Advancing Education for Sustainability:
Teaching the Concepts of Sustainable Building to All Students
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This strategy document investigates challenges and opportunities faced by the higher education institutions of U.S. and recommends strategies to educate all students about basic green building principles.

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I. Preface

Humanity is at an unprecedented crossroads. Despite all the work we have done on environmental protection, all living systems are declining at an increasing rate, we are severely disrupting the stability of the climate, and there are huge social, economic and public health challenges worldwide. This is happening with 25% of the world’s population consuming 70-80% of the world’s resources. The crucial question for all of humanity is: How will we ensure that current and future humans will have thriving communities and economic opportunity in a world that will have nine billion people and that plans to increase economic output 4-5 times by 2050? This is arguably the greatest challenge human civilization has ever faced. It is bigger in scope than the Manhattan Project, the Marshall Plan for Europe, the Apollo Project and the War on Cancer combined.

The cultural operating instructions of modern society are that if we just work a little harder and smarter and let the market forces run society, all these challenges will work themselves out. It is obvious that we need a transformative shift in the way we think and act. As Einstein said, “We can’t solve today’s problems at the same level of thinking at which they were created.”

This shift must be led by higher education for two critical reasons. Colleges and universities prepare most of the professionals who develop, lead, manage, teach, work in, and influence society’s institutions, including the most basic foundation of K-12 education. Unfortunately, the current educational system is reinforcing the current unhealthy, inequitable and unsustainable path that society is pursuing. This is not intentional – it is because of deeply held beliefs that humans are the dominant species and separate from the rest of nature, the predominance of disciplinary learning and an implicit assumption that the earth will be the gift that keeps on giving - providing the resources and assimilating our wastes and negative impacts - ad infinitum and irrespective of the size of the population or its level of its material desire.

Fortunately, there are significant efforts in higher education to accelerate its ability to provide the knowledge and graduates necessary meet this great human challenge. The scale and speed of the challenge will require many layers of specialized focus that will be part of and/or complement the broader scale movement. One of the most important of these will be to focus on the built environment.

Buildings have a significant impact on the environment, accounting for one-sixth of the world’s freshwater withdrawals, one-quarter of its wood harvest and two-fifths of its material and energy flows with very large negative impacts on the environment and health. The built environment is directly responsible for 48% of total worldwide greenhouse gas emissions and indirectly responsible for another 25% from transportation, given that more than 80% of all travel is to go from one built community to another. Structures also impact areas beyond their
immediate location, affecting the watersheds, air quality, and transportation patterns of communities. The resources required to create, operate and replenish this level of infrastructure are enormous and are diminishing. By all accounts, we will have to renovate 75% of the existing infrastructure and double its total size in the next 40 years to accommodate the demand. We must strive for net zero impact buildings. And it is doable. According to an analysis by Architecture 2030, a single investment in energy efficiency of $21.6 billion would replace 22.3 conventional 500 MW coal-fired power plants, reduce annual CO2 emissions by 86.7 million metric tons, save 204 billion cu. ft. of natural gas and 10.7 million barrels of oil each year, save consumers $8.46 billion in energy bills annually (less than a 3-year simple payback) and create 216,000 permanent new jobs.

Of course, all the professionals, skilled workers, and citizens who plan, design, develop, construct, operate, maintain, finance, oversee and occupy buildings will need new conceptual and practical knowledge, skills and perspectives to ensure that the built environment and the communities of which it is a part will have a net zero impact on the local and global environment, ensure that the inhabitants will be healthy and productive while providing all the other desirable attributes. Education for sustainable building is provided at some colleges and universities, but mostly within specialized programs such as architecture and engineering. This narrow approach to providing an understanding of concepts that should be second nature to all college and university graduates is unlikely to result in a society where all buildings are constructed and renovated sustainably and where there is no such distinction anymore as “green building” versus “conventional building.” Many higher education institutions are incorporating green building and operations into their facilities plans; why not make a similar commitment to educating students about the concepts and principles behind these efforts?

For this reason, Second Nature and the U.S. Green Building Council have partnered to develop strategies to ensure that the current and future workforce will have these skills and knowledge. This document is a companion piece to the American College & University Presidents’ Climate Commitment guidance document, *Education for Climate Neutrality and Sustainability*, which discusses and offers strategies for a broad approach to integrating sustainability into the higher education curriculum. This document drills down to the specifics of educating about one very important and far-reaching topic within sustainability. *Teaching the Concepts of Sustainable Building to All Students* is the first step in the process to develop strategies specific to an education that highlights the built environment as a critical piece of achieving sustainability. We invite you to work with us on this important effort.

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II. Introduction

Why Educate Students about Sustainable Building?

How will we ensure that current and future generations will be healthy, and will have strong, secure, thriving communities and economic opportunity for all?

Buildings and communities set the foundation for an increasingly urbanized, global population. At the most basic level, these structures provide shelter and protection. In increasingly complex scenarios the design, construction and operation of both new and retrofitted buildings and communities can set a sustainable paradigm for the structure of our social systems – from college campuses to suburban neighborhoods and urban centers.

Building and community design, construction and operations, can exemplify the intersection of sustainability’s three tenets as they:

- Reduce the ecological footprint of the built environment
- Produce healthy, vibrant places for people to live and work
- Make sound economic sense by reducing the cost to operate and maintain these spaces.

Increasingly, colleges and universities are embracing sustainable design, construction, and building operation and maintenance as an essential element of their plans to “go green,” achieve carbon neutrality, and fulfill sustainability commitments. However, the construction and operation of sustainable buildings only take us part way to answering the questions of both today’s and tomorrow’s generations. How do we make sure the students, faculty, and staff living, learning, and working in these buildings and on these campuses recognize and understand the foundational principles of sustainable building? How can the members of today’s campus communities become the leaders and spokespeople for building and maintaining strong, sustainable communities, tomorrow? As all students are exposed to education about sustainable building they will develop problem solving and critical thinking skills that will:

- Ensure they are prepared to meet the great challenges of this century
- Understand and apply smart solutions to help solve complex problems
- Prepare themselves to enter a newly defined professional landscape

This paper will emphasize the importance of introducing all students, across every discipline, to sustainable building principles and practice, while highlighting successful methods for curricular and co-curricular integration. The goal is simple and attainable: today’s students will be the developers of tomorrow’s thriving communities, new economic opportunities, and a healthy regenerative environment.
To Meet 21st Century Challenges

Humanity is at an unprecedented crossroads. As 25% of the world’s population consumes 70-80% of the world’s resources,¹ many believe that this is the greatest intellectual, moral and social challenge human civilization has ever faced. Climate disruption is real and is already affecting us: it is worse and happening faster than predicted by the most conservative scientists. Moreover, the emissions of carbon dioxide today will continue to disrupt the climate for the next century and a half, creating an ecological debt for future generations. These effects on the climate are irreversible, and include the whole scale extinction of species and the rapid melting of all the earth’s glaciers.²

Building construction, operation and demolition have massive and undeniable effects on climate change, representing 38 percent of carbon dioxide emissions, 39 percent of U.S. primary energy use, 72 percent of U.S. electricity consumption, and 14 percent of U.S. potable water.³ Taking a smart approach to how we construct and renovate buildings is vital to our success in combating climate change, saving resources, money, and ensuring healthy living and learning environments. Every year in the U.S. approximately 5 billion square feet of new buildings go up, 5 billion square feet are renovated and 1.75 billion square feet of existing buildings are demolished. By 2035, 75 percent of the built environment in the U.S. will be either new or renovated and so these next 30 years represent a huge opportunity to dramatically reduce energy demand in the United States.⁴

If built to high performance “green building” standards, buildings can reduce energy use by 24-50 percent, CO2 emissions by 33-39 percent, water use by 40 percent and solid waste by 70 percent.⁵ In comparison to the average commercial building, green buildings consume 26 percent less energy, have 13 percent lower maintenance costs, and produce 27 percent higher occupant satisfaction and 33 percent less greenhouse gas emissions.⁶ These buildings provide improvements in indoor air quality that can reduce healthcare costs and work losses from respiratory diseases by 9-20 percent, from allergies and asthma by 18-25 percent, and from sick building syndrome by 20-50 percent.⁷ In addition, school test scores in buildings with the most daylighting were 7-18 percent higher than average.⁸ Many cost effective green buildings in the U.S. and Europe have shown that these performance percentages can be improved upon with advanced quality design. A substantial number of new buildings are reaching for and achieving net zero status, which means that the building produces at least as much renewable energy as it consumes in total energy.
To Understand and Apply the Solutions

There is a critical and immediate need to shift thinking and practice in regards to the built environment. Namely, the location, design, construction, and operation of buildings, as well as communities in which they are located, can mimic the way nature operates by running on renewable energy, using materials in a complete cyclical fashion and eliminating the concept of waste, or using renewable non-toxic materials and fitting in with natural systems. To reduce environmental impact, protect public health and improve environmental equity and justice, we must change principles for building practice. In effect, all buildings must be sustainable.\(^9\)

What Makes Buildings and Communities Sustainable?

Whether labeled “green,” “sustainable,” or “high performing,” there is an undeniable shift to ensure buildings and communities use less energy, water and natural resources, have less negative impacts to surrounding habitats, and are healthier for occupants. This signifies a shifting paradigm away from conventional design principles to a systematic, highly collaborative approach in the way buildings, neighborhoods, communities, and cities are designed, built, and operated. The intent of sustainable building and design is to promote high-performance, healthful, durable, affordable, and environmentally sound practices in the construction, operation and maintenance of the built environment.\(^10\) This methodology results in the ability to optimize site potential, minimize non-renewable energy consumption, use environmentally preferable products, protect and conserve water, enhance indoor environmental quality, and optimize operational and maintenance practices.\(^9\)

This practice is rooted in the “triple bottom line” of sustainability, emphasizing the ability to reduce negative impacts on the environment, while having healthy and positive impacts on the humans in their residential and work environments and lowering operating costs and producing economic benefits.\(^11\) Central to the practice of sustainable building is the integrative design approach. This method is rooted in systems theory, emphasizing the interconnectivity of all aspects of a project. The practice must reach from the earliest stages of planning to beyond the end of life. It runs up and down the supply chain. It encompasses the production and fate of every substance that crosses into or out of a project.\(^12\) Buildings help to define communities, transportation patterns, and the flow of natural resource stocks among other impacts outside the walls of the building itself; a truly sustainable approach to green design is based in an understanding of systems and interdisciplinary perspectives.\(^13\)
A sustainable building strengthens the local economy by using local building suppliers and materials as well as creating new jobs, especially in the disenfranchised communities that are often negatively impacted by current waste practices. Basic education regarding the benefits offered by sustainable built environment and prudent building use decisions could connect these communities to the larger sustainability movement while decreasing the negative impacts of their built environment. This will also help save resources that could be then invested in myriad of community development projects. Says Grace Eason, associate professor at the University of Maine-Farmington, “this is not some future utopian ideal. These buildings can truly rejuvenate local economies.”

To Become Qualified Professionals in a Changed Landscape
Over the past decade, “green building” – which is how the design fields have commonly referred to sustainable building (although “green” building typically brings benefits beyond environmental protection) – has evolved from a niche market, gained momentum and is now moving towards becoming the norm for many industries that are associated with the built environment. Broadly, the construction market accounts for about $1.7 trillion (13 percent) of the $13 trillion U.S. GDP. The green building market is anticipated to more than double from today’s $36-49 billion to $96-140 billion by 2013. In particular, the K-12 and higher education market, accounting for 27 percent of all commercial construction activity, is building green faster than any other sector in the building and green construction market, and McGraw-Hill Construction predicts the green building portion of the education market to be larger than 5-10 percent by 2010.

Building Science and Planning Professional Programs

Among leaders in the fields of building science and planning, it is often recognized that they are working to make today’s innovative practice, tomorrow’s conventional practice. Green building is already progressing in a clear direction to move beyond considering the impact of one new building at a time, to focus on greening of communities and existing buildings. This is evidenced by the Architecture 2030 project, initiated by building professionals to rapidly transform the global building sector to become a central part of the solution to global warming and involving an imperative to integrate green building curriculum into architecture programs.

It seems equally important that the traditional division between designers and building science specialists is bridged if truly green projects are to emerge from the building sector. As such, the American Institute of Architecture Students argues that current architectural education is not providing an understanding of the ethical, social, political, and economic forces that impact
design and the importance of people, communities, and society in design decisions. Design and creativity need to be taught in conjunction with the research and quantification skills required to address climate change mitigation strategies. The emerging green building professionals coming out of technical schools as well as colleges and universities will be well placed to benefit from the growth in the industry and the push toward innovation. Students studying architecture, engineering, landscape architecture, interior design, construction, planning and facility management are the most likely to receive training in the concepts and principles of sustainable building, and will therefore be more competitive as professionals in this burgeoning marketplace. In response, many are calling for widespread transformation of curriculum for these professional track programs to better integrate the principles of sustainability.

The Emerging Green Workforce

Increasingly, environmental and energy issues have driven the need for policy changes to support an emerging green workforce. There have been several key pieces of legislation that have helped propel green building forward. In June 2009 the White House Blog released information about increased funding for green jobs and the trainings that would support these careers. The 2009 Recovery Act has and will continue to have a huge impact on the green economy in terms of training, creating the largest weatherization program in history and supporting the renewable energy industry. Congress has made schools and education pillars of green initiatives. The University Sustainability Partnership was passed to support systemic change toward literacy about our sustainability challenges and skill building for engagement in the solutions. Similarly, Green For All is an organization dedicated to improving the lives of all citizens by creating strong and inclusive green economy. In addition to the fact that green jobs are not only good for the environment but are also well paying, the economic framework created by these green jobs has the potential to bridge the gaps between various socio-economic strata, train skilled workers, as well as sustain healthy and vibrant communities. The Green Energy Education Act of 2009 will fund Integrated Graduate Education and Research Traineeships to support graduate level programs related to energy. Additionally, the 2007 Green Jobs Act allocated more for “energy efficiency and renewable energy worker training programs.”

These federal initiatives are clear indicators that many of the jobs of the future will support clean energy industries and efforts to mitigate climate change. A Center for American Progress study identifies energy-specific industries that can yield high and quick returns on investment, and we can infer that these areas will be the first place we see a transition from traditional occupations to a green workforce. One of the main areas they singled out is that of building retrofits with a potential annual investment level of $80 billion.
The Wide Reach of the Green Building Field

In addition to the early adopters already mentioned, the growth in the green building industry and in green jobs will touch upon many professions. Business owners and managers need to be familiar with innovations in technology as they make decisions about their company’s property portfolio. Property and real estate managers, who oversee the performance and expected revenue of commercial and residential properties, are increasingly seeing the influence of the green building industry on their work. Lawyers and paralegals also play a critical role in green building as mediators and legal counsel for others in the industry. As more K-12 schools, colleges and universities build green on their campuses and work to integrate the lessons of these projects into their academic offerings, educators from a multitude of disciplines need to be prepared to easily integrate green building and sustainability concepts into their curriculum.

Students preparing for careers in any profession – be it chemistry, computer science, or philosophy – will someday be building owners and occupants. In this important role, they will determine the future of green building and our society’s ability to mitigate and adapt to the impacts of climate change. As occupants of homes, office buildings, and other structures, their behavior will determine the true environmental, social, and economic impacts of a building. When building occupants fail to understand or fully take advantage of their green buildings, there can be a performance gap that reduces the expected operational savings; according to the USGBC, this knowledge gap must be filled to truly transform the built environment.25

Students of all disciplines can have a large impact on the growth of the green building industry and its eventual transformation into “the building industry” when all structures are built, renovated, and operated to the highest performance standards with multiple benefits to the environment, economy, and human health. Our society will not realize the maximum benefit of green building until consumers demand these principles in construction and renovation.
III. A Call to Action

Despite the growing opportunities in green professions and the promise of sustainable building for reducing and averting climate change impacts, few colleges and universities are educating their students about how sustainability applies to the built environment. Most of the best practices for teaching the concepts of sustainable building now lie within the specialized niche of design programs and schools, but even there much progress is still needed.

Ironically, many schools have the tools for educating their students about sustainable building, but these resources are not being fully utilized. With increasing speed, at an average rate of growth of 82 percent a year according to the USGBC, colleges and universities are registering their buildings for LEED certification. These buildings are tangible demonstrations of the concepts of sustainable building, and represent a great educational opportunity for students if the buildings are used as teachers.

This paper calls for institutions of higher education to educate all students – in the wide range of disciplines – in the basic concepts of sustainable building so that they gain the knowledge and skills that they need to be proficient building occupants, informed professionals, and responsible citizens in an era of climate change: “architecture on the scale it has been practiced in the last 150 years has become a decisive player in the Earth’s responsive systems.”

Higher Education is a Leverage Point for Advancing Sustainable Building

The Role of Higher Education in Society
Higher education plays a unique and critical role, one often overlooked, in making a healthy, just and sustainable society and a stable climate a reality. Higher education has been granted tax-free status, the ability to receive public and private funds, and academic freedom in exchange for educating students and producing the knowledge that will result in a thriving and civil society. Higher education prepares professionals to develop, lead, manage, teach, work in, and influence society’s institutions; it sets the basic foundation for K-12 education. Today’s and tomorrow’s businesses, governments and professionals – architects, engineers, landscape designers, construction managers, planners, developers, policymakers, homebuyers – will need new knowledge and skills that only higher education can provide on a broad scale. Universities and colleges are also centers of innovation and demonstration, showing the public what is possible in a world seeking solutions to climate change and other challenging issues.
The Rise of Sustainability Initiatives in Higher Education

There has been exponential growth in distinct programs related to environmental protection in higher education in the last decade. Environmental studies and graduate programs in every major scientific, engineering and social science discipline are abundant and growing. Progress on modeling sustainability in campus operations has grown at an even faster rate.\(^{27}\) Higher education has embraced programs for energy and water conservation, renewable energy, waste minimization and recycling, sustainable buildings and purchasing, alternative transportation, organic food growing and local purchasing.

Interest in greening new and existing building stock on campuses across the country grew significantly in the past two years. According to the USGBC, Leadership in Energy and Environmental Design (LEED) registered projects for higher education broke the 3,000 projects threshold in May 2009 with the number of registered and certified projects continuing to grow since then. Furthermore, the second most frequently chosen “Tangible Action” for meeting the American College and University Presidents’ Climate Commitment (ACUPCC), next to the integration of Energy Star on campus, is the adoption of a policy that demands all new built or retrofitted buildings meet LEED Silver standard or its equivalent (rating system under a comparable third party system with requirements at least equivalent to the requirements of LEED Silver requirements), with 72 percent of the signatories choosing this as one of their primary paths to achieving carbon neutrality.\(^{28}\)

Joining Operations and Education

While many schools are helping to begin the cultural shift to making deep and comprehensive sustainability the goal of higher education, the overwhelming majority of graduates know little about the importance of sustainable design or how to have their personal, professional and civic lives aligned with sustainability principles. Many colleges and universities still view modeling sustainability as an option to pursue when they can afford it, and even fewer embrace these concepts in their academic programs.

Daniel J. Sherman, Professor of Environmental Policy & Decision Making at the University of Puget Sound, states, “Currently, the term [sustainability] is primarily associated with prescribed practices for individuals and campus operations. Although this association is positive, it limits the potential of the concept to integrate broadly across the curriculum. For sustainability to realize its full transformative potential in higher education and society, it must transcend an association with prescribed practices and even specialized areas of study.”\(^{29}\)

Appropriate communication plays a crucial role in this process. There is a significant potential for education in making the impacts and benefits of the built environment visible by the interpretation of initiatives through signage, display and other interactive media. These means that visually showcase buildings’ performance educate students, faculty, parents, and the community about how sustainable built environment could enrich their lives.
Universities and colleges that embrace the expanded form of learning, operation and service necessary to offer all students exposure to the concepts specific to sustainable building and to sustainability in general will better fulfill their mission and better prepare students for character and citizenship as well as commerce and career. They will attract new and better students and faculty, attract new funding for teaching and research, expand alumni support, improve town-gown relationships and have a more dynamic and involved campus.30

Engaging Stakeholders in Sustainable Building Education

The Students
At the moment, sustainable building education primarily focuses on engaging students in architectural, engineering, and construction management programs.31 Additionally, community colleges will undoubtedly play a significant role in transitioning traditional workers to green collar work, which includes, “building, construction, assembly, installation, operation, maintenance, transportation, and manufacturing.”32 As demand for skilled workers in green jobs rises, students across the country are demanding that their community colleges offer more sustainable building courses.

Mindy Feldbaum and Hollyce States discuss the vital role that community colleges will play in building a green workforce and the importance of retraining the “middle-skilled” jobs that will be in high demand:

“It is important to note that although there will be a growing number of new green occupations requiring new knowledge, skills, and abilities, it is expected that the majority will be transformed from existing jobs, requiring a redefinition of skill sets, methods, and occupational profiles. While some emerging green occupations will require the creation of new industry-recognized credentials and training programs, many will only require modifications to existing programs and courses to integrate green skills.”33

These audiences – building professionals and green collar workers – represent the early adopters who recognize a need to integrate sustainable building into their practices. However, there are still at least 15 million students in higher education studying outside these fields who are not formally introduced to sustainable building and who need a fundamental understanding of the field in order to truly transform the built environment. Sustainability through the dual lens of both climate change and social equity must drive students’ inquiry, projects, and cut through all aspects of their experiences in school.34
The Educators: University and College Trustees and Administrators
University and college administrators, presidents, and/or chancellors can implement policies, curricular opportunities and co-curricular activities for university staff, students and faculty to work together in creative ways. Such activities will ultimately save energy and money, enrich student-learning experiences, and prop up university value. Numerous opportunities for student experiential learning will free up with the development of innovative policies, providing students with internships or course credit to work on campus facilities and grounds, the documentation for a new building project, or monitoring the energy consumption of an existing building.

University and college administrators can join the movement towards a systemic understanding of sustainable building. High-level support from administrators and institutional leaders is imperative for faculty attempting to integrate diverse interdisciplinary sustainability concepts in both their research and teaching. The future administration must have sustainability as their priority. Only such united front regarding sustainability in higher education could make the academy shift its perspective. First and foremost, administrators must educate themselves with a basic understanding of sustainable building, including key statistics on energy savings, occupant health and productivity, and increases in university value. Administrators also need excellent and real model policies to look to for guidance in developing a university’s direction, and financial return-on-investment. This addresses several potential hurdles – lack of precedent, legitimacy of policy effectiveness, and a general de-mystification of the campus built environment. Also, in these difficult economic times as institutions are struggling for students, administrators may only view “the bottom line” as their priority and not see the potential in promoting sustainability on college campuses. However, it is important to note that students are already leading the way. Tuition/revenue comes from motivated passionate students, and based on the current scenario, more number of students are demanding sustainability as part of their college experience. It is important that administrators perceive the urgency of building onto this existing momentum.

Absent a requirement by professional accrediting bodies to have graduates of institutions be proficient in sustainable design, trustees as fiduciaries are the single most important body that can energize the entire community - students, faculty and administrators - to recast their respective curricula. Unleashing the innovative creativity of the most imaginative members of every institution’s community will predictably produce a diversity of sustainability curricula from the current state of the art knowledge in each profession that will serve both the nation and the world.

The Educators: University and College Faculty
Faculty members are instrumental in the design of coursework, student research, campus activities, and outreach. Although faculty members enjoy relative autonomy in their practice, they also face many barriers in teaching students about sustainability. The greatest challenge is
the discouragement of interdisciplinary study and research by tenure requirements that favor academic silos and specialization. Such practices lead to an isolationist faculty culture, not conducive to collaborative exploration of sustainable building and sustainability. While there is a high demand, and lack of supply, for quality teachers who can teach these relatively new concepts, there are also few rewards for initiating and participating in interdisciplinary efforts. Furthermore, faculty may not feel sufficiently well-versed in these concepts. Moreover, the dominant culture has not encouraged faculty to view the campus or local community as an important focus of their research or to perceive inquiry-based, experiential learning as an important and scholarly way of learning.

Programs to engage faculty in dialogue on sustainable building and other aspects of sustainability are necessary to close knowledge gaps, and develop educational value for these topics. There is high demand for faculty development programs that help professors, deans, and provosts think through ways to adopt and implement education for sustainability best practices, which can have content and instructional aspects that differ from what most faculty have used in the past. Team-taught courses can be an excellent way for faculty to learn from each other. Incentives, rewards, and recognition of faculty sustainability champions by the administration and others can encourage people to step outside of their comfort zones. Explains Grace Eason at the University of Maine-Farmington, “faculty should not be penalized (denied tenure or promotion) for attempting to incorporate new concepts in their courses. Administrators must realize that this takes time as faculty attempt to modify programs and courses.” In the long run, changes to incentives, such as accreditation and publication requirements for scholarly journals, can help to make the teaching and research of interdisciplinary subjects more mainstream.

On Accreditation
Modifying accreditation requirements and criteria to include sustainable building education may facilitate the integration of sustainable building concepts into the curriculum across institutions and would accomplish two primary goals among many others. Strengthening the core education through interdisciplinary approaches would enable integration of the natural and social sciences and the humanities, accommodate local knowledge, support critical pedagogy, and continue to regard education as a form of enlightenment linked to a vision of more sustainable futures. Secondly, the changes in the current requirements could impose an organizational change that would promote a culture of acceptance among the faculties, administration and other groups at the institution.
In 2007, at the Conference on Sustainability in Architecture and Higher Education, a group of practicing professionals and members of the American Institute of Architects (AIA) presented their opinion on how accreditation criteria may influence architecture curriculum to incorporate sustainability education.

Participants outlined that working with the current system is important and that, as Thomas Fisher, Dean of the University of Minnesota School of Architecture, indicated, the way to get faculty to pay attention to sustainability in the curriculum is to gather information about their school as part of either accreditation or evaluation. Mr. Fisher proposed the following formats for the introduction of such criteria:

- cross-disciplinary sustainability courses
- required sustainability courses
- elective sustainability courses
- studios focused on sustainability
- faculty involved in AIA-COTE, LEED, etc.
- faculty with access to LEED-certified buildings
- environmental activities in college/university of sustainable buildings on campus graduate-level degrees in sustainability MS/Ph.D.
- sustainability conferences on campus
- lecturers addressing sustainability

According to Peter Papesch of the Boston Society of Architects Sustainability Education Committee, accrediting bodies like the National Architecture Accrediting Board (NAAB) should but do not yet play a vital role as regulators of sustainability curricula offered in professional educational institutions. In particular, he finds NAAB’s focus to be the incremental improvement of traditional architectural education components rather than a call for the wholesale revamping of architectural education in light of climate change implications for not only for the profession but society and the world.

Other disciplines are also involved in similar efforts. The accreditation criteria for engineering and interior design schools already stipulate that a school must include sustainability concepts in the curricula to get accredited. The civil engineers have created a body of knowledge for these curricular developments. Visiting teams need to hold institutions to these sustainability standards when conducting site visits and making accreditation decisions.39
The Educators: University and College Staff

While facilities, campus planning, and sustainability staff do not always share the same office, they share many of the same challenges and are provided similar opportunities when it comes to educating about the built environment on campus. These professionals are responsible for educating and ensuring long-term behavior patterns of building occupants, including students, faculty, and staff, because how occupants use buildings determine performance.

University and college staff, who are the connectors between campus facilities and the community, need a fundamental and clearly communicated policy with funding behind it in order to support any educational efforts. For many of these staff, the primary focus is saving money via operational efficiency; they have much to teach students from their hands-on experience with sustainable building technologies and much to gain from more informed building occupants. In order to meet the new demands of campus sustainability, facility managers must, as the International Facility Management Association states, “Learn about LEED, ENERGY STAR and other high-performance building ratings systems and initiatives” in order to build a sound business case for sustainability. New trainings for these staff are critical for advancing the best practices, while reducing costs and improving the buildings impacts.

These staff members become valuable educators about sustainable building, and therefore require effective instructional skills. Faculty on campus could share educational techniques, providing guidance to help campus staff guide a student intern’s interest, enthusiasm and final reports or end products as well as to work with students as mentors on their class and independent projects. Guest lectures in sustainability classes are another way to link these professionals with students and faculty.

The Educators: Members of the Local and Regional Community

Bringing colleges, universities, and communities together to create mutually beneficial service and economic relationships will unlock a plethora of opportunities for developing systemic understanding of the built environment. In these hard financial times, cities and universities need to find more ways to collaborate in order to share services, programs and costs for mutual benefit. Good town and gown relations are built on partnerships between academic institutions and their communities, and many schools have an outreach mission that facilitates this process.

Working with communities and with service-learning projects students will be grounded in experiential learning and will graduate with a record of hands-on experience and community service. Also involving students in the planning commission meetings could prove crucial in educating them about the real world issues pertaining to sustainable buildings. Local planning departments and design and construction companies often seek the assistance of eager, educated minds, and civic clubs, such as Rotary or Lions, may be able to connect students to projects with large community involvement. Community examples of sustainable building may be more plentiful, in some cases, than on-campus examples; for example, in some states,
annual green home tours can offer students a memorable educational experience. An education based on real people facing real challenges can best prepare students to become qualified professionals. Community members, who have direct experience with the issues surrounding sustainable building, often make the best teachers, and they can contribute to a students’ learning experience as internship or independent project supervisors, lecturers, faculty, and as examples and role models. One approach for community engagement allows students to convene the community and explore significant sustainability issues. In this way, students gain the experience of hosting a charrette, the first step in any green building project. The ideas gathered at this community forum can feed an ever-evolving database of service learning projects that are relevant across disciplines.

While local and regional communities have much to teach students, campus green buildings can provide rich education to the surrounding communities. Visitors to campus who learn from the technologies and processes of sustainable building can take these lessons out into the wider community. Says Mitchell Thomashow, President of Unity College, “We aspire that our campus becomes an exemplary learning and living laboratory for a sustainable culture. We hope that people who visit our campus (students, parents, community members, donors) will get dozens of ideas that will in turn inspire their own practices.”
IV. What is Sustainable Building Education?

Sustainable building education cannot be divorced from the broad teachings of ecological literacy, which imparts the values and understanding necessary to guide construction, renovation, and operations as mechanisms operating within a larger system that determines human health, quality of life, and ecosystem functioning. It becomes the mindset in which all activities take place, the conceptual sea in which everybody is immersed. Ecological literacy, or “Education for Sustainability” which encompasses the three-legged stool of ecology, economics, and society, is the lens through which students will bring sustainable building education into their professional and personal life. Lessons in sustainable building education start with this wider perspective but must also impart more specific concepts that relate in particular to the built environment.

Education for Sustainability

Education for Sustainability (EFS) prepares students to enter as skilled professionals and responsible citizens into a changing world, for which sustainable building is a critical tool. Three principles guide EFS educators:

1. The context of learning makes human/environment interdependence, values and ethics a seamless and central part of teaching of all the disciplines, rather than isolated as a special course or module in programs for specialists. Colleges and universities operate as fully integrated communities that “practice what they preach” by modeling economic, social and ecological sustainability in their own operations. Through partnerships with the local, regional and global communities, students co-learn and contribute to helping society become socially vibrant, economically secure and environmentally sustainable.

2. The content of learning reflects interdisciplinary systems thinking, with courses covering the fundamental sustainable building concepts. The dynamics and analysis for all majors and disciplines are taught with the same lateral rigor across the disciplines as there is vertical rigor within them.

3. The process of education “teaches what it practices,” by complementing formal curriculum with active, experiential, inquiry-based learning and real-world problem solving on the campus and in the larger community. Creativity and innovation in students is fostered to meet global challenges.

Education for Sustainability involves recognizing that all parts of the college or university system are critical to achieving profound individual, institutional, and societal change. The educational experience of graduates can reflect an intimate connection among (1) curriculum;
(2) research; (3) understanding and reducing any negative ecological and social footprint of the institution; and (4) working to improve local, regional, and global communities so that they are healthier, more socially vibrant and stable, economically secure and environmentally sustainable. Academia must adapt existing courses and create new courses, collaborations and expansion, on sustainability solutions.

An excellent way to teach the systemic interconnections of nature, economy, and society and other foundational sustainability concepts is to link course content to unmet needs in the community. When inquiry-based learning is applied to problems of the local community, students gain hands-on experience working with professionals and community members, and the community benefits from the students’ help in solving complex issues and assisting in sustainable community development. Real world issues – especially those involving environmental, economic, and social dimensions – are inherently interdisciplinary or transdisciplinary. For example, David Orr at Oberlin College, who is recognized for his theories that students learn from everything they do and everything around them, has demonstrated that campus buildings can be effective “teachers.”

Higher education for sustainability embraces its role to make positive or negative health, social and environmental impacts visible. Imagine that one day all students are taught where resources come from and where waste goes. Our current ecological, health and social footprint is largely invisible to most of us. The average American does not know that buildings use 40 percent of raw materials globally and 3 billion tons annually, or that in a single year, 136 million tons of building-related construction and demolition debris is generated in the United States, compared to 210 million tons of municipal solid waste generated in the same year.

**Sustainable Building Core Concepts**

In addition to imparting the broader concepts discussed above, sustainable building education specifically provides students with the skills and knowledge needed to:

1. Speak the language of sustainable building
2. Understand the systems behind a sustainable built environment
3. Make informed decisions about building design and operation

Some propose that the central questions that must be asked to guide this education are, “How can this building assist in reducing greenhouse gas emissions? How can it reduce the use of carbon energy. And how can it/could it become net zero energy consuming?”

Second Nature and the USGBC surveyed the higher education field to identify what introductory topics are best in providing exposure to sustainable building concepts. From two online surveys with 50 diverse representatives from higher education, the following topics
emerged that may serve as the basis for sustainable building education for all students.49

1. Interconnectedness of the Built and the Natural Environment
2. Systems Thinking (Integrated Design)
4. Renewable Energy and Energy Efficiency
5. Sustainable Building as a Tool to Pursue Social Equity
6. Sustainable Building as a Model for Financial Security and Profitability
7. Sustainable Building Certification and Rating Systems
8. Sustainable Building Industry Drivers

These topics are described in more detail, below:

1. **Interconnectedness of the Built and the Natural Environment:** Students learn about the impact of the built environment on ecosystems and climate change and how sustainable building can minimize this impact; or, in some cases, have no impact (net-zero energy building) or help to reverse the impact (regenerative building).

   **For example:** Within the University of Virginia’s Built Environment and Public Health Course Curriculum, “Natural and Built Environments,” provides students with understanding on important dimensions of the natural environment and the impact of the built environment on its ecosystems. Students learn about the built environment’s effects on the larger issues of climate change as well as public and environmental health. Topics such as Land Use and Transportation, Environmental Impact Assessments, Health Impact Assessments, Indoor and Outdoor Air Quality Analysis address the relationship the built environment shares with the natural world.50

2. **Systems Thinking:** Students receive an introduction to the concepts of the Integrated Design Process (see text box on page 9). They learn to perceive a building as part of a larger system, which includes the ecosystems from which the building materials originate; the human communities which benefit or are harmed by the building process; and the relationships between the building and land-use. Teaching from this perspective makes the environmental, social, and economic impacts visible to the student.

   **For example:** At Yavapai College, the Residential Building Technology Program teaches students to design, build, as well as manage residential construction resulting in healthy, durable, energy and resource efficient, environmentally responsive houses. Students learn to look at buildings as coherent systems by learning to incorporate appropriate building materials, energy systems and technologies, while making prudent design and material selections based on current applied building-science principles and sustainable
building design practices. In addition, a collaborative relationship with Prescott Area Habitat for Humanity further involves students in their community, providing a much-needed service to the area residents while teaching students about the role green buildings could play in sustainable community development.51

3. The Built Environment and its Impact on Public Health: A critical piece of understanding the buildings and communities as part of a larger system is making the connection between human health and individual decisions made at the building level. Students learn about indoor air quality and health impacts of building upon nearby communities and upon the communities from where materials are sourced.

For example: The Harvard University environmental studies course, “Sustainable Buildings: Design, Construction, and Operations” examines how building components and systems affect human performance and well-being. The built environment is explored as a critical determinant of health, comfort, and productivity for occupants. This course highlights local, national, and international entities adopting green, sustainable criteria for new construction and renovations.52

4. Renewable Energy and Energy Efficiency: Because energy efficiency and renewable energy are valuable tools in sustainable design, students learn about the environmental, social, financial and political issues that contribute to the adoption of practices that use these tools in construction and renovation.

For example: A group of University of New Hampshire students' undergraduate research project on local ordinances regulating residential wind systems led to a new state law that supports the use of residential wind energy. The new law provides guidelines for cities and towns regarding what to do when someone wants to erect a residential wind energy system. It addresses height issues, noise, setbacks, and aesthetics, and outlines a process for input from neighbors affected by such systems.53

5. Sustainable Building as a Tool to Pursue Social Equity: The planning and building process can be a route to social equity through the decisions that are made about where the materials are sourced, and sustainable building and other green campus initiatives can provide models and inspiration for a green economy. Students learn by hands-on experience and case studies about how building decisions are tied to regional and local community building. Types of design and construction also impact how occupants will be affected throughout the use of the building.

For example: At the University of Texas Austin, students of the Sustainable Design and Development Workshop (SDDW) participate in identifying deserted and underutilized alleys throughout the eastern part of the City of Austin where alley flats [secondary
dwellin[g] units can be built. These students work collaboratively with the Blackland Community Development Corporation and the Guadalupe Neighborhood Development Corporation (GNDC) for the prototype designs. Eventually these students learn about the S.M.A.R.T. Housing certification system and the Austin Energy Sustainable building Program Five Star.

6. **Sustainable Building as a Model for Financial Security and Profitability:** Students in all disciplines are taught that sustainable building brings economic benefits in operational savings from reduced energy and water costs in the medium and long-term and other less tangible paybacks such as increased occupant performance. Students are exposed to how these benefits are measured and evaluated.

   For example: In 2002, at the *College of Charleston in South Carolina*, political science students, environmental science students and faculty members from several departments were involved in a project called “Implementing Sustainable building Technology: Utilizing a College of Charleston Historic Building as a Model for the College and Charleston Communities.” Students investigated the most cost-effective sustainable building techniques for buildings on campus, the before and after effects of the implementation of sustainable building practices and its multifaceted relationship with the community wellbeing and sustainable community development. The end product was an academic paper written by political science students that was presented at the 2003 Annual Meeting of the American Political Science Association.

7. **Sustainable Building Certification and Rating Systems:** Due to the important role certification and rating systems play in determining what makes a building “sustainable” or “green,” students are informed about the most popular systems such as LEED, Green Globes, Energy Star, and the National Association of Home Builders (NAHB) certification programs. Learning about these programs has a secondary benefit of teaching students about what building systems and materials can comprise a “sustainable” building.

   For example: A group of nine Simon Fraser University business sustainability honors students completed a review and comparison of sustainability initiatives at SFU, the University of British Columbia, and the University of Victoria (BC), where they investigated active student sustainability groups, leading sustainability researchers, energy management, sustainability-related courses including LEED certification, and made recommendations to the administration on how SFU can improve its standing.

8. **Sustainable Building Industry Drivers:** While not all students will choose a career that is closely associated with the building industry, a basic introduction to career advancement and leadership opportunities within the sustainable building field can help some students to apply their new knowledge in a very direct way towards a profitable
career. At community colleges, this topic may be given higher weight because of the numbers of students at these schools training for green jobs. Many of the programs in community colleges are the result of a push from the business community and some involve the colleges pushing the businesses to incorporate sustainable practices.

For example: At Duquesne University, The “Green Building Alliance” consists of a student team that works closely with architects, construction firms and manufacturers of green building materials. In different semesters students focus on various aspects of green building industry, such as conducting primary research to identify information gaps in the green building supply chain, and developing survey instruments to collect data on green building products, supply chains, and the decision process involved in acquiring green products for new and retrofit building projects. This program helps students understand the potential and opportunities that lie within the infrastructure of the green building industry.  

\(^{60}\)
V. Sustainable Building Education Today

To meet the demand from half a million and growing bachelor’s degree seeking students, and countless more in the community colleges, there are many universities and community colleges offering sustainable building courses in higher education today. The major difference between university and community college offerings is that universities are attempting to integrate sustainable building lessons into an existing curriculum, such as architecture or engineering, whereas community college course-content both integrates sustainability into existing curricula such as architecture, engineering technology, HVAC (heating, ventilation and air conditioning technician programs) and landscaping/horticulture, and offers many programs focusing on experiential sustainable building teaching techniques. A growing number of these programs lead to sustainable building certificates upon completion.

The following section explores strategies that are being practiced or considered by a selection of colleges and universities to educate tomorrow’s leaders and experts about sustainable building principles and practices. This list is not exhaustive, but rather representative of the breadth of current initiatives at colleges and universities.

These strategies include:
1. Integrating sustainable building principles into coursework
2. Introducing service learning requirements
3. Applying real world problem solving
4. Connecting higher education with future employers
5. Learning from what others are doing

In primary research published by the National Wildlife Federation, a survey of more than 715 universities revealed that only 13 percent of the universities offered a required course in “environmental education.” On the other hand, while interdisciplinary courses with an environmental focus are increasingly popular in colleges and universities, they remain under-utilized. The institutions now practicing these sustainable building education strategies are among the pioneers in the realm of higher education where the integration of sustainable building concepts into the educational experience requires gathering momentum and magnitude.
Pioneering Institutions and Initiatives

The following section offers examples of how schools are integrating sustainable building education into the curriculum and co-curriculum. These examples include service learning requirements and the development of real-world problem-solving skills. Additional examples outline how sustainable building education is getting a boost from collaboration with the industry and future employers. This section also offers models from other countries that can be models for integrating sustainable building knowledge and skills into the educational experience in the United States.

Strategy 1: Integrating Sustainable Building Principles into Coursework

Some of the ways in which higher education institutions are currently educating their students about sustainable built environments are through the following:

- Courses that use real projects as teaching tools,
- Discipline specific courses such as courses for engineering students or architecture students, and how these need to be interwoven in order to design buildings and environments that are focused on climate change mitigation,
- Interdisciplinary academic courses and most importantly - interdisciplinary studios,
- Subject specific courses such as courses on energy efficiency, and
- Distance-learning programs.

Often a **hands-on approach** is implemented at colleges and universities to educate students about real-time onsite facets of sustainable building practice. **Nova Scotia Community College** has launched Energy Sustainability Engineering Technology, a new two-year program where students will work with faculty who are energy experts to master the art of creating customized energy systems that include solar, wind, biomass, geothermal, tidal, and other alternative and renewable sources. Graduates will be qualified to audit energy systems and recommend the best alternative energy for new and existing commercial or residential properties. The Sustainable building Construction Skills Certificate program at the **Santa Fe Community College-New Mexico** provides students with knowledge and skills needed for entry-level positions in the sustainable building construction industry. The program requires the students to gain employment in the construction field to apply their training in the “hands-on” practice.

Many **campus sustainable building projects act as catalysts for sustainable building education**. A construction management program at **Wake Community College** uses the Northern Wake Campus as a lab setting where students learn both conventional building methods and those elements of sustainable construction that have led to LEED certification at the college. At **De Anza College**, the Kirsch Center was conceived and is operated by De Anza faculty, staff and students, with the philosophy that this facility is "a building that teaches about energy,"
resources and stewardship.” It houses the college’s Statewide Energy Management Program (SEMP) lab and classroom, which function both as a high tech demonstration area for energy equipment and systems and as a computer lab.66 Also, at Oberlin College, the Adam Joseph Lewis Center for Environmental Studies, a pioneering sustainable building, was conceived as “a demonstration project, testing ground, educational venue, and catalyst for the emerging field of ecological design” to teach students and visitors about sustainable technologies and sustainable building design.67

Creating new courses that are cross-referenced across departments and team-taught can bring a holistic understanding of challenges, principles and solutions pertaining to sustainable building practice among students. Furthermore, co-teaching could be helpful in the process of grooming faculty who may be hesitant to incorporate sustainability in their curricula because they do not have trained background in the topic.68 At Brown University, the ENVS 1400 Sustainable Design in the Built Environment course provides students with an in-depth understanding of sustainability, as it relates to fields such as planning, engineering, architecture, landscape architecture and construction. Students learn to examine planning, design and building problems holistically, by conducting economic and environmental analyses in comparison to the long-term costs of traditional development approaches and work in interdisciplinary teams on applied projects.69 Also at Cornell University, within the Collaborative Green Building Practice course, in addition to the traditional lectures and guest speakers, an interactive web-based curriculum facilitates interdisciplinary communication among students, professionals and community members offering a broader understanding of sustainable building practice and interaction with the government authorities, researchers, building professionals, and the public to investigate the broader context of green design and construction.70

Collaborating with other higher education institutions and industry experts is often an efficient route to teaching students about the current demands of the building industry. York University has partnered with the World Green Building Council to develop an international education program in sustainable building design. The program has been launched with a three-week design for sustainability in the built environment interactive workshop. The workshop will bring together 25 upper-level undergraduate students from around the world, “working to create a new language for green design; one that is open, inclusive and global in scope,” said Andrew Bowerbank, the council’s executive director.71 The Los Angeles Community College District (LACCD) is aligning academic programs and courses with the emerging green technology industries that have the highest potential for job growth in the Los Angeles area and is creating state-certified sustainable development curricula.72 More and more, similar examples are cropping up all over the country. For instance, in the collaboration between Boston Architectural College architecture students and Tufts University, engineering students in their joint submission to the 2009 DOE-sponsored Solar Decathlon exhibit on the Washington Mall.
Distance-learning courses help students get exposed to sustainable building industry principles and practices. UMassOnline, the online learning division of the University of Massachusetts, has introduced the Green Building Professional Development Series program to offer on-line sustainable building courses.73 Also, California Polytechnic State University - San Luis Obispo, Yale University and the University of South Florida are developing a cyber-based learning tool to enable engineering students to self-regulate their development in key areas that underlie the ability to design for sustainability. The tool educates students in not only the scientific concepts, but enables them to see how they, in their chosen profession, can contribute to the solution.74 The Boston Architectural College offers 4 sustainable certificate programs and 31 distance learning courses in sustainable design.75 Harvard University has developed a popular distance course on sustainable building design and construction that shares lessons learned from its more than 56 campus sustainable building projects.76 Oakland Community College offers an online certificate in Renewable Energies and Sustainability that includes courses on: sustainable products and processes; sustainable building design; energy efficiency, auditing and energy management; marketing and sales for sustainable building components; and a variety of renewable energies courses.77 The Consortium for Education in Renewable Energy Technology also offers a Renewable Energies Certificate that includes a course in Sustainable Design and offers these courses for remote students, and as professional development and/or pass through courses to colleges wanting to start their own programs.78

[There are many other methods that could help institutions integrate sustainable building principles into the coursework, such as crafting overarching, semester and year-long themes that impact all disciplines, bringing experts to campus, and celebrating institutional efforts in these areas. Also hosting conferences and institutional retreats around sustainability topics and exploring the role of the built environment could provide platform for further integration of these principles into the curricula. An extensive, but not exhaustive, list of colleges and universities educating their students about sustainable building is included in the Appendix of this report.]

Strategy 2: Introducing Service Learning Requirements

Commonly practiced by schools, universities, and community organizations nationwide, service learning is a highly effective educational strategy that has positive impacts on both the provider and recipient of the service. In fact, “Community members, students, and educators everywhere are discovering that service-learning offers all its participants a chance to take part in the active education of its youth while simultaneously addressing the concerns, needs, and hopes of their community.”79

Community and residential projects teach students the benefits of sustainable buildings for sustainable development and provide opportunities to work with sustainable building industry
experts. Additionally, academic courses imbedded with service learning components have the potential to disseminate awareness and teach practical skills required for building and managing sustainable built environments. Arguably the oldest program of Service Learning has been practiced at the Boston Architectural Center, which since near its inception in 1890 adopted as one of its tenets that all graduates have 3 years of professional practice before they may graduate.

An architecture class at The University of Kansas (KU) recently designed and built a sustainable building and transported it to Greensburg, Kansas, community that was destroyed by a tornado last spring. KU expects the building to achieve LEED certification. EcoMOD, the research and design/build/evaluate project at the University of Virginia School of Architecture, aims to create a series of ecological, modular and affordable house prototypes, while working in partnership with the UVA School of Engineering and Applied Science and community housing agencies to explore methods for bringing sustainable housing to low-income residents.

The Institute for the Built Environment (IBE) at the Colorado State University, originally established by faculty in the College of Applied Human Sciences, brings together professionals and students from the related fields of design and construction to solve problems through research related to the built environment. IBE’s “United Way Housing Services Day Center” project provided green design and construction consulting services for the building of a LEED Silver certified resource center, “The Housing Services Day Center,” a community initiative to address homelessness and poverty in Larimer County.

**Strategy 3: Applying Real World Problem Solving**

“Inquiry-based and Experiential Learning is a process through which students discover knowledge through direct experience, taking place inside or outside the classroom, on the campus or in the larger community. This approach is a good fit for education for sustainability because it provides the opportunity for students to develop problem solving and systems thinking skills that can be applied to interdisciplinary issues.”

At colleges and universities, student competitions, experiential learning opportunities such as internships, study-abroad and research programs, collaborative projects with the ‘out-of-the-classroom’ component, real projects on the campuses as well as student-led initiatives are platforms that offer real-world understanding of the sustainable building techniques and tools.

At Green Mountain College, students enrolled in the Introduction to Ecological Design and Economics course were engaged in a semester-long, in-class project to design a prototype green campus building for Green Mountain College. In this project, they applied basic ecological design principles such as energy performance, sustainable materials, heating options, and spatial design to a building that could serve as a residence hall for the College, and presented their final design to the College's administration.
Students are also learning from engagement in projects related to the built environment, outside of the actual design and construction process. A group of University of California-San Diego undergraduate students designed, built, and deployed a network of five weather-monitoring stations as a key step toward helping the university use ocean breezes to cool buildings, identify the sunniest rooftops to expand its solar-electric system, and use water more efficiently in irrigation and in other ways.\(^8^5\) University of New Hampshire (UNH) students enrolled in a horticulture technology class project to install native landscaping around a university building. This holistic learning experience offered the students opportunities to manage a staff of volunteers, work with vendors, and solicit donations from nearby nurseries.\(^8^6\)

At Unity College, campus green buildings serve as teachers through interpretation and exhibits. “Interpretation means that the campus should serve the broadest education function in calling attention to its sustainability efforts,” says Mitchell Thomashow, President of Unity College. “Are visitors to the college adequately informed about the campus sustainability initiatives? Does the campus have interesting and evocative signage that performs a teaching function?”\(^8^7\) At Carnegie Mellon University, a 7000 square foot “living laboratory” for innovations in building components and integrated systems – The Intelligent Workplace - is used for sustainability research, teaching and design charrettes, and is a test bed for demonstration.\(^8^8\) Vivian Loftness suggests, “every academic institution should have a living laboratory suited to their climate, with intentions of ongoing testing and innovation with the engagement of the multiple disciplines that are key to sustainability.”

**Strategy 4: Connecting higher education with future employers**

Another strategy that could become a catalyst for the integration of sustainable building lessons into the educational experience is to connect higher education institutions with the future employers that demand sustainable building expertise in the graduates hired. As described earlier in this paper, higher education is responsible for providing graduates with the knowledge and skills to succeed in the workforce. Employers also have a major stake in this issue because the quality of their future employees’ education determines success in a green economy.

Community colleges provide outstanding models of successfully applying this strategic approach. Many community colleges choose to start with the low-difficulty-high-impact changes to basic courses and programs, with the overall aim of streamlining the students’ skill sets to align with the current industry demands. “The opportunity for growth and return on investment in job categories beginning with manual labor jobs, especially in the building industry, is significant,” explains Rusty Stephens, President of Wilson Community College in Wilson, NC. “For example, the vast majority of buildings in the current inventory of our built environment are highly inefficient. Traditional businesses...need to upgrade the skill sets of
their employees and/or be able to hire subcontractors with new sustainable building skill sets.”

Connecting colleges and universities with employers who demand graduates with knowledge of sustainable building and other sustainability practices will require these institutions to incorporate the lessons of sustainable building and sustainability into their curricula and, as importantly, provide their students, faculty, administrators as well as visitors with an experiential reality of these concepts through monitoring, visual presentations of energy consumption data, and other means. Higher education institutions will need to develop innovative programs to expose students to sustainable building and other sustainability topics to enable them to find their niche in the competitive job market.

Following are a few examples of the programs that connect higher education institutions with employers:

• The Green Academy Workforce Initiative is working to understand local employers’ green workforce needs in Alameda & Contra Costa County, California, and to get workforce training providers and educational institutions to align their green technology training programs, resources, and curriculum to meet employers’ demands. Participating higher education institutions include University of California-Berkeley, California State University – East Bay, Merritt Community College, and the Peralta Community College System.

• The New Energy Workforce Initiative is a consortium of community colleges working together with the local workforce boards to respond to the industries’ current and emerging new energy workforce needs. Their projects include “launching coordinated courses in photovoltaic and energy management, expanding offerings in renewable energy, and providing “Train-the-Trainer” courses for instructors at other schools.”

• The Oregon Built Environment & Sustainable Technologies Center (BEST) is partnering with the Oregon State University (OSU) and Portland State University (PSU) to establish the Oregon BEST Green Building Research Laboratory at PSU in order to offer Oregon’s sustainable building businesses access to advanced research tools, expertise and well-trained employees.

• The Pennsylvania Green Growth Partnership brings together industry, university, economic investment groups and non-profit partners to develop the state’s position in the sustainable building marketplace. Higher education partners include Philadelphia University, Carnegie Mellon University, Villanova University, Pennsylvania State University, and Temple University.
• The University of Oregon enables students to access future employers by offering opportunities where green building case studies are integrated into course work in two ways. In design studios, students seek precedents in building type, aesthetics, form, materials, and recently as icons of building performance. The second means challenges students to conduct a building performance case study as part of a required class and/or an advanced technology elective. Often, case study investigations are set up with firms and students work with practitioners to examine drawings, intentions and present outcomes at the end of the term. Case studies are often written up as technical papers, presented at national conferences (AIA, ASES, Greenbuild, ARCC, PLEA, SBSE) and placed on students’ resumes, which are often picked up by prospective employers and seen as benefit to the firm.

Strategy 5: Learning from What Others are Doing

Exploring the creative initiatives undertaken in various countries around the world can help inform strategies for the integration of sustainable building lessons into the educational experience in the United States. Some of the more notable examples of sustainable building education in other countries are described below:

The Leadership Networks for Climate Change at the University of Tasmania grew out of a pilot initiative to create cross-disciplinary teaching networks. In the trail year, professors from disciplines as diverse as geology, zoology, business, education, and marine conservation worked collaboratively to engage more than 1500 students in relating climate change concepts to their field of study. This effort has now grown to encompass four universities, spread out throughout Australia: University of Tasmania, University of Wollongong, University of New South Wales, and Murdoch University. Despite difference in organization and audiences served, leaders from these institutions are working toward the common goal of utilizing real-world problem solving opportunities to teach about the complex topics of climate change. Keys to the success of this initiative include the network integrator, an on-campus, paid staff member dedicated to keeping the network connected and progressing towards their goal. Additionally, the network integrator is charged with engaging new faculty members to participate in future years of the program.

The Sustainable Design Research Centre at Kingston University, London serves as the hub for the sustainable design research for the Faculty of Art, Design & Architecture. The Centre promotes collaboration between faculty at the college on a diverse range of topics including the use and specification of recycled materials, sustainable building design, designing for social impact, indoor air quality and its impact on the health of building occupants, and sustainable landscape architecture. The Centre also invites participation from prospective PhD, MA Research and MA Design for Development students interested in the field of sustainable design.
Chinese and European universities are participating in a **network for practical and intellectual knowledge and training exchange** in the field of sustainable building design and construction. The project will establish the Sino-European Centre of Building and Construction; a web central resource for information and communication that would include a database of appropriate tools, case study examples and teaching material in the field of sustainable building design and construction; and develop a long term Sino-European collaborative, among other activities. Participants in this project include Aalborg University, Denmark; Cambridge University, UK; Chongqing University, Chongqing, China; and Technical University of Lisbon, Lisbon, Portugal.95

The Indian Green Building Council (IGBC) reported in the January 2009 GreenHabitat Newsletter that it had signed a Memorandum of Understanding with the Centre for Environmental Planning & Technology in Ahmedabad, India "to **facilitate greater industry & institution interaction**, which would help in research and training in areas of sustainable buildings." Such proactive steps to build camaraderie between non-profit organizations that focus on sustainable building practice and higher education institutions could promulgate awareness and understanding of sustainable building in the educational experience.96

In some countries, **metrics are being developed** to aid in the introduction of sustainable building concepts into the curriculum. The DEEDS (Design Education & Sustainability) teaching and learning resource was developed in response to the problem that design for sustainability was lingering on the outer boundaries of design education and practice. The International Centre for Innovation and Sustainability (ICIS) in Denmark took the lead and successfully applied for a grant from the European Commission to set up the DEEDS project. DEEDS derived SCALES teaching and learning themes “that need to be addressed when considering how design can positively impact sustainability.” 97

**Engaging students in the process of developing resources** may be instructive in the United States. For example, in the Faculty of Art Design and Architecture at the **Kingston University** in London, Anne Chick, Director of the Sustainable Design Research Centre, developed the **Entrepreneurship for Everyone Student Text Resource** book, targeted for students without strong business theory backgrounds.98 At SB05, the 2005 World Sustainable Building Conference in Tokyo, hosted by the **University of Tokyo**, the organizers took the initiative to call for drafts from the students. Following this, the Student Session published the "Sustainable Building Design Book" that contains the work of Japanese architects selected by student organizers, as well as design and research projects undertaken by several international students.99

These experiences of schools in other countries suggest that to assimilate and advance sustainable building knowledge in the educational experience at colleges and universities, the higher education institutions in the United States can:
1. Promote cooperation with other higher education institutions that leads to knowledge sharing,

2. Support the development and improvement of metrics to gauge the effectiveness of educational programs that incorporate lessons of sustainable building and sustainable design into the curricula,

3. Develop academic resources such as textbooks, websites, libraries, etc. that pull together ideas and information for incorporating sustainable building lessons into the professional training and decision making, and

4. Advance collaboration between different academic and administrative departments to create innovative interdisciplinary programs.

Case Studies of Sustainable Building Education for All Students

This section of the paper highlights efforts a few colleges and universities are currently undertaking to educate all their students about basic sustainable building concepts. At these institutions these learning opportunities are made available to students from a diversity of majors, not only to students that are enrolled in building/construction related tracks. Another aspect to note here is that these institutions educate their students by offering an interdisciplinary (integrating the disciplines) and multi-disciplinary (bringing many disciplines around the table) learning environment and real-world problem solving projects.

What is distinct about these three institutions is the ways in which they approach sustainable building education. One institution provides hands-on training by having students construct an actual building. Another institution looks at its campus green building as a laboratory and on-going learning platform. And, the third institution delves into sustainable building education within its larger framework of systems thinking approach.

Unity College, Maine

The Barn Project: A Hands-On Experience

Unity College was established in 1965 and is located on 225 wooded acres of farmland in the village of Unity, Maine. Unity is a private, liberal arts college that offers 22 majors, 13 minors and 10 certification programs. Unity has been a signatory of the American College and University Presidents’ Climate Commitment (ACUPCC) since 2007, and Unity’s president, Mitchell Thomashow serves on the ACUPCC Steering Committee.

Unity College’s Environmental Stewardship Curriculum is a primary component of the Unity educational experience. Required in all baccalaureate degree programs, the curriculum is designed to teach important academic skills, knowledge, and dispositions through interdisciplinary and traditional courses that stress the connections and inter-relatedness of the...
various disciplines that comprise environmental studies. Together with the professional degree requirements, these courses prepare Unity graduates for leadership roles in environmental issues, on levels ranging from local to global. The Environmental Citizen course is one of the interdisciplinary core courses offered to all students. This course gives students the opportunity to “work together with classmates, faculty, and community members to identify a pressing environmental concern, investigate the issue, imagine ways to help, and then help.” For this course, the instructors decide the areas of focus for the course and design syllabi to help achieve the program goals.

Teaching the Concepts of Sustainable Building
The Unity College Barn project started as part of this Environmental Citizen course. Within this course, students build a barn for the institution or the community. An initial class of 20 students worked with Professor Mick Womerlsey to start this project, and although the barn was not completed within the 2008 fall semester, the students gained hands-on experience in green building. The students in this class were also able to learn about sustainable agriculture principles by working on other farms in Maine. Students continued the work in the fall 2009 offering of the course. The context of the course teaches interdependence between ecosystems and resources, as well as relationships between the built and the natural environment.

The content of the program reflects interdisciplinary thinking as students are drawn from different majors and work together to find solutions to a shared concern. Lastly, the process of education includes classroom work mixed with the experience of working on an actual project to benefit the rest of the college community. Students in the 2008 class helped to build a barn for the Maine Organic Farmers and Gardeners Association (MOFGA) and the 2009 class has been involved in work for the Unity College barn. Students in the program reused the materials from a barn that previously occupied the site.

What do Students Learn?
Rather than looking at sustainable building concepts in isolation, the program intends to makes students aware of the relationships between the built and the natural environment. This educational experience has proved crucial in teaching students about holistic systems thinking and the interconnectedness of systems such as the building infrastructure and agriculture, as well as community development.

Students’ reflections on the program blog in 2008 indicate that they explored what it truly meant to be environmental citizens and created a desire to see more courses like the barn building class at Unity College. The students also had the opportunity to explore green buildings as a tool to pursue social equity as they helped MOFGA to expand its reach and provide more organic food to the local community. The program also considered the triple bottom line by providing a solution that encourages local food growing, and provides Unity
College students with the opportunity to learn how to grow their own food as well as build green.

**Duke University, North Carolina**

**The Duke Smart Home Program: The Building as Teacher**

Duke University was founded in 1924 and is located in Durham, North Carolina. Duke is a private research university and consists of 10 schools that offer degrees in Law, Medicine, Engineering, Business, and Public Policy, among other academic areas. Duke has been a signatory of the American College and University Presidents’ Climate Commitment since 2007, and President Richard H. Brodhead is spearheading the university’s sustainability efforts.

The Duke Smart Home Program focuses on engaging undergraduate students in a research-based approach to smart living, sponsored by the Pratt School of Engineering. The Duke Smart Home program complements a formal curriculum with real-world problem solving as students “Actually live in the house while developing the systems in and around it.” The program encourages students from various disciplines to explore smart ways to use technology in the home and encompasses a 6,000 sq. ft. residential dorm and research laboratory called the “The Home Depot Smart Home,” a LEED® Platinum certified building.

The Home Depot Smart Home started as an independent study course topic designed by a senior electrical and computer engineering major, grew into a 20-student design project, and now functions as a complete student program at Duke University. One of the courses offered within this program is a 100 level design course in the engineering department that is open to students of all disciplines.

**Teaching the Concepts of Sustainable Building**

This program serves as a test bed for solutions that could be implemented in homes in the larger community. Students live and learn in an environment that adheres to high standards of environmental sustainability. This academic program is an example of how sustainable buildings can function as living laboratories teaching students about the holistic issues around sustainability and green lifestyles.

The Smart Home building features a green roof, a rainwater irrigation system, photovoltaic panels as well as power monitoring systems that are currently in testing phase. The Smart Home Program is a good example of how the principle of Integrative Design teaches students to take an interdisciplinary approach to the management and design of building features. This program has offered opportunities to student teams to conduct research projects that allow them to explore systems and technologies that help to improve the efficiency and operations of the Smart Home. For example, within this program, students have conducted research into...
the LEED certification system, water catchment and purification/rain harvesting systems, as well as geothermal pumps.\textsuperscript{119}

This program also fosters strong relationships with industry through collaborative projects, tours and interviews, guest lectures and internships. This program also intends to offer practical design experience, project management and communications experience, exposure to cross-disciplinary teamwork, and understanding of the intellectual property awareness as well as relationships with corporations and communities.\textsuperscript{120}

**What do Students Learn?**

The program encourages students from different academic disciplines to form teams and explore smart ways to use technology in the home or any building to make it more sustainable. The emphasis on 'smart' is about finding the best technological solution for a particular problem, not just finding a high tech solution or the latest gadget on the market. This approach naturally leads students to identify 'gaps' in the marketplace—problems that just aren't being addressed through commercially available technology. These gaps then become the basis for exploration.\textsuperscript{121}

This course demonstrates the interconnectedness of the built and natural environment through its design and features. Students also learn how to strategize and plan for building related projects since they are involved in the decision-making processes pertaining to the Smart Home. The project also serves as a model for financial security and profitability because students are continually working toward making the home smarter than before while reducing the costs associated with energy systems through increased efficiency levels. The students also learn about the green building certification process, and information on how the credits were achieved is publicly available on the program website.

In all the above ways, the program helps produce aware students and educated citizens who are going to form tomorrow’s workforce as well as be prepared to make educated decisions as consumers and occupants of buildings.

**Georgia Institute of Technology, Georgia**

**Brook Byers Institute for Sustainable Systems: An Interdisciplinary Approach**

The Georgia Institute of Technology was founded as the Georgia School of Technology in 1885 and was renamed Georgia Institute of Technology in 1948 to reflect a growing focus on advanced technological and scientific research.\textsuperscript{122} Georgia Tech offers several undergraduate and graduate degrees in the Colleges of Architecture, Engineering, Sciences, Computing, Management, and the Ivan Allen College of Liberal Arts.\textsuperscript{123} Georgia Tech has been a signatory of the American College and University Presidents’ Climate Commitment since April
2007, and has a goal “that every student will take at least one course in sustainability” with “more than 260 courses spanning every college.”

The Brook Byers Institute for Sustainable Systems (ISS), which developed from the Institute for Sustainable Technology Development (ISTD), was founded in order “to catalyze a unifying and integrating effort in interdisciplinary research and education on environmental and economic sustainability.” A major aspect of its mission is education and outreach geared toward students and faculty. The “shadow” curriculum of Georgia Tech found in the student dormitories, student clubs, etc., is where students further develop lifelong patterns, values, and choices. The institute develops programs where green living and sustainability become an integral part of the residential college structure and the academic departments, including informational sessions on "green" resource use, recycling competitions, energy conservation workshops, and orientation sessions for new students and staff members.

Georgia Tech's tradition in sustainability is an interdisciplinary, systems-based approach that focuses on a hierarchy of integrated technological, scientific, and management systems, which interact in complex ways. Taking inspiration from such tradition, the Institute for Sustainable Systems is organized around the following intersecting programs: Sustainable Energy Systems, Climate and Environmental Stewardship, Sustainable Enterprise and Sustainable Urban Systems. The content of learning at the institute also reflects interdisciplinary systems thinking as explained by its emphasis on, “System science, system engineering, and system management [that] seeks to gain insights into the whole by understanding the linkages and interactions between the elements that comprise the system.” The program also draws on the expertise of different research centers and institutes across the campus, in addition to providing information to students on how to learn about sustainability in their programs of study.

The institute pulls together Georgia Tech's work in several of its other research centers and institutes, including the Center for Biologically Inspired Design (CBID), the Center for Quality Growth and Regional Development (CQGRD), the Institute for Leadership and Entrepreneurship, as well as Strategic Energy Institute (SEI) and Sustainable Design and Manufacturing (SDM), under one roof.

Georgia Tech strives to operate as a fully integrated community that models economic, social and ecological sustainability. As a signatory to the ACUPCC, the institution has pledged to establish a policy on greening all new campus construction..

**Teaching the Concepts of Sustainable Building**

The program stresses and demonstrates that understanding the interdependence of the natural and the built environment, as well as environmental values and ethics, should be central to all tracks of higher education. The process of education also complements formal curriculum with
active, experiential, inquiry-based learning and real-world problem solving on the campus and in the larger community. The program is based on “five interrelated strategic pillars: research, education, economic development and entrepreneurship and partnerships and innovative policies, and green campus development.”

Sustainable building principles are given considerable importance within these program pillars. In the research pillar, one of the major thrusts is Sustainable Urban Systems where the program is an exploration of a, “Systems dynamics approach to integration and design of regional transportation, energy, and water systems with the built environment.” As part of the education pillar is, “Interdisciplinary Graduate Education and Research Training [with] new programs being developed in Ecosystem Engineering, Harnessing the Sun, and Biologically Inspired Design.” In addition, the program also supports Georgia Tech’s leadership in developing and sustaining a green campus. As the program incorporates all aspects of sustainable systems development, sustainable building is a component of the institute’s work as it relates to Sustainable Energy Systems, through energy efficiency and consumption, and Sustainable Urban Systems, through sustainable, “Design of regional transportation, energy, and water systems with the built environment.”

John Crittenden, the Director of the institute, emphasizes, “Improving the design of the urban infrastructure is one of the three areas in which ISS can have the greatest impact.”

What do Students Learn?
As indicated above, the program is teaching the students about the interconnectedness of the built and the natural environment; systems thinking as it relates to the design process; the environmental, social, financial and political issues around renewable energy and natural resources; the impact of buildings on public health; and the use of green buildings as a tool to pursue social equity.

A sample of sustainability courses taught in 2009 includes courses in Architecture such as ARCH 3231: Environmental Systems I that examines, “Human physiology, the occupation of space, and principles of sustainability, micro-climate, energy consumption, thermal loading, passive solar strategies, daylighting, optics, and acoustics” and in Building Construction, BC 4710: Green Construction, which focuses, “On the means, methods, strategies, and technologies to improve the energy efficiency and performance of buildings, and to reduce the environmental impact of buildings. Courses teaching about sustainable building are not restricted to the building focused tracks, but are also offered to other students, such as those who are studying Public Policy. For example, PUBP 6320: Sustainable Systems, is a, “Historical introduction to sustainable development” that examines topics such as “the ethical, economic, ecological, and technological dimensions of sustainability,” “sustainable development in developing and developed countries” and “sustainable communities, new urbanism, regenerative technologies.”
The work of the institute underscores the larger work of Georgia Tech’s Office of Environmental Stewardship, which hopes for Georgia Tech “students, faculty, and staff to live and work in a sustainable environment and carry that experience, way of life, and way of thinking with them as they venture into the world.”

**Opportunities**

There are many opportunities for partnerships that can leverage individual efforts and for funding to advance the work in higher education to provide sustainable building education to its students. Students also can become civically engaged through curricular and co-curricular activities to help pass legislation that will remove market barriers and create appropriate regulations to build a strong green and sustainable economy.

**Federal Policy Initiatives**

Federal government programs aimed at developing education resources for the new green economy are just taking off. Secretary of Labor Hilda L. Solis, Secretary of Housing and Urban Development Shaun Donovan, Secretary of Energy Steven Chu, and Secretary of Education Arne Duncan announced on May 27, 2009 a joint partnership committed “To developing new policies, proposals and ideas to help America's middle class,” which includes new green education initiatives. Through an additional effort by Solis, Duncan and Chu, training programs and career pathways for students from high school to postsecondary education will be a main focus.

The National Science Foundation is another source for federal funding for innovative curriculum programs, such as for integrative graduate education and research traineeship programs (IGERT). According to NSF’s Web site, its annual budget of $6.06 billion provides funding for “Approximately 20 percent of all federally supported basic research conducted by America’s colleges and universities.” The funding section of NSF’s Web site provides information on grants to support sustainable building education programs.

The Campaign for Environmental Literacy organizes and mobilizes the environmental education and sustainability in the higher education community in order to secure federal support and encouragement for education and training for sustainability. On-going campaigns, in partnership with Second Nature, include the University Sustainability Program, authorized as part of the Higher Education Opportunity Act of 2008 (HR 4137), and the Education for a Green Economic Recovery Act (EAGER), not yet introduced. An expected catalyst for colleges and universities to develop and implement more programs and practices modeling sustainability, the University Sustainability Program would support between 25 and 200 projects at higher education institutions and associations each year. EAGER would allocate $1-4 billion per year of carbon emissions permit auction proceeds to climate change education.
Collaborative Opportunities

Although still an emerging concept within the higher education sphere, some organizations and associations working to improve education for climate neutrality and sustainability are integrating a focus on sustainable building education in their initiatives. The groups and individuals – interviewed for this report – are potential partners for efforts to provide sustainable building education to all students:

*The Association for the Advancement of Sustainability in Higher Education* (AASHE) ([www.aashe.org](http://www.aashe.org)) is an association of colleges and universities that are working to create a sustainable future. Its mission is to empower higher education to lead the sustainability transformation. They achieve this by providing resources, professional development, an annual conference, and a network of support to enable institutions of higher education to model and advance sustainability in everything they do, from governance and operations to education and research.

AASHE is involved in various activities to further education for sustainability on college and university campuses. Examples of such activities include Train the Trainer workshops, organized twice a year. Attendees of these workshop return to their respective institutions and develop workshops on how to infuse sustainability into the curriculum. Additionally, the AASHE Resource Center, an online resource library, offers access to curricular materials, maintaining a list of sustainability oriented architecture, engineering and other sustainable building programs.

In 2010, AASHE is bringing the higher education sustainability community together to develop national strategies for addressing curriculum issues and how to move from thousands of participating faculty to hundreds of thousands. AASHE will be working with a variety of partners to face the challenge of transforming the higher education curriculum to include more knowledge, skills, and values grounded in principles of sustainability and to change the pedagogy to reflect the problem-posing/problem-solving goals of sustainability education.

Paul Rowland, the executive director of AASHE, feels that green building principles need to be addressed in the context of the more holistic sustainability issues. Since students of different majors take different coursework, it is important to systematically question the core curriculum, the non-formal education, student behaviors outside the classroom, and potentials for introducing mandatory or required sustainability education. The national strategies that come out of AASHE’s curriculum discussion could prove crucial in promoting the mission of this paper.

Geoffrey Chase, Dean of Division of Undergraduate Studies at San Diego University and Chair of the AASHE Board, commented on integrating sustainability into the educational experience, “Pressure around infusing sustainability into college and university curricula seems to be gaining momentum. When asked about his thoughts around basic sustainable building...
education for all students, he suggested, “Questions the students ask about the building are more important than what they could say about the building features.” It is critically important to understand how students are connected to buildings as this could develop student awareness, and provide a guide into teaching them about systems thinking.

**USGBC Students** ([http://www.usgbc.org/students](http://www.usgbc.org/students)) is the college and university student engagement program of the U.S. Green Building Council. The program was created to help recruit, equip, and connect the next generation of leaders to the green building movement and sustainable design industry. USGBC Students are involved in peer education, advocating for sustainability on campus, engaging with the latest innovations in green building, and participating in community service-learning initiatives.

This program was launched in the spring of 2009 with participation from 52 schools across the country. By empowering the next generation of leaders to transform their campuses, communities and careers, USGBC Students engages two overlapping groups of students: those in building sciences, such as architecture, engineering, construction management and interior design, as well as motivated change agents with a passion for sustainability issues, representing a cross-section of disciplines.

“USGBC Students takes an integrated approach to invite stakeholders from across the campus to engage in the dialogue about sustainability and to take action. Our student leaders are initiating conversations with faculty and administration about how to better integrate sustainability into curriculum.” On the other hand, the broader community of USGBC Students, representing business, health care, and the humanities, among other majors, are helping to educate their peers on sustainability and the benefits of green building. “Students are learning about sustainability through service and experience,” according to Anderson. “We are excited that USGBC Students are finding ways to leave a positive impact on their campus and community and welcome others to join us in the process.”

**USGBC Emerging Professionals** ([http://www.usgbc.org/DisplayPage.aspx?CMSPageID=116](http://www.usgbc.org/DisplayPage.aspx?CMSPageID=116)) are students and young professionals with the vision and dedication to be the future leaders of the sustainable building movement. EGB groups around the country offer young people the opportunity to get involved in sustainable building locally, gain access to USGBC resources, and participate in local events.

The Emerging Green Builders program has been recently refocused and rebranded as the “USGBC Emerging Professionals” by USGBC, broadening its reach to all young professionals at colleges and universities who are interested in developing careers in sustainability and sustainable building industry. Participants advocate for sustainability where they work, making sure their firms understand the value. They also get involved in organizations such as Designers Accord ([http://www.designersaccord.org/](http://www.designersaccord.org/)), where they agree as professionals to ask their...
clients about sustainable building. Since this program focuses on professional development, leadership development and networking, this group could become an effective partner in promoting the mission of this paper according to Brandon Anderson, the manager of the Student and Young Professionals Programs at the USGBC.

*The National Council for Science and the Environment* ([http://ncseonline.org](http://ncseonline.org)) is a not-for-profit organization dedicated to improving the scientific basis for environmental decision-making.

David Blockstein, the director of education and senior scientist with the National Council for Science and the Environment, suggests that detailed knowledge might not be always particularly relevant for all students; there should be contextual learning that students could apply in their lives. According to Blockstein,

> “Most students and recent college graduates are living and working in dwellings that they don’t own, therefore the emphasis really needs to be on aspects that they actually have some control over in their lives and not the technologies that are likely to change by the time they are actually in a position to affect building construction and management. What the effort [educational strategy] really needs to do is look at how to use scholarly activities, integrate this into classes; for example, to develop really good problem-sets that can be used in physics classes, to use building and energy issues to teach fundamental principles of physics, statistics and mathematics.”

He also explained that the examples educators are currently using are very esoteric. Blockstein asserts there is a need to develop practical examples that illustrate broader principles within the core disciplines. Leveraging existing courses, especially in core science, technology, engineering and mathematics courses provides a strategy to pursue while teaching sustainable building principles to all students.

When asked about the synergies between the efforts of his organization and the goal of this paper, he described a project to create a Climate Adaptation and Mitigation E-Learning (CAMEL) community, commencing in October 2009. The National Council for Science and the Environment (NCSE) has been awarded a three-year grant of $1,666,820 by the National Science Foundation (DUE-0950396) to create a nationwide cyber-enabled learning community for solutions to climate change. CAMEL will engage experts in science, policy and decision-making, education, and assessment in the production of a virtual toolbox of curricular resources designed for teaching climate change causes, consequences, and solutions.

This project will create the infrastructure and community for educators to develop materials to teach students about climate change, and even more importantly, for students to understand options and opportunities for mitigating and adapting to climate change. Over the 3-year timeframe, issues and concepts related to sustainable building would be one of the major areas
that this project will cover. An opportunity for partnership lies in using the framework that the National Academy of Sciences (NAS) will establish though this e-learning community. Furthermore, partner organizations can collaboratively develop the content to be included in E-learning material. These efforts will help disseminate material among faculty and students, with a feedback loop supplied by evaluations of how effective this material is in learning and teaching about sustainable building and sustainability.

The CAMEL project’s focus on matching topical content with proven educational techniques, allows NAS to collaborate with those who are not only experts on the content/subject matter, but are also knowledgeable about how to design courses and case studies. More information on CAMEL can be found at the Council of Environmental Deans and Directors’ website (http://www.ncseonline.org/CEDD/cms.cfm?id=2348).

**Project Kaleidoscope (PKAL)** focuses on building leadership at the institutional and national levels to ensure that American undergraduates have access to robust learning experiences in science, technology, engineering and mathematics (STEM) fields. One component of this project focuses on the development of science buildings and science labs at colleges and universities that are conducive to and supportive of sustainability education and green principles.

The PKAL Facilities Planning Resource presents a portfolio of materials and information about 21st Century Facilities for Undergraduate STEM Learning. This resource highlights people and the process in this field, providing valuable information on how to determine the project scope, vision and context. This project explores ways to design curriculum while employing and integrating lessons learned during the planning and design of a green and sustainable campus building, and therefore presents significant synergies between the goals of this paper and PKAL.

**The Disciplinary Associations Network for Sustainability (DANS)** (http://www2.aashe.org/dans) provides faculty and staff development to support the creation of sustainability focused curricula and integration on college campuses.

“We are more than glad to collaborate, so we can be more effective about faculty development and bring it to the systemic level where it needs to be,” said Debra Rowe, founder and facilitator for DANS. Faculty often get excited about the value of sustainability education when provided with quality professional development opportunities through their disciplines and on their campuses. Professional development can help faculty create classroom learning activities that combine sustainability concepts with academic disciplinary concepts quite easily. Faculty should be given the basic background information on sustainability as well as an opportunity to explore the unique and important contributions their discipline can make to a sustainable future. Sustainability education grows when faculty members are given a support system where they can share their questions and concerns. Says Rowe, “One shot faculty development
does not create an ongoing culture of engagement in sustainability education, and that is what is needed.”

The American Institute of Architects (http://www.aia.org/index.htm) has been the leading professional membership association for licensed architects, emerging professionals, and allied partners since 1857. With nearly 300 state and local chapters, the AIA serves as the voice of the architecture profession. They carry out their goals through advocacy, information, and community building.

“Part of what is going to happen with sustainable buildings is that the consumers will also become operators. Sustainable buildings are going to rely on people becoming smart about how to use them.” AIA has been working with the National Architectural Accrediting Board (NAAB) and the Society of Building Science Educators to implement sustainable building requirements and to develop Carbon Neutral curriculum for architectural schools. Many believe through regulation, NAAB can become less involved with prescribing detailed student performance criteria and focus more on the overall performance of these architecture schools in developing curricula for carbon neutral/zero net energy characteristics that form an integral part of excellently-designed architecture and environments.

Equally important, according to Henry Siegel, a member of the National Advisory Group for the AIA’s Committee on the Environment, is teaching collaboration with other professionals to implement an integrated approach to project planning, design, construction and post-occupancy issues. Assisting this work are the Architecture 2030 goals of AIA and the Ed Mazria initiative (http://www.architecture2030.org/), which are helping transform the architecture profession into a more climate responsive practice.

Second Nature and the U.S. Green Building Council, as the authors of this paper, are also potential collaborators in any initiative to educate all students about sustainable building. Information about these organizations and their programs are included in the Appendix.
VI. Recommendations

In writing this paper, Second Nature and USGBC have come together to inspire action at higher education institutions throughout the country. Clearly, there is an urgent and decisive need for colleges and universities to educate all students about the basic concepts of sustainable building, advancing education for sustainability. Higher education plays a unique and critical role in our society. As educators of the emerging workforce, these institutions can ensure graduates have the skills and knowledge to succeed as professionals. As training centers and community focal points, these institutions support adaptation and encourage growth in our economy. As research centers, these institutions promote innovation that will lead to widespread health and well-being, efficiency and conservation, and prosperity, for all.

How higher education institutions could address this dire need and start educating students about the importance of sustainability vis-à-vis sustainable buildings is succinctly described in the form of flow-charts in the Recommendations section of the paper. These chart out approaches and strategies that could enable higher education institutions in translating the learning principles into teaching practices. These are hands-on, solution-based methodologies that underscore the opportunities arising from cross-disciplinary learning, potential that is embedded in the unified engagement of staff, faculty, administration and students, as well as value of leveraging what is already available, in terms of educational resources, expertise and pedagogies. Whether you currently work or study at an institution that:

- Does not yet teach courses in sustainability or sustainable building;
- Teaches sustainability courses, but do not focus on sustainability building concepts;
- Or teaches sustainable building courses, but only to students of specific tracks

There is a path for you to follow, to grow your personal practice, and make certain all students are introduced to these concepts. The campus is a living laboratory, filled with opportunity for student engagement. We invite you to imagine the possibilities and take the next step to ensure that current and future generations will be healthy, and will have strong, secure, thriving communities and economic opportunities for all.
Reference List


Front Page Photo Credits:
American College and University Presidents’ Climate Commitment, www.presidentsclimatecommitment.org.

Advancing Education for Sustainability:
Teaching the Concepts of Sustainable Building to All Students

Second Nature
Education for Sustainability

USGBC