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Case Study: A Practitioner Perspective on Implementation of Sustainability Initiatives at the University of California, Davis

Camille Kirk

Office of Sustainability, University of California, Davis, Director of Sustainability and Campus Sustainability Planner, 1 Shields Avenue, Davis, California, United States

corresponding author: cmkirk@ucdavis.edu

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Abstract. For over a century, the University of California (UC), Davis campus has been a living laboratory to innovate and implement scalable solutions to sustainability challenges. Four recent sustainability efforts reviewed in this case study include the first Fossil Fuel Free Pathway Plan in the UC, a Voluntary University Review of UC Davis' contributions to the Sustainable Development Goals, the Big Shift project to lower the district heating carbon footprint, and the climate change-driven Living Landscape Adaptation Plan. Sustained engagement of all sectors of the campus community is critical to successful adoption of these initiatives. Key success drivers include: a) use of data-driven decision making; b) intensive collaboration among many stakeholders, c) inclusion of faculty and students as active participants, and d) an emphasis on sharing best practices and findings.

Keywords:

Success Driver, Change Management, Engagement, Sustainable Development Goals, Campus As Living Laboratory, Climate Action

1. Introduction

For over a decade, the University of California, Davis (UC Davis) has been a model for environmental sustainability action in higher education, as validated through external rankings and ratings, such as the GreenMetric World University Rankings [1] and the Sustainability Tracking, Assessment and Rating System [2]. This case study postulates that enduring engagement of all sectors of the campus community is critical to successful adoption of sustainability initiatives, and will offer a consideration of core factors that the author, a sustainability practitioner, proposes as success drivers for creating this sustained

engagement. Four different, recent initiatives are reviewed and analyzed, using each initiative to highlight one success driver.

1.1. Context of UC Davis

Our context shapes our response to sustainability challenges. UC Davis is part of the University of California, which is a public, comprehensive, higher education and research institution with 10 campuses, 6 academic health centers, and 3 national laboratories. Opened in 1908, UC Davis is the most academically comprehensive university on the West Coast of the United States, and is located in Northern California near the state capital of Sacramento.

UC Davis is essentially equivalent in population and infrastructure to a mid-sized United States city. As of 2023, it serves nearly 39,000 students, has over 25,000 employees and is a powerful economic engine for the region and state, generating over $12.5 billion in economic activity [3]. It has over 2,000 hectares of land, and nearly 1.9 million square meters of built space, much of which is high energy- and water-use lab and medical space.

UC Davis owns and operates most of its utilities and services, and runs the bus system that serves both the City of Davis and campus. District heating is done through steam and hot water, district cooling through chilled water, and large steam boilers and a cogeneration plant currently use fossil natural gas.

We are located in a state with ever-evolving environmental protection goals written into state laws, such as the suite of climate action bills signed by Governor Newsom in fall 2022, one of which is the California Climate Crisis Act [4], and which calls for direct action decarbonization by 2045. UC Davis has also signed a number of voluntary commitments for climate action.

The University of California has a systemwide policy on sustainable practices [5]; mainly operational in nature. Many of the goals are quite ambitious, and the policy is a living document that is continuously updated by systemwide working groups [6].

1.2. Case study matrix

Figure 1 presents a matrix of the four different initiatives that each will be reviewed and analysed with respect to one success driver. However, all of the success drivers apply to all of the initiatives. This case study uses this analytical approach to what are actually synthetic, interwoven systems problems in order to isolate and consider each success driver.

Table 1. Four UC Davis sustainability initiatives and key success drivers

Initiative Example	Big Shift	Fossil Fuel Free Pathway Plan	Living Landscape Adaptation Plan	Voluntary University Review
Success Driver	Use of data-driven decision-making	Intensive collaboration among many stakeholders	Inclusion of students and faculty	Emphasis on sharing best practices and findings

2. Key success drivers

For the purposes of this case study, a success driver is some element or factor that

propels change in a positive fashion. As a sustainability practitioner with nearly two decades of experience in the field, I find that in higher education, an environment of shared governance and many stakeholders, sustainability programs and projects benefit from an interrelated, yet distinct, set of factors that are success drivers. These include: 1) use of data-driven decision-making; 2) intensive collaboration among many stakeholders; 3) inclusion of students and faculty and use of the campus as a living laboratory; and 4) emphasis on sharing best practices and findings. All of these success drivers are tied to engagement.

2.1. Use of data-driven decision-making

In a shared governance setting, with many stakeholders and multiple perspectives on what to prioritize, a key way to come to agreement and make decisions is to rely on a data-driven process. Such a process involves soliciting feedback from stakeholders on what measurable (quantitative) or assessable (qualitative) factors are key inputs; building some type of assessment tool, for example, a life cycle cost analysis model; and then evaluating a project or program using these factors and the analytical tool to produce a more objective analysis for decision support.

While data-driven approaches cannot be truly objective (confirmation bias and blind spots, even if unintentional, create some degree of biased or subjective analysis) [7], such an approach still allows all stakeholders to review the inputs and outputs of an assessment tool, and this approach does help create more transparency and accountability in decision making by leadership. It is a way to reassure stakeholders in a shared governance setting that leadership decisions have some basis in external, more objective rationales and are not whimsical or driven by favouritism or other undemocratic reasons.

Data-driven decision-making is the underlying foundational success driver and the other success drivers discussed in this case study necessarily stack on each other and intersect. Starting with a data-centered approach to decision-making helps to create more trust in the process and among stakeholders because the stakeholders can evaluate for themselves whether the decision outcomes align with the narrative offered from the data, and can offer counter-narratives to try to influence decision-making as they engage with the decision-making process.

2.2. Intensive collaboration among many stakeholders

Moving an institution towards greater social and environmental sustainability is essentially a change management [8] effort. Change management requires cultivating acceptance, and then hopefully embrace, of some significant, often visionary, shift in an organization. One way to gain acceptance and embrace is through collaboration and co-creation. A shared sense of ownership is necessary for change to take place and endure, especially in matrixed organizations or in shared governance settings. In a matrixed or shared governance organization, command-and-control or autocratic decision making may take place but changes resulting from such top-down approaches are unlikely to be fully implemented or to endure because a sense of shared ownership is lacking.

Intentionally inviting many stakeholders with varied, even contradictory perspectives, in to help collectively solve problems is typically messy, slow, and fraught with complication. Such an approach can feel chaotic to participants, outside observers, and to the leader. Leaders (of the institution, or of the project/program being co-created) may occasionally feel that their vision is being co-opted by the co-creation process. Nonetheless, real collaboration

is one of the most powerful ways to make lasting change because with collaboration many more people are invested in the success of the effort or project, as opposed to the effort or project being seen as just one person's pet idea.

Critically, operational stakeholders must be included if operational changes are desired to achieve sustainability outcomes. For example, if a campus wishes to change its waste management practices to drive towards a waste reduction goal or a reuse goal, then key operational stakeholders might include custodial services, groundskeeping, events planning, procurement, and other groups who would be affected by or able to have an effect on any change to waste management practices. Initially, there may be reluctance to participate in a collaborative process, or there may be surficial agreement to participate but quiet resistance from behind the scenes. At the onset of a collaboration effort, it is critical for the project champion or leader to ask a lot of questions of the stakeholders to understand key concerns and potentially conflicting objectives as part of the collaborative process. Successful collaboration, let alone a sense of shared stake in a successful outcome, is not likely if stakeholders do not find that their concerns are being heard and grappled with.

Intensive and intentional collaboration builds off of data-driven decision-making. With data, the collaboration is situated within a more objective and transparent framework of measurable and assessable inputs, and the multiplicity of perspectives can help expand the data inputs and the evaluative methodology, and help manage confirmation bias, blind spots, and data skewing. These are mutually reinforcing interactions which build trust and engagement in the process.

2.3. Inclusion of students and faculty using the campus as a living laboratory

Higher education is uniquely positioned to link campus operations and academic research and teaching [9]. This is not news, and many institutions have been doing pilot projects and small research projects using their campus assets for a long time, but not nearly as many institutions have constructed intentional, broad, and deeply structural approaches to successfully treat the whole campus as a living laboratory, bringing together operational and administrative expertise and resources with academic expertise and resources. To create such structural approaches to a campus as a living laboratory typically requires dedicated resources and commitment from both the administrative and academic sides of the institution, and a sense of trust has to be built and carefully nourished.

For operational stakeholders – who have regulatory, business continuity, health and safety, and financial constraints and requirements – turning over aspects of campus operations to experimentation and infusing research and teaching into the business operations of the campus is fraught with operational uncertainty. For academic research, teaching, and co-curricular stakeholders, working with operations and administration colleagues can feel unnecessarily bureaucratic and stifling. Building trust through establishing agreed-upon problem statements, principles, definitions, data sets, and program or project requirements like schedule and resources is the starting point for establishing a cooperative and productive living lab program.

Academic stakeholders bring a clear and deep connection to the core mission of the institution, and help operational and administrative stakeholders advance best practices and innovate by experimenting with campus operations and incorporating research findings and evidence-based operational management.

By explicitly drawing academic stakeholders into campus operations for sustainability-related projects, more members of the campus community become stakeholders in shared success and help to champion needed investment and resource allocations.

2.4. Emphasis on sharing best practices and findings

Seemingly obvious in a higher education setting is an emphasis on sharing best practices and findings from projects and programs. This success driver is the keystone in translating lessons learned and scaling up from pilot projects. Translating and scaling are part of the public service mission of higher education – doing the work on our campuses is only the first step. To effect needed societal change, higher education practitioners need to actively participate as subject matter experts in local, regional, and international settings to share what has worked and how it was achieved, as well as share what did not work as intended or expected.

Sharing practitioner insight helps other entities – be they other higher education institutions, NGOs, governmental bodies, or corporations – advance more quickly. And, given rapid climate change and biodiversity loss, we must scale and spread successful sustainability initiatives faster than we currently are.

Additionally, sharing best practices and findings helps the institution piloting the effort achieve recognition and credit for work they've invested in undertaking, and this recognition can build pride and trust that can be leveraged for new or extended projects and programs to advance sustainability outcomes.

3. Using success drivers to create lasting engagement and achieve sustainability initiative implementation

The four success drivers described above may seem obvious, especially in higher education settings, but in the pacing of a planning process or a project they may be viewed as impediments that slow down progress because it takes time to build and analyse data sets and work through a consultative, collaborative process. The success drivers are all factors that help build lasting change, and may be viewed instead as part of the planner's adage that we go slow in the planning phase so we may go fast in the implementation. Each of the drivers will be considered separately within four implementation examples from UC Davis sustainability initiatives.

3.1. The Big Shift project and use of data-driven decision-making

The UC Davis Big Shift [10] project reveals the utility of data-driven analysis to support decision-making. The Big Shift is a multi-phased decarbonization effort to convert the Davis campus district heating system from steam to low-temperature hot water, with heat recovery from our district cooling system with daily storage. Key gains for the campus include reducing reliance on fossil fuels, thus reducing GHG emissions; moving to a lower temperature for heating which can be generated with renewable energy; reducing distribution energy loss; improve energy efficiency and water conservation; and create a safer and easier to maintain heating system.

The campus started with a climate action plan that identified a shift from steam to hot water as a potential GHG emissions reduction action. The next step was a funding request brief by campus staff outlining the need for a more detailed engineering study. Based on that

briefing paper, the campus funded a first engineering study that proposed converting one part of the campus steam system, and included cost modelling. The study spawned a second staff-written briefing paper proposing additional detailed engineering analysis to convert the entire steam system. The additional engineering analysis was funded, and it was this deeper effort that resulted in the consulting engineering firm creating a life-cycle cost analysis (LCCA) tool of the existing steam system and several possible hot water system options for converting the entire steam system.

The LCCA assumptions and inputs included a baseline case of investing in the existing steam system, since the system had capital renewal needs. The LCCA also included operations and maintenance costs (including commodities), initial and future capital costs, a social cost of carbon, carbon offsets costs, and used a 60-year time horizon, since the steam system base case was expected to have a capital renewal cycle of 60 years (see Figure 2).

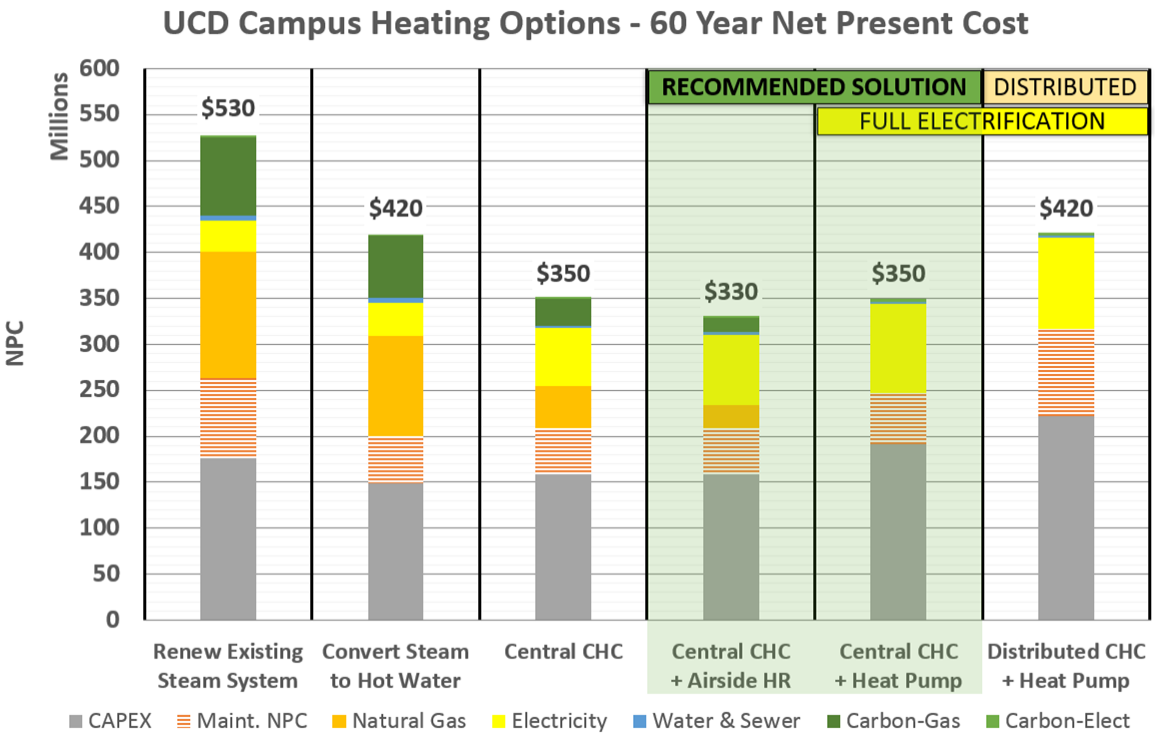

Figure 1. Life Cycle Cost Analysis of UC Davis District Heating System Options

With these assumptions, which were discussed and reviewed with stakeholders and campus leadership, the LCCA model revealed that even with electricity being more expensive than fossil natural gas, moving to a hot water system tied by heat recovery chillers to our district cooling system, and producing any additional needed hot water with renewably generated electricity was cheaper than reinvesting in the steam system that would lock the campus into steam boilers fired by fossil natural gas.

As a result, the project team gave campus leadership a recommendation to begin investing immediately in the multi-phased project to convert from steam to hot water. This recommendation was accepted and the Big Shift project completed its first phase in February

2023. The planning and construction documents are being prepared for the second phase, anticipated to start construction in 2024. The data-driven decision-making approach presented a clear business case for investing now in this infrastructure transformation. Additionally, the use of LCCA in evaluating options for infrastructure capital planning has made UC Davis a recognized leader in the UC, as the UC continues to invest across its different campuses in actions to decarbonize and increase climate resiliency.

3.2. Fossil Fuel Free Pathway Plan and intensive collaboration among many stakeholders

In early January 2022, UC Davis Chancellor Gary May requested the preparation of a campus planning study [11], referred to as the Fossil Fuel Free Pathway Plan (FFFPP) [12], to eliminate nearly all use of fossil fuels in campus business operations, including on-site combustion in central plants, buildings, fleet, and small equipment, and purchased utility sources of fossil-fuel use.

The FFFPP was galvanized by a late November 2021 petition from UC Davis students, faculty and staff to wean university operations off of fossil fuels. And, the FFFPP builds on over a decade of studies prompted by the UC Davis 2010 Climate Action Plan [13], regarding decarbonization of UC Davis' district energy systems and generation of renewable energy on and off-site.

The FFFPP investigates and documents needed building, infrastructure, management, procedural and financial changes to shift the university from operational use of fossil fuels to biofuels and renewable electricity, including consideration of strategies for renewable energy procurement. The FFFPP evaluates potential dates and costs associated with the proposed solutions, documents the findings, and provides recommendations and options to campus leadership that can inform infrastructure investments and operational decisions. It is the first comprehensive decarbonization plan undertaken by a University of California campus and is one of the earliest comprehensive plans in the United States higher education sector.

Decarbonization is a process UC Davis has been incrementally implementing for decades. As of 2022, UC Davis has reduced total greenhouse gas emissions (GHG) associated with university operations to below year 2000 GHG levels, despite more than doubling in owned and leased square footage and growing by 75 percent in population over the past 33 years (1990-2022) [14] through investments in infrastructure and renewable energy, and operational changes.

The FFFPP is intended to continue these efforts at scale while recommending a financially responsible, phased approach that allows the university to refine its efforts as progress is made to incrementally step-down fossil-fuel use. Eliminating fossil fuel use is also a challenge of persistent engagement and effort, and requires deep collaboration across all sectors of campus.

UC Davis is fortunate to have a great wealth of subject matter expertise across the institution, and many of those experts participate on the Campus Advisory Committee on Sustainability, or CACS. Formed in 2021, the initial charge for the CACS did not include a fossil free plan, and this was added to the CACS' portfolio with the January letter from Chancellor May to the co-chairs of the committee.

Typically, a university would hire this type of technical planning work out to a consulting firm, and the firm would ask the campus operations teams for energy, fleet and

other relevant data and then prepare a plan for the campus that staff would receive and provide feedback and further refinement.

However, as project managers for this planning study, the committee co-chairs deliberately did not outsource this work to a consulting firm because they wanted UC Davis' operational stakeholders to help articulate the solutions, since those stakeholders will be responsible for implementing and operating the solutions. If the stakeholders are deeply involved in this chance to rethink operations and seize opportunities to make improvements in infrastructure and other owned assets, they are more likely to identify detailed solutions they have noticed as opportunities to make change from their daily operations and maintenance activities. The solutions for eliminating fossil fuel use have to meet operational needs and be embraced and advocated for by the operational stakeholders as champions for the solutions. If the solutions are foisted on operational stakeholders, they are not as likely to be implemented and maintained.

The CACS co-chairs started by working with the CACS to define fossil fuel free, and to co-create a vision statement for the plan. The committee developed a consensus definition and target to eliminate 95 percent of 2019 fossil-fuel use for university operations. It chose the baseline year 2019 as the most recent year representative of full university operations considering COVID-19 pandemic impacts. The CACS vision for the FFFPP includes climate justice and resiliency.

Then, the co-chairs asked specific operational stakeholders to serve as lead authors of individual chapters, and invite other stakeholders to participate in the co-creation of the solutions as appropriate and relevant. One of the co-chairs formed a project management team that met weekly, and held daily short check-in meetings to answer questions and keep the plan moving forward. This is a fairly novel way to write a plan of this nature, and it intentionally uses intensive collaboration as a way to surface stakeholders' ideas and solutions, and thus, their engagement with the plan as a tool to help solve other operational challenges they experience, such as aged and difficult-to-maintain mechanical systems.

The FFFPP includes a plan summary from the co-chairs, a call-to-action chapter from faculty and research colleagues, a setting and regulatory context chapter from planning and environmental safety colleagues, and then several chapters with detailed analysis for each type of fossil fuel use in our business operations, each authored by operational stakeholders, such as campus energy engineers, utilities data analysts, capital and space planners, building project managers, and other subject matter experts. Two appendix chapters suggest policies and processes the campus could consider for managing indirect use of fossil fuels associated with commuting and air travel emissions.

Figure 3 summarizes the identified solutions created by the stakeholders. Behind each of these solutions is a complex analysis and implementation timetable looking at all of the steps and costs, as well as savings, to wean UC Davis off of fossil fuel use by 2040. UC Davis has identified a path to eliminate 95 percent of fossil-fuel used in university operations by 2040 compared to 2019 levels of fossil fuel use.

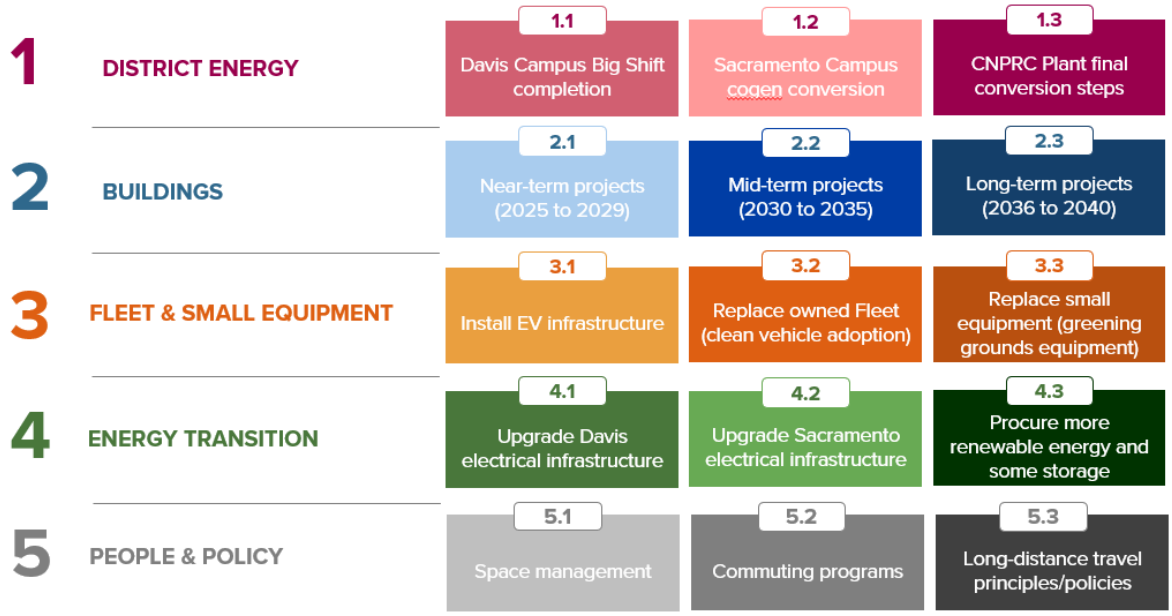

Figure 2. Matrix of UC Davis Fossil Fuel Free Pathway Plan Solutions

The full draft FFFPP will undergo review and feedback from the full campus community (including students and staff), as well as invited faculty peer review of the chapters. The peer review comments and campus community feedback will be addressed as appropriate and incorporated into the final plan expected to be published in fall 2023.

3.3. Living Landscape Adaptation Plan and inclusion of students and faculty

The Living Landscape Adaptation Plan (LLAP) [15] is intended to guide the transition of UC Davis' current landscapes to meet the challenges of climate change by 2100, using climate science and the campus' academic expertise, while also providing student involvement opportunities.

Downscaled localized climate modelling suggests that by the end of the century, our Davis climate will be more like that of a high desert city, such as Phoenix, Arizona, and our current campus tree canopy will be vulnerable and even unsuitable in this changed climate. The LLAP articulates strategies and actions to prepare the campus landscape for this changed climate, anticipating it will take about 20 years to change the species composition of the tree canopy and 50 years for the new species composition to mature into an urban forest that offers similar benefits and ecosystem services of the current campus urban forest.

As part of the LLAP planning process, the UC Davis Arboretum and Public Garden organized a three-day campus workshop [16] on campus landscape adaptation in a changing climate, and involved various faculty experts in horticulture, climate and environmental science, and landscape design, as well as campus staff who maintain and care for the campus landscape. Outcomes from the workshop were distilled into five strategies for the LLAP, one of which is: Engage academics, students, community, donors, and other partners in the work of the LLAP. This strategy is specifically connected to the success driver of including students and faculty using the campus as a living laboratory.

As the LLAP was developed using the outcomes and information from this three-day workshop, a set of action steps emerged to seize opportunities to: leverage on-campus

expertise; use UC Davis research on tree species; engage UC Davis scientists to create living lab/on-campus demonstration areas and serve as expert advisors; engage faculty and climate experts in ongoing monitoring, evaluation and reporting; design the LLAP as a model for other campuses to draw upon and evolve; and connect to the existing Arboretum Learning by Leading program [17] for student environmental education and leadership development.

The Learning by Leading (LxL) program is an international model at this point for how to engage students first as volunteers and then as paid leaders of student teams on a wide variety of campus landscape-related efforts, some of which are now connected to the LLAP, such as the Texas Tree Trials program [18]. The UC Davis Sustainability office hosts The Green Initiative Fund (TGIF) [19] program, which has provided some funding in the form of grants for student LxL projects, and has extended the student engagement connection to campus operations and the LLAP.

3.4. Voluntary University Review and emphasis on sharing best practices and findings

In 2015, the UN Sustainable Development Goals [20] (SDGs) were introduced and passed by all UN member states as a "blueprint to achieve a better and more sustainable future for all." The SDGs address the major global challenges facing human society, including poverty, inequality, climate change, environmental degradation, peace and justice.

UC Davis is actively supporting the UN Sustainable Development Goals (SDGs) through innovation and collaboration in teaching, research and service. For the past two years, UC Davis has been focusing on two central goals: 1) Raise awareness and inspire involvement in the SDGs among the UC Davis community; and 2) participate in meaningful ways in the SDG Agenda with collaborators around the world.

UC Davis has an institutional initiative evolving and growing in a partnership between the Global Affairs office, the Diversity, Equity and Inclusion office, and the Sustainability office. This partnership is a unique leadership area for UC Davis, and is helping us interconnect social sustainability and environmental sustainability more and more. We've done this through various activities such as jointly funding grant programs to advance UC Davis engagement with the SDGs, jointly hosting campus forums on the SDGs, and issuing joint communications. As we developed our partnership, we advanced the idea of preparing a Voluntary University Review [21] (VUR), which is essentially a downscaled version of a Voluntary National Review.

Voluntary National Reviews were established as a way for governments around the world to share experiences, strengthen policies and institutions, and mobilize stakeholders and partnerships to accelerate implementation of the SDG Agenda. As universities have become more involved in the SDG Agenda, the concept of the VUR has gained interest. UC Davis is one of the first universities to complete a VUR.

Sustainability assessments are critical strategic tools for helping us understand where and how we can have impact. The VUR creates a new framework to assess UC Davis' contributions toward the SDGs, and helps the campus strategize ways to continue building capacity locally and globally to address these fundamental interconnections.

UC Davis developed several objectives for the campus VUR: First, the inaugural VUR is intended to measure a baseline for UC Davis on progress addressing the SDGs. Considering the SDGs are global goals, we wanted the report to demonstrate our contributions on an

international scale. We also wanted to take an interdisciplinary approach by connecting the internationalization, sustainability, and DEI strengths on our campus. Another objective was to utilize the VUR to build awareness and inspire involvement on campus. Building off of our interdisciplinary approach, we were hoping to bring together points of connection and common interests across campus. For example, connecting faculty and researchers working on separate projects that both address similar SDGs. Lastly, we wanted the VUR to be a resource that programs and projects with local and global collaborators could use as a reference point.

As one of the first and few universities to conduct a VUR, we have been asked by other universities and organizations to share how we conducted our VUR, and we have actively and repeatedly given presentations nationally and internationally on our process and findings since we published our VUR in September 2021 [22]. We have viewed our work on the VUR as something we want to share widely to help other institutions leverage our lessons and best practices to improve and advance their own VURs and engagement with the SDGs [23].

4. Concluding remarks

The success drivers of data-driven decision-making, intensive collaboration with many stakeholders, inclusion of faculty and students, and sharing best practices are all both necessary to achieve lasting sustainability outcomes, and also introduce complications and additional time to complete an initiative. However, by taking the time to gather and use data for decision-making, to build collaboration and coalitions, to link both the academic and the administrative sides of higher education and use the campus as a living lab, and to follow up by sharing best practices and findings, we can go faster in implementing and scaling solutions by going a little slower in the planning phases. And higher education institutions are more likely to achieve lasting change, instead of short-lived projects.

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