordingly.

UC's biggest task in achieving carbon neutrality in its operations is the eventual move away from CHPs and the natural gas combustion that accompanies that activity. UC's CHPs provide cost-effective power and thermal energy. Biogas supply is a way to keep these systems operational while lowering their carbon footprint. However, directly eliminating the emission of carbon dioxide at these locations will require thoughtful planning and capital investments in new central-plant technologies, including strategies developed through UC's own applied research.

Many of the actions required to achieve carbon neutrality will improve the quality of campus operations and business processes. In keeping with UC's threefold mission, the Carbon Neutrality Initiative is leveraging UC's ongoing applied research, providing its students with innumerable learning opportunities, and serving the global public by leading the way to a sustainable climate future.

Key to Acronyms:

CCC	Cool Campus Challenge
CHP	Combined Heat and Power Plant
CNI	Carbon Neutrality Initiative
CO2	Carbon Dioxide
ESP	Electric Service Provider
GCLC	Global Climate Leadership Council
GFI	Global Food Initiative
LEED	Leadership in Energy and Environmental Design
MW	MegaWatt
PV	Photovoltaic
SEP	Statewide Energy Partnership
UC	University of California

Attachment:

Attachment 1: Executive Summary – Overcoming Barriers to Carbon Neutrality, a Report of the Carbon Neutrality Finance and Management Task Force