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A sustainable campus for the higher education institutions in the U.S.

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A sustainable campus for the higher education institutions in the U.S.

by

Md Imtiajul Alam

A thesis submitted to the graduate faculty
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Major: Architecture

Program of Study Committee:
Andrea Wheeler, Major Professor
Linda Hagedorn
Ross Adams

The student author, whose presentation of the scholarship herein was approved by the program of study committee, is solely responsible for the content of this thesis. The Graduate College will ensure this thesis is globally accessible and will not permit alterations after a degree is conferred.

Iowa State University

Ames, Iowa

2018

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DEDICATION

For those who are grateful and never give up.

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ABSTRACT

The green and sustainable campus concept is not something new to US universities, but well-organized and coherent activities to effectively “green” campuses are not that common, and efforts are minor in comparison to the potential of these universities. This thesis investigates different approaches taken by higher education (HE) institutions that are considered successful in their objectives toward achieving a sustainable campus. It also examines the process of integration of sustainability into the higher education institution’s policy, pedagogy, and research process; approaches taken by HE institutions aim to impact students’ perceptions and their behavior toward the world that they will live with for the rest of their lives and those of their children. This thesis reviews different frameworks for sustainable higher education campuses by examining a set of major national and international declarations related to environmental sustainability in HE campuses. It investigates those declarations and learns from the initiatives taken by selected HE campuses through case studies; it also examines different issues related to the selection of goals and approaches to actually affect the advancement of sustainable HE campuses. This research also argues that an HE campus requires a willingness to adopt a diverse approach of physical modifications to buildings and infrastructure, as well as educational modification to achieve sustainability goals. Finally, some concrete initiatives are outlined as recommendations which may be undertaken by HE institutions in order to achieve their sustainability goals.

CHAPTER 1. INTRODUCTION

The best time to plant a tree was 20 years ago.

The second-best time is now.

– Chinese Proverb

1.1 Problem Statement

Out of 873 higher education (HE) institutions that are members of The Association for Advancement of Sustainability in Higher Education (AASHE), only three have achieved the highest achievement of platinum status in the Sustainability Tracking, Assessment and Rating System (STARS). While this system is an optional tool developed for HE institutions to measure their sustainability, there are barriers to HE institutions' widespread adoption of sustainability strategies. Thus, this thesis critically examines the role that HE institutions have in promoting sustainable development; discusses the necessity for such institutions to play a leading role in action toward sustainable development; and determines how they can better approach questions of sustainability both in terms of educational initiatives and curriculum and in the design of the built environment. This first chapter will explore the context of the problem through a review of literature, and the second chapter will continue the review with a more specific focus on the problems of HE institutions.

1.2 Background

The Sustainability Tracking, Assessment & Rating System™ (STARS) is a transparent, self-reporting framework for colleges and universities to measure their

sustainability performance. Of those who have decided to adopt the system, three have achieved Platinum status, as already suggested; 122 institutions have achieved the gold standard, which is the 2nd highest rating; 211 earned silver; and 70 achieved bronze status respectively (AASHE, 2010). From these statistics and AASHE reports, it can be determined that almost all of the HE institutions in the U.S. are still reliant on inefficient and non-renewable means of energy sources and have facility management procedures poorly adapted to the demands of the twenty-first century.

This is in a context where even grocery stores such as Walmart are taking cost-saving sustainability initiatives like installing solar panels on their roofs (Maloney, 2016). Large HE institutions are the breeding places for ideas (Staley, 2015) and should be the forerunner on sustainability initiatives (i.e., they should lead by example), but they are, in fact, falling far behind in innovation on the matter of sustainable development.

According to the Dowlatabadi and Ritchie (2015), a few private academic institutions are taking initiatives such as installing solar energy, operating organic farms, minimizing fossil fuel consumption, adopting efficient rainwater harvesting and waste management, and increasing the number of the electric vehicles for university fleets. Nevertheless, large public universities are still far behind in comparison to such private institutions, even though large public institutions often have more land, more building facilities, and a larger faculty and student body.

When it comes to a discussion about sustainability, sustainable development has been defined in several different ways. It is described as a “contested question” and a “challenging global conversation,” but there are, nevertheless, pressing needs to be addressed. For example, humans have yet to find how best to mitigate against the

worldwide problem of excessive consumption, dwindling earth resources, climate change, population growth, population migration, political conflict, and social and economic inequality. The most frequently quoted definition is that of the Chairperson of the Brundtland Commission, Gro Harlem Brundtland: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). The meaning of sustainable development has, nevertheless, developed since 1987 and the publication of the pivotal Brundtland Report, especially in respect to the field of education. It is apparent that geographic location also plays a vital role in achieving environmental sustainability (Rediscovering Geography: New Relevance for Science and Society, 1997). In terms of reducing energy consumption, developing renewable energy technologies, and basing decisions on location, some places are best suitable for wind energy and some are for solar. Places like California, Arizona, and Nevada are suitable for solar energy while Iowa is best suitable for wind energy. Sustainable energy options thus vary from place to place (Owusu & Sarkodie, 2016). However, questions also arise about the need to either reduce or contain unfettered economic growth or to support community economic development, and thus the response to social and economic inequalities arising is determined by location, country, and state.

1.3 History of Sustainability

Concern about sustainability can be traced back to Thomas Malthus (1766 - 1834), William Stanley Jevons (1835-82), and other eighteenth and nineteenth century thinkers who were worried about resource scarcity, the growing population, and the shortage of coal which was the major source for energy generation for that time. In the

writing of Fairfield Osborn and Samuel Ordway, this issue was also raised in the 1950s. Issues of sustainability as understood today, however, first came into public concern on a large scale during the 1960s and 1970s when environmental hazards, specifically health hazards due to industrial pollution, were affecting numerous human lives. This led to an environmental critique questioning conventional, growth-oriented economic development.

In the year 1972, a report titled “The limits of growth” undertaken by a group of scientists from Massachusetts Institute of Technology concluded that the carrying capacity of the planet would be exhausted if the existing trends of population growth, food production, exploitation of resources, and pollution continue at the same rate. According to this group of scientists, the result would be collapse of the ecosystem, famine, and war. Another scholar, Herman Daly, agreed with this idea and proposed his own argument of “steady state economics” which recognized absolute limits to economic growth (Daly, 1977). It was focused on physical limits to growth, however, and ignored the possibilities of technological innovations. This argument was also criticized heavily for its overly pessimistic view. Nevertheless, in spite of the criticism, the argument of “limits to growth” was important as it pointed toward the necessity to limit growth in some areas and support growth in others. However, it also presented the complex challenge of sorting out the acceptable types of growth.

In the year 1972, in Stockholm, Sweden, a conference took place on the human environment. It was attended by 113 states and representatives from 19 international organizations and was the first international conference that was solely devoted to environmental issues. During this conference, a group of 27 experts articulated the

connections between environment and development. They declared that “although in individual instances there were conflicts between environmental and economic priorities, they were intrinsically two sides of the same coin” (Vogler, 2007).

Another outcome of the Stockholm Conference was the creation of the United Nations Environmental Program (UNEP). The mission for this program was “to provide leadership and encourage partnership in caring for the environment by inspiring, informing, and enabling nations and peoples to improve their quality of life without compromising that of future generations” (Brundtland, 1987, p. 24). This conference played an instrumental role in promoting the later adoption of international agreements concerned with ocean dumping, pollution from ships, and the endangered species trade. During this conference, the “Stockholm Declaration on the Human Environment” was also adopted. This included forward-looking principles, such as Principle 13, that acknowledged the need for integration and coordination in development planning to allow for environmental protection. However, the Stockholm Conference was limited in its effectiveness, and this was precisely because environmental protection and the need for development, especially in developing countries, were seen as competing needs and moreover, were being dealt with in a separate, uncoordinated fashion (Prizzia, 2007). Prizzia argues that the conference was more concerned with identifying trade-offs between environment and development than more importantly promoting harmonious linkages between environment and development (Prizzia, 2007). UN documents later acknowledged that after the Stockholm conference, little was accomplished to substantially integrate environmental concerns into development policies and plans.

Thus, a more integrated perspective that combined both economic development and environmental sensitivities was clearly required.

In the year 1980, the International Union of Conservation of Nature and Natural Resources presented the “World Conservation Strategy” (IUCN 1980), and it was at this time that the term “sustainable development” came into the public arena. Nevertheless, this conversation was only focused on ecological sustainability, and thus, it was constrained and failed to link sustainability to wider social and economic issues.

It was not until the year 1987 when the World Commission on Environment and Development (WCED) published its report titled “Our Common Future” which specifically addressed the link between the social, economic, and ecological dimensions of development for the very first time. The WCED was led and chaired by Gro Harlem Brundtland who also was the Prime Minister for Norway during that time. “Our Common Future” is also commonly known as the Brundtland Report.

Hence, the Brundtland Report identified “sustainable development” as an ecological goal with economic, social, and environmental dimensions. This idea was unique as it suggested the possibility of development while maintaining ecological sustainability. Hence, this is different from the IUCN approach which was only concerned with environmental conservation. For this reason, the famous and most popular definition of sustainable development has been taken from the Brundtland report: “Development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1978, p.8).

Overall, when it is the matter of the capacity of humankind to evolve collectively and constructively to create a sustainable future, the Brundtland formulation projects an

optimistic view. It includes the potential of technological advancement to move communities forward in sustainable development. Nevertheless, Brundtland envisions for a common future a more fundamental process of change than simply a technical fix, and this is one that involves economic, environmental, and social components which include cultural and lifestyle changes along with technological and institutional transformation.

1.4 History of Sustainability after Brundtland Report

The next step after the Brundtland Report was the UN Conference on the Environment and Development (UNCED). During the summer of 1992, this was held in Rio de Janeiro, Brazil. It was an unprecedented historical event with the largest gathering of 114 heads of state, including 10,000 legislators from 178 countries and 1,400 nongovernmental organizations represented by an additional thousand legislators. There were three major outcomes of that conference, and they are known as Rio Declaration¹⁷², Agenda 21¹⁷³, and the Commission on Sustainable Development¹⁷⁴. All these agendas revolved around the topics of sustainable development.

In the year 1997, a conference on climate change occurred at Kyoto. In this conference, developed countries made agreements to establish a specific target to reduce GHG emissions. Later, this agreement was widely known as the Kyoto protocol. While the European Union proposed a 15% reduction of GHG emissions, the U.S. did not agree with this number. Instead, the U.S. proposed to stabilize the emissions only. Ultimately, the U.S. did not approve Kyoto protocol, and the EU could not reach its goal either. Instead, both the U.S. and the EU increased their GHG emissions by 50 percent and 18 percent respectively (Camhis, 2006, p. 74).

In September 2000, the Millennium Development Goal was declared in New York. These were eight international development goals that were set for the year 2015. These goals demonstrated that “the livelihoods and well-being of the world’s poor could now be conceptualized in terms of access to opportunity and absence of insecurity and vulnerability” (Adger et. al., 2007). There were eight goals in total and they were:

1. To eradicate extreme poverty and hunger
2. To achieve universal primary education
3. To promote gender equality and empower women
4. To reduce child mortality
5. To improve maternal health
6. To combat HIV/AIDS, malaria, and other diseases
7. To ensure environmental sustainability
8. To develop a global partnership for development

1.5 Criticism for MDG

The Millennium Development Goals received criticism from a wide range of experts from various fields. Though some of the developing countries like China and India have shown some progress in those goals, much of the world is far behind targets. Hence, this section provides a brief summary of the criticisms of MDG.

At the very beginning, it created disagreement between national and international statistics as discrepancies have been found between national and international monitoring systems and data. Also, there were no set guidelines on how to customize this goal on an international level based on their national realities and regional dynamics. This agenda

did not address the issues of middle income countries which comprise a significant amount of global population.

Another criticism was that MDGs' suggestions were often based on an international benchmark instead of local conditions and often ignored the complexities and challenges of the development process. As a result, there were no effective mechanisms to measure the considerable progress made by countries with low initial levels of human development, especially in Africa. Poverty reduction, creation of employment, and improved rural livelihood were not clearly expressed in the MDG Framework. Follow-up and monitoring for the progress was inadequate. It also failed to explain the widespread inequalities across the globe. Sub national and regional complexities were ignored when assessing the progress and challenges at the national level. And last but not least, although the MDG was signed by a huge number of developing countries, they were written almost completely without them. The original idea behind the MDG was developed by some development agencies in hotel conference centers throughout the 1990s. When MDG was presented in 2015 in front of the world, the donors were already aware of the problems that they wanted to solve and the indicators were already there to measure them.

1.6 Sustainable Development Goals (SDGs) of the United Nations

As a result of the inability to meet the targets of the MDG, the Sustainable Development Goals (SDGs) were thus developed and are a set of 17 "Global Goals" with 169 targets between them. These goals were led by the United Nations through a planned process of involving its 193 States which are also the members of this organization and are considered as global civil society. The 17 goals include:

Goal 1: End poverty in all its forms everywhere

Goal 2: End hunger, achieve food security and improved nutrition, and promote sustainable agriculture

Goal 3: Ensure healthy lives and promote well-being for all at all ages

Goal 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

Goal 5: Achieve gender equality and empower all women and girls

Goal 6: Ensure availability and sustainable management of water and sanitation for all

Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all

Goal 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment, and decent work for all

Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation

Goal 10: Reduce inequality within and among countries

Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable

Goal 12: Ensure sustainable consumption and production patterns

Goal 13: Take urgent action to combat climate change and its impacts

Goal 14: Conserve and sustainably use the oceans, seas, and marine resources for sustainable development

Goal 15: Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation, and halt biodiversity loss

Goal 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all, and build effective, accountable, and inclusive institutions at all levels

Goal 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development

1.7 Criticism for SDG:

While the Sustainable Development Goals (SDGs) are bold and idealistic, there is a precedent of this agenda; before the SDGs, there were the eight Millennium Development Goals (MDGs) which spanned poverty, hunger, education, health, and the environment, and unfortunately, these goals could not be achieved. There is an argument that the SDGs, which have replaced the MDGs, are just an academic exercise meant to justify the relevance of the UN to its members. Critics have expressed their opinion that the UN should have waited until the MDGs come to an end, then carried out an extensive country or regional evaluation of the success or failure of the MDGs rather than adopting another program before the other one has come to an end. Furthermore, in the eyes of some critics, the sheer quantity of SDGs is problematic, and some of the goals have vague targets along with a lack of independent accountability mechanisms to measure whether individual member states have met the steep benchmarks. If the leaders of all countries and the UN are sincere about these goals and if they want to actually achieve

this goal, a specific set of actions and commitment are required. Unfortunately, the SDGs 2030 also lack accountability to all the parties that have adopted the agenda.

Global politics is another important aspect that is missing. There is no indication of how political implications on the overall successful implementations of this agenda would happen. In reality, the political implication on this agenda is a crucial factor to its success by 2030. The recent political instabilities in many UN member states, specifically in the Middle East, have contributed to an unprecedented crisis in health, poverty, hunger, and migration. The issue of migration has not been directly addressed by the agenda.

Another point of criticism is the volunteer nature of involvement. It is projected to be implemented by the voluntary involvement of member states. Serious issues, however, lie in ending the poverty of global climate change that cannot be tackled solely by voluntary participation of its member states.

So, if the SDGs represent a common aspiration for sustainable development worldwide, should universities adopt a more stringent and wide-ranging approach to address sustainability on campus? The question is how to carry out such a translation of goals to the unique and important context of the higher education campus. Some principles exist, but this paper will argue these are lacking both in ambition and effectiveness.

1.8 Why We Need to be Sustainable

Humankind has been living in harmony with nature for millennia. Global climate has been threatened after the industrial revolution occurred few hundred years ago. Since then, humankind has witnessed unprecedented growth in wealth, assets, urban

development and other areas of lives. However, these developments are made by often not considering their effects on environment and future generations. So, when we ask ourselves how to take an ethical responsibility toward our future generations, we have to consider some possibilities that are likely to happen and likely to impact human wellbeing. Here are some predictions about the environment that we are going to face:

- The world population may reach 9 billion in 2050, around 1.5 times of current population (Pearce, 2003).
- In order to adapt the external changes due to this massive population growth, world economies require to maintaining a 2-3% economic growth (Holdren and Ehrlich, 1974).
- The world requires to bridging the prosperity gap between developed and developing nations for a conflict free and peaceful world (Holdren and Ehrlich, 1974).
- To reduce the prosperity gap, it requires 5-10% economic growth. This demand for economic growth is creating further burden on the environment which has already been overexploited. We have to be five to fifty times more efficient in extracting natural resources from earth in the coming decades (Holdren and Ehrlich, 1974). This factor is not only a challenge but also an opportunity if we look into it positively.

Realizing these as strong probabilities, several multinational companies have taken sustainability as a part of their business practice. The World Business Council for Sustainable Development comprises many companies like Shell and Unilever, and they

are putting together their efforts for sustainable development. These companies recognize that if they work toward sustainable development, it will benefit their business. In the past, consumers were interested in price and performance of products but did not care about sustainability that much. Political and ethical issues like public health, safety, environmental impact, greenhouse gas emission levels, and other similar factors are monitored by the governments, but the consumers of our time care not only for the consequences of their own consumption. They are also concerned for the long-term availability of products and services with acceptable quality at acceptable prices. Morality and ethics are increasingly mixing up in the entanglement of people, social aspirations, and organizational practices, and it can be difficult to untangle effective social and environmental strategies from manipulation of sentiment. Nevertheless, there are some very clear problems that will have to be faced. These include agricultural necessity, climate change, global financial stability, and uncontrolled city development.

1.8.1 Agricultural Necessity

With ever-growing population, agriculture will have to figure out ways to produce and feed around three billion more people than it currently does. If we continue to use the same method of seeding, tilling, irrigation, pest control, and harvesting, future agriculture will become costly as fuel resources will run out.

1.8.2 Control Climate Change

Through sustainable development, issues related to climate change can be partially remedied. Sustainable development practices essentially require a lower use of

fossil fuels, which are not sustainable and a major cause of production of greenhouse gases. As the population increases, however, more people will be requiring more energy and will create additional load. A sustainable approach for development has to be developed to respond to the problems climate change will bring.

1.8.3 Provide Financial Stability

Sustainable development helps to establish a financially sustainable economy across the globe. Resource-poor economies will gain access to free and accessible energy through renewable energy sources. This also creates an opportunity to train workers for jobs that will not be displaced by the basic reality of finite resources. Jobs that are built around the "old" model of unsustainable development will face a challenge to keep their relevance. This will happen because industries that were built around a reliance upon a resource that will not be available into the future will ultimately fail. These factors will leave sustainable development as the only economic option moving forward toward the future.

1.8.4 Accommodate City Development

Along with the rise of population and rapid urbanization, cities are required to accommodate the influx of their new residents. This also will force cities to increase their capacity, size, and the extent of their activities. For this reason, the cities solely dependent on finite fossil fuels will get more expensive as non-renewable energy will run out over time. The higher volume of these fuels that is required to produce energy for this

larger population and megacities will also negatively impact the air quality, environment, and public health. A sustainable city is more resilient, economic, and environmentally friendly.

1.9 Sustainability in Higher Education

So, what is the role of HE institutions in teaching younger people to be able to meet these challenges? In known history, we are the first group of people who are capable of determining the livability of the planet for ourselves and other species. The limiting factors for future economic growth are not labor and technology (Hawken, 1997). Instead, they are natural capital and social capital. According to the World Forum on Natural Capital, “Natural capital can be defined as the world’s stocks of natural assets which include geology, soil, air, water and all living things” (Edinburgh 2017. (n.d.). Retrieved March 30, 2018, from <https://naturalcapitalforum.com/>)

A wide range of services that are derived by humans, which are often called ecosystem services and make human life possible, are sourced from the total amount of natural capital. When it comes to the definition of social capital, there are many definitions and every one of them has their own uniqueness. In the Oxford English Dictionary, however, social capital has been defined as “The networks of relationships among people who live and work in a particular society, enabling that society to function effectively.” As the objective of sustainable development is to create a society that is functional at present and in the future, this definition of social capital resonates with the goal for sustainability. In the context of higher education, we can consider this definition: “The number of people who can be expected to provide support and the resources those people have at their disposal” (Boxman et al. 1991, p. 52).

As HE institutions have resources like infrastructure, research laboratories, and resourceful people such as faculty members, scientists, researchers, and experts in all areas that a human society may have, higher education is one of the institutions that works with social capital. Humankind's dream must be for a place where all present and future humans are healthy and have met their basic needs. In such a place, everyone would have a reasonable and just amount of access to the Earth's resources, a decent life, and a celebrated culturally diversified society in which they coexist with each other. In such a society, scientists, engineers, and business people of the future will design technology and economic activities that sustain instead of destroy the natural environment. This sort of society would enhance human health and the overall well-being of the mass of the population. Chances could be that humankind will design their technology inspired by biological models found in nature, and these technologies could be operated by renewable energy. The concept of waste will be eliminated, or reduced to the bare minimum, as every waste product is a raw material or nutrient for another activity or other living species. All professionals will understand their connections to the natural world and to their fellow humans. People will be informed about the ecological impact or benefit of sources of a product and services they will enjoy. They will also be informed about the ultimate destination of the waste that they produce and know its consequences to this planet. These are the sorts of ideas and ambitions that are being described as the road to a more sustainable future. If we come back to our present time, however, and look into the reality rather than the aspiration, the average American does not know that they consume the same amount as their body weight in solid materials per day. In the United States, for every 100 pounds of product, people in the U.S. move 3,200

pounds of material and energy. Before the end user ever sees the product or service, more than 94 percent of that material and energy goes to waste (Hawken, 1997).

Our ecological footprint is invisible to most of us to the greater extent and we must make it visible to comprehend the impact of our consumption or action (Cortese, 2003).

When we compare visions for our ideal world (like the one previously suggested) and world we are living in now, the vast majority of people would opt for the ideal. The question is, however, can we really implement those ideas and create the future that we desire in the shortest possible time? To achieve such a vision, a fundamental, transformative shift in thinking, in values, and action by all of society's leaders and professionals as well as the general population needs to take place. In Albert Einstein's words, "The significant problems we face cannot be solved at the same level of thinking we used when we created them" (cited in Calaprice 2000, p. 317). As universities are the breeding place for new thinking and ideas, the role of HE institutions thus comes to play.



Figure 1.1: Making the impact visible

1.10 Role of Higher Education in Sustainability

To achieve the visions presented for a bright sustainable future, it is necessary to change the mindset of individuals and organizations, and it takes long term effort to transform education at all levels. Although there are many individuals and groups putting efforts in a sustainable future within formal education systems, education for a just and sustainable world is still not a high priority (McIntosh et al., 2001). Unfortunately, it is the same people who are coming out of the world's best colleges and universities who are also leading us down the current unhealthy, inequitable, and unsustainable path. Only a few architecture schools like ECOSA, University of Virginia, and University of California, Berkeley have taken sustainable design as a foundation of education and practice (Glyphis 2001). This is true and the same in the education of virtually every intellectual discipline and profession. The current state of the world is the greatest evidence of the necessity to transform education. Also, the tremendous efforts that are given by thousands of nongovernmental organizations (NGOs) and environmental and sustainability education departments in different schools are supporting the idea of "fixing" the traditional educational system.

If we look into the problem deeply, we find that several structural aspects of the current system are responsible for this problem. According to Anthony Cortese, "Interactions between populations, human activities, and the environment and strategies, technologies, and policies for a secure, just, and an environmentally sustainable future are among the most complex and interdependent issues with which society must deal" (Cortese, 2003, p. 16). These issues are complex and multidisciplinary as they cross over each other's boundaries.

Higher education is commonly organized into highly specialized areas of knowledge and traditional disciplines. If we want to design a sustainable human future, it requires a paradigm shift toward a systemic perspective that emphasizes collaborative teamwork and cooperation. Traditionally, much of higher education focuses on individual learning and competition and because of that, professionals are often ill prepared for the efforts that require teamwork and extensive collaboration. Learning methods are often fragmented, and faculty, responding to long-established incentives such as tenure, research and professional practices, are often discouraged from extending their work into other disciplines or inviting interdisciplinary partnership. As a result of these factors, much of higher education curricula rarely asks students to challenge the following common assumptions that contribute to the problem of achieving sustainable higher education institutions. For Cortese this includes the assumptions that:

- Humans are the dominant species and separate from the rest of nature.
- Resources are free and infinite.
- Earth's ecosystems can adapt all human impacts.
- Technology will solve most of society's problems.
- All human needs and wants can be met through material means.
- Individual success is independent of the health and well-being of communities, cultures, and the life support system (Cortese, 2003).

Table 1.1 The Common Assumptions

The common assumptions made by people about earth resources and ecosystem	
1	Humans are the dominant species and separate from the rest of nature.
2	Resources are free and infinite.
3	Earth's ecosystems can adapt all human impacts.
4	Technology will solve most of society's problems.
5	All human needs and wants can be met through material means.
6	Individual success is independent of the health and well-being of communities,

What In this context, David Orr has also said, “The kind of education we need begins with the recognition that the crisis of global ecology is first and foremost a crisis of values, ideas, perspectives, and knowledge, which makes it a crisis of education, not one in education” (Orr, 1994). If higher education takes the leadership role to achieve a sustainable society the way it did in the space race and the war on cancer, the nature of higher education would be different than now. The learning process for all professionals would reflect a new approach to learning and practice. Modeled by social and biological sustainability, a college or university would operate as a fully integrated community that is interdependent with the local, regional, and global communities. At present, in many cases, teaching, research, operations, and relations with local communities are considered as separate activities, which although in reality are not (Cortese, 2003). According to Cortese, students constantly learn from their surroundings and everything around them. A complex web of experience and learning is developed from these observations and activities. David Orr also agrees with this statement and in his opinion, all parts of the university system are critical to attaining a transformative change that can only occur by connecting “head, heart and hand.” Again, Orr didn’t forget to mention other larger

“institutions” that play a crucial role in educating students’ minds. These institutions are not merely some buildings on campus, rather these are the places that we know as highways, shopping malls, supermarkets and other megastructures. In Orr’s words, “However well-intentioned, formal education cannot compete with the larger educational effects of highways, shopping malls, supermarkets, urban sprawl, factory farms, agribusiness, huge utilities, multinational corporations, television and non-stop advertising that teaches dominance, speed, accumulation and self-indulgent individualism” (Orr 2002, p. 31).

To align educational experiences of all students with the sustainability principle, the pedagogy requires an interdisciplinary system of thinking, dynamics, and analysis regardless of the majors, disciplines, and professional degrees. This only can happen if HE institutions move forward to take this lead. HE institutions can teach students to understand how the world works and how to operate human technology and activity that imitate the nature and live within the limits of natural systems. HE can train its students to operate on renewable energy and eradicate the concept of waste by making every waste product a raw material or nutrient for another species or activity or return it into the cycles of nature (McDonough and Braungart, 2002).

Higher education should prepare to address these issues in order to preserve, restore, and nurture cultural and biological diversity. Diversity and inclusion in culture are the essential elements in building a sustainable future. When higher education would consider sustainability as their priority, it will emphasize active, experiential, inquiry-based learning and real-world problem solving on the campus and in the larger community. For example, and as part of the curriculum, the learning experience for

students could include working on actual, real-world problems facing their campus, community, government, and industry. The process would also increase the amount of group work and learning; hence, graduates will be able to team up effectively and more extensively on complex problems as future leaders and managers.

This chapter has described the most contemporary perspectives on sustainable development, and it also introduced some of the key problems in education within the HE context in terms of sustainable development. The next chapter will describe in detail the problem of introducing sustainability into HE institutions.

CHAPTER 2. LITERATURE REVIEW

This review of literature will expand on the context of the problem of sustainability and the higher education campus and explore specific and important literature on the topic of sustainability efforts in U.S. higher education. This chapter will highlight:

- 1) the role of sustainability on campus and
- 2) how scholars critically engaged with questions of achieving a sustainable HE campus broadening the discussion of the U.S. context toward enhancing a diverse student experience.

2.1 Sustainability in U.S. Higher Education Institutions

Research studies show that sustainability efforts have been under the radar of many scholars since the 1970s (Brinkhurst, Rose, Gillian & Josef, 2011). Some studies stress that sustainability is not a priority on U.S. campuses (Green & Thompson, 2005; McNulty, 2015; Clugston & Calder, 1999). An analysis carried out in 2005 of sustainable practices on campuses revealed that top campus officials were not concerned about promoting sustainability on campus, and it concluded that in the absence of strong leadership, sustainability efforts on campus would not be successful (Green and Thompson, 2005). Higher education institutions need to determine whether the sustainability education efforts they roll out assist students in knowing how to restore and maintain the environment. They also need to define the purpose of learning about sustainable development at each institution if leadership is ambivalent (McNulty, 2015). Universities and colleges are thus called to integrate the applied and the educational

dimensions of sustainability, to emphasize collaboration, and to promote the possibility of providing expertise for an unsustainable world economy (Clugston & Calder, 1999).

In reviewing literature the role of sustainability on campus can thus be defined thus into a series of categories: to address the interrelated issues of how to educate about the problem of sustainability (a function of curriculum); to foster sustainable citizenship providing the environment conducive for this development (an issue for pedagogy); and to lead by example (an issue for facilities management, architectural design, and the campus faculty in leading initiatives for demand reduction).

2.2 Role of Universities on Consumer Demand and Individual Behavior

Universities can be considered as miniature version of society. In general, campuses are comprised of offices, classrooms, housing, food service, waste management, retail shops, recreation, entertainment, and transportation. The challenges that U.S. cities and towns are facing are very similar to those of higher education institutions (Cole, 2007). Students learn more when universities led by example by implementing sustainability practices, by achieving high efficiency in building operation, managing rainwater, using renewable energy, and recycling, the entire campus transforms into a living laboratory for sustainability. If this enhances graduates' appreciation of the possibility of achieving a sustainable environment at a deeper level and helps graduates to enter their first graduate employment opportunities with a deeper appreciation and determination about how to implement these practices in their day-to-day living and working lives, some institutions of higher education are on track to be precursors of sustainability actions and development, according to much of the literature. Universities can develop the leaders of the future, and as literature argues, this means that "campus

organizational conditions provide an atmosphere conducive to sustainable leadership” (Shriberg, 2002). In spite of this widespread hypothesis, Shriberg (2002) observed an unwillingness of universities across the world to integrate environmental issues into different levels such as curricula, services, research, and processes.

When students initially arrive on campus and in their youth, a majority of them having are leaving home for the first time in their life, and this is, probably, the very first time that they can investigate, discover, and wonder about their own values. They also make new friends with different values and ponder about the lifestyle that they are living. They are also presented with an excellent learning opportunity to establish new patterns of behaviors of inquiry and ethical action which can be established into their lives and become an integral part of their lifelong learning process. Hence, if campuses offer them a tangible experience and examples of sustainability, from energy efficiency to recycling in every aspect of life, a new generation of environmentally sensitive adults could become socially responsible citizens (Thomashow, 2014). American universities thus have the capacity to create a “new model for living – one that is highly energy efficient, produces little or no waste, supports regional economies, engenders an abiding respect for life and fosters bonds among all members of the community of life” (Uhl & Anderson, 2001, p. 42).

2.3 History and Growth of Sustainability in Higher Education

Colleges and universities are exceptional places to understand the strategic advantages of changing approaches to the questions of sustainability with their facilities, curricula, and mission statements (Cole, 2007). Some of the primary and pragmatic reasons for implementing sustainability initiatives that can be determined from literature

include the global and widespread nature of environmental issues; exhaustion of non-renewable energy; human health concerns caused by poor environmental quality; and widespread instability created by combined social, environmental, and economic factors (Cole, 2007; Hitchcock & Willard, 2006).

In the year 1990, President Jean Mayer of Tufts University led an international conference of 22 university leaders in Talloires, France. Talloires Declaration was created during that time and signed by over 300 higher education institutions, of which 86 of them were American universities (Litten & Newport, 2004). This was the very first declaration which was a written statement and signed by university leaders who were committed to sustainability in institutions of higher education (Wright, 2002). The document was prepared to drive and enhance further commitment among university leadership to push for environmental change at the higher education level so that institutions could make positive change in the global environment. It is the colleges and universities that play the major role in the education of future citizens and in research and policy creation that can also make a positive change to environmental conditions to allow this to happen. It can be argued that is why communication, loyalty, and commitment is needed among higher education institutions so that the goals can be achieved collaboratively (Wright, 2002). There is also another additional commitment which is the American College and University Presidents' Climate Commitment (ACUPCC). Launched in December 2006, it was a national pledge signed by more than 650 institutions. This commitment suggested additional formats for campus infrastructure, curriculum, and further study of sustainability (ACUPCC, 2015).

2.4 The Talloires Declaration

University leaders and researchers in this field are exposed to the fact that if the degradation of the environment continues, it will destabilize economic success. Economic models are at risk with rapid changes in climate. With the signing of the Talloires Declaration in 1990, a significant improvement was made in the level of awareness of colleges and universities to have a positive contribution on the way toward environmental improvements (Clugston & Calder, 1999). The Talloires Declaration was followed by two new commitments, the “Halifax Declaration” and the “Lunenburg Declaration”; however, they were not widely adopted or effective. The Halifax Declaration stressed cooperation and commitment toward sustainability, and the Lunenburg was focused on actions and offered more structure on implementing sustainability programs across universities and colleges (Dade, 2010). Often, universities are criticized for making commitments to sustainability, but with few actions (Thompson & Green, 2005). However, the following 10 actions were required from the signers in the Talloires Declaration (See Figure 2):

THE TALLOIRES DECLARATION

WE, THE PRESIDENTS, RECTORS, AND VICE CHANCELLORS OF UNIVERSITIES FROM ALL REGIONS OF THE WORLD are deeply concerned about the unprecedented scale and speed of environmental pollution and degradation, and the depletion of natural resources.

Local, regional, and global air and water pollution; accumulation and distribution of toxic wastes; destruction and depletion of forests, soil, and water; depletion of the ozone layer and emission of "green house" gases threaten the survival of humans and thousands of other living species, the integrity of the earth and its biodiversity, the security of nations, and the heritage of future generations. These environmental changes are caused by inequitable and unsustainable production and consumption patterns that aggravate poverty in many regions of the world.

We believe that urgent actions are needed to address these fundamental problems and reverse the trends. Stabilization of human population, adoption of environmentally sound industrial and agricultural technologies, reforestation, and ecological restoration are crucial elements in creating an equitable and sustainable future for all humankind in harmony with nature.

Universities have a major role in the education, research, policy formation, and information exchange necessary to make these goals possible. Thus, university leaders must initiate and support mobilization of internal and external resources so that their institutions respond to this urgent challenge.

WE, THEREFORE, AGREE TO TAKE THE FOLLOWING ACTIONS:

- 1) Use every opportunity to raise public, government, industry, foundation, and university awareness by openly addressing the urgent need to move toward an environmentally sustainable future.
- 2) Encourage all universities to engage in education, research, policy formation, and information exchange on population, environment, and development to move toward global sustainability.
- 3) Establish programs to produce expertise in environmental management, sustainable economic development, population, and related fields to ensure that all university graduates are environmentally literate and have the awareness and understanding to be ecologically responsible citizens.
- 4) Create programs to develop the capability of university faculty to teach environmental literacy to all undergraduates, graduate, and professional students.
- 5) Set an example of environmental responsibility by establishing institutional ecology policies and practices of resource conservation, recycling, waste reduction, and environmentally sound operations.
- 6) Encourage involvement of government, foundations, and industry in supporting interdisciplinary research, education, policy formation, and information exchange in environmentally sustainable development. Expand work with community and nongovernmental organizations to assist in finding solutions to environmental problems.
- 7) Convene university faculty and administrators with environmental practitioners to develop interdisciplinary approaches to curricula, research initiatives, operations, and outreach activities that support an environmentally sustainable future.
- 8) Establish partnerships with primary and secondary schools to help develop the capacity for interdisciplinary teaching about population, environment, and sustainable development.
- 9) Work with national and international organizations to promote a worldwide university effort toward a sustainable future.
- 10) Establish a Secretariat and a steering committee to continue this momentum, and to inform and support each other's efforts in carrying out this declaration.







TITLE DATE

ASSOCIATION OF
UNIVERSITY LEADERS
FOR A
SUSTAINABLE FUTURE

Figure 2.1 The Talloires Declaration

Table 2.1 The Talloires Declaration

The Talloires Declaration		
1	Increase awareness of environmentally sustainable developments	Use every opportunity to raise public, government, industry, foundation, and university awareness by publicly addressing the urgent need to move toward an environmentally sustainable future
2	Create a culture of sustainability on campus	Encourage all universities to engage in education, research, policy formation, and information exchange on population, environment, and development to move toward a sustainable future
3	Educate students for responsible citizenship	Establish programs to produce expertise in environmental management, sustainable economic development, population, and related fields to ensure that all university graduates are environmentally literate and responsible citizens
4	Foster environmental literacy	Create programs to develop the capability of university faculty to teach environmental literacy to all undergraduate, graduate, and professional school students
5	Practice ecology at institutions	Set an example of environmental responsibility by establishing institutional ecology policies and practices of resource conservation, recycling, waste reduction, and environmentally sound operations
6	Collaborate between disciplines	Encourage the involvement of government (at all levels), foundations, and industry in supporting university research, education, policy formation, and information exchange in environmentally sustainable development. Expand work with nongovernmental organizations to assist in finding solutions to environmental problems
7	Involve all campus stakeholders	Convene school deans and environmental practitioners to develop research, policy, information exchange programs, and curricula for an environmentally sustainable future
8	Enhance capacity at K-12 schools	Establish partnerships with primary and secondary schools to help develop the capability of their faculty to teach about population, environment, and sustainable development issues
9	Increase outreach across the nation and the world	Work with the UN Conference on Environmental and Development, the UN Environment Program, and other national and international organizations to promote a worldwide university effort toward a sustainable future
10	Maintain the movement	Establish a steering committee and a secretariat to continue this momentum and inform and support each other's efforts in carrying out this declaration (Report and Declaration of the Presidents Conference, 1990)

2.5. Higher Education and Sustainability Efforts

Cortese (2003) has agreed that higher education institutions possess a strong moral responsibility to spread awareness, skills, and values that will contribute to a bright sustainable future for the environment. Higher education “prepares most of the professionals who develop, lead, manage, teach, work in, and influence society’s institutions” (p. 17). However, higher education curricula have not really changed that much since the 1950s (Orr, 2004). David Orr writes, “The skills, aptitudes, and attitudes necessary to industrialize the earth are not necessarily the same as those that will be needed to heal the earth or to build durable economies and good communities” (p. 27). Higher education institutions should review their sustainability efforts in a tangible way toward the questions of education. Colleges and universities should include sustainability in their curriculum, teach their students about research solutions to environmental problems, and demonstrate sustainability in both theoretical and practical ways. Higher education institutions have a very important role in implementing sustainability on their campuses as these are the cradle of new ideas and experimentation. Hence, there should also exist a strong and regular measuring process to guide the journey toward the achievement of sustainability goals and initiatives (Robinson, 2004). Once institutions have established standards and systems of measurement, these could help them to maintain an equilibrium between economic and socio-environmental benefits of sustainability initiatives (Robinson, 2004). Well-performing universities like Stanford and the university of California’s have well-established standards and specific measurable goals for their sustainability efforts.

Since the last decade, in the higher education institutions around the world, thousands of people from different levels have begun to consider sustainability as a significant element in education for sustainable development. However, the process of becoming a sustainable university is still at its primary stage, so many obstacles exist and prevent the success of campus sustainability efforts.

This chapter has discussed the role of sustainability on campus including university commitments for sustainability and how scholars critically engaged with questions of achieving a sustainable HE campus.

CHAPTER 3. PURPOSE STATEMENT

In the previous chapters, the context to the development of the sustainable Higher Education campus was discussed, but despite the literature few universities have achieved the full ambitions of goals as discussed. So what are the obstacles to adopting sustainable initiatives in major public higher education in the U.S.?

3.1 Case Study Method: Introducing Why These Criteria Have Been Chosen

When case studies were conducted on sustainable higher education campuses, it was found that different universities have different approaches. Even within the university, different campuses have a different foci and strengths in their efforts to achieve sustainability. There are commonalities in some areas where all institutions strive to excel, and there are certain areas where improvements in those areas factor a great amount in achieving their sustainability goal. This paper focuses on curriculum, transportation, and facility management. Curriculums are important because this is the place where the future leaders are enriching themselves with necessary information. Curriculum also equips students with the tools to work as more responsible citizens. Another one is transportation which is a crucial factor in context of the U.S. Most of the cities and college towns in the U.S. are not well equipped with public transport, and fossil fuel operated personal vehicles could be a key barrier in achieving sustainable higher education campuses. Universities that are striving in achieving sustainability in their campuses, often emphasize sustainable means of transport options such as bicycles, public transportation, and electric and hybrid vehicles. This is why this paper has chosen transportation as an aspect of this study. And finally, this study considered facility

management as another important component in achieving sustainability. A group of well-intentioned scientists, researchers, and university leaders may fail in achieving their sustainable goal if support from facilities management is missing. It is them who run, operate, and maintain physical infrastructures, and thus they are the inseparable part of the team.

3.1.1 Sustainability in Curriculum

It is very important to educate our next generation on pathways toward a more sustainable way of life to make this planet more livable. In order to achieve this goal, education should get the highest priority, and academics are a vital population with whom to work. Also, the topic of sustainability must be woven into teacher education and preparation programs (Nolet, 2009). Preparing a more informed academic requires explaining major sustainability challenges and solutions in a meaningful way. In addition to these, a sincere concern should be there to meet humankind's need to ensure equity among generations and to safeguard the Earth's renewal capacity to heal itself from human intervention (Our Common Future, 1986). Scholars have extended this understanding to include environmental concerns more specifically through science and to signify the ecological relationships that exist between human-nonhuman and flora-fauna-land interactions (Kates et al., 2001; Orr, 1992). To solve these problems, evaluate solutions, and keep pace with ever growing inequities, education should act as a central component to improve human conditions. Addressing to populations that educate rest of world has the potential to achieve the most catalytic effect in achieving the goals of sustainability. *Our Common Future*, the "Report of the World Commission on

Environment and Development” (1987), states that "the world's teachers have a crucial role to play" in helping to bring about "the changes in attitudes, in social values, and in aspirations related to and required for the longevity of our planet” (WCED, 1978, p.8). In addition to these, *Our Common Future* highlights that these changes will play out in the public sector through deliberate education and public engagement. Because of these factors, sustainability in curriculum was included in this paper’s comparative case studies.

3.1.2 Transportation

The heavy dependence on vehicles as a primary mode of transportation has serious consequences on our environment. The shape of our cities, neighborhoods, and schools is heavily impacted by the way we use vehicles. Our mode of transportation continuously influences and structures our way of life. Almost all, if not all, of this transportation is run by petroleum fuel. This petroleum fuel consumption in university campuses is a common phenomenon for everyday activities like transportation. Petroleum fuel is used in cars, motorcycles, buses, and all types of transportation except those operated by human labor such as a bicycles. At present, nearly 97 percent of the vehicles in the world burn petroleum fuels in combustion engines. Gasoline engines are highly inefficient, wasting nearly “two-thirds of the fuel they burn and emitting nearly 20 pounds of CO₂ into the air for every gallon of fuel burned” (Sperling and Gordon, 2009). In addition to this, fuel consumption has increased with the increased population as people are driving even farther and roads are getting more congested. Every year the average automobile discharges enough pollution into the atmosphere to equal its own

mass (Department of Environmental Quality, 2004). Faculty, staff, and students, who are the majority portion of a campus demography, regularly commute to and from campus, and some of them commute several times each day. This burning of petroleum fuel from commuter traffic is “one of the largest impacts a typical educational institution imposes on the natural environment” (Tour, 2003).

Universities are in a unique position to address this challenge. They can meet the challenge of mitigating impact of petroleum fuel consumption on the environment through education and outreach. A higher education institution that take action can be an example for other universities and influence the actions of the surrounding communities (Uhl and Anderson 2001). For this reason, the case studies will investigate how universities are performing in achieving sustainable transportation systems.

3.1.3 Facility Management (FM)

Facility management (FM) has the potential to play an important role in relation to an organization’s environmental and social profile. As buildings and their ongoing operation and maintenance cost a great deal in energy and material consumption, FM can be a decisive factor in achieving campus sustainability. FM also has a significant effect on the health and well-being of users of the buildings that include operators and service personnel. FM in the public sector can influence the social aspects of sustainability at a local level. For example, it is important for social coherence of the general public to have the openness and accessibility to the general public. As university buildings are operated and maintained by FM team, if they are performing well in the standard of sustainability,

it would be a significant achievement for the university toward achieving sustainability. For this reason, facilities management is another criteria for review in the case studies chosen.

3.2 Method Statement

This chapter will carry out some case studies on targeted HE institutions and focus on the specific criteria suggested. This selection will be made from the Sustainability Tracking, Assessment & Rating System™ (STARS), which is a transparent, self-reporting framework for colleges and universities to measure their sustainability performance. For those who have decided to adopt the system, three have achieved Platinum status; 122 institutions have scored as gold standard, which is 2nd highest rating; 211 scored silver, and 70 scored bronze status respectively (AASHE, 2010). From this report, this study examined one of the top three platinum status HE institutions which is Stanford University. This paper has also studied University of California, which has 10 separate campuses in 10 different locations. While this university is not scored as Platinum, there is evidence to suggest that the combined achievement of all campuses means that they are taking actions beyond the STARS system and their interest in sustainability exceeds this tool or method. In addition, this paper has also included two more HE institutions:

1. University of British Columbia in Canada for its success in achieving its sustainability goal.
2. University of Waterloo in Canada for its failure in achieving its sustainable goal in spite of having a well-drawn blueprint for the sustainability.

The author of the present study collected case studies, articles, and other written material on these HE institution and investigated their successes, challenges, and failures.

3.3 Case Study Summaries

3.3.1. Summary: Stanford University and Its Energy and Climate Plan

3.3.1.1 Introduction

Stanford's Land, Buildings and Real Estate's Department of Sustainability and Energy Management (SEM), which was formed in 2007, works on utilities infrastructure related to sustainability. SEM is responsible for leading initiatives in campus infrastructure and the areas of energy and climate, water, transportation, green buildings, and sustainable information technology programs. The Office of Sustainability links between several campus organizations and entities and forms a collaboration with them to integrate sustainability as a fundamental value. The Office of Sustainability also works on sustainability analysis in the long range, evaluations, reporting, publications, conservation campaigns, and collaborative governance.

Situated on 8,180 acres, Stanford, one of the nation's best private higher education (HE) institutions, possesses more than 1,000 building on campus and consumes a substantial amount of energy to support its academic program and the research functions. It is very important for the university's future that it manage its energy supply, demand, and greenhouse gas (GHG) emissions efficiently. Since the year 1980, Stanford has been trying its best to minimize its operational and environmental costs.

Energy metering has been employed in all its campus facilities, energy efficient natural gas-fired cogeneration is used for years for its energy supply, and buildings have been retrofitted with efficient systems. Stanford University also has implemented stringent building standards, has made investments on renewable power, and has a well-

planned system to conserve water. It has also reduced automobile emissions that are caused by commuting.

In spite of all these efforts and achievements, climate change which is caused by greenhouse gas emissions, is one of the greatest environmental and socioeconomic challenges and opportunities of our time. Stanford has taken the challenge to go way beyond these efforts and raise its own standard in the use of innovative and renewable energy supplies to reduce its environmental impact and operational costs even more. It has done this through an envisioning process and through its Energy and Climate Plan.

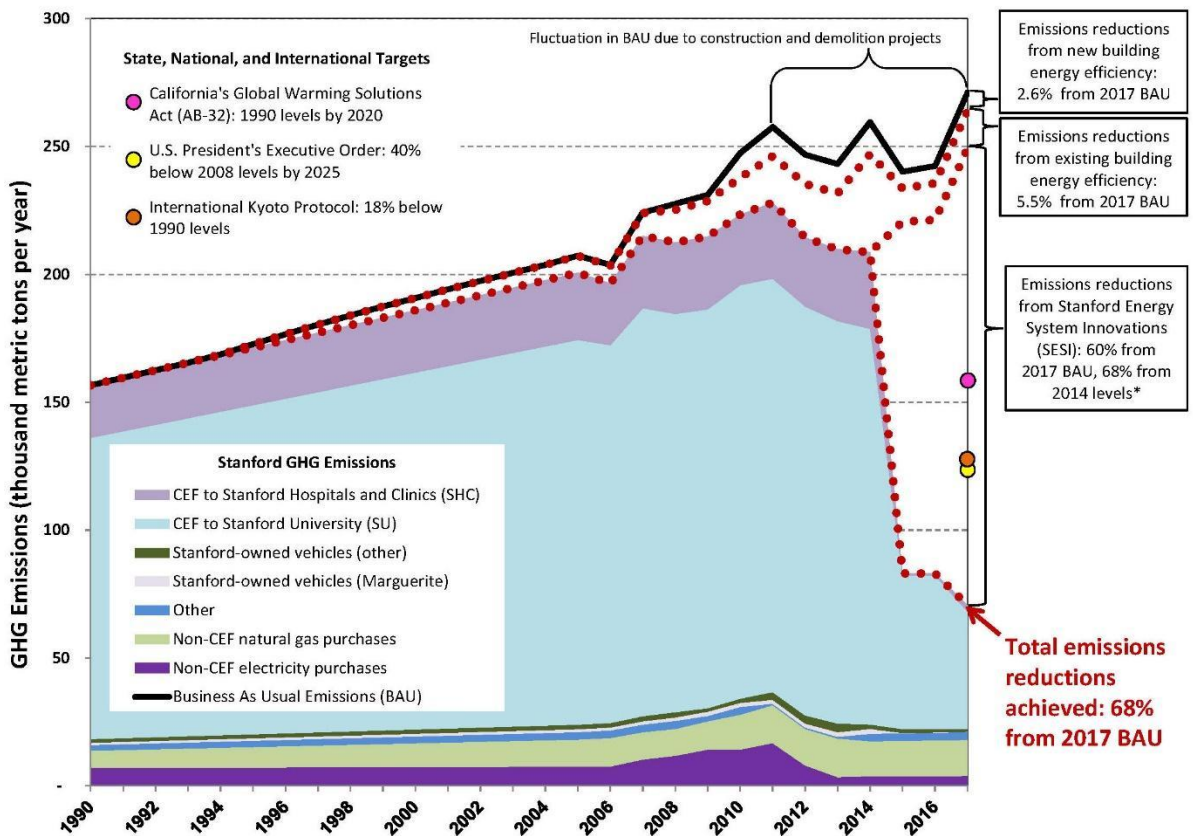


Figure 3.1 Emission reduction wedges and targets set by the Stanford University

3.3.1.2 Planning Purpose

Stanford's long-range Energy and Climate Plan was collaboratively developed by both engineering and financial experts and also peer reviewed by the faculty. This plan proposed a balanced approach to improve infrastructure and significantly reduce greenhouse gas (GHG) emissions despite campus growth without relying on market carbon-based instruments like petroleum, coal, natural gas, or liquid natural gas. This plan is serving as a blueprint for implementation and demonstrates long-term cost effectiveness and sustainable natural resource use. This also guides critical campus infrastructure development and reduces financial and regulatory risks to Stanford's long-term energy supply. Through this plan, a vision for the campus' energy future is provided while maintaining flexible options through a comprehensive, long-term approach to reduce campus GHG emissions.

The Energy and Climate Plan's proposed solutions include "the Stanford Energy System Innovations" (SESI) program. This program not only represents the most economical energy option, it is argued, but also immediately reduces campus GHG emissions by 68 percent and potable water use by 15 percent. It has also opened a path to full energy sustainability over the time through greening the campus electricity supply. The energy and climate plan also includes a space utilization study to investigate the possibility of renovation of existing buildings, so that Stanford can create space for new purposes. This also proposes a mandatory efficiency standard for new buildings, which must use less energy and water than of peer buildings. Guidelines were thus prepared for sustainable buildings that address site design, energy use, water management, materials, resources, waste, and indoor environmental quality. Due to these strict guidelines, all new campus buildings completed in recent years have the compliance with these standards.

3.3.1.3 Planning Approach

Stanford's long-range Energy and Climate Plan was designed with the vision of a long-term, holistic, and flexible approach guided by Stanford's intellectual resources and leadership in the climate change movement. A comprehensive analysis of current campus energy use and GHG emissions was the first step in its development. Since 2006, Stanford has been tracking and publicly reporting its amount of carbon emissions. Emissions totaled close to 179,000 metric tons CO₂ equivalent in 2014. By using this data, campus growth projections were made. This data is used to create a GHG emissions forecast and informs the development of the Energy and Climate Plan. Based on projected growth to support Stanford's academic mission to maintain its large and diverse existing campus building inventory and its traditional reliance on natural gas for energy creation, the Energy and Climate Plan provides "a balance among investments in new buildings, existing buildings, and energy supply" (Stanford University Energy and Climate Plan, 2015, p. 4)

3.3.1.4 High-Performance New Building Design

In the context of the university's significant growth plans, constructing new high-performance buildings with to minimize the impact of growth on campus energy systems and GHG emissions is a key strategy. Stanford's sustainability report states:

"The Guidelines for Sustainable Buildings, originally published in 2002 and updated in 2008, in combination with the Guidelines for Life Cycle Cost Analysis and the Project Delivery Process Manual, provide the framework for minimizing energy demand in new construction and major renovation projects on campus."

(Stanford University Energy and Climate Plan, 2015, p. 4)

3.3.1.5 Energy Conservation in Existing Buildings

Since the 1980s, Stanford has employed energy metering at the building level in all its facilities to monitor its energy use. It is very important to reduce energy use in existing buildings to create a sustainable campus. The university has extensive and specific programs to improve energy efficiency in the campus. These programs are stated below:

1. The Energy Retrofit Program improves building energy efficiency. This program has a cumulative annual energy savings of 300 billion BTU since 1993.
2. The Whole Building Retrofit Program. This program targets the most inefficient buildings in the campus for retrofits. As of spring 2015, 14 projects have been completed, and eight more projects are ongoing. Four million dollar has already been saved annually through this program.
3. The Energy Conservation Incentive Program focuses on reductions in energy use through human behavior, rather than technology.
4. The Plug Load Energy Consumption Reduction program focuses on reducing the energy consumption of the biggest “energy hogs” of equipment identified by Stanford’s campus-wide plug load inventory. IT equipment, lab equipment, and space heaters fall into this category.

The university has thus pursued energy conservation in an aggressive manner for many years and it has proven over the years that, programs like these are very effective strategies of the Energy and Climate Plan.

3.3.1.6 Stanford Energy System Innovations (SESI)

The Energy and Climate Plan's major focus was Stanford's energy supply because Stanford's natural gas-powered cogeneration facility produced 90 percent of Stanford's GHG emissions from 1987 to 2015. As the cogeneration plant moved toward the end of its life-cycle, Stanford studied ways to new options that were reliable, were cost effective, and produced less GHGs. Stanford Energy System Innovations (SESI) is Stanford's new district for energy heating, cooling, and electricity system that was designed to meet Stanford University's energy demand in a way that is sustainable and economic at the same time.

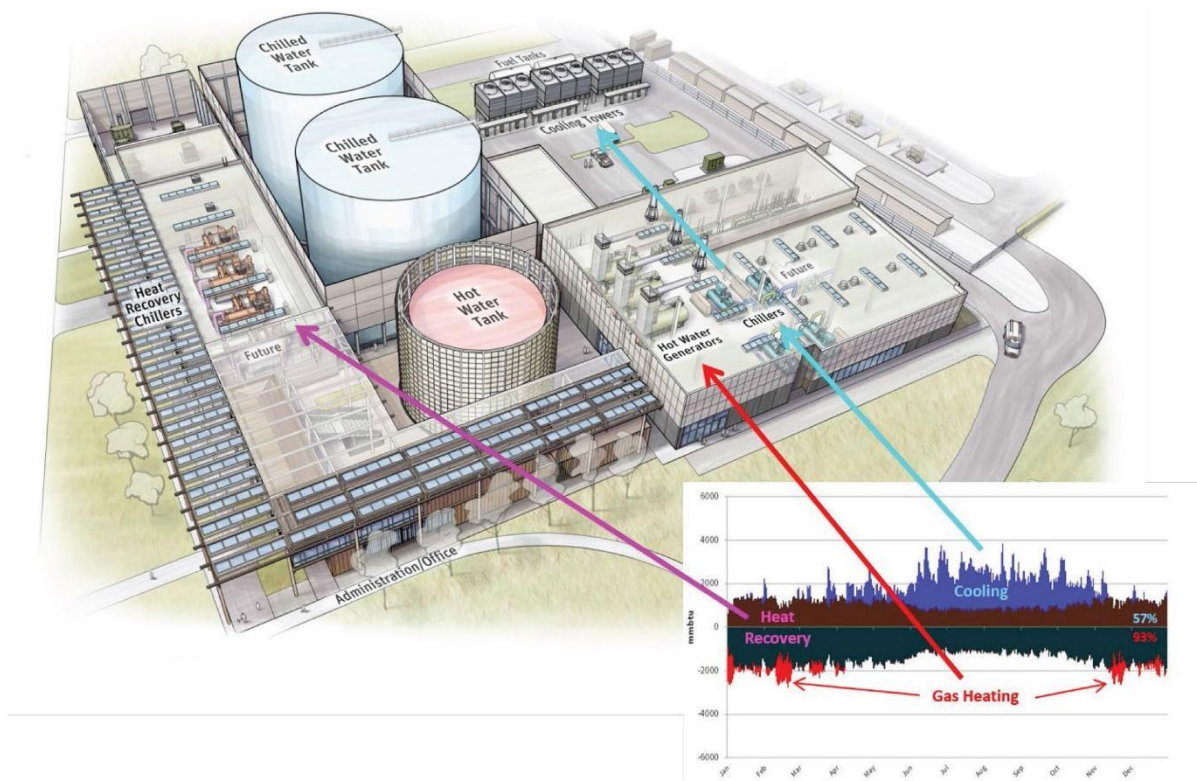


Figure 4.1 Heat recovery potential at the Stanford University



Figure 5.1 Stanford University energy supply

3.3.1.7 Next Steps for Caretakers of a Legacy

Stanford's Energy and Climate Plan is therefore built on the principle of innovation and flexibility to adapt to new technologies. The university's goal, which mirrors the Brundtland Commission's definition of sustainability, is to meet the demand of the future without compromising the needs of the present. SESI is thus a balance of realism and vision by design, and this meets the institution's short and long-term needs with sustainable approach.

3.3.1.8 Guiding Principles of Stanford's Energy and Climate Plan

3.3.1.8.1 Holistic and Long-Term Approach

This principle recognizes that emissions reduction may come from a number of areas on campus. These areas include facilities design, construction, operations, maintenance, a diverse group of students, staff, and faculty across all academic and administrative departments, and the surrounding community.

This principle also recognizes that Stanford is bound to operate within the regulation, broader context of energy infrastructure and emissions reduction.

It also states that both short-term and long-term improvements are needed, and “that the long-range impacts of many upcoming decisions on long-lived buildings and infrastructure must be considered before those decisions are made” (Stanford University Energy and Climate Plan, p. 15).

3.3.1.8.2 Vision

The term “Vision” is suggesting the application of Stanford’s intellectual and financial resources to provide leadership in climate change solutions, even if these efforts contradict popular perceptions on GHG reduction or are greater than governmental regulations.

3.3.1.8.3 Flexibility

By this principle, it recognizes that “achieving the ultimate vision of climate stability could take decades and require technologies that may not yet exist. Stanford chose to address both short and long-term actions to achieve GHG goals with flexibility to accommodate new technologies and changes in climate science as they develop” (Stanford University Energy and Climate Plan, p. 15).

3.3.1.8.4 Energy and Climate Plan Process

The following key steps are taken by Stanford to develop this Energy and Climate Plan. The Stanford University Energy and Climate Plan, revised September 2015, third edition states,

3.3.1.9 High-Level Summary of Steps

1. Formation of an analysis team under the leadership of the executive director of the Department of Sustainability and Energy Management (SEM)

2. Preparation of an inventory of current campus energy uses and GHG emissions; development of campus growth projections and subsequent base-case energy demand and GHG emissions forecasts development of options and costs for:
 - Levels of energy efficiency in new building standards
 - Energy conservation in existing facilities, and
 - Energy supply sources

3. Creation of a composite energy model—including all viable supply-side GHG reduction options—to allow detailed comparison and prioritization of options for minimizing, and then meeting, campus energy demands, while reducing GHG emissions

4. Creation of financial models and budget schemes to support the most efficient choice and preparation of final recommendations for campus and Board of Trustees approval”

3.3.1.10 Sustainability Measures Taken by Stanford University

3.2.1.10.1 Minimizing Energy Demand in New Construction

Even though the university has pursued aggressive demand-side energy management for many years, non-stop campus expansion requires even greater attention to initial demand reduction and energy efficiency in designing new building. In addition

to this policy, the energy efficiency and water conservation standards for new buildings, existing buildings, and major renovations are no longer reviewed separately. Rather, this is now calculated and reviewed in the context of the campus as a whole, as each and every project is connected with the electricity, heat, chilled water, and domestic water network. Few key standards for Stanford's high performance sustainable built environment are described below.

3.3.1.10.2 Optimized Space Utilization

Stanford conducts a rigorous space utilization study to check if renovation of existing buildings can create space for new needs, before any new building project. The university's space planning guidelines have been updated by the Department of Capital which conducted numerous studies to ensure that Stanford adds new space only when truly necessary. As a result, a new building is only constructed if there is no way to accommodate the new functions into the old or retrofitted structure.

3.3.1.10.3 New Building Standards

As per Stanford's Project Delivery Process (PDP) manual, "the university is committed to providing a sustainable and inspiring built environment for its students, faculty, staff, and visitors." At Stanford, sustainability means that buildings not only use energy, water, and other natural resources efficiently, but they also provide a safe, productive, and educational environment to meet the teaching and research needs of faculty, staff, and students. Stanford recognizes the tremendous impact on the natural environment by the building industry, both regionally and globally. Stanford also

recognizes the university has the opportunity to take a leadership role in creating buildings that conserve resources and inspire its users.

3.3.1.10.4 Continual Innovation and Learning through Building Design

Experimentation with new technologies has been encouraged in Stanford's internal guidelines. The university acknowledges that it is not possible for all new building projects to achieve established efficiency targets individually. However, architects and engineers from Stanford exchange ideas and information learned through design, construction, and operation of new buildings. The lessons learned are used in future projects to achieve their efficiency target.

3.3.1.11 Reducing Energy Use in Existing Buildings

3.3.1.11.1 Energy-Saving Programs

Stanford has several substantial programs to encourage energy efficiency and conservation on campus. Each program is designed to serve a specific market sector and offer incentives to associated decision makers.

3.3.1.11.2 Whole Building Retrofit Program

Thirty million dollars have been allocated to the whole building retrofitting program for major capital improvements to the most energy-intensive buildings on campus: The Whole Building Retrofit Program. So far, fourteen projects have been completed, which have collectively saved 9.5 million kWh, 5 million ton-hrs of chilled water, and 71 million pounds of steam annually. This amounted to four million dollars in avoided energy costs and over 14,000 metric tons of avoided GHG emissions.

3.3.1.12 Plug load energy consumption

3.3.1.12.1 Direct Timer Install

Stanford will install timers on equipment for which the energy savings will have less than a one-year payback, such as coffee makers and cable boxes. This program has the potential to save over 230,000 kWh or \$13,500 annually.

3.3.1.12.2 Space Heating

Stanford conducted a follow-up study on electric space heaters to identify systems-level heating and cooling issues in the 17 buildings with the highest numbers of space heaters. Adjustments have been made to heating and cooling systems and five percent of space heaters have been removed from the campus as a result. The study also captured valuable feedback on space heaters and provided valuable information regarding future space heater minimization efforts.

3.3.1.12.3 Sustainable IT

Stanford has been offering a comprehensive program aimed at increasing the energy efficiency of equipment associated with information technology since 2008. “Initiatives include centrally-controlled desktop power management, deployment of smart power strips, procurement of Energy Star and EPEAT certified equipment, and increased data center energy efficiency, including server consolidation and virtualization and HVAC system improvements. The program has already saved \$2.5 million in electricity costs and \$760,000 in avoided cooling costs.” (Stanford University Energy and Climate Plan, 2015, p. 27)

3.3.1.12.4 The Green Lab Program

At Stanford, lab equipment comprises 49 percent of the plug load energy use on campus. Energy reduction for lab equipment is part of a comprehensive Green Lab. This program also addresses water, waste, and green chemistry. The Green Lab program offers rebates and incentives for energy efficient lab equipment.

3.3.1.13 Conclusion

From Stanford's sustainability initiatives and success, it is evident that a comprehensive energy and climate plan at a growing research institution should consider following three key energy components:

1. demand-side management for new construction,
2. demand-side management and efficiency programs for existing buildings, and
3. supply-side solutions that offer a clear path to sustainability.

The plan should also take a holistic, long-term approach instead of only short- or intermediate-term strategies and goals. The decision made in building design, energy infrastructure, and energy supply will live for a long span of time, and thus the consideration during planning must include the life cycle of the building and its effects on people and the environment.

The Stanford Energy and Climate Plan takes this concept into account, and not only offers significant improvements but also enables a future of energy sustainability. Through renewable electricity generation, converting campus energy systems from a fossil fuel base to an electricity base opens a clear pathway toward sustainability. It is evident that implementation of this plan will not stop with the projects and programs,

rather it will continue through ongoing quest for economical and sustainable technologies.

Stanford's achievement toward sustainability is remarkable, however, it may not be imitated in other campuses as a significant amount of money is needed to initiate those projects. For example, Stanford allocated \$30 million just to retrofit the existing buildings which is a significant amount for many HE institutions to collect and spend on this purpose. Also, public HE institutions are accountable to several government and public organizations for their budget and expenses whereas Stanford is free from many of these challenges as a private institution. This has given this institution more freedom in taking action for sustainability initiatives which may not be the same for public HE institutions.

3.3.2 Summary

3.3.2.1 University of British Columbia's Engagement with Sustainability

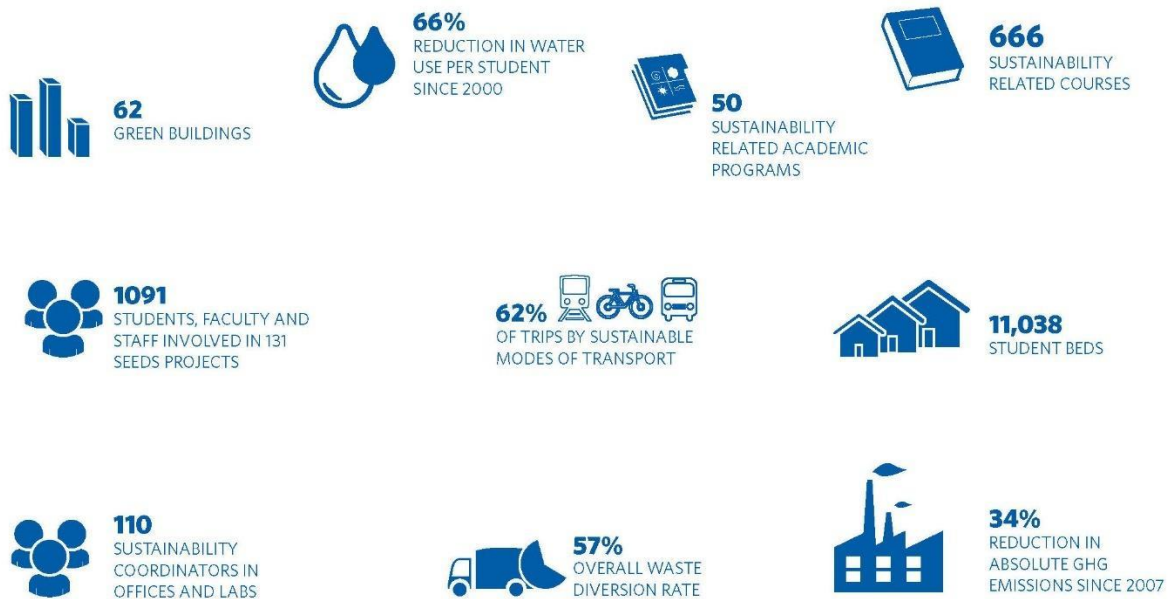


Figure 6.1 Achievement in sustainability by the University of British Columbia

3.3.2.2 Introduction

In the article titled “Recreating the university from within,” the authors Janet Moore, Freda Pagani, Moura Quayle, John Robinson, Brenda Sawada, George Spiegelman and Rob Van Wynsberghe share valuable information about the University of British Columbia’s engagement with Sustainability efforts. The University of British Columbia is the third largest university in Canada with more than 35,000 students and 1,500 faculty members. This university is a complex educational compound with learning spaces, numerous research labs, a recreational area for the students, a major hospital, a theater, sports facilities, parking lots, and fast food outlets.



Figure 7.1 Centre for Interactive Research on Sustainability (CIRS)

This section discusses the university's roles in terms of issues of sustainability, ecological, and social justice. It also investigates UBC's regular functions and teaching practices which are widely practiced across the university. While investigating the challenges, however, in achieving success in their sustainability efforts, a number of major obstacles were found. These included the following:

3.3.2.3 Lack of Institutional Commitment

Although UBC is regarded as the pioneer among the sustainable campuses for higher education, according to the authors more commitment is desired from "the institution" as a whole. Like many other higher education institutions, there are three levels of decision making authority at UBC. According to Janet Moore, Freda Pagani, Moura Quayle, John Robinson, Brenda Sawada, George Spiegelman, and Rob Van Wynsberghe there is no strong chain of command and thus directing the decisions to other levels is ineffective (Moore, J., Pagani, F., Quayle, M., Robinson, J., Sawada, B., Spiegelman, G., & Wynsberghe, 2005). Hence, sometimes, decisions that are made by university administration may be drastically altered or even completely ignored by faculty. Thus, it is very difficult to ensure institutional commitment as a singular goal.

3.3.2.4 Diffuse Power and Unclear Decision Making

The role of power in decision making is another important factor in achieving sustainability across campus. Among the faculties, the departments, the administration, and the individual faculty members, which entity has the most power in the universities is always a matter of great debate. In some opinions, it is the administration and the

perceived hierarchy who hold the power structure, and while others believe the power belongs toward students and faculty members. What is often ignored is student and faculties' own power with regard to decision making at the university.

Compared to government or private sector institutions, power at UBC is distributed in unusual ways. At UBC, most of the power lies in the academic side of the programs. One of the participants in an interview taken by the authors said "In my experience academic rationales trump most other reasons for discussions, a fact that is very frustrating sometimes to university operations like Land and Building Services or Development" (Moore, Pagani, Quayle, Robinson, Sawada, Spiegelman, Wynsberghe, 2015, p. 74).

If academics had more decision-making power in the subject matter of building services or development, that would be bound to create confusion. In addition to this, power is often concentrated in particular pockets. One's ability to get access to these pockets depends on the informal personal networks that one is able or willing to build up rather than an organized professional networking system.

In reality, according to many participants, many other sources of power have existed at the university both at the top and at the grassroots like students' level. Most of the participants agreed that the students could have access to a lot of power at UBC if they were proactive about their learning community and learning environment rights and used them strategically. Because of their youth, energy, and less commitment in compared to faculty, students have more potential to move the sustainability agenda ahead faster than faculty.

Also, additional support is needed from the administration and more activism is required on the part of students to move sustainability education forward.

3.3.2.5 Difficult to Balance Energy and Exhaustion

It is a big challenge to maintain a full-time position on a campus and invest the energy for social and institutional changes while working in the same system that is resistant to change. As a recommendation to counter this challenge, suggestions have been made to introduce an award for the faculty for their sustainability work (Moore et al., 2015, p. 76).

Another recommendation was to integrate awards into current university administration for promotion and hiring. It was also suggested to promote and develop further existing rewards system, if already presenting in universities. Faculty should be recognized by the administration for the participation in sustainability efforts which can be placed under “community service.” Recommendations have also been made for reviewing the curriculum so that focus can be given entirely on sustainability projects where academics are recognized and awarded for participation.

3.3.2.6 Lack of Strategic Vision or Historical Continuity

According to the author, many of the participants in the interview were curious about the UBC’s vision for sustainability and greater good for the society. As universities are often influenced by diversified funding sources and different types of government initiatives, there is an existence of discontinuation of long term vision. The authors of the article “Recreating the university from within” suggest a long-term plan with a deadline for the UBC. In the authors’ words, “A strong strategic vision enables opportunities that

support the vision and those that are contrary to it to be put aside.” (Moore et al., 2004, p. 119). Like many other institutions, UBC also has had numerous plans and visions that only last for a short span. The authors put emphasis on developing a strong vision that is compelling, has a strong community support, and will be implemented.

3.3.2.7 Difficult to Walk the Talk of Sustainability

It is a common phenomenon that university faculty are critical about theories while staff members are enthusiastic about creating practical solutions on practical fields. One of the participants stated, “This really gets to the heart of the sustainability problem. If we find ourselves unable to practice the things we know are right in theory then we will never be sustainable. It is easy to talk theoretically about sustainability but hard to put it into practice” (Moore et al., p. 78).

If we look into the field of medicine, we will find that society will put extra efforts in ensuring the best or most up to date care for a medical problem. If universities could educate people about the environment as thoroughly as society works to improve healthcare, it would be easier to achieve sustainability goals. Moore et al. have other suggestions for the faculty and staff. They suggested that faculty should spend a good amount of time in a staff job and vice versa. This will enlighten both parties. Faculties will realize the complexity of the practical world and explore the difficulties to put theories into practices. Also, staff will understand the intricate process of developing theories and the tremendous effort that is required to make them defensible. Both practitioners and theoreticians need to complement each other’s situations, expertise, and efforts, and carefully consider what each can exchange with other. Thus, applied research can be more applicable to real life.

3.3.2.8 *Conclusions*

Although sustainability initiatives, policies, and practices are becoming more relevant than ever, they yet have not received a place at the forefront of decision making or teaching at the academic institution. The authors urged for more institutional commitments that are more than a policies and few programs. They also recommended considering sustainability as an integral part of the decision making structure and a part of everyday rituals for the whole university. A suggestion was also made to have an open and transparent decision-making process so that everyone can get involved in the process and be able to share their concern.

Finally, the authors have concluded the article “Recreating the university from within” with the following three recommendations to help UBC and other institutions in their journey toward sustainability education.

1. Universities need to be transformed. Experimentations should be made during the transformation. A new path should be drawn that “demonstrates values, re-defining work-places and making innovations in course content and delivery.”
 2. Institutional self-reflection should be fostered with the purpose of understanding which will lead to changing the damaging institutional policies and structures. More avenues for discussion should be created so that the dialogue can be made to investigate the issues within the traditional university system.
 3. For a true interdisciplinary communication, necessary efforts and time should be recognized. This additional time and extra effort will help to educate people.
- And finally, a successful process requires a common platform where different groups will work together to achieve sustainability goals.

3.3.3 Summary: Barriers to The Construction of Green Buildings on Campus. A Case Study of The University of Waterloo, Ontario

3.3.3.1 Introduction

In Canada and around the world, HE institutions are physically expanding their campuses to meet the growing demands of ever-growing student populations. Since the last decade, the full-time student population at the universities in Canada has increased by 12 percent (CAUT, 2005). This physical expansion of campuses has a substantial amount of impact on both energy and resource consumption by HE campuses. This additional energy consumption also contributing additional CO₂ in the environment and global warming.

This summary investigates a case study of the building-making process at the University of Waterloo (UW). In this summary, the term “green building” has been used broadly. The term “green building” is used to describe a building that is energy and resource efficient, produces less waste, makes less pollution in its surrounding environment, and promotes a healthier environment to its occupants than a regular building. In Canada today, building construction and operation accounts for one-third of the nation’s energy consumption. It consumes 50 percent of the natural resources that the nation produces and contributes to 25 percent of Canada’s total landfill waste (www.buildingsgroup.nrcan.gc.ca/aboutus/about_e.html#innovation).

Green buildings have four major benefits in their design and construction over standard buildings. Firstly, environmental benefits usually stand out as the main reason for the design and construction of green buildings (Orr, 2004). Secondly, green buildings

reduce expenses of the owner/company because of energy efficiency, water efficiency, mechanical equipment downsizing, reduced insurance and liability costs, building value, and demolition costs (Johnson, 2000; von Paumgarten, 2003). Thirdly, improved indoor working conditions in green buildings can boost profitability by escalating customer satisfaction, increasing worker productivity by up to 16 percent, and reducing staff truancies by as much as 45 percent (Heerwagen, 2000). And finally, the development of green buildings provides prosperity to HE institutions by presenting a positive image and reputation for the HE institutions by practically representing progressive social and environmental obligations, and develops academic literature on green buildings by providing more case studies to examine (Scofield, 2002). In addition to all these four benefits regarding HE institutions, green buildings can provide opportunities for students (e.g. as a learning tool, by leading by example, and by boasting technology) and pass on the benefits of green buildings to a wide range of users, including the community in which the university functions (Beaudoin and Tremblay, 2002). The fight for HE institutions to take the lead in executing green buildings is reinforced by Orr (2004) who states that institutions are a small-scale version of the real world and should be the site of innovation for testing with sustainability. Bordass (2000) identifies that many, however, fear the unknown and are unwilling to be early visionaries in this area.

3.3.3.2 Green Building Perceptions

UW staff and faculty educated in the design and construction of standard buildings regarded the term “green building” with cynicism. Informants generally stated that the term “green building” is synonymous with “green” features such as solar panels, green roofs, and gray water systems and were quick to identify the long payback time required

to recover the initial cost of these features. Some informants were strongly against incorporating green design features into buildings on campus, citing economic considerations as the reason behind this belief. Sources acknowledged that some green features that have long payback times can be noteworthy for demonstration and education purposes but rejected these intangible benefits as reasons to incorporate green design features into campus buildings.

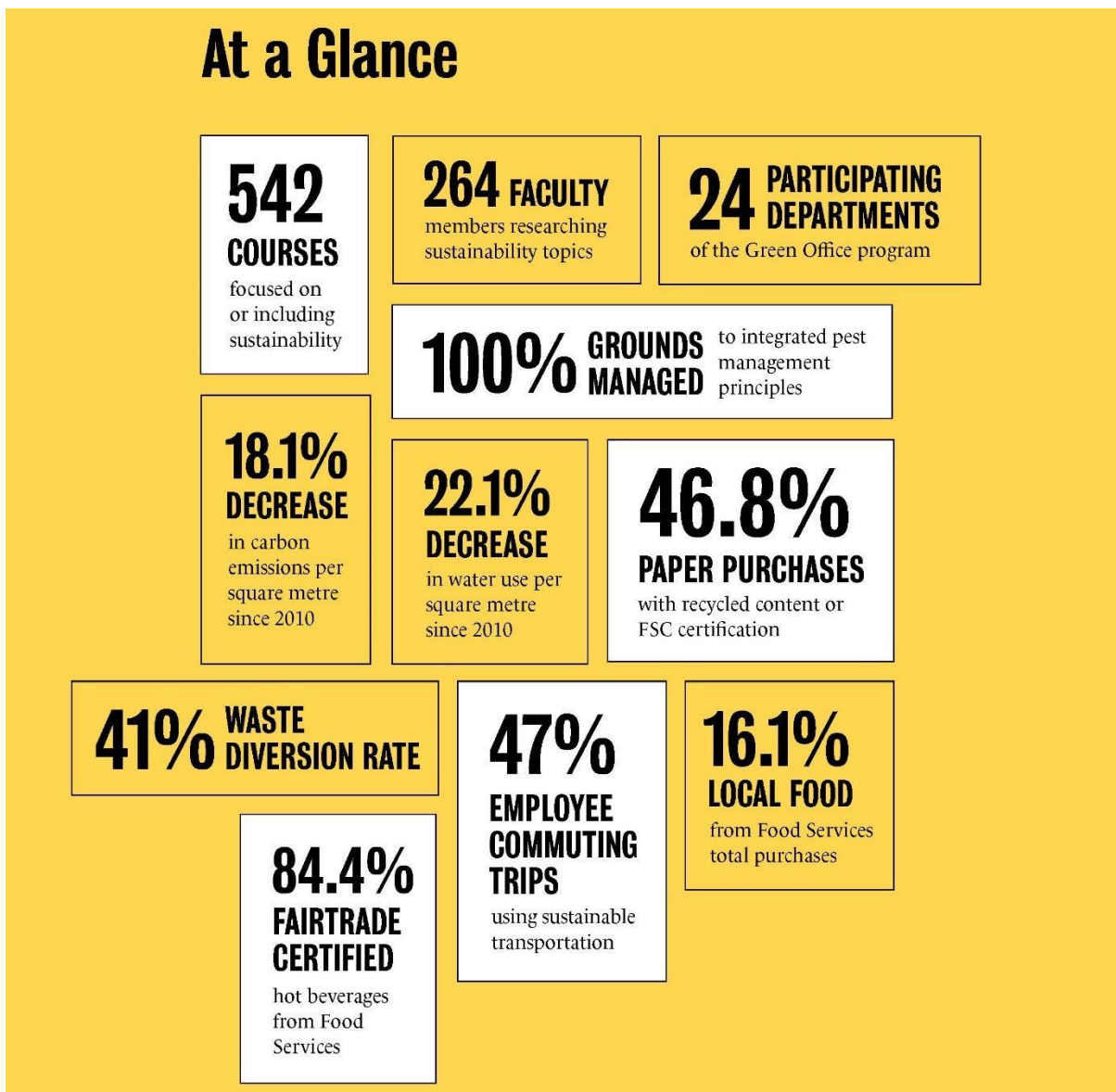


Figure 8.1 Progress toward sustainability goals by the University of Waterloo

The prevailing attitude was that if faculties wanted to incorporate distinctive features into buildings for demonstration or teaching purposes, then these faculties should raise the money and pay for these features via fundraising. The interviews also identified that negative perceptions, such as poor payback times for installations of solar panels, and continued debate over marginal technology associated with green buildings are preventing action on proven and economically viable solutions. One informant felt that “politically attractive” green features elevate the price of buildings because the most efficient technologies are not used (Richardson, 2013).

3.3.3.3 Faculty Barriers

There are three major financial barriers at the faculty level to the construction of green buildings on campus. First, several informants stated that once funding is available for a new building, the objective of the faculty sponsor is to maximize the use of space often at the expense of efficiency. In other words, faculty prioritizes maximizing classroom, laboratory, or office space over the benefits of high-efficiency mechanical equipment or better building materials which could reduce maintenance costs and resource inefficiencies significantly over the lifecycle of that building. According to undisclosed interviewees, “If you were a faculty and you had raised \$30 million to build a building, you want to get as many square feet as you can for that \$30 million. You don’t truly care how much the utilities are going to cost for that building” (Richardson, 2013). As the personnel does not pay directly for their building’s utility costs, the monetary motivation to build an energy efficient building is absent, since the workforce will not yield any of the advantages achieved through more efficient designs.

Second, many informants were not able (or unwilling) to separate between idle energy use and energy expended through the activities of people inside the building. Sources recognized that unwise utilization of power by the workforce, staff, students (i.e. not turning off lights, computer, and other appliances) increases the electricity bill, and steps should be taken to change their personal lifestyle rather than building design.

Third, in the design stage, faculties are given responsibility to think about what they want in a building, but some faculties may not have the knowledge to understand what aspects are needed for a high-efficiency “green” buildings.

3.3.3.4 The Funding Arrangement for Facilities

Another essential obstacle to the construction of green buildings on campus is that while the responsibility for building design is on the campus staff, there is not any financial incentive for these facilities department to recognize efficient design characteristics. While workforce and investment expenses are determined by the central administration, the UW utility budget is not fixed; this budget is determined by facilities and yearly put aside by the financial department. Facilities are not accountable for spending on utilities.

As the execution of new buildings is not directly connected to the facilities’ operating budget, there are no price incentives for the association to increase the efficiency of new or existing buildings on campus. Furthermore, communication hurdles are formed as funding for modification is fundamentally politically determined. There are no designated cost/benefit criteria that would inspire energy-efficient modifications that would reduce long-term operating costs.

UW administration relies on facilities to implement efficient energy use on campus without providing the department with appropriate incentives such as price caps, consumption targets, revolving loan funds, or the return of money saved on reduced utility costs to the faculty.

3.3.3.5 Not Upholding Long-Term Commercial Interests

The UW administration was found not to uphold long-term interests in maximizing its operating budget by building high-efficiency sustainable buildings. One of the main obstacles to sustainable building construction at the administrative level was the perception by UW administrative staff that there is a higher initial cost to design and build green buildings. UW has a fixed operating budget based on student tuition fees, federal and provincial grants, and private donations. Recent budget cuts of 2 percent at UW show the difficulties in finding additional capital to invest in the initial design and construction phase of a new building to realize long-term efficiencies. Tight budgets were used as the reason for not building green or high-efficiency buildings (Richardson, 2013).

However, expert sources noted how campus buildings could be more energy and resource efficient with equal capital construction costs. One sustainable building expert, for example, noted the lost opportunity to construct an economically viable green co-operative education building (operational at the end of 2002). The expert noted that decisions on the orientation of the building toward the sun and the choice of expensive and inefficient custom windows reduced the environmental and economic performance of the building significantly. This is just one example of where building expertise could be utilized to make energy efficiency savings at no additional capital cost to the project.

Interview results revealed that UW imposes no formal sustainable building policy or target; does not actively pursue collaboration with faculty building experts; and has not explored using the endowment fund to realize better life-cycle costs. Even when green design features were a proven equal cost alternative to standard design features, they were not considered.

In summary, UW is not imposing reasonable policies to maximize building efficiencies for the benefit of the long-term operating budget.

3.3.3.5 Organizational

3.3.3.5.1 Communication between Facilities/Administration and the University/Public

With respect to the construction of new buildings on campus at UW, no formal communication channels exist between the facilities and the public. Opportunities for the “public” or even consultations open to faculty, students, and staff members are limited and in many cases not available. Furthermore, this research identified that there is no easily accessible documentation either in print or on the UW website with in-depth information about UW physical operations goals, objectives, plans, project timelines, and information regarding energy and water consumption. Facilities or the UW administration also do not publish the formal university policy for maintenance endowment funds or the minutes of the UW President’s Advisory Committee on Design, which makes key decisions including the selection of bids for architects and contractors. Interviews with informants of this study, which include senior administration, facilities employees and members of two building committees, are presenting the only way to access in-depth information on the building process. In interviews, the senior

administration at UW argued that the university is “doing good things,” but at the same time did not make publicly accessible details of UW’s building program. The lack of communication was found to have several unnecessary and undesirable cascading consequences for the relationship between facilities and UW administration with public, faculty, and student stakeholders. UW faculty, staff, and students also feel powerless about providing input on decisions. Even when implementing innovative environmentally beneficial projects facilities continue to receive criticism because faculty and students do not know or have details about the projects. As well as breeding skepticism from students, faculty, and the public, propriety records on energy consumption for buildings on campus prevent independent scrutiny of facilities performance in operating, maintaining and constructing campus buildings. When asked, facilities do provide faculty and students with information such as energy consumption, but it is often perceived as a “hassle” to obtain it. UW might well be taking positive steps toward energy efficiency (and other green initiatives) in new or existing buildings; however, it is currently difficult to tell, given the lack of transparency in communicating this information to the campus community and beyond.

3.3.3.5.2 Leadership

Faculty sustainable building experts noted that an important means to progress sustainable construction practices on campus is for UW leaders to state sustainable goals, objectives, and targets. Informant interviews, however, revealed that UW administrative leaders are not formally committed to the construction of green buildings at UW. One senior informant in an informal meeting stated openly that he/she is averse to sustainability targets. Senior administrative informants stated the top UW priority for new

buildings is that they are on time and on budget—all other considerations including the environmental impacts of the building are considered secondary. One senior informant stated that it is up to students, faculty, and staff to present to senior administrative staff a “convincing argument” for sustainable buildings. This shows that committed individuals must raise awareness of green buildings, especially among senior members of staff, to realize their construction at HE institution. On the other end of the spectrum, a faculty member felt that to move forward with green buildings on campus, some principle needs to be established with respect to the performance of the buildings that are being designed.

3.3.3.5.3 Communication Among UW Researchers with Research Interests in Green Buildings

Thompson and Green (2005) states that a small stable group of faculty and staff committed to campus greening is important for institutionalizing sustainability at an HE institution. At UW, a core group of advocates including staff, students, and faculty have been vocal in initiating and maintaining WATgreen: the advisory committee responsible for campus greening on campus. However, with regard specifically to green buildings, this research identified a communication gap among green or sustainable building experts at UW. Faculty with an interest in green buildings have not formed a cohesive group to advance the construction of green buildings at UW or pursue cross-faculty research.

3.3.3.6 Conclusions and Recommendations

The focus of this paper was to explore the barriers to the planning and construction of green buildings at UW, an HE institution, like the majority worldwide, with no green building policy, no campus sustainable policy, and no practical

implementation of a green building. This study is unique because it does not focus on an institutional success story or an analysis of an attempt to green an HE institution. Instead, this study uses a qualitative methodology and an analysis of UW literature to document the building process and identify the influences on the lack of construction of green buildings on campus.

This analysis shows that UW has strong academic prowess in sustainable buildings but weak administrative leadership for sustainability, no sustainability targets, an only minimal collaboration between UW academic experts and facilities employees, and little financial incentives for either faculty or facilities to improve energy efficiency in the design of new buildings and operations of existing buildings. It is unlikely that prospective students will choose not to go to UW because of a lack of green building policies. However, if the university administration looked at green buildings as an opportunity to showcase its innovation to incoming students this may attract and retain additional students, and professors to the campus.

The findings of this case study of UW complement and support the barriers and motivations that have been identified in the literature. For the successful implementation of green building policies, four main organizational and financial factors are important. These four elements were developed with the key ingredients shown in Figure 1. The findings show that UW has weaknesses in all four areas of the diagram. Based on these barriers, this concluding section addresses recommendations for improving UW building performance and institutionalizing the construction of green buildings. These recommendations focus on changing the culture inherent in the administration at UW. Rather than being revolutionary in nature, they provide examples and incentives that

encourage critical thinking and innovation. This approach may be useful to other HE institutions. These recommendations represent a “carrot” rather than a “stick” approach which should diminish resistance to the changes and encourage more innovative ideas.

3.3.3.6.1 Develop Strong University Leadership

It is UW’s responsibility to champion the construction of aesthetically pleasing green buildings on campus. This leadership needs to come from those on campus that have decision-making authority regarding the construction of new buildings. One way to do this would be for university leaders through senior administrative meetings, university senate, or board of governors to establish a Green Building Task Force as McGill University has done, to establish green building targets, guidelines, and strategies for UW to move forward.

3.3.3.6.2 Establish Guidelines and Quantitative Sustainability Targets

UW should make sure that quantitative sustainability targets are stated and implemented from the start of the building project. Experts at UW have practical experience on how to fulfill guidelines and targets and are easily available for advice.

3.3.3.6.3 Facilitate Collaboration and Partnerships

When the researchers and facility employees establish a relationship among them, UW gets a direct benefit from their relationship. Collaboration between academic building experts and facilities employees would not only establish credibility for UW building researchers but also improve the economic and environmental performance of buildings on campus.

In conclusion, recording the university specific building handle from a building's concept to completion is vital to understand policy/process qualities and shortcomings and to move forward with useful changes. The investigation also illustrates that any move toward developing the maintainability on campus will require the administration to open communication channels and permit the college organization to tap the information bolted inside its resources. A more straightforward building process at UW framework would lead to better communication, less doubt about facility motives, and most importantly, advancements in the vitality and sustainability performance of university buildings.

As a final point, the elements that were discussed here were the basic components of a sustainable HE campus. However, there are numerous other staff-, student-, and faculty-initiated maintainability activities that are an indispensable portion of the UV community. For example, weekly on-campus farmers markets selling locally grown food, the living wall that was newly installed in the Faculty of Environmental Studies building, the student-sponsored solar panels that are on the roof of Federal Hall and the indigenous gardens around campus are all examples of sustainable effort. From the time the analysis for this study was finished, predictions have been made that green roofs will be incorporated into the designs of the new School of Accountancy, Quantum-Nano Center and the Accelerator Centre that is part of the Research and Technology Park on the north end of UW's campus. This is a positive indication that sustainability and energy efficient design is increasingly being taken into thought when new buildings are designed. This is an excellent beginning, but it is not sufficient. The UW has traditionally, been in the limelight for sustainable universities in Canada.

3.3.4 Summary: University of California Energy and Climate Plan

3.3.4.1 Introduction

The thirteenth Annual Report on Sustainable Practices features the continuous advance of the University of California (UC)'s extensive sustainability program, incorporating improvement in every aspect of the Sustainable Practices Policy as in research and education, Presidential Initiatives, and student, workforce, and staff engagement. Energy efficiency efforts keep on cutting overall energy consumption and costs significantly. Throughout the college, more than 1,000 projects have enlisted with the Energy Efficiency Partnership program which gained \$82 million in incentive payments and avoided \$28 million in annual energy costs.

Under the Carbon Neutrality Initiative, UC promised to achieve operational carbon neutrality by 2025. UC Santa Barbara, UC Berkeley, and UCLA have just surpassed the goal of achieving 1,990 greenhouse gas emission levels by 2020. Achieving carbon neutrality by 2025 will require a system-wide scaling up of current endeavors. In response to this challenge, the UC Office of the President built up a Strategic Planning Framework for Carbon Neutrality with methodologies and expenses for achieving the 2025 objective, which will fill in as a guide to enable UC to achieve its goal system-wide.

UC embraced new water policies in 2015 which include a 36 percent per capita reduction by 2025. UC Davis, Irvine, Merced, and San Francisco have recently met or surpassed the 2025 target; UC Berkeley, Riverside, San Diego, and Santa Cruz are on track to meet the 2025 target.

In 2016, twenty projects earned a LEED certification. In 2015 and 2016, UC included more than 2 million square feet of LEED-certified buildings; right around 20 percent of UC's total building space is LEED-certified. In 2016, 17 projects got a sum of \$1.1 million in building energy efficiency incentives; the projects are expected to avoid \$300,000 yearly in energy expenses. UC campuses redirected 76 percent of waste from landfills in 2015 and 16. While the objective is to achieve zero waste by 2020, it remains challenging to capture the compostable waste stream and to persuade suppliers to give reusable or recyclable packaging. UC is also focusing on food and food procurement as UC is continuously making an effort to source from local, community-based, fair, ecologically sound, and humane food sources. Private dining programs moved 22 percent of total food spending, medical centers moved 20 percent, and retail food operations moved 18 percent in 2015 and 2016. In short, University of California diversified their efforts in achieving sustainability in several sectors and remained persistent in their effort. They have already achieved some success, and they are making progress on some other sectors.

3.3.4.2 UC Sustainable Practices Policies

The previous year, essential system-wide advancement was made regarding climate action planning, renewable energy development, and energy efficiency projects. Highlights include the following:

1. On-site solar photovoltaic systems have been installed at 12 locations, with 36 MW of 100 percent carbon-free electricity in operation. Another 13 MW of on-site solar projects are in the planning and construction phases. UC achieved two sources of renewable biogas, which together will offset approximately 10 percent of UC's current natural gas consumption.

Progress Toward Policy Goals

Climate and Energy



GOAL	PROGRESS
Climate neutral by 2025	UC emits 3% less greenhouse gas emissions than it did in 2000, despite expanding campus built space by 14.2 million assignable square feet, representing an increase of 23%. UC's emissions reductions are equal to removing 35,800 cars from the road.
10 MW of on-campus renewable energy by 2014	Campuses exceeded this goal in 2013. More than 36 MW of on-site solar energy, is currently installed, enough to power more than 10,000 homes for a year. Another 80 MW of off-site solar will provide roughly 14% of UC's total electricity use.

Food



GOAL	PROGRESS
By 2020, 20% of UC foodservice spending will be from sustainable product	20% of UC food purchases in 2015-16 were sourced from sustainable products. 6 of the 10 campus' residential dining services and four of the campus' retail services have met the goal four years early. 3 of the 5 medical centers have also met the goal early.
Certify at least one foodservice facility on each campus as a green business	7 of the 10 campuses and 5 medical centers have certified at least one foodservice facility as a green business.

Green Building



GOAL	PROGRESS
LEED Silver minimum for all new construction	252 Total LEED-certified Buildings 51: Platinum 132: Gold 56: Silver 13: Certified
Certify at least one LEED EBOM certification on each campus	37 certifications across 8 campuses

Transportation



GOAL	PROGRESS
50% of all new light-duty fleet vehicles by 2025 to be zero emission or hybrid	29% of all new fleet vehicles in 2015 were purchased as all-electric or hybrids.
By 2050, more than 60% of UC employees will commute by means other than single-occupancy vehicles (SOV)	In 2015, 53% of UC employees biked, walked, carpooled or took public transit to campus, nearly double the statewide average of 27%.

Waste



GOAL	PROGRESS
Zero Waste by 2020	76% of campus waste was diverted from landfills in 2015-16. UC sends 198 lbs per person to landfill per year, 26% less than other comparable universities.

Water



GOAL	PROGRESS
Reduce per capita potable water use 20% by 2020 and 36% by 2025	UC Davis, Irvine, Merced and San Francisco have already met or exceeded the 2025 goal. In total, campuses saved enough potable water this year over last to fill 647 Olympic sized swimming pools.

AWARDS

STARS GOLD-CERTIFIED UC CAMPUSES

Riverside
Merced
Santa Cruz
Santa Barbara



SIERRA COOL SCHOOLS (2016)

3rd Irvine
8th Davis
18th Santa Cruz



PRINCETON REVIEW GREEN COLLEGES (2016)

7th UC Santa Cruz
13th UC Santa Barbara



Figure 9.1 Progress toward policy goal by the University of California

2. The first of two large-scale solar photovoltaic projects began generating electricity in Fresno County in the fall of 2016 for UC's Wholesale Power Program. The second system joined in the summer of 2017. Together they are bringing UC to a total of 80 MW of off-campus solar energy. These projects are generating electricity in an amount roughly equal to 14 percent of UC's total electricity use.

3. To date 1,023 university projects have been certified with the Energy Efficiency Partnership program, receiving \$82 million in incentive payments and evading \$28 million in annual energy costs, an amount equal to their debt service payments. In the year 2016, 28 energy efficient projects and 17 new construction projects joined in these programs and earned \$4.4 million in incentives. Due to their energy efficient design strategies these projects are projected to save more than \$550,000 annually in utility bill.

4. In 2016, the UC Office of the President designed a Strategic Planning Framework for Carbon Neutrality. This framework outlines potential approaches and costs for reaching the 2025 goal and will be a living guide to help identify systemwide actions that can be taken to help UC accomplish its goal. Since then campuses are improving their Climate Action Plans.

UC GREENHOUSE GAS EMISSIONS COMPARED TO CLIMATE GOALS

(Millions metric tons CO₂e)

- Scope 3 (campus commute, business air travel)
- Scope 2 (purchased electricity)
- Scope 1 (natural gas, campus fleet, fugitive)

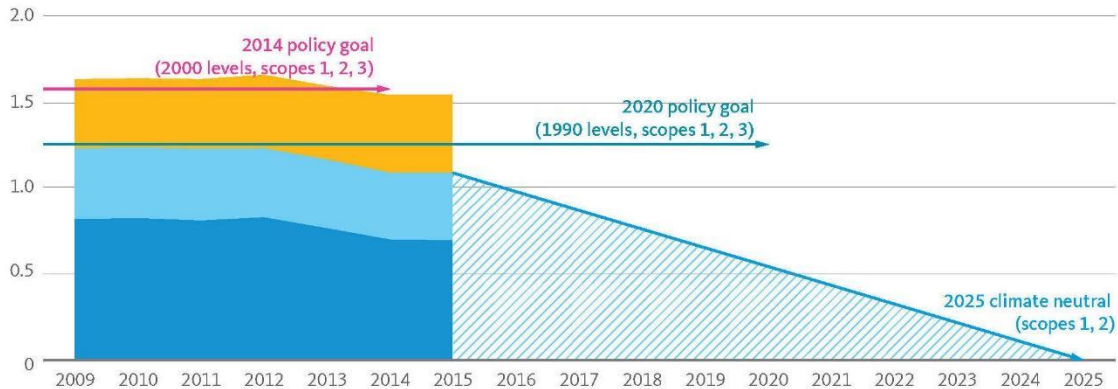


Figure 10.1 University of California greenhouse gas emissions

3.3.4.3 System-wide Energy Programs

3.2.4.3.1 Wholesale Power Program

In 2014, the Regents of the University of California acquired status from the California Public Utilities Commission as an enlisted Electric Service Provider (ESP), which enabled the college to give power to campuses qualified to "direct access" service. In 2015, the university started giving power directly to all (or parts of) the seven campuses and three medical centers that are qualified to get electricity from elements other than investor-owned or publicly-owned utilities. Around 25 percent of the college's power usage is qualified for direct access and is currently served by the college's own ESP as a part of the college's Carbon Neutrality.

3.3.4.3.2 Energy Efficiency Partnership Program

In 2004, the university established a unique energy efficiency partnership program with the California State University system and the state's four investor-owned utility companies to improve the energy performance of higher education facilities. The partnership provides funding for retrofitting of equipment, monitoring, training, and education. In the year 2016, the Los Angeles Department of Water and Power, which is a publicly owned utility, had joined the partnership. This provided UCLA full access to the program. Since its beginning in 2004, this program not only reduced greenhouse gas emissions but also has allowed UC campuses to avoid nearly \$200 million in utility costs. Despite these historical successes, the completion of new energy efficiency projects has slowed in recent years. In recognition of this slowdown, UC is working to identify and eliminate barriers to energy efficiency project implementation as a core strategy to achieve carbon neutrality and reduce operating costs.

3.3.4.3.3 Sustainable Transport

In the year 2015, 29 percent of all new fleet vehicles was either electric or hybrid vehicle. UC's climate goals include the reduction of emissions from the campus fleet and campus fleet emissions decreased by 13 percent in 2015.

Highlights from past years include the following:

1. UC Davis campus fleet received Fleet Sustainability accreditation from the National Association of Fleet Administrators (NAFA). Another UC campus, UCLA, received the 2015 NAFA Pacific Southwest Chapter Sustainable Fleet Award for running more alternative-fueled vehicles than any other UC campus.

2. By the assistance of The Green Initiative Fund (TGIF), UC Santa Barbara developed and implemented a Vehicle Incentive Program. This program assists campus staff with selecting “green” fleet vehicles and also provides grants to balance the additional cost of alternatively fueled vehicles.

3. Inspired by success of other campuses, several campuses are expanding their electric bus fleets. UCLA purchased two battery-electric transit buses to replace their remaining two diesel buses. This purchase has made UCLA as the first public university in California with electric buses.

Highlights from this past year include the following:

1. UC Santa Cruz experienced a 28 percent increase in the number of unique electric vehicle (EV) users using its charging stations on campus, serving over 200 unique EV drivers.

2. Leveraging the continued success of UC Riverside’s UPASS program, the campus completed a feasibility study for the construction of a mobility hub close to the center of campus. This multi-modal facility will enable Riverside Transit Authority to expand CommuterLink service to campus, provide a facility to anchor its two new RapidLink routes and connect bicycle and pedestrian pathways into the heart of campus.

3. In response to a campus travel survey, UC Davis spent over \$2 million in road, sidewalk, and bike parking improvements.

4. Car sharing is increasing on campuses. UC Davis Medical Center added four Zipcars, and UC Merced added three.

5. UC Irvine was awarded the EPA “Clean Air Excellence Award” for its Sustainable Transportation program as well as the “Best Workplaces for Commuters” (part of the National Center for Transit Research) “Best Of” standing in the University category.
6. Biking continues to be a flourishing area for most campuses. At UC Irvine, to create the Bike Parking Center, there are over 300 bike parking spaces and skate docks, and several repairs stands have been installed. The UC Davis ANR building includes a fleet of bicycles with helmets for staff; in the past year, staff have opted to take a bike instead of driving a car over 730 times. Six UC campuses have been recognized as Bicycle Friendly universities by the League of American Bicyclists (Platinum: UC Davis; Gold: UC Irvine, UC Santa Barbara; Silver: UC Berkeley, UCLA, UC Santa Cruz).
7. UC San Diego received a Diamond Award at the Platinum Level from the San Diego Association of Governments and the regional Commute program as recognition for its alternative transportation programs, which have helped reduce traffic congestion and greenhouse gas emissions in the region.

3.3.4.3.4 Green Building

The University of California added over 2 million square feet of LEED-certified buildings in 2015 and 2016; almost 20 percent of UC’s building space is now LEED-certified. Systemwide, UC owned 252 LEED certifications. Among these, 37 have acquired LEED for existing buildings, operations and maintenance.

In 2016, eight projects earned LEED-Platinum certification, six Gold, six Silver, and two Certified. Of these projects, six were LEED-EBOM certifications for UC Irvine

and five were LEED for New Construction Platinum certifications for UCLA. The campus profiles at the end of this report track each campus's LEED certifications over time. A complete list of all UC LEED certifications is available at <http://ucal.us/LEEDcerts>.

The Sustainable Practices Policy requires all new construction and major renovation projects to register with the Residential or Non-Residential Savings by Design Program. In 2016, 17 projects received a total of \$1.3 million in incentives. Those projects are projected to avoid nearly \$200,000 annually in energy costs due to their energy-efficient design strategies.

3.3.4.3.5 2015-16 LEED Platinum Certification Highlights

UCLA completed seven LEED certifications in 2015 and 2016, six of which were Platinum. The Center for Health Sciences south tower seismic renovation is UCLA's 30th LEED certification. A seismic upgrade and major renovation of the 443,000-square-foot former hospital transformed the 1950s building into research laboratory space, saving the university \$78 million by reusing the existing building. Innovative exterior stair towers employ high-performance glass curtain wall and "solar chimney" natural ventilation to conserve lighting and conditioning energy. Stair windows and views offer an inviting alternative to elevators, in line with UCLA's Healthy Campus Initiative.

The newly built 78,000 square-foot Merage School of Business II at UC Irvine accommodates a high-tech 300-seat auditorium, several offices, one lab, and a 70-seat capacity multi-purpose room. The project, which was delivered through a design-build process, received LEED Platinum certification through special attention paid to water and energy efficiency as well as materials and resource management.

Completed in fall 2015, UC Santa Barbara's Sierra Madre Villages is the first residential complex in the UC system to attain LEED for Homes Platinum certification. Each of the five apartment buildings in the complex incorporates energy efficiency measures such as EnergyStar appliances, high-performance building envelopes, daylighting, LED fixtures, and rooftop solar thermal systems. One of the more innovative features of the project is the onsite wetland restoration project. The project partnered with UC Santa Barbara's Cheadle Center for Biodiversity and Ecological Restoration (CCBER) to develop and manage the wetlands, which restore habitat, soil and water quality to the former golf course site.

3.3.4.3.6 Zero Waste

Collectively, UC campuses and medical centers diverted 58 percent of municipal solid waste from landfills from 2015 to 2016. Including construction and demolition (C&D) waste, the total diversion rate was 69 percent. However, excluding medical centers, the systemwide diversion rate was 76 percent this year, up 4 percent from last year.

UC Irvine continues to achieve the highest waste diversion rate at 80 percent (not including C&D). UC Riverside (78 percent), UC San Francisco (74 percent), UC Davis (72 percent), and UC Santa Barbara (68 percent) are not far behind.

Waste diversion rates have plateaued on many campuses in recent years, with only UC Riverside and UC San Francisco achieving symbolic increases in diversion rates since 2014. There are several potential explanations for the lack of further progress toward the zero-waste goal. There are multiple barriers to achieving zero waste. These barriers involve having control over compostable waste streams, ensuring supply of

reusable or recyclable packing from the suppliers, coping with the ever-changing market for the recyclable materials, and the scarcity of composting facilities.

However, flattened diversion rates are also partly due to the success of programs emphasizing the principles of “reduce and reuse,” such as reusable water bottle campaigns. For example, reuse means that there is a reduction in total waste; however, some of that avoided waste was recyclable material like plastic water bottles. Diversion rates therefore do not fully capture efforts to reduce or reuse waste.

To track the success of waste reduction efforts, campuses also report waste generation per capita as a complementary metric to the diversion rate. The Merced, Riverside, San Diego, and Santa Cruz campuses reported the lowest pounds of waste per weighted campus user.

3.3.4.3.7 Water

Several campuses made significant efforts toward reducing potable water use during California’s continued drought. Compared to the state’s baseline, UC Merced achieved a 23 percent reduction and UC Davis achieved a 25.7 percent reduction in potable water use from June 2015 through February 2016.

Significant reductions in potable water use were achieved by removing turf areas on campuses. UCSF saved 9.5 million gallons of water by eliminating turf irrigation; UC Santa Barbara eliminated potable water irrigation on three landscapes; and UC Davis removed approximately two acres of turf from areas in student housing and replanted with California native plant and drought-tolerant species, which will save more than one million gallons of water annually.

UC Santa Barbara retrofitted 63 benchtop condensers with closed-loop cooling, which will save almost three million gallons per year per. UC Irvine replaced 36 single pass cooling systems, resulting in annual savings of 1.6 million gallons of potable water. UC Santa Barbara and UC Irvine both worked to remove single pass cooling units in laboratories.

UCLA's Geffen Hall installed a 10,000-gallon storm water and condensate storage tank to offset toilet flushing and save the campus 139,000-160,000 gallons per year.

Construction bringing reclaimed water from the City of San Diego to UC San Diego's two main central utilities plants for use as makeup for cooling towers was completed in early 2016. The project has reduced potable water consumption at the towers by 80 percent and enabled the university to replace potable irrigation with reclaimed irrigation across a majority of the campus.

3.3.4.4 Presidential Initiatives & Carbon Neutrality Initiative

In November 2013, President Janet Napolitano declared the Carbon Neutrality Initiative (CNI). This declaration commits UC to emitting net zero greenhouse gases from its buildings and vehicle fleet by 2025. The initiative is built upon UC's pioneering work on climate research and its leadership on sustainable business practices.

To advise UC on achieving this ambitious goal, President Napolitano formed a Global Climate Leadership Council (GCLC). This council provides guidance on integrating carbon neutrality and other sustainability goals into UC's teaching, research, and public service mission. This council is a combined team of scientists, administrators, students, and experts from inside and outside UC. In its third year, the council continues

to engage the entire university community in pursuit of the best practices, policies, and technology to achieve carbon neutrality. The council has allocated funding for and supported implementation of 26 systemwide carbon neutrality projects. The projects focus on leveraging faculty, students, and staff to improve the energy efficiency of buildings and develop carbon neutral energy supplies, while advancing complementary research and education initiatives. In the spring of 2016, each campus and ANR hosted a series of workshops designed to incentivize, support, and connect faculty across campuses who willingly chose to combine and update existing syllabi with applicable courses associated with climate and sustainability topics.

Follow-up networking workshops were held in the fall where the workshop participants presented their climate change and sustainability curriculum innovations to the broader campus. More than 200 courses have integrated climate and sustainability concepts in new ways because of this project and these courses reach around 11,000 students every year.

3.3.4.5 Achievements on Individual Campus

3.3.4.5.1 UC Berkeley

In the past year, UC Berkeley has achieved several milestones. Primarily, UC Berkeley has installed Solar PV systems at the MLK Student Union, the new Eshleman Hall building, the Recreation Sports complex, the University Village apartments, and Jacobs Hall. All these are providing 1 MW of renewable energy to the campus. In May, 10 departments received green certification, meaning that over 3,000 staff and faculty (or 20%) are now part of a green department.

Secondly, during their regular commute, faculty, staff, and students walk around 9.6 million miles per year and bike 10.1 million miles per year. At present, over 5,500 people are commuting by bicycle to the campus. Campus water use has also been reduced cumulatively to almost 20 percent less than 2008 levels. Total use is estimated to be down by 10 percent since the drought declaration and by one-third since 1975.

Finally, UC Berkeley was recognized for its impressive sustainability efforts this year. Sustainability manager Kira Stoll received the 2016 UC Sustainability Champion award at the annual California Higher Education Sustainability Conference. Cal Dining won awards for the new local sourcing concept at Brown's and for their 'extreme local' theme dining hall meals. At the national collegiate waste-diversion competition, the campus took top honors at the 2016 PAC-12 Zero Waste Challenge while also defending its Recyclemania title for the fourth straight year.

3.3.4.5.2 UC Davis

In the year 2016, UC Davis took notable actions to reduce greenhouse gas emissions and make progress on sustainability goals. In November 2015, UC Davis officially opened a 16.3 MW large solar power plant which is the largest known of any university campus. Yearly, this solar power plant generates approximately 33 million kilowatts-hours for the campus. Reduction of greenhouse gas emissions by about 14,000 metric tons is possible for this plant. The UC Davis Library formed a very competitive team for the UC Cool Campus Challenge, and due to their work they received a campus-sponsored grant to deepen their sustainability efforts through the campus Green Workplace program.

The campus achieved a 27 percent reduction in water use for the 2015-2016 fiscal year using recycled tertiary-treated wastewater in campus cooling towers, major reductions in irrigation, fixture replacements, and behavior-based savings. To further waste reduction, the campus reduced both paper purchases by nearly 13 percent and paper usages by 7 percent by switching to paper towels and toilet paper without cardboard rolls. In laboratories, UC Davis diverted an estimated 31,000 pounds of hard-to-recycle laboratory pipette tip boxes, foam coolers and gloves. UC Davis also added more Zipcars due to the popularity of the program on campus.

UC Davis moved up one spot to place third in environmental sustainability in the 2016 international GreenMetric Global Ranking, a survey of more than 400 colleges conducted by the University of Indonesia that lauded UC Davis's teaching, research, campus lifestyle and management.

3.3.4.5.3 UC Irvine

Over the past year, UC Irvine has continued to move forward to its operational sustainability goals and to prepare the next generation of thinkers, innovators, and entrepreneurs. These are the professionals of future that will help the world to meet its overwhelming environmental challenges.

Recognized for its leadership in sustainability, Irvine was ranked among *Sierra* magazine's top 10 "Coolest Schools" in the nation for the seventh consecutive year. Irvine's progress toward reducing single occupancy vehicle commuting and its leadership in green buildings and energy efficiency earned the campus its third-place ranking. Commute options were expanded this year with the addition of a 300 stall Bike Parking Center to the campus core. For this and other efforts, Irvine received a gold level Bicycle

Friendly University designation from the League of American Bicyclists and the Clean Air Excellence Award in Transportation Efficiency from the U.S. Environmental Protection Agency. In green buildings, Irvine received its 14th LEED for Building Design and Construction Platinum certification.

Irvine was also recognized for its student sustainability programs, receiving the Best Practice Award for Sustainability in Academics: Arts, Humanities and Social Sciences at the California Higher Education Sustainability Conference for its Student Institute for Sustainability Leadership. The program has trained 114 students, including climate and food fellows from all ten UC campuses. In addition, a successful pilot of the academic credit-based Campus as a Living Lab internship resulted in a two-fold increase of student and campus partner participation for the upcoming year

3.3.4.5.4 UCLA

In 2015, UCLA's Sustainable LA Grand Challenge, an ambitious research project connecting hundreds of faculty, students, and community members, released a five-year work plan detailing over 100 research recommendations critical to creating a Sustainable LA Implementation Plan for Los Angeles County by 2020. The plan suggested the way of transition of the USA to 100 percent renewable energy and 100 percent locally sourced water. This also discussed the enhanced ecosystem health by 2050.

The campus continued to collaborate on campus operations and planning including working with the mayor's office on strategy for climate resilience. In partnership with the City of Los Angeles, UCLA certified 21 additional offices under the Green Business Certification program, bringing the campus total to 45. UCLA was

recognized by the LA Department of Water and Power as first in Energy Efficiency and third in Water Efficiency in their inaugural citywide sustainability awards.

The campus reached 30 LEED certifications in 2015, including six new Platinum certifications. A number of these building projects were recognized with awards including Best Design Project from the LA Business Council. UCLA continued collaboration between the Healthy Campus Initiative, Global Food Initiative, and sustainability programs on campus, taking an integrated approach to the built environment, food systems, and active transportation. The campus increased overall sustainable food procurement to 18.4 percent and achieved the designation of Fair Trade University, becoming the largest Fair-Trade University in the nation. Increased support for active transportation on campus garnered the university a Silver Bike Friendly University designation by the League of American Bicyclists.

3.3.4.5.5 UC Riverside

Over the past year, UC Riverside has made great strides in sustainability. The campus continues to improve its ranking on the 2016 Sierra “Cool Schools” list and earned its first STARS Gold rating from the Association for the Advancement of Sustainability in Higher Education. UC Riverside graduate students won a Best Practice Award at the California Higher Education Sustainability Conference for creating a new Graduate Sustainability Liaison position within the Graduate Students Association (GSA). As part of the GSA Executive Council, this position is responsible for the recruitment of eco-ambassadors and organization of a graduate student sustainability committee across campus.

UC Riverside continues to be a pioneer in sustainable laboratories with its Green Labs Certification Program. Fifteen labs have been certified in the last two years accompanied by robust energy, water and waste diversion efforts in a total of 29 labs. The university also increased lab efficiency through the installation of an energy and water efficient autoclave in the new Environmental Health and Safety building that consumes 90 percent less water and 80 percent less energy than a traditional unit.

UC Riverside has published an interactive Sustainability Story Book to showcase its sustainability achievements. The virtual tour displays campus sustainability landmarks, including LEED-certified buildings, the 3.5 MW solar farm and the highly acclaimed Living Laboratory Community Garden, R'Garden.

3.3.4.5.6 UC San Francisco

UC San Francisco received two Best Practice Awards and an honorable mention at the California Higher Education Sustainability Conference for its efforts to reduce waste, increase energy efficiency, and promote sustainable food. In the past year, UC San Francisco's waste diversion reached 80.6 percent due to an innovative waste reduction effort. A total of 26 special waste pickup days for e-waste, bulky items, and Styrofoam were held at four locations. Through a program by Bio-Link Depot, local middle and high school science classes also received university donations of unused university scientific equipment.

The campus reduced energy use by 2.2 percent through building specific efforts including five large Monitoring Based Commissioning projects, several Statewide Energy Partnership energy efficiency projects, a fume hood competition, a Smart Labs program, and the ULT Freezer Rebate Program. The campus reduced water consumption

significantly to 40 percent below the baseline through various efforts including a state-of-the-art pool treatment system that cut drainage frequency in half.

3.3.4.5.7 UC Santa Barbara

UC Santa Barbara is focused on global leadership in sustainability through education, research, and action. UC Santa Barbara won a 2016 Best Practice Award at the annual California Higher Education Sustainability Conference for its partnership with Santa Barbara Metropolitan Transit District to launch a new bus route to service campus locations as well as Isla Vista and Goleta. Along with these achievements, UC Santa Barbara has been recognized as a Gold Level Bicycle Friendly University (BFU) by The League of American Bicyclists.

In the year 2015, UC Santa Barbara received a LEED for Homes Platinum certification for Sierra Madre Villages. The university is the only campus in the system with any LEED for Homes certifications.

Over the past year, UC Santa Barbara broke ground on a multi-site solar photovoltaic project. In aggregate, this project will total over 5MW of renewable energy capacity and save the campus an estimated \$270,000 annually in annual utility costs.

With the current state of water resources in California, UC Santa Barbara has focused significant efforts on water reductions. In addition to expanding recycled water infrastructure, the campus distributed and installed closed-loop cooling for 63 benchtop condensers in campus research laboratories, decreasing annual water usage by 1.2 percent.

Last year, UC Santa Barbara promoted healthy food and eating on campus through the launch of the Food, Nutrition, and Basic Skills Program which offered a total of 36 workshops to students.

3.3.4.5.8 UC Santa Cruz

UC Santa Cruz made advancements in many key areas of sustainability during the 2014-15 academic year. During the height of California's drought, the campus committed over \$350,000 to operational improvement projects and reduced potable water usage by over 25 percent. Student teams audited every restroom and kitchen fixture across campus and educated campus users on how to monitor individual building water usage.

Innovative water conservation projects included an academic study with the International Drought Experiment to evaluate ecosystem response to the drought, as well as the installation of a grant-funded rainwater harvesting system on campus that collects both rainwater and condensation from fog to flush toilets at the campus athletic facility.

In collaboration with a team of consultants, UC Santa Cruz launched a yearlong integrated Climate and Energy Study that included the development of a climate-centric techno-economic analysis tool. The tool, which will be shared with other campuses, will analyze various scenarios for development, project implementation, technology application, and policy updates to help identify the best suite of strategies for achieving carbon neutrality by 2025 and for mitigating regulatory compliance costs.

In addition to significant operational projects, the campus also made headway in advancing sustainability through the curriculum. In fall 2015, the campus launched a new sustainability minor and a new academic concentration in sustainable food and agriculture.

3.3.4.6 Conclusion

At the University of California, education, research, facility management, cutting-edge entrepreneurship, and public service have been combined and have created these positive results. As a public research university, UC has been dealing with challenges in multiple areas such as undertaking basic and applied research, changing pedagogy, modifying the building operation, and being a model of positivity toward sustainable efforts.

In spite of their continuous efforts and improvement, many challenges remain, and demand for energy is ever increasing. Hence, the goal for carbon neutrality by 2025 is not easy.

UC campuses are privileged with a specific location and a climate conscious population. California has long been ahead of the movement on climate policy and clean energy, and the University of California is directly benefiting from that. Universities' initiatives are also appreciated and supported by the community which think alike, and hence both the community and HE institutions are supporting each other. This is not very common for other places in the U.S. State policies for sustainability and public attitude toward sustainable developments vary from place to place, so sometimes it is difficult to other HE institutions to follow the footsteps of the University of California.

CHAPTER 4. BARRIERS TO SUSTAINABLE HE CAMPUSES

From case studies and other literature reviews, it is evident that the prevalent understandings of sustainable development are conceived as a holistic concept that aims to integrate technological, social, economic, environmental, and cultural procedures to ensure high-quality sustainable growth. It is also evident that there are barriers in achieving sustainability on university campuses. Some of the barriers are discussed in this section.

4.1 Reducing Energy Demand in New Construction

When the issue is reducing energy demand in new building construction, Stanford University has an outstanding performance in this regard. Stanford University has processes in place to review and calculate the electricity, heat, and hot and cold-water consumption as a whole and to maintain demand by a well-established management system. They have achieved this by monitoring and managing their consumptions throughout the year and also by attention in reduction of energy in newer buildings. Also, emissions minimization has come from facilities design, construction, operations, maintenance, and a diverse group of students, staff, and faculty across all academic and administrative departments. This also often includes the surrounding community. This trait of a holistic and long-term approach is not very common, however, in the HE campuses in the U.S. So, from the case study and literature review, it is evident that lack of experiences and expertise to reduce demand for the energy in newly constructed buildings is common, and new buildings are often consuming more or at least the same amount of energy than the older ones.

4.2 Continual Innovation and Learning Through Building Design

It is necessary for an institution to be involved in continuous innovation and research to experiment with new technology and innovation in energy reduction. It requires financial support and a dedicated team of researchers to carry on this goal, which is a challenge for many HE institutions. From the case study research, it was found that in Stanford, even though all buildings could not reach at the desired level of efficiency, architects and engineers have constantly shared their ideas and information from their design, construction, and operation of their existing or new buildings. This trend, however, is also not widely practiced yet, and there is generally a lack of innovation and learning that affects HE sustainability goals.

4.3 Expensive Retrofitting Program

An aggressive retrofitting program may save a good amount of energy and resources in the long run; however, it requires initial investment. For example, Stanford University has allocated \$30 million for their retrofitting program, which is a massive amount for many public universities. Thus, high expenses for retrofitting existing buildings are another barrier to achieving sustainability on HE campuses.

4.4 Lack of Commitment from HE Institutions

University authority is structured in different layers and decisions are made in different levels. As there is no strong chain of command between these levels, it is hard to direct the decision to other layers. There is always a debate on who holds the most decision-making power in universities among the faculties, departments, administration,

and individual faculty members. Sometimes, it is the administration and the perceived hierarchy that holds the power structure, and in some other cases, students and faculty members are credited for this privilege. Because of this, decisions that are made by HE administrations are sometimes altered or even completely ignored at the faculty level. This complexity is not rare in HE institutions, and because of that, this lack of commitment for a singular goal is a barrier to sustainable HE campuses. Students, nevertheless, do have power in HE campuses (often unbeknownst to them), and initiatives in demand reduction that are initiated by students would hold the potential to motivate change in HE Institutions.

4.5 Lack of Historical Continuity and Strategic Vision

Universities are funded by diversified sources and often influenced by these funding sources. Government initiatives differ time to time which also is reflected in universities' policies. Thus, it is a challenging task to establish a long-term vision. From the case study, it is evident that the University of British Columbia had a good number of plans and visions; however, they only lasted for a short time. This is a common case for many universities in the U.S. Historical discontinuity and the lack of a long-term vision are barriers to sustainability in HE campuses.

4.6 Preconceived Notions about Green Buildings

In general, for the mass population, the term “green building” is synonymous with “green” features such as solar panels, green roofs, and grey water systems. People who are not experts in sustainable design often associate green buildings with a long payback time that is required to recover the cost of “green” features. Because of this notion,

university policy makers are often against implementing green design features into HE campuses, and thus, there is education to be had for the university policy makers about the wide ranging and holistic benefits of the sustainable campus.

4.7 Barriers from Faculty

Unfortunately, sometimes barriers come from the faculty members too. It is evident from the case study that once a fund is allocated, sometimes faculties concentrate on classroom, laboratory, or office spaces to maximize the usage of space instead of high-efficiency mechanical equipment or better building materials. Although advanced equipment or cutting-edge material can reduce building operation costs and save utility bills in the long run, the immediate need for a better space gets priority over efficiency.

Secondly, faculty could encourage their students to be considerate while using energy or building facilities on campus regardless of their area of study. Unnecessary usage of energy by the faculty, staff, and students (such as not turning off lights, computers, and other appliances) increases the electricity bill, and this could be avoided greatly if students were advised more frequently by the faculty.

Furthermore, faculties are experts in their field and not necessarily adequately informed about sustainable options. As a result, when they are in planning process, they may miss identifying the best component for a high efficiency green building.

4.8 Communication Gap Between Facilities/Administration

Across the case studies a communication gap is visible. Formal communication channels between HE campuses and the public are very limited. Even the students within the campus are not fully aware of sustainability efforts taken by the university.

Sometimes while implementing innovative environmentally beneficial projects, the design and facilities team continue to receive criticism as the other faculty and students have very little or no information about the projects. Sometimes, faculty and student are not included in decision making process, and they feel powerless on this matter. Also, it is possible to avail information from the facility management team, however, the people outside of the design, facilities, and management team consider this a troublesome process.

CHAPTER 5. RECOMMENDATIONS

RECOMMENDATIONS

1. Make a Commitment to Environmental Sustainability
2. Establish High Sustainability Standards for New Buildings and Reduce Energy Demand in New Constructions
3. Maintain Continuity and Long-Term Plans
4. Conserve Energy in Existing Buildings
5. Promote Collaboration and Partnerships
6. Develop strong university leadership
7. Create a Permanent Sustainability and Recycling Coordinator Position
8. Develop a High Impact Sustainability Website
9. Promote Sustainable Transportation Across and Around the Campus
10. Include Sustainability in Curriculum

Figure 11.1 Recommendations

5.1 Make a Commitment to Environmental Sustainability

Many HE institutions have adopted the American College & University Presidents Climate Commitment (ACUPCC) as a proof of their intention to specifically reduce their greenhouse gas emissions and continue overall sustainability goals. By signing a pledge like ACUPCC, institutions promise to develop strategies and take necessary actions to reduce energy usage and greenhouse gas emissions in a measurable scale within a definite time period. By making this pledge, universities also agree to publish their plans and progress through reports. Making a commitment is the first step, and for this reason, HE institutions should make such commitments toward measurable and realistic goals and with a specific deadline to achieve sustainability on their campus. The question nevertheless remains as to the ability to meet such goals, as is demonstrated by the Millennium Development Goals.

5.2 Establish High Sustainability Standards for New Buildings

Universities are required to set a high standard for all new buildings. This standard should set a benchmark for each building component. Designers and experts are there to take challenges. Because of the strict guidelines, architects, planners, and engineers will take sustainability as one of the highest priorities and design the structure or campus accordingly. A well-planned design inspired by well-thought-out guidelines generates a good solution at a particular point in time and depends also on the standards and guidelines of sustainability in architecture and planning. Also, it is important to have a check and balance with energy supply versus demand. If HE institutions can reduce the energy demand in their new buildings instead of raising the demand for energy, that would be a significant achievement. Therefore, even at the level of campus buildings, the

role of students and faculty is paramount. Demand reduction can be achieved by having a precise calculation of electricity, heat, hot and cold-water consumption, and total maintenance cost for a specific time. By using these data, universities can manage, monitor, and supply energy according to those numbers and thus they can reduce their energy consumption. However, the contribution of humans, students and faculty, and their behaviors will always remain in question without strategies to elevate the role of humans and their choices in sustainable development. This opens the horizon in the design of the campus to a serious investigation of the role of education in sustainable development.

5.3 Maintain Continuity and Long-Term Plans

Achieving a sustainable higher education campus is not merely a goal; it is also a continuous journey. However, universities are funded from diversified sources, there is a risk of being influenced by those funding sources and their different ideologies. Along with a short-term goal, vagaries of such influence are possible, and that is why a long-term vision is thus necessary to commit to in order to carry on the movement toward a green campus.

5.4 Conserve Energy in Existing Buildings

To create a sustainable campus, it is very important for universities to give attention to minimizing their energy use in existing buildings. An extensive and specific program should be there to improve energy efficiency across the campus. Universities should recognize that energy saving efforts come from diversified areas on campus. These areas include, but are not limited to, facilities planning and management, design,

construction, operations, ongoing maintenance, a diverse group of students, staff, and faculty across all academic and administrative departments, and the surrounding community. Retrofitting old buildings is another effective means to conserve energy in existing old buildings. Energy efficient light bulbs like LED and sensor-operated switches that turn off the lights and air-conditioning when not in use should be installed to avoid any slightest amount of wastage. This approach should not be underestimated in the development of a sustainable HE campus. Strategies in building development rarely concern themselves adequately with the value of preserving buildings and reusing buildings which saves significantly at the level of material resources.

5.5 Promote Collaboration and Partnerships

Universities harvest the benefits when scholars, researchers, faculty, students, facility employees, and other organizations outside of campus establish a collaboration among them. Collaboration between a diverse group of scholars not only establishes and improves credibility for the university personnel but also improves the academic, economic, and environmental performance of buildings on campus. Because of these benefits, universities should promote partnerships with other entities. The role of education in establishing an inclusive environment for education should not be underestimated as a goal of the sustainable development of HE campuses. While these goals can be considered “soft” goals (already a derogatory description) in relation to the engineering and planning language of efficiencies, the HE campus is primarily a place of education.

Thus, meeting the sustainability needs of inclusive environments and access to education, as described in Development Goals, addresses the dual needs of educational excellence and sustainability.

5.6 Develop strong university leadership

Universities should develop their own stream of leaders for now and for the future. This leadership needs to come from people on campus that have the authority in decision-making regarding the construction of new buildings or the operation of the existing ones in sustainably prescribed manner. This can be achieved by combined efforts from existing university leaders through senior administrative personnel, University Senate, Board of Governors, and student leaders. Leadership with a vision can take an organization to its highest potential, and universities are one of the best places to create those leaders and receive benefits out of this.

5.7 Create a Permanent Sustainability and Recycling Coordinator Position

A permanent position is required to coordinate and promote effective sustainability efforts on campus. This coordinator position will channel student interest and enthusiasm for sustainability in an effective way. This position will also work as point of contact for the people from and outside of campus that are interested in sustainability efforts. This permanent position must become the focus of knowledge in the development of the campus, and this position can also instigate collaborative activities across the campus of students and facility in order to develop a common, community connected and place-based vision for the campus.

5.8 Develop a High Impact Sustainability Website

A lack of knowledge on sustainability among common people is one of the barriers to achieving sustainability goals. The benefits of energy conservation, harvesting renewable energy, reducing carbon emission, and recycling are not always widely understood by a majority of people. Even the students and surrounding communities are not well informed about HE institutions' efforts for a sustainable campus. A well-designed, well-informed, and widely publicized website may reduce this information gap. This dedicated website for sustainability will provide information about the university's efforts and increase awareness among students and the surrounding community. This website will also display university's achievements and publish annual reports.

5.9 Promote Sustainable Transportation Across and Around the Campus

When it is the matter of sustainability on HE campuses, transportation is one of the main areas that must be considered. As most of transportation in the U.S. is run by non-renewable petroleum fuel, transportation plays a vital role in achieving campus sustainability. HE institutions should have efficient campus bus service networks across and around the campus. It is also important to have well-designed proper bus shelter that is appropriate for campus environment. Frequency, number of buses, schedules, and bus shelters should be proportionate to the students' number and demand. Introducing electric vehicles for mass transport and replacing old fleets that are not environmentally friendly and fuel efficient are other important aspects for achieving campus sustainability.

HE institutions should also promote a bicycle friendly campus environment. Separate bike lanes will increase the usage of bicycles and ensure their safety. There should be a good connection between bike paths, the campus area, and the city to

increase flexibility for bikers. HE institutions should also increase the number of bike stations and ensure their security.

A pedestrian friendly campus is also necessary to make the HE institution green. Within the campus, walking is one of the main modes of transportation, and therefore it is essential to ensure quality walking facilities across the campus. To encourage walking and facilitate a pleasant walking experiences, universities should increase the number and quality of public spaces. Shading devices, well-designed street furniture, lighting fixtures, and appropriate signage along the pedestrian routes have to be ensured. Also, a well-networked linkage should be there between pedestrians, cycling routes, bus stations, and car parkings.

5.10 Include Sustainability in Curriculum

HE institutions should go beyond developing specialized knowledge and technical skills. HE institutions should teach, promote, and develop values to enrich society. Universities must prepare future leaders and professionals who are able to meet social, cultural, and environmental needs along with their professional capabilities. This is only possible when sustainability will become an integral part of the higher education curriculums. For this reason, the entire educational process should take a holistic approach to implementing sustainability skills across the university so that students will be able to make decisions and take action while considering sustainable criteria. HE institutions also should offer postgraduate courses and other programs that are specialized in the area of sustainability. While designing the curriculum, it is very important to consider time and space and to integrate those factors in the pedagogy.

It is also very important that students will learn different contexts through a curriculum that address local and as well as global issues that are affecting the planet and sustainability.

CHAPTER 6. CONCLUSION

As an institution, universities are at the center of climate change research. Universities are the places that host researchers and scientists who measure the effects of global warming and predict our remaining carbon budget to prevent extreme danger. At the university, it is the engineers who are developing renewable energy solutions. Architects, scientists, and designers collaborate and design net zero buildings. Social scientists give their advice on government policies, and at the same time, they research the changes in behavior to reduce our demand for energy. HE institutions have been educating hundreds of thousands of students every year if not millions. Tens of thousands of staff are employed by HE institutions. All these people have an impact on the local community in many ways, so what local communities and the university body do has a significant multiplier effect. This multiplier effect could be positive or negative. Considering the availability of knowledge, manpower, logistic support, and infrastructure, modern informed society has been expecting HE institutions to be the beacons of innovation that will run their facilities sustainably in a way that is coherent with their scientific findings. HE institutions possess the knowledge and experiences not only to plan and become sustainable ahead of other institutions or organizations, but also, they can initiate transformative change that is beyond their own borders through their continuous research, scholarship, and teaching—locally, nationally, and internationally. Hence, in HE institutions, sustainability should not be left for one discipline, nor one department, to consider and implement. The goal for the sustainable HE campuses suggests a movement toward transdisciplinary and transformative ways of knowing and

being at the university. The sustainability movement is a continuous journey rather than a merely goal at the end of the road.

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