Green Living At Dartmouth College

BUILDINGS, COMMUNITY AND THE ENVIRONMENT

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DARTMOUTH COLLEGE

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INTRODUCTION AND SUMMARY

I. OUR PROJECT

This year the Office of the Provost asked the students of ENVS 50 to analyze the environmental performance of Dartmouth residence halls and make suggestions pertaining to new and existing buildings. Professor Howarth agreed that this was an important and relevant topic, especially considering the timing of the McLaughlin Cluster construction, and offered our class a plan of attack. And so the work began. The goal of this report is to provide a framework of recommendations that the Provost can follow to achieve a "greener" Dartmouth. Due to the College's rural location, proximity to the Appalachian Trail, the Connecticut River, and the White Mountains, it has attracted students who enjoy spending time exploring the outdoors. The Dartmouth Outing Club maintains a strong presence on campus and is evidence that students have much interest in enjoying the outdoors. As the character of the College has evolved throughout the long history of the institution, its environmentally conscious reputation has persisted. Our report addresses the significance of this self-defined character, how it is manifest in student programs and college housing, and what opportunities the future holds for the College to further this green image. Professor Howarth elaborates on his motivations behind this project, stating:

> "As Dartmouth itself has learned in recent years, a commitment to green buildings can actually save money while at the same time improving the aesthetic qualities and functional characteristics of the spaces where people live and work. A core challenge for Dartmouth is to integrate the insights, knowledge, and values of students in the design and management of student living spaces. My hope is that this year's ENVS 50 project will help crystallize understanding of and ultimately action on issues that have been championed by students over the course of several years."

To begin this project the class divided into four groups to answer questions and investigate different aspects of energy efficiency at Dartmouth. These groups analyzed the plans for the new dorms and the state of the existing dorms, conducted comparative studies on peer institutions, and combined months of research to create a proposal for a Sustainability Center at Dartmouth. This approach provides a well rounded and in depth look at what Dartmouth has done, is doing, and can do to become an environmentally progressive campus. The class believes that Dartmouth can and should emerge as a leader in environmentally sustainable building and behavior, and this report outlines steps necessary for this goal.

We begin by defining "green building" and explaining its relevance to the College's plans for new residences. Green building incorporates sensitivity towards the environment into the design of buildings, with a focus on reducing the environmental impact of the finished product. This type of sustainable architecture can save not only energy but also costs, and results in a "low-tech" structure that minimizes consumption, draws upon local resources, and encourages an environmentally friendly lifestyle.

In section two we give an overview of the new dorm cluster, McLaughlin, which will sit on the College's north campus and will meet the need for more student housing. We describe the history of the site, sources of funding, qualifications of the selected architects and their previous accomplishments, and analyze the dorms' designs. The Facilities Planning Office (FPO) emphasizes the sustainable goals of the McLaughlin project and expresses a desire to incorporate aspects of green building into their plans. Dartmouth is registered with the Leadership in Energy and Environmental Design (LEED) program, and is aiming to meet certain requirements to achieve certification for the McLaughlin cluster. In this section, we provide a thorough critique of the LEED certification program and make recommendations for ways in which Dartmouth could create residence halls that are even more energy efficient.

Next, the existing dorms section analyzes the success of the ECO and SPARCS programs and the current state of residence halls on campus. By conducting a survey we determine students' levels of awareness about environmental programs, and assess general sentiments concerning energy efficiency on campus. From these results we are able to devise educational programs to improve student awareness. In addition to student behavior, we look at the dorm buildings themselves. We analyze windows, heating systems, lighting, and appliances for energy efficiency, and pinpointed what the Office of Residential Life (ORL) has done in the past to retrofit older buildings. ORL also provided us with information concerning future renovations. From this research, aided and inspired by case studies of successful programs and technologies at other schools, we outline recommendations for the College to implement a more rigorous energy saving precedent for housing.

The fourth section is a proposal for a Sustainability Center. We describe the need for an integrated living and learning space that will be in a central location on campus for students, faculty, and community members to gather and build relationships revolving around a common commitment to environmentally friendly practices. Our proposal outlines the main functions and goals of the Sustainability Center. We focus on minimizing energy use, and state how this will shape the physical building design and the center's role in improving the quality of life at Dartmouth. A supporting petition, with over 200 signatures from students and faculty, expresses the mounting desire for a Sustainability Center within the Dartmouth community. This proposal provides an exciting glimpse at what Dartmouth's future could hold, as the College emerges as a true leader in green building.

Finally, we investigate what our peer institutions have done in terms of their commitment to environmental stewardship. In this section we describe innovative and state of the art administrative leadership efforts, environmental policies, student involvement programs, and financial structures found at other schools. Many of the universities examined face similar challenges as Dartmouth. Therefore, we hope Dartmouth can learn from the successes and failures of other schools, determine what will work at our campus, and develop the institutional structures necessary to guide the College towards the development of a more sustainable campus community.

The report you are about to read is full of facts and information, compiled over the course of the term. More importantly though, are the recommendations that have come out of our analysis of this information. We aim for this report to be used as a learning tool for the College. Following is a compendium of our creative suggestions; ones we truly hope will materialize.

II. OUR RECOMMENDATIONS

Chapters I and II: Green Building and New Dorms

Recently the College has taken significant physical steps to tackle the housing shortage that began in the 1970s when Dartmouth opened its doors to women. Under the initiative of Dartmouth College President James Wright, Provost Barry Scherr, and the guidance and of Jack Wilson and his team at the Facilities Planning Office, multiple new dormitory projects are in progress

For example the state of the art McLaughlin Cluster dormitory will add 342 additional beds to the College and will occupy the northern part of campus by College Street and Rope Ferry Road. The way in which the College and the architects are primarily addressing sustainable building is through the United States Green Building Council's Leadership in Energy and Environmental Design (LEED). By registering and following a LEED-mandated checklist of sustainable practices regarding sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, innovation and design process, and by investing enough time and money, McLaughlin has a chance to become LEED-Certified. This would be quite an impressive and notable feat considering that fewer than 200 buildings have been LEED-certified since 2000.[i]

The College's acceptance and initiative of LEED is a momentous step in the right direction, but it is worth noting, LEED is not without its shortcomings. In addition to certification difficulty, other common LEED-driven problems are high costs, crippling bureaucracy, "point mongering", difficulty in energy modeling, and misleading claims of green building benefits.[ii] Because of this, alternative green building frameworks, such as the United States Environmental Protection Agency's Energy Star Program, are appealing because they can achieve many of the same outcomes of LEED while they lack many of the aforementioned potential pitfalls.

Recommendations:

- Enroll in the USEPA Energy Star program
- Implement a solar heating system
- Do not install the radiant cooling system due to the drawbacks of energy consumption and the possibility of condensation and mold growth
- Install light shelves on all the south facing windows of the new dorms

Chapter III: Existing Dorms

We decided to take on the task of examining and evaluating the use of energy in existing dormitories around campus. After a thorough assessment of the nature and state of energy use in the dorms, we proposed recommendations for alterations in College energy use policy, student energy use, and retrofitting measures that can be made in the dorms. We broke our work down into five main components. First, we created, circulated, and analyzed a survey to students on campus. This allowed our group, as well as other groups, to see how dorm occupants valued energy usage as well as living habits and personal preferences. Second, we made recommendations in terms of how students (both current and incoming) can be better educated about environmental issues and sustainable living habits. Third, we

[i] Auden Schendler and Randy Udall, "LEED is Broken... Let's Fix it." (2005).
[ii] Ibid.

created a "Rent-a-Refrigerator" program for students as a means to save both energy and money in the long run. Fourth, we proposed a program in which posters will be placed in each of the dorms illustrating to students what their energy consumption levels are—if students are aware of this then we feel they will be more conscientious of their habits and usage. Fifth, we looked at the technical aspects of the dormitories, including heating and lighting systems, and assessed their current condition. And finally, we investigated what can and will happen in the future with residence halls on campus.

Recommendations:

- Institute "Rent-a-Refrigerator" Program
- Retrofit heating systems in dormitories
- Install motion sensors for lights in all dorm kitchens, study lounges, and hallways
- Create and distribute posters for every dorm illustrating energy usage
- Circulate list of energy efficient appliances to incoming students
- Create sustainable living assembly or seminar for first-year students during orientation week
- Rework the ECO and SPARC programs

Chapter IV: Sustainability Center Proposal

Our group looked at the need for and the plausibility of building a Sustainability Center at Dartmouth. To do this, we took several steps. First, we determined through a petition/awareness campaign that there is, in fact, widespread student interest in a Sustainability Center. The rest of our time was spent meeting with various Dartmouth faculty and administrators and town officials to discuss the availability of space for such a center. Working with a town planner, a Dartmouth architect, a director of Facilities, Operations, and Management, the Office of Residential Life, and the Dartmouth Real Estate office, we determined the most appropriate and plausible of alternatives for a Center.

The culmination of our work is an in-depth proposal that outlines our vision and mission statement for the Center, as well as a history of past proposals and ideas. It also includes our recommendations for implementation of the project, including funding, support, and location.

Recommendations:

- The building itself should be an educational tool and should be visibly sustainable.
- The Center should not be a residence
- The Center should be accessible to all students, faculty, staff, and other community members
- The Center should provide space for environmentally-minded student groups which currently do not have offices on campus
- The Center should be a truly interdisciplinary building, incorporating the social, academic, and extracurricular aspects of life at Dartmouth by including:
    - a lounge
    - a venue for concerts/lectures
    - a kitchen for cooking workshops
    - offices
    - small classrooms

- The Center should be closely affiliated with, if not run by, the newly-hired Sustainability Coordinator, as well as a minimum of two and a maximum of three Dartmouth students/recent postgraduates
- Our suggested location for the Center is a small plot of land, just north of Burke
- While the Center should be allowed to change as is needed, in order to remain socially sustainable, the principles listed below should remain integral to its management and purpose on campus. Its Mission Statement is as follows:
    - It is an experiential and interactive learning space.
    - The physical structure is itself an educational tool
    - The facility offers a social space reflecting interest in sustainability, in accordance with the Student Life Initiative (SLI)
    - It fosters relationships between students and community members with interests in sustainability and environmental consciousness
    - It broadens and diversifies the scope of the student community interested in sustainability

Chapter V: Implementation: What We Can Learn from Peer Institutions

In order for our recommended policies, programs and technologies to be implemented in an efficient and coordinated manner, Dartmouth's administration must take a leadership role in building the institutional structures necessary for the establishment of a more sustainable campus community. High-level administrative commitments to finding funding and promoting communication across university divisions are invaluable for successful implementation. In addition, an effective environmental policy will help Dartmouth translate environmental ideals and rhetoric into meaningful energy savings by providing a broad set of goals to coordinate environmental efforts and help integrate environmental values into all facets of the College. The potential for environmental leadership exists at Dartmouth. It is up to the current administration to take action to ensure that our college emerges as a strong leader in this increasingly vital global realm.

Recommendations:

- Institutionalize lines of communication between Dartmouth's new sustainability coordinator, high-level administrators, faculty and students
- Increase the influence of the Resource Working Group (RWG) by expanding it to include students and other conservation minded staff
- Spell out a clear environmental policy
- Consolidate all Dartmouth's environmental groups under one umbrella organization
- Encourage sustainability projects by creating a loan fund designed to give interest-free loans for projects that have a payback period of five years or less
- Engage faculty members and administrators in the approval process so they gain familiarity with Dartmouth's environmental policies and programs

2

GREEN BUILDING

Traditionally, architecture has meant the planning and design of buildings to better meet the human need for shelter from environmental elements. But buildings also provide a place for worship, food preparation, storage, meeting, education, and other basic human activities. The architecture of these buildings combines elements of science, engineering, and art to form a plan that serves a range of functional and aesthetic user requirements.

"Sustainable architecture" is a term that has become so ubiquitous and integral to current understandings of both environmental sustainability and modern architecture that in many ways it is difficult to divorce the two concepts to which it refers. As defined by Williamson et al in their book *Understanding Sustainable Architecture*, sustainable architecture is "a revised conceptualization of architecture in response to a myriad of contemporary concerns about the effects of human activity."[1] But architecture is about more than just shelter, or shelter with style; it is a study of environments and ecological interactions. The architect must consider how human users interface with the built structure – the human environment – and also how the structure interfaces with the greater environment – the terrain, local geography, surrounding built environment, watershed, and other considerations. In 1993, the Union of International Architects' World Congress of Architects issued a statement confirming the profession's commitment to "environmental and social sustainability" and bringing "all existing and future elements of the built environment – in their design, production, use and eventual re-use – up to sustainable design standards."[2]

The construction of new buildings is a tremendous creative act, yet it also represents destruction. The modern-day construction site is a familiar vision in contemporary experience – it makes a scar on the landscape of steal beams, smoke-spewing machinery, felled trees and blighted greenery. Construction projects call for additional pollution – fossil fuel consumption and waste-water runoff – as well as the use of building materials – harvested lumber, quarried stone and mined metals – and a general interruption of the existing environment. It is through this destruction of one environment that a new, human-created environment can arise.

In recent years, architecture has been enriched by an increasing sensitivity and commitment to wider environmental concerns. In step with the general public's movement towards sustainability, sustainable architecture or "green building" have emerged as major priorities in building design. In simple terms, one can say that architecture has evolved from merely protecting humans from the environment to also protecting the environment from humans.

Acts of creation like constructing buildings may seem antithetical to an ethic of sustainability, which seems by nature to favor reduction. Indeed, there is a strong tradition in green building that favors "low-tech" building, for example simple functional solutions with low environmental - and often economic – costs. In comparison to the established trend of energy and material gluttony in the modern era, sustainable architecture presents alternatives like small-footprint buildings, modular homes, and the incorporation of indigenous lifestyles and building methods.

In the introduction to *Sustainable Architecture: Low-Tech Houses*, Mostaedi describes the concept of sustainable architecture as "the use of ecological or recycled

materials, self-sufficient energy systems and systems for achieving a good temperature without heating." These actions, he says, "can make a building something more than an artificial volume in the landscape and turn it into a space in which the built and nature respect each other."[3]

This focus on recycling and reusing materials, minimizing material and energy consumption, and designing for reduced environmental impact is consistent with the tenets of sustainable development, as described by various recent local, global, and professional conventions, conferences, and studies. The Brundtland Report, published by the 1987 U.N. World Commission on Environment and Development provides a widely-cited definition for sustainable development as follows:

> Sustainable development is not a fixed state of harmony, but rather a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are made consistent with future as well as present needs.[4]

This definition's emphasis on a dynamic attitude towards consumption, technology, and developmental needs helps inform an understanding of not just sustainable development, but a more local-scale understanding of sustainable architecture and building. A revision of attitudes towards building can contribute to bringing the human-made environment into coherence with comprehensive planning for the future.

The benefits of thoroughly-considered sustainable architecture can have far-reaching effects on not only humanity's physical environment, but also our social and economic environment. Architecture that is coherent and compatible with the local community, culture and physical environment may help promote a psychological sense of connection, encourage community-building, and support an appreciation for the local region.

By building with an eye towards the future, sustainable architecture can cut energy costs with the efficient use of heating, cooling, water and waste management, and insulation. These benefits can be accomplished through principles of reduction and simplification, but do not require a decrease in building services. Simple engineering and purchasing solutions like implementing passive ventilation and the use of local or sustainably-harvested materials can often address local needs more effectively and cost-efficiently than conventional building choices. Designing for longevity also cuts down on the need to replace and consume more, so long-lasting materials and design features can help further reduce costs and environmental impact. Furthermore, a commitment to sustainability-friendly technology and economic policies enriches the community by encouraging a progressive and comprehensive attitude towards ecological and economic ethics.

In the case of new residence halls at Dartmouth College, the challenges of sustainable building are complicated by the requirements of hundreds of college students living semi-communally in close quarters which must be reused by different individuals year after year. The residential-academic environment calls for functional study and social space, while the geographic locale – in a four-season, cold winter climate – necessitates effective temperature regulation. The new residence hall construction sites on Tuck Mall and north of Maynard Street are limited by the context of the surrounding campus: how will the new buildings make sense with existing structures and pathways? How will the surroundings – other residence halls, green spaces, academic buildings, dining facilities, etc. – affect the function, style, and shape of the new buildings? These functional needs are made more complex by concerns more specific to Dartmouth: will the College's sense of history and community be preserved in the new buildings' style? How can new building design combine traditional

nostalgia, preserve a campus-wide sense of aesthetic coherence, and also appeal to students, alumni, faculty, and visitors? Finally, how can architecture combine innovation, technology, and an ethic of sustainability with longevity and flexibility for future developments?

3

NEW DORMS

Dartmouth can better promote and achieve a sustainable-living educational and practical experience through the creation of infrastructure and new spaces which implement and encourage sustainable living practices. This would overlap with the College's need to increase residential offerings for undergraduate students, summer conferees, and other visitors while progressing towards the College's longer-term goals of expanding the campus for the growing student body and institutional community.

The new McLaughlin residence hall cluster, currently under construction, addresses the College's residential program through the addition of hundreds of new beds, dining facilities and other common areas while also providing a myriad of educational, experimental and cost benefits through sustainable building and living initiatives. The McLaughlin project addresses essential sustainable building concerns such as architectural harmony with the local environment, the sensible application and exploration of life-cycle and resource analyses, and the creative use of a range of technologies and building solutions. In compliance with the LEED set of building sustainability standards, the new dorms will implement an extensive array of techniques to reduce and mitigate environmental damage. Plans call for the inclusion of relatively innovative features like an alternative energy refueling station for College vehicles, hydronic radiant heating and cooling, low-flow water fixtures and waterless urinals. These will be combined with simple energy-saving design considerations like the installation of bike racks, the elimination of irrigation systems for landscaping in favor of rainwater, the employment of extensive daylighting and indirect up-lighting, and the use of locally-produced and/or recycled building materials.

The McLaughlin project demonstrates Dartmouth's remarkable receptiveness to sustainability practices and innovation; however, there is still much room for improvement and re-evaluation. While the above-mentioned building and design elements contribute towards the College's goal of achieving a LEED certification status of Silver, Dartmouth – which is already a partner in the EPA's EnergyStar energy efficiency program – may benefit through participation in EnergyStar's building certification program. The LEED program has been criticized for its costly and inefficient bureaucracy. Indeed, the LEED program may encourage an inefficient managerial myopia, or "point-mongering," by assigning equal LEED point values to design elements that are often difficult to quantitatively compare, or lavishing outsized awards to business-as-usual components like bike racks, walking paths, and other structures that are nearly mandatory to the college residential experience. The College's decision to incorporate a cooling system seems particularly unnecessary and costly, while the omissions of appropriate and beneficial components like water-heating solar collectors represent unfortunate missed opportunities for Dartmouth to provide pioneering leadership in sustainable-building innovation.

This chapter presents an overview of the environmental features of the new McLaughlin construction project. We identify key concerns in sustainable building with a particular eye for Dartmouth's needs, interesting and innovative green building elements, and recommendations for re-evaluation and project improvement. This document aims to promote an informed, critical understanding of sustainable building concerns and options in

the continued process of the McLaughlin construction project as well as planning for other building projects in the future.

I. THE NEED FOR HOUSING

In recent years, the growing demand for student housing has been a pressing issue at Dartmouth. Recent building projects such as the East Wheelock Cluster including McCulloch Hall is an example of the College's attempts to alleviate its housing shortage. However, according to the Facilities Planning Office, whose mission is "to plan and execute facilities projects that contribute to the beauty, efficiency and excellence of Dartmouth College's physical infrastructure,"[1] the need for housing is a constant issue to be addressed:

> The Trustees charged the administration with increasing the number of beds on campus by 500 in order to increase the College's capacity to house undergraduates on campus…While enrollment has remained relatively constant over the past fifteen years, the pressures on existing housing have increased due to fluctuations in enrollment in off-campus programs, higher demand for leave-term residence, and renovation of existing residences to address building code issues. The addition of the Wheelock Cluster and McCulloch Hall helped to address the shortage, but the College continues to have fewer rooms than needed for students. While there is no plan to increase the size of the undergraduate student body, the additional beds will address the demand for housing. In addition, as the College continues to renovate residence halls, beds will be lost to code requirements and program plans.[2]

Because of this demand for more housing, the Facilities Planning Office has decided to break new ground and construct additional dorms. The FPO is an office which reports to the Provost. Among the major tasks for which the FPO is responsible:

- Campus master planning
- Evaluation and qualification of program needs
- Selection and management of architects and consultants
- Management of the facilities design process - with attention to the needs of Dartmouth's many constituent groups
- Management of permitting and community issues related to facilities growth
- Management of project costs and overall budget
- Management of construction
- Management of the campus space database and electronic space plan files [3]

Of these tasks, one particularly pertinent to the realization of any new project is the selection process by which the FPO decides on an architect and its unique design. This process can easily take upwards of six months. The first step in the process is to put together a standing selection committee. This standing Campus Planning and Design Committee differs slightly depending on the context of each project, but it generally consists of administration, faculty (specific to the building, for example, if it is a chemistry laboratory, chemistry professors, etc.) and selected students.

Once the selection committee is assembled, it then looks through architectural materials and information on firms that the College already has on file. In most cases, the

committee starts with a list of 20-30 possibilities and after putting the information through the committee, the list gets narrowed down to about 10 firms. Then, those 10 firms are usually asked to come to campus for interviews.

II. OVERVIEW OF THE MCLAUGHLIN CLUSTER

One current Dartmouth College building project aimed at fulfilling the need for a new dormitory is the $44 million dollar McLaughlin Cluster. The dorms will occupy the northern part of campus, in the area between College Street and Road Ferry Road. Mary Hitchcock Memorial Hospital was located here from 1889 to 1993, but with gradual development by the College to the north, the hospital had difficulty expanding and moved to a new site southeast of Hanover. In the late 1980s, Dartmouth College purchased the Hospital's Hanover property.

Use of the site was delayed for some time, as students and alumni expressed fears of the school expanding too quickly. In 1995, the College demolished the old hospital and created a parking lot, which would reserve the space for any future construction. Soon after, the College readdressed the need for more dormitories and a new dining hall. This area of Dartmouth campus was selected as the site for the McLaughlin Residential Cluster,[4] and it will certainly become a much more significant region of campus. According to the FPO website:

> The McLaughlin Cluster residence halls will add 342 undergraduate beds. The western residence hall includes 163 beds in singles and two-room doubles, a graduate assistant apartment, and a commons area for the cluster: a 2000 square foot room for parties, lectures, dinners or other gatherings. The eastern residence will have 179 beds and a community director apartment. Each floor of the residence halls includes study spaces, lounges, and a kitchen.
>
> The two residence halls will consist of three brick buildings, connected by glass-enclosed spaces used for lounges and kitchens. The overall look of the cluster will blend with the overall appearance of the Dartmouth campus, working in aspects of both older and contemporary architecture.[5]

Figure 1.1: Center building, eastern elevation.

Because of the significance of McLaughlin to the overall plan of the College, the process by which the architectural firms were selected was more intense and elaborate than most

Dartmouth projects. In addition to having a standing Campus Planning and Design Committee that narrowed the architectural applicants down to four firms, a final architectural competition was designed to see which of the four had the best plans for Dartmouth's North Campus vision. Among the competing architecture firms were: Robert A.M. Stern Architects of New York, Bohlin Cywinski Jackson Architects of Wilks-Barre, Pennsylvania, Moore Ruble Yudell Architects of Santa Monica, California and Polshek Partnership of New York.[6] Ultimately, the College chose the combination architecture team of Moore Ruble and Yudell as well as Bruner/Cott and Associates from Boston, Massachusetts. MRY is largely in charge of the design aspect of McLaughlin while Bruner/Cott and Associates is the construction firm and the facilitators of the project. Moore Ruble and Yudell was founded 27 years ago and according to its website the firm prides itself on a:

> Passion for an original architecture that grows out of an intense dialogue with places and people, celebrating human activity while enhancing the nurturing community... Moore Ruble and Yudell work successfully on a broad range of building types around the globe, including civic and cultural, institutional, technological and research as well as mixed-use and housing.[7]

In regards to McLaughlin, Moore Ruble and Yudell is applying its campus and educational expertise to Dartmouth's North Campus. According to MRY, they view Dartmouth College as being:

> An intimate, informal and nurturing place, which can still compete on the highest level of research and education. It is a place of true collegiality, which supports interdisciplinary work and informal student-faculty interaction, where the preservation and enjoyment of the physical environment is integral to student education. These qualities are inextricably bound to the scale, proportions and expression of the buildings and landscape.[8]

Under its goals for how to best achieve the balance of creativity and thoughtfulness that Dartmouth College requires for its North Campus vision, Moore Ruble and Yudell lists four objectives:

> 1) Respect the natural topographies that remain from the primal "valley" morphology.
> 2) Allow for both formal axial and informal transverse movements to support the historic campus patterns.
> 3) Configure new larger buildings both to align with existing streets and to allow for multiple informal site movements.
> 4) Configure new buildings as aggregations of approximately scaled and simply shaped forms.[9]

Moore Ruble and Yudell is very well founded in campus and educational work with nearly 60-70% of its commissioned work designated for that purpose.[10] One example of another academic project facilitated by MRY is the Tacoma Campus Master Plan at the University of Washington. Other examples include, Manzanita Village Student Housing at University of California, Santa Barbara; The Sloan School of Business at MIT (currently in design phases); and the Avery Center at the California Institute of Technology.

In addition to being experts in the field of campus buildings, Moore Ruble and Yudell also applies sustainable building philosophies to their design. According to the architects:

> [Our] approach to sustainable design is fundamental and interdisciplinary, using integrated systems and approaches applied throughout the planning process. Even before sustainability became an accepted criterion in building design in the United States, our work in Europe over the past twenty years has integrated strict energy guidelines and the use of healthy materials from local sources. Our architecture and urban planning has always responded to its climate and natural context in its siting, massing, and choice of materials and construction methods.
>
> In recent years, MRY has worked constantly to increase its knowledge base in sustainable building systems and technologies. We have engaged in discussions with institutions like the Center for Building Performance and Diagnostics at Carnegie Mellon University, or Panels such as the American Institute of Architecture Green Building Council.[11]

Moore Ruble and Yudell lists a number of sustainable building projects that integrate energy guidelines and healthy materials from local sources. One example is the Santa Monica Library in California which boasts under-floor air distribution, recycled structural steel rebar and flooring, high efficiency HVAC equipment, high-performance dual glazed windows, and a solar electric generation system.[12] Other projects listed include the National Tropical Botanical Library in Hawaii, Tango Housing in Sweden, as well as the Dartmouth College North Campus Plan.

While Moore Ruble and Yudell is charged with the design of the project, the Boston-based firm of Bruner/Cott and Associates is more responsible for the construction facilitation and implementation of that design. "Bruner/Cott is an excellent architectural firm," said Assistant Director of Facilities Planning Jack Wilson. "They are handling a lot of the more intensive on-site work: interviewing people, developing program statements, addressing issues. With their experience in student residences and dining halls, they bring an in-house expertise coupled with a closer proximity."[13]

Bruner/Cott & Associates, Inc., is a full service architectural firm in Cambridge that was established in 1972. According to its website "[Brunet/Cott] frequently serve as facilitators during the earliest phases of project definition and program planning."[14]

> Bruner/Cott is committed to creative and cost effective design for institutions, private developers and individuals. Our emphasis on design excellence and attention to detail combined with our knowledge of construction and building costs has ensured repeat work from our most valued clients. Our originality in rehabilitation and adaptation of existing buildings for new uses has achieved national recognition for three decades. While we are best known for our work with complex rehabilitation projects, we are equally at ease with new buildings and mixtures of old and new construction.[15]

Bruner/Cott's expertise includes: campus planning, the design of dormitories, student centers and educational facilities; athletic and recreational facilities; dining and food service facilities; market-rate and subsidized housing; commercial office buildings; space planning and interior architecture.[16] Other academic building examples by Bruner/Cott and Associates

include buildings at Phillips Andover Academy, Brown University, MIT, Dean College, University of Florida, Vanderbilt University and Williams College.[17]

III. LEED

According to Jack Wilson, the Director of the FPO, other factors that play a significant role in the architecture firm selection process are creativity, the demonstration of previous institutional work, and experience with building performance initiatives such as Leadership in Energy and Environmental Design (LEED).[18] A part of the United States Green Building Council (www.usgbc.org), LEED is the primary way the College tries to achieve its sustainable building goals in new building projects. The USGBC is a non-profit building industry group that certifies environmentally responsible buildings according to the LEED standards. LEED certification is based on a checklist of 69 points [Appendix A] that builders must document and USGBC affirms. The LEED certification levels are Certified (26-32 points), Silver (33-38), Gold (39-51), and Platinum (52-69).[19] Dartmouth is aiming for Silver certification for the McLaughlin residence halls.[20] Some of the points that this project will receive are a result of explicit decisions that the College has made in an effort to improve energy efficiency, and some of the points are achieved simply because of circumstance. According to a poster in the Facilities and Planning Office the initial planning of the new McLaughlin dorm project establishes these sustainability goals:

- Architecture in harmony with environment
- Sustainable architecture having educational and experimental benefits
- Life cycle assessment and resource analysis is key to success
- Low and high tech solutions explored
- Creative use of building materials[21]

LEED has been embraced by a large percentage of architecture firms around the world to achieve sustainable building practice recognition: "10,000 design professionals have trained to become LEED accredited. Overnight, LEED has become a dominant brand, like Nike in athletic shoes or Dell in personal computers."[22]

> LEED provides a complete framework for assessing building performance and meeting sustainability goals. Based on well-founded scientific standards, LEED emphasizes state of the art strategies for sustainable site development, water savings, energy efficiency, materials selection and indoor environmental quality. LEED recognizes achievements and promotes expertise in green building through a comprehensive system offering project certification, professional accreditation, training and practical resources.[23]

In order for a Dartmouth College building to become LEED Certified, it must first register with LEED. Registration, however, does not guarantee certification. "Since 2000, LEED has certified fewer than 200 buildings, with 1772 projects registered but not certified."[24] Once the registration application is submitted, the College must prepare proper documentation to support the LEED required checklist. "The LEED checklist prompts designers to reduce impacts in five categories ranging from site planning to energy consumption, water usage, indoor environmental quality, and building materials."[25] Currently,

the College has four projects that are LEED registered: Tuck Mall, McLaughlin, Kemeny Hall, and the Engineering Sciences Center.[26]

LEED Certification

In examining the construction process and the efficiency of materials used, it is important to recognize the standards LEED uses to evaluate the environmental impacts of construction. There are five subsections of the LEED checklist for new construction. Each of these sections has several points related to energy efficiency in construction:

- Sustainable Sites
- Water Efficiency
- Energy and Atmosphere
- Materials and Resources
- Indoor Environmental Quality

*Additionally, LEED awards points based on the innovation and design process of each.

Under the Sustainable Sites category, the McLaughlin project will receive four points for Alternative Transportation by having bicycle storage, access to public transportation, an alternative fuel refueling station, and adequate parking with preferred spots for carpools.[27] Each of these points was fairly straightforward for the College to achieve; for example, ORL requires that all residence halls have bicycle storage, and the McLaughlin cluster is located near an Advance Transit route.[28] Only the alternative fuel refueling station constitutes an explicit action to improve energy efficiency; it will serve the College's electric vehicles.[29]

Under the Water Efficiency category, the project will receive 1-2 points for Water Use Reduction and up to two points for Water Efficient Landscaping.[30] Technologies include low flow toilets, showers, and efficient washing machines. The McLaughlin cluster will use 20-30% less water than a typical building of its size. Points for Water Efficient Landscaping are earned by eliminating irrigation systems or using rain water in place of potable water for landscaping.[31]

Under the Energy and Atmosphere category, the project will receive points for Optimizing Energy Performance and Green Power. Optimizing the energy performance of a building involves reducing the energy cost of the whole building, including HVAC systems and lighting. LEED assigns two points for each 10 percent reduction past 20 percent and up to 60 percent, as compared to the ASHRAE Standard 90.1 (an industry-wide standard for energy efficiency).[32] The McLaughlin cluster will have a final energy reduction of 40-50%, for a total of 6-8 points.[33] LEED assigns up to three points for on-site production of renewable energy. While the McLaughlin project will not generate renewable energy on-site, it will receive one point for buying at least 50 percent of its energy from off-site renewable sources through Granite State Electric Company[iii].[34]

Under the Materials and Resources category, the project may receive points for Recycled Content, Local/Regional Materials, and Certified Wood. LEED assigns up to two points for using building materials and furnishings made from recycled content, and up to two points for using materials that are manufactured within 500 miles of the project.[35] Dartmouth is using some recycled and local materials, though the exact percentage and LEED approval are yet to be determined.[36] The McLaughlin project may earn a LEED point by using Forest Stewardship Council (FSC) certified wood for framing and blocking. Additionally, wood harvested from the Second College Grant will be used for furniture in

[iii] See <http://www.nationalgridus.com/granitestate/> for more information.

McLaughlin. Since 1999 College Grant wood has been Green Tag certified by the National Woodland Owners Association.[37] However, because this wood is not FSC-certified it does not contribute to a LEED point.[38]

The McLaughlin project will earn 8-11 points under the Indoor Environmental Quality category, although these points are related more to occupant health and comfort than to energy efficiency. The project may earn one point for Controllability of Systems, meaning that the residence hall will have on average one operable window and one lighting control per 200 square feet of occupied living space.[39] LEED also assigns points in this category for features such as low-emitting paints and carpets, and carbon dioxide monitoring.

The final LEED category includes points for innovations beyond the specified categories. The McLaughlin project may receive up to four points in this category, pending final LEED approval.

IV. BUILDING DESIGN

Environmental considerations in construction at Dartmouth

Building at Dartmouth follows the "integrated design" philosophy, so that construction is integrated into each of the other components of the project.[40] The architect, engineer, environmental consultant and client work together throughout the process, instead of working individually and sequentially. This integrated design process ensures that the client's needs and the environmental impacts of the project are thoroughly considered from all viewpoints and in all aspects of the project.

ORL Specifications

Before the initial planning of the McLaughlin Cluster, the Office of Residential Life defined what they envisioned for a new residential hall in their November 2000 "Residence Hall Program." This document outlines the core values needed in an undergraduate dormitory. The foundation of these core values is the creation of enough space where individuals feel comfortable, while also encouraging socialization with peers.[41] Here is a condensed list, taken from the "Residence Hall Program" document, of ORL specifications for a residential cluster:

- Residential floors should be composed of between 40 and 60 residents
- Each floor should have two study rooms, two lounge areas and one residential cooking/dining/den room area
- Rooms and common spaces should be designed in such a way that privacy is afforded while creating an environment that encourages interaction
- Bathrooms should be designed so that no more than six residents are expected to share a fixture
- Hallways should be wide enough to allow for hanging out on the floor and include plenty of light
- Adequate space should be provided for recycling, trash and custodial needs
- A classroom/seminar room should be incorporated into each building
- Some lower level space should be used for programmatic endeavors such as a dance/aerobics area, music practice space or game areas[42]

Design

Best Practices

Although McLaughlin represents a significant improvement over other Dartmouth dormitories in terms of energy efficiency, there is potential for Dartmouth to progress further in future building projects. Below are a series of recommended technologies, sorted by application.

Windows

Windows play a key role in reducing energy use in buildings and improving occupant comfort. Generally, window selection represents a tradeoff between transmitting daylight and conserving heat. For example, bedrooms in the McLaughlin cluster will have fewer and smaller windows for better heat conservation and less daylight, while common rooms and hallways will have more and larger windows for more daylight but less heat conservation.[43]

New double-pane windows with gas fill and coatings present significant energy savings over older single- and double-pane windows. Further, new windows that are certified as energy efficient provide particularly high comfort and energy savings. The McLaughlin project will use Eagle windows that are rated by the National Fenestration Rating Council (NFRC) and certified by EnergyStar.[44] NFRC is a non-profit organization that rates windows, doors, and skylights based for energy efficiency.[45] EnergyStar certifies windows that meet performance standards based on the NFRC rating system.[46]

The NFRC ratings are based primarily on a U-factor (a measure of heat loss) and a solar heat gain coefficient, SHGC (a measure of sunlight blockage).[47] The U-factor is usually between 0.20 – 1.20, with lower numbers indicating more efficient windows. Eagle vertical slider windows have U-factors of 0.30 – 0.50, which are scores toward the lower end of the range and therefore indicate very efficient windows.[48] The SHGC is between 0-1, with lower numbers indicating more efficient windows that transmit less solar heat.[49] Eagle windows have SHGCs of 0.25 – 0.54, indicating windows that are moderately efficient.

The best windows, in terms of energy efficiency, depend on a building's heating or cooling load. Buildings in cold regions that use energy primarily for heating require windows that are highly insulated (low U-factor) and less-reflective (high SHGC). For a window to be EnergyStar certified in the Northern region, it must have a U-Factor of < 0.35, so many of the Eagle windows are certified.[50] There is no SHGC requirement for Northern region locations. Using EnergyStar certified windows instead of standard double-pane windows saves an estimated $65 per year in a single-family home in New England;[51] savings in a large residence hall would likely be much greater.

Daylighting

Examining the McLaughlin floor plans, one can see that there is extensive use of windows. Each dorm room will have a window and many windows will occupy the social spaces of the buildings. Common rooms, study rooms, living rooms and hallways all have many windows that can be used for daylighting. During the day, natural sunlight often supplies enough light so electrical lighting will not be needed. The older residence facilities lack enough windows in hallways and lounges to utilize daylighting. Natural lighting is frequently preferred by residents and creates a healthier atmosphere, which can also cut down on the use of energy. It will just be a matter of residents turning off electric lights when the amount of sunlight from the windows is sufficient for the space.

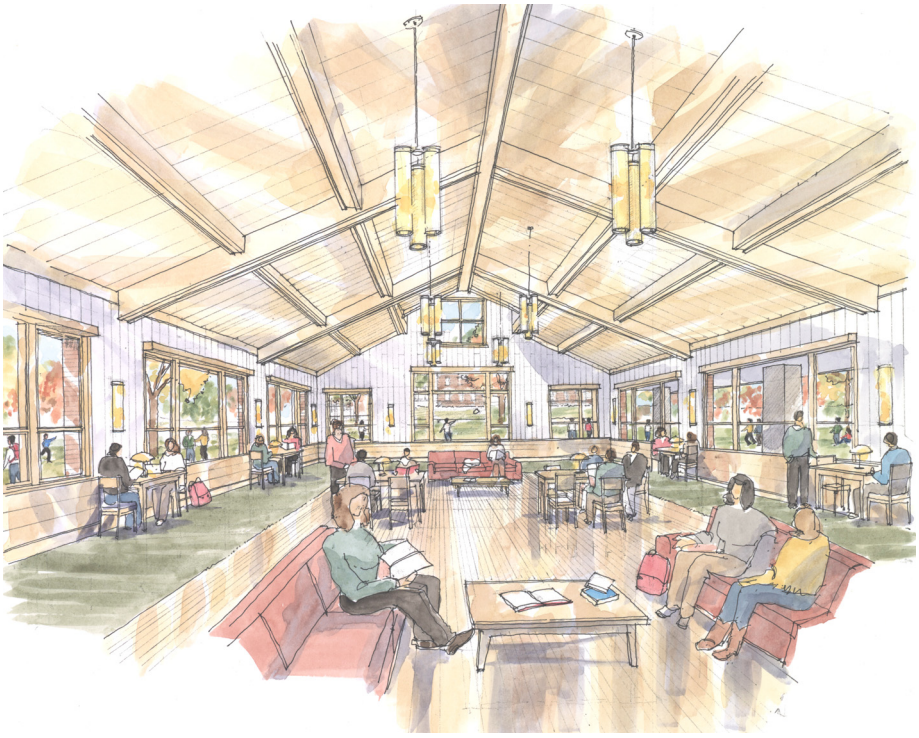


Figure 1.2: McLaughlin Cluster commons.

Daylighting can and should be used in lounges and study rooms; however, daylighting has not been taken into consideration for dorm rooms. With only one window, many may feel that daylighting cannot be utilized. But, there are ways in which daylighting can be used while also helping create a more comfortable temperature in the rooms. Light shelves are an easy way to utilize daylighting in areas that may not receive as much sunlight. Shown below, light shelves are curved pieces of reflective material that extend from the exterior to the interior of a room, towards the top of each window. Light shelves are in use in the new West Quad dormitories at the University of South Carolina.[52] These dorms are a great example of energy efficiency, with light shelves contributing to their 45% energy savings over traditional residence halls.[53] Light shelves are installed on every south-facing window in the cluster and provide the dual benefits of climate control and daylighting maximization. When the sun is higher in the sky during the summer months, some light is reflected off of the outside portion of the shelf, making the room cooler. During the winter however, the sun is low enough in the sky for sunlight to shine directly into the windows. Throughout the year, sunlight is reflected off of the inside portion of the shelf onto the ceiling, reducing the need for electric lighting. Light shelves should be considered for future projects. Using daylight instead of artificial light would be beneficial to residents' health and comfort, while also reducing the amount of energy used in the dormitories.

Figure 1.3

Materials and Insulation

Energy is expended in both creating and transporting materials, so using local and recycled materials can reduce this cost. Similarly, lightweight materials require less energy for transportation. Higher quality materials may be more costly but also more durable, and so they are cost-effective for buildings that are meant to be enduring structures, such as Dartmouth's "100-year" buildings.

Building residence halls requires additional insulation considerations beyond typical projects. For example, walls and floors must be constructed of materials that act as good sound insulators. The McLaughlin project uses concrete and masonry walls that are dense, so they keep rooms quiet and have a high heat capacity, making them efficient for keeping buildings warm or cool.[54]

There are new alternatives to traditional pre-cast concrete forms or wood framing with poured concrete, two methods used to build structural walls. Alternatives include several types of insulated concrete forms. A lightweight foam forms take the place of wood framing and remains in place after the concrete is poured.[55] These systems improve insulation and are often composed of recycled material[56] and so reduce both dependence on natural resources and carbon emissions during production. Insulated concrete forms are more expensive than traditional wood framing, and are primarily marketed towards individual homeowners and builders in warmer climates.[57] Though the benefits of reduced energy use from improved insulation are appealing, these alternative materials may not be appropriate for Dartmouth's construction projects.

Heating and Cooling Systems

The new dorms currently under construction have made great strides in creating an environmentally efficient heating system that should also be extremely comfortable for the residents. The plans call for a hydronic radiant floor heating system that pumps "heated water from a boiler through tubing laid in a pattern underneath the floor"[58] This system provides an ample amount of comfortable heat, as the heat source is the entire floor rather than point sources like a radiator or air vent. In ordinary heating systems, "heating outlets or

baseboards are place on outside walls and the system is designed to fill the area with warm air...air stratification and heat loss to the ceiling are significant with convective heat."[59] In the new dorms, the floor and ceilings will be brought up to temperature and this massive heat source will allow the buildings to operate their heating system at temperatures far lower than a conventional system would allow. According to "studies conducted by the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)...with radiant heating systems people can be comfortable at temperatures 6°F to 8°F lower that with convective systems."[60] The College is planning to run its system at a narrow temperature range of 68°F to 72°F thus allowing for a comfortable environment, while using far less energy than a conventional heating system.[61] This allows for the system to operate using warm water rather than steam, reducing heating costs.

The heating systems for both the Tuck Mall and McLaughlin residence halls will consist of a heat exchanger that converts steam from the College steam infrastructure into warm water. The water will then be pumped through cross-linked polyethylene (PEX) tubing in the concrete underneath the flooring.[62] This is considered a "wet" installation where "the tubing is embedded in the concrete foundation slab, or in [this instance] a lightweight concrete slab on top of a subfloor, or over a previously poured slab."[63] Because the system will be heating the entire floor, controlling the system on an individual level will be impossible. The concrete slab "takes many hours to heat up if it is allowed to become cold,"[64] thus the system's heat must be maintained and cannot be subject to constant fluctuation. While this lack of personal control may be frustrating to residents at times, it comes with "fuel savings of 15% to 20% over forced air systems."[65] The College has taken great strides in increasing heating efficiency in its buildings by implementing such an effective heating system—but it falls short of being an environmentally revolutionary project because the plans do not call for the implementation of several relatively simple and effective green technologies.

The current plans call for a cooling system that would pump cold water through a separate PEX tubing infrastructure in the ceilings of the new residence halls. This seems somewhat unnecessary considering the average summer high temperature in Hanover is only 82.7°F[66] and with relatively effective design and insulation the internal temperature of a building should never reach that temperature. The cooling system also has the potential to cause major difficulties, because "in humid climates, problems with over-cooling the floor could lead to wet slippery surfaces and fungus growth."[67] The College has addressed this issue by ensuring that the new dorms have a tight seal and thermal sensors in the outer walls and the floor slabs so that the temperature difference does not cause condensation.[68] The temperature of the water in the cooling system will likely be maintained at around 68°F, thus the water only needs to be cooled and not intensively chilled like in a conventional air-conditioning system.[69] While the radiant cooling system in the new dorms is more efficient than most cooling systems, the relatively low need for a cooling system in New Hampshire coupled with the concerns about condensation—make a significant argument for not implementing a cooling system.

While the heating system should operate quite effectively, this system easily lends itself to the implementation of solar collectors in the creation of warm water for the system. Currently the University of South Carolina's West Quad dormitory uses a solar heating system to warm water before it is used in the dorm.[70] A similar system could easily be put into use in conjunction with the radiant heating systems in the new dorms. Solar panels would be very effective on the south facing roofs of both new buildings. While it may seem quite difficult to implement solar technologies in the cold of New Hampshire, "it is possible

to use solar energy in these areas. It is just not as easy as it is in Colorado. A solar energy system must be very efficient and well thought out to be practical in some areas, but it can be done."[71] Some may have doubts about the effectiveness of solar energy in the New Hampshire climate, but "one factor that really helps with solar heating performance is the fact that the sunshine often comes when you really need it. In Vermont, November is a quite cloudy month, but it is generally mild. The cloudiness tends to result from warmer air coming up from the South. The brutally cold weather that we get in winter, along with much of the Northern parts of the US, is the result of very clear, cold and dry air coming down from the North. The result is the most brilliant sunshine that we get all year, just when it is coldest. This 'happy confluence of solar circumstances' is just what we need to get the most from our solar heating systems." [72]A substantial amount of the surface area of these buildings is facing south—the most effective direction to have a solar collector face. The addition of solar collectors to this heating system can be effective because "the radiant floor system requires water temperatures in the same range that the solar system can generate. Hydronic baseboards and fan coil systems, by comparison, require water temperatures that are much higher than most solar systems can provide."[73] Adding solar energy would allow for these new buildings to score higher in the LEED evaluations in the Energy and Atmosphere by optimizing energy performance (EA Credit 1) and having a portion of the building's energy provided by on-site renewable energy (EA Credits 2.1, 2.2, and 2.3).[74] Adding solar energy collectors would be extremely cost effective as "this could reduce heating fuel consumption from 10% to 90%."[75] It is simple improvements like these that could make the new construction projects not only an example of efficiency, but also an example of active environmental improvement.

The Shortcomings of LEED

For the most part, Dartmouth College has taken significant steps towards more sustainable building practices in its new dorms by way of its focus on LEED Certification and also the selection of architectural firms such as Moore Ruble and Yudell and Bruner/Cott and Associates that are heavily experienced with sustainable design. However, the College should be careful not to focus solely on achieving LEED Certification. According to Auden Schendler and Randy Udall, in their article, *LEED Is Broken…Let's Fix it,* "The best green buildings don't just have fresh air and daylight, they have heart, soul, humanity: palpable qualities you can feel. In contrast, interactions with the LEED rating system tend to be rigid and soulless, as stark and clinical as a colonoscopy."[76] The authors point out five significant flaws with the LEED system, which are applicable to Dartmouth's registered projects. Potential pitfalls of LEED are:

1) **LEED costs too much.** "LEED certification typically adds 1% to 5% to the budget of any project."[77] If money is a driving factor behind the construction of new dorms at Dartmouth College, this budget increase should be of significant importance. The question arises, is LEED the most economically efficient way to achieve more sustainable buildings? For example, "Milwaukee's new Urban Ecology Center is one of the greenest buildings in the upper Midwest. Certified? No, 'because it could have added as much as $75,000 to the cost, just for the paperwork.'"[78] Many design teams and contractors now are using LEED Checklists as guidance for sustainable building practices, but

never registering with LEED because the process is too time consuming and expensive.

2) **Point Mongering and the LEED Brain**. When a design team obsesses and focuses solely on getting credits rather than adding environmental value, inefficient technologies are pursued. "LEED Brain is a term for what happens when the potential PR benefits of certification begin driving the design process." [79] The irony of focusing on LEED points can be illustrated by the fact that the College can get 1 point towards certification by providing ORL mandated bike racks (approximate cost $300), while in order to get another similarly weighted point towards certification, the College might need to spend 1 million dollars for a LEED-approved HVAC system that could save $500,000 in long-term energy expenses.
3) **Energy modeling is fiendishly complicated. "**In order to achieve any of the energy credits, you have to measure building performances following American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) guidelines, *except as modified* by LEED's protocols. It can be complicated and time-consuming to follow both procedures."[80]
4) **Crippling bureaucracy.** LEED specifications lack the simplicity required for intuitive understanding, and instead "are fast taking on the complexity of the federal tax code."[81] One example of this is how Dartmouth goes about using wood from the College Grant. According to the LEED Checklist, buildings must use Forest Stewardship Council (FSC) certified wood.[82] According to Phil LaClaire, the Dartmouth Project Manager for the McLaughlin Cluster, Dartmouth College took the expensive steps to certify the College Grant in 1999, but that certification was not with the Forest Stewardship Council.[83] Therefore, under LEED bureaucracy, the use of well-managed Grant wood for construction does not fall under LEED Checklist Guidelines and cannot be used towards LEED certification.
5) **Overblown claims of Green Building Benefits are Misleading.** When you build green, so many different benefits are claimed (such as worker productivity) that they may dilute other more tangible benefits such as energy efficiency. Overblown claims can make builders more skeptical of the costs of green buildings, and miss the huge benefit that energy savings have on the bottom line.

EnergyStar: An Alternative to LEED

Dartmouth College is currently a partner in the US Environmental Protection Agency and Department of Energy's EnergyStar program. The use of EnergyStar appliances has the significance of saving Dartmouth money in reduced costs, because of the energy efficiency of these products. EnergyStar was a program created by the EPA in 1992.[84] The purpose of the program was to decrease both greenhouse gas emissions and energy use by advocating the use of energy-efficient products.[85] The EnergyStar label marks a various range of products for use in the home, workplace, and industry, and the label is even used to characterize

buildings that have excelled in their attempts to reduce energy usage and greenhouse gas emissions.

Organizations work with the EnergyStar program to create a business model which will reduce the organization's use of energy. In joining the program, the EPA and Department of Energy work to ensure that an organization understands the ways in which it can increase the energy-efficiency of its buildings. The EnergyStar program is funded by the government, and the program's budget is "used to provide businesses and consumers with information and tools that break down major market barriers and alter decision making in the long term."[86]

The government's endorsement of the EnergyStar program differentiates EnergyStar from LEED. When an organization seeking to implement energy-efficiency goals gains the support of the EnergyStar program, it closely works with that organization to develop a model that would ensure greater energy savings. Joining the EnergyStar program does not require a fee, and saves that organization in future electricity costs. In order to gain LEED accreditation, however, an organization lacks such backing, having to pay the costs of creating a Green Building along with consultant fees and the cost to apply for LEED certification.[87]

Rather than the point-based system used by the USGBC to grade buildings, EnergyStar employs a method of analyzing performance that is simpler and more easily understandable than the LEED system. The EPA and the DOE created an energy assessment system, the national Energy Performance Rating System (EPR), which quickly and cost-effectively analyzes buildings through the measurement of source energy. Source energy is a measurement of energy consumption, determined by adding the energy consumed at the location of a building (site energy), and "energy used to generate, transmit, and distribute the energy to the building."[88] A building's grade is determined by its performance relative to other buildings in its category. The building is given a grade from 1-100.[89] This grade can be determined using a portfolio manager on the Energy Star website.[90]

Buildings receiving a grade of 75 or above can qualify for EnergyStar certification, a distinction meant to demonstrate that building's success in energy management.[91] To gain the EnergyStar certification, after the EPR has been established, a Professional Engineer licensed within the state where the building is located has to examine the building to "determine if the building meets indoor standards for comfort and indoor quality," and verify his findings by signing a Statement of Energy Performance.[92] Then, a letter of agreement to the terms of the EnergyStar guidelines has to be signed and sent, along with the Statement of Energy Performance, to the EPA. If the building is certified, recipients receive a Bronze plaque recognizing their achievement.[93]

As of right now, over 1100 buildings have been given the EnergyStar honor.[94] However, this honor currently cannot be applied to College residence halls. The inability to achieve EnergyStar certification has not hindered the College's decision to provide only EnergyStar appliances for use in the common areas of McLaughlin Cluster. All public refrigerators, television and VCR/DVD systems, exit signs, vending machines, and washing machines for use in the future dormitory will be Energy Star designated.

Dartmouth's use of EnergyStar appliances for the McLaughlin Cluster demonstrates the College's commitment to achieving greater energy-efficiency. With further expansion of the EnergyStar program, there arises the possibility of extending its certification system to College residence halls. If College dormitories became eligible for EnergyStar certification,

the McLaughlin Cluster stands as a strong candidate for this honor. For future building projects, it may be beneficial for Dartmouth to seek Energy Star, rather than LEED, certification.

V. APPENDIX 3A: LEED CHECKLIST

Sustainable Sites 14 Possible Points
Prereq 1 **Erosion & Sedimentation Control** Required
Credit 1 **Site Selection**
Credit 2 **Urban Redevelopment**
Credit 3 **Brownfield Redevelopment**
Credit 4.1 **Alternative Transportation**, Public Transportation Access
Credit 4.2 **Alternative Transportation**, Bicycle Storage & Changing Rooms
Credit 4.3 **Alternative Transportation**, Alternative Fuel Refueling Stations
Credit 4.4 **Alternative Transportation**, Parking Capacity
Credit 5.1 **Reduced Site Disturbance**, Protect or Restore Open Space
Credit 5.2 **Reduced Site Disturbance**, Development Footprint
Credit 6.1 **Stormwater Management**, Rate or Quantity
Credit 6.2 **Stormwater Management**, Treatment
Credit 7.1 **Landscape & Exterior Design to Reduce Heat Islands**, NonRoof
Credit 7.2 **Landscape & Exterior Design to Reduce Heat Islands**, Roof
Credit 8 **Light Pollution Reduction**

Water Efficiency 5 Possible Points
Credit 1.1 **Water Efficient Landscaping**, Reduce by 50%
Credit 1.2 **Water Efficient Landscaping**, No Potable Use or No Irrigation
Credit 2 **Innovative Wastewater Technologies**
Credit 3.1 **Water Use Reduction**, 20% Reduction
Credit 3.2 **Water Use Reduction**, 30% Reduction

Energy & Atmosphere 17 Possible Points
Prereq 1 **Fundamental Building Systems Commissioning** Required
Prereq 2 **Minimum Energy Performance** Required
Prereq 3 **CFC Reduction in HVAC&R Equipment** Required
Credit 1.1 **Optimize Energy Performance**, 20% New / 10% Existing (2 points)
Credit 1.2 **Optimize Energy Performance**, 30% New / 20% Existing (2 points)
Credit 1.3 **Optimize Energy Performance**, 40% New / 30% Existing (2 points)
Credit 1.4 **Optimize Energy Performance**, 50% New / 40% Existing (2 points)
Credit 1.5 **Optimize Energy Performance**, 60% New / 50% Existing (2 points)
Credit 2.1 **Renewable Energy**, 5%
Credit 2.2 **Renewable Energy**, 10%
Credit 2.3 **Renewable Energy**, 20%
Credit 3 **Additional Commissioning**
Credit 4 **Ozone Depletion**
Credit 5 **Measurement & Verification**
Credit 6 **Green Power**

Materials & Resources 13 Possible Points
Prereq 1 **Storage & Collection of Recyclables** Required
Credit 1.1 **Building Reuse**, Maintain 75% of Existing Shell
Credit 1.2 **Building Reuse**, Maintain 100% of Shell
Credit 1.3 **Building Reuse**, Maintain 100% Shell & 50% Non-Shell
Credit 2.1 **Construction Waste Management**, Divert 50%

Credit 2.2 **Construction Waste Management**, Divert 75%
Credit 3.1 **Resource Reuse**, Specify 5%
Credit 3.2 **Resource Reuse**, Specify 10%
Credit 4.1 **Recycled Content**, Specify 25%
Credit 4.2 **Recycled Content**, Specify 50%
Credit 5.1 **Local/Regional Materials**, 20% Manufactured Locally
Credit 5.2 **Local/Regional Materials**, of 20% Above, 50% Harvested Locally
Credit 6 **Rapidly Renewable Materials**
Credit 7 **Certified Wood**

Indoor Environmental Quality 15 Possible Points

Prereq 1 **Minimum IAQ Performance** Required
Prereq 2 **Environmental Tobacco Smoke** (ETS) **Control** Required
Credit 1 **Carbon Dioxide** (CO_2) **Monitoring**
Credit 2 **Increase Ventilation Effectiveness**
Credit 3.1 **Construction IAQ Management Plan**, During Construction
Credit 3.2 **Construction IAQ Management Plan**, Before Occupancy
Credit 4.1 **Low-Emitting Materials**, Adhesives & Sealants
Credit 4.2 **Low-Emitting Materials**, Paints
Credit 4.3 **Low-Emitting Materials**, Carpet
Credit 4.4 **Low-Emitting Materials**, Composite Wood
Credit 5 **Indoor Chemical & Pollutant Source Control**
Credit 6.1 **Controllability of Systems**, Perimeter
Credit 6.2 **Controllability of Systems**, Non-Perimeter
Credit 7.1 **Thermal Comfort**, Comply with ASHRAE 55-1992
Credit 7.2 **Thermal Comfort**, Permanent Monitoring System
Credit 8.1 **Daylight & Views**, Daylight 75% of Spaces
Credit 8.2 **Daylight & Views**, Views for 90% of Spaces

Innovation & Design Process 5 Possible Points

Credit 1.1 **Innovation in Design**: Specific Title
Credit 1.2 **Innovation in Design**: Specific Title
Credit 1.3 **Innovation in Design**: Specific Title
Credit 1.4 **Innovation in Design**: Specific Title
Credit 2 **LEED™ Accredited Professional**

Project Totals 69 Possible Points

Certified 26-32 points **Silver** 33-38 points **Gold** 39-51 points **Platinum** 52-69 points

4

EXISTING DORMS

Creating a greener Dartmouth primarily requires two things*:* targeting student behavior and physical dorm features. In this section we will first address student attitudes towards energy efficiency and then turn to the physical aspects of Dartmouth's existing dorms, focusing on energy use. During the past few months, we analyzed the Environmental Conservation Organization [ECO]'s and the Save Power and Reduce Cost [SPARC] Programs' success at decreasing student energy consumption, and offer recommendations where needed. The survey results are particularly telling about what programs need help and why. Survey feedback helped us determine solutions to increase students' environmental-consciousness. These solutions include raising people's awareness of their energy use and the associated implications, and implementing new programs such as the proposed Refrigerator Transfer Program.

In addition, we analyzed existing dorms to determine their energy efficiency. We primarily looked at residential heating systems, lighting, windows, bathroom fixtures, and appliances. After pinpointing energy sinks in dorms, we consulted the Office of Residential Life to determine what has been done in the past to retrofit older buildings, and what will be done in the future to save energy in residential halls. Throughout this section are short case studies detailing successful energy saving techniques used on other college campuses. Finally, we offer our suggestions of how ORL can retrofit existing dorms to become even more eco-friendly and further decrease dorm energy use.

I. SAMPLE RESIDENT SURVEY – EXPLANATION AND ANALYSIS OF RESULTS

The goal of this survey was to gain insight into student behavior and energy use habits of dorm residents. The survey focuses on energy consumption, such as light and appliance use (See Appendix I: ENVS 50 Survey: Energy Use in Residential Halls). It also focuses on a couple of Dartmouth's student energy resources such as ECO and SPARC. While it is important for the College itself to work towards a "Greener" campus, it is of great importance that students are educated on and take actions for reducing energy usage as well.

After creating our survey, we distributed it via email to all the residents of Mass Row. Of these 240 students, we received forty-one responses, a return rate of 17%. To increase the diversity, we surveyed a random sampling of students in Thayer lobby, giving us a total of sixty-seven responses.

We chose the Massachusetts Row Cluster as the survey pool because of the large number of occupants and the wide range of years and activities of the students residing there. Because of this diversity, the surveyed group is fairly representative of students from every contingent of environmental awareness and living habits.

Overall, students make a concerted effort to recycle and do a relatively good job of turning off lights when exiting rooms. For example, 33% gave themselves a rating of

ten, or "extremely conscious of," for turning off lights, and fourteen students gave themselves ten for turning off lights when exiting bathrooms. We found student habits to be rather environmentally-friendly***;*** however, actions initiated by the College to raise awareness and promote good habits have been disappointing (See Appendix II: Survey Data).

The ECO and SPARC programs have proven ineffective in their implementation and effectiveness on campus. Seventy-three percent of those surveyed were unsure of who the ECO representative for their floor is and do not see them as useful resources. The SPARC incentive program for energy conservation also seems to be inconsequential to those surveyed. Only 24% knew what the program was, and 18% actually aimed for the targets or knew the guidelines set by the program. Essentially, the survey points to the fact that ECO reps and the SPARC program are invisible and ineffective for students. In addition to this, students are also relatively uninformed by the College as for who to contact in case something malfunctions in their dorm room; those students unsure were 27%. Such information is important for a student to know. For example, when something such as the heater malfunctions, an alternative for students is to open the window to control temperature, which is a huge waste of energy.

Some of our ideas to create more energy-efficient habits and lifestyles around campus received very positive feedback from students. Many felt that the circulation of a list of efficient appliances to incoming students would be an excellent idea and that it would definitely guide their purchases; 72% of students felt that it would be a good idea and would consider more energy-efficient appliances. Several said they would purchase the appliances only if they are reasonably priced in comparison to appliances which consume the normal amount of energy. The "Rent-a-Refrigerator" program we have proposed also garnered the approval of 67% of students Though some said they would not participate at this point because they already own a refrigerator, many were enthusiastic to participate in this program, especially because of its convenience. This program is discussed at greater length later.

In terms of student preferences, students would like to see more windows installed in residences and that functioning in natural light is vastly preferred to artificial light provided in many hallways, common areas and study areas (a substantial 76%). Though many students recycle on a regular basis, it is at times inconvenient and some would like to see waste warriors on every floor, as some do not even know where one is located in their dormitory. 82% of students feel that the heating systems are atrocious and desperately need be reworked; these students use their windows as thermostats because they are unable to control the heat themselves.

In order to get students more involved in environmentally-sound living habits and more aware of environmental issues around campus, surveyed students feel that posters, blitzes, and UGA-led events during the term would be most effective for raising awareness. Students felt that an incentive- or reward-based system for leading more energy-efficient lifestyles would be effective as well, and they felt that rewards for their efforts to save energy in the form of food and money would be the most persuasive. If the College or the ECO program would support more high-profile rewards programs for energy conservation around campus, then students would certainly take notice and change their habits accordingly if there is incentive. Such an incentive-based system could lead to some very positive changes in student behavior, as indicated by the survey.

Most students are aware that there are indeed ways that they can conserve energy on a daily basis. For example, most know that if they are more conscientious about turning off lights when they leave a space and turning off appliances, such as computers, when not in use. Overall, students are aware that their individual actions do make a difference. This awareness, combined with the reworking of the ECO and SPARC programs, the circulation of the efficient appliance list (which received the approval of 72% of respondents), the implementation of the rewards program, and the suggested notification and awareness programs via blitz mail, posters and events, should really assist the College make large strides in its reduction in energy consumption.

II. ENVIRONMENTAL EDUCATION

ECO and SPARC Programs

The two most obvious recommendations that can be extracted from the results of our survey are that the ECO program needs to be reworked to be more visible and effective and the SPARC program needs to be more publicized around campus. An ECO representative should be chosen at the beginning of each school year (or term) and then should attend all ECO meetings. The purpose and guidelines of the SPARC program should be blitzed out once a term around campus, as well as clearly posted on each floor as well as in common areas such as kitchens and study rooms. As an incentive for this, we recommend that ECO reps be paid for their work. This will be discussed at greater length later in this section. UGA-led events should also be held each term to raise awareness about the SPARC program and what each floor can do.

Our survey results indicate that the majority of Dartmouth students are not aware that the Environmental Conservation Organization (ECO) even exists. This implies that students are similarly unaware of many of its programs and activities. The purpose of the Education and Awareness section, then, is threefold: to generally introduce ECO, to specifically describe some of its energy-conservation programs, and to compare them to programs from other schools, and to suggest ways by which ECO can better advertise and better organize to make it a more prominent and effective—especially with regard to energy conservation—environmental entity on campus.

ECO is the most prominent extracurricular environmental organization on campus today. It is a student-run, largely volunteer-based group that encourages sustainable living habits and activities, and spreads practical knowledge about the place we live and environmentally benign ways to live in it.

ECO is composed of both paid and volunteer positions. The paid positions include one coordinator and seven interns. The intern positions include an FO&M intern, an energy intern, a recycling intern, a SPARC intern, and four residence hall "rep head" interns. The unpaid positions include approximately 50 "ECO reps"—about one student volunteer per floor, per dorm.

Generally, the duty of the ECO coordinator is to direct, organize, and motivate the ECO interns. Also, he/she acts as a liaison between ECO and other environmental groups on campus, as well as between ECO and its subsidiaries, which are the Tucker Foundation and Facilities, Operations and Management (FO&M). The FO&M intern conducts research similar to that of this report, recording energy use and proposing ways to reduce use and increase efficiency. The recycling intern ensures the presence of waste

warriors and recycling receptacles in all buildings—residential and non-residential—on campus. The SPARC intern coordinates the "Save Power and Receive Cool Stuff" competition between dorms each term. (For more specific information on the duties of the coordinator and these three interns, see Appendix III: ECO Interns).

The four residence hall "Rep Head" interns are responsible for recruiting, educating, and communicating with the volunteer ECO "Reps." Along with the volunteers, these rep heads are the organizers and facilitators of residential environmental activities. Also, along with the volunteer reps, they serve as the primary source of environmental knowledge and advice for students. Finally, they ensure that ECO reps monitor and empty dormitory waste warriors. (For more specific information on the duties and activities of rep heads and volunteer reps, see Appendix IV: Rep Head Activity Summary.)

All interns report to a supervisor. The coordinator currently reports to Tracy Dustin-Eichler of the Tucker Foundation, while all other interns report to Linda Hathorn of FO&M.

Sample "ECO" Projects at Other Schools:

Energy Saving Computers
The Harvard University Kennedy School of Government, in partnership with the EPA's ENERGY STAR program, saves more that $14,000 a year on its energy bills by enabling 800 computer monitors to power down to sleep mode when not in use. This was made possible through the use of EZ Save software developed by ENERGY STAR. At the undergraduate level, the Harvard Computer Energy Reduction Program employs the ENERGY STAR EZ Wizard software tool to allow students, often not hooked up to a network, to activate monitor power management on their computer quickly and easily by clicking on an icon located at their web site.[1]

Model Dorm Rooms:
Tulane University has been highly successful in creating an ENERGY STAR showcase dorm room. The room features ENERGY STAR labeled lighting, office equipment, and home electronics. The two sophomore students living there estimated that their room would save approximately $130 over the course of the school year. If every one of Tulane dorm rooms used ENERGY STAR products, they estimated Tulane would save over $200,000.[2]

Also important in terms of education and raising awareness is the SPARC program. It is essentially an energy-saving contest between all the residence halls on campus. Begun in 1998, it is held every fall, winter, and spring term. At some point in each of these terms, hall residents are notified by blitz that for the next month, their energy use as a building will be monitored by Facilities, Operation, and Management. The winner of the contest is the dorm that reduces its energy use the most from the same month of the previous year. At the end of the month, kilowatt hours are calculated; a non-monetary prize, for example a massage party, is awarded to winning dorm.

Despite a lack of awareness of its existence, ECO continues to energetically persist on campus. This state of affairs indicates that ECO is not currently doing enough to make itself and its mission known; on the other hand, it indicates that the potential exists for a significant increase in membership and activism when it does. Imagine what could be achieved by combining the existing direction and organization of ECO with the self-motivation and drive of dozens more Dartmouth students. We believe the most significant barrier currently preventing such a union is a simple lack of knowledge. The solution is education.

ECO, therefore, has two educational responsibilities. The first is to continue educating about the environment, and how and why we should care for it. The second, and perhaps currently more pressing, is perhaps one not previously considered: ECO has to educate about itself. The organization has to make itself known. The more students who know about it, the more students who will become active within it, and the more prominent and effective it will become.

This will not be easy. In a community as active as Dartmouth's, it is difficult to 'get the word out' about anything. Every night a dozen lectures are taking place, half a dozen films, one or two cultural events, and a contest of some sort. Societies, clubs, and Greek houses are meeting. Weekends brim with parties, sports events, and DOC trips. And any spare time, of course, is filled with school work. This is ironic, as we believe environmental activism and awareness should not need to compete at all for prevalence. Conserving energy in dorms, for example, should not be an activity you meet with your friends once a month about and then put on your resume as an accomplishment; it must take place daily, hourly, must be mandatory, expected. Knowledge about Energy Star compliance and tons of carbon dioxide emitted per kilowatt hour produced should not be optional and extracurricular; it must be *curricular*, taught in the classroom, and taught interdepartmentally.

Dartmouth may not yet be ready to make this transition, but progress can begin at a secondary level. Because ECO is Dartmouth's primary motivator of environmental activity, it is also the College's best hope for introducing environmental awareness into its student body. To make this happen, ECO must simply out-compete other organizations for membership, excitement, and opportunities. Increasing student participation and enthusiasm will in turn create ripples among the faculty, administration, and greater Dartmouth community. Only then will necessary shifts in lifestyles—especially, as we are reporting on, in energy use—occur. To make this possible, we offer some suggestions on restructuring, reorganizing, and revamping the program.

It is our firm belief that increasing awareness and better educating the student body on environmental issues can have a profound impact on student behavior, having subsequent benefits not only for the environment but for Dartmouth as an institution. We can see how Harvard's Resource Efficiency Program (See Appendix IV: Harvard's Resource Efficiency Program**)** has been a success. We believe that Dartmouth has already established the basis for similar success through ECO. However, while ECO has achieved many positive results there still remain some areas where ECO with the help of the College could be improved to achieve much more.

Full Time ECO Director

The recent hiring of a Sustainability Coordinator is a clear and positive step in the right direction towards increasing environmental consciousness across campus. Not only will the Sustainability Coordinator be a liaison between students and administration, but he will also be a crucial connection to the student body. For these reasons, it is clear that this position is of critical importance to maintaining a common awareness among administration and students regarding the environment.

Currently, ECO is run by students, but there would be a number of benefits in having the Sustainability Coordinator oversee and direct this program. It seems that ECO members introduce well thought-out and interesting ideas pertaining to the environment and how Dartmouth can benefit from certain actions only to have these ideas lost as the term ends and ECO positions change[3]. Thus, having someone to oversee ECO would prove beneficial in ensuring that ideas are carried over from one term to another. As previously mentioned we also see the Sustainability Coordinator acting as a liaison between ECO, ORL, FO&M, and other organizations/people on campus that have an influence over potential environmental programs and policies. The Sustainability Coordinator could also prove extremely valuable in raising funds for ECO through acquiring sponsorship and grants which we believe would undoubtedly benefit ECO's ability to raise awareness across campus, resulting in increased student involvement in the environment.

ECO Floor Reps

The role of ECO floor reps is another aspect of the organization which would be improved with the help of the Sustainability Coordinator. Currently, the role of the ECO reps is to empty the waste warriors; these representatives are volunteers. Since the work can be unpleasant, it is worth looking at funding to pay ECO reps for their work and limiting the number of ECO reps in each dorm to one. This idea stems from the success seen with the Resource Efficiency Program [REP] at Harvard, where some of their funding comes from sponsorship and grants. If ECO reps were to be paid, then limiting the number of reps should not be a problem as currently enthusiasm for this position appears to be lacking. In fact, the last ECO rep meeting had a very poor turnout: only 10 out of 50 reps showed up[4]. Employing students would increase consistency.

We believe the most immediate way to increase student interaction with ECO reps is through encouraging close relations with UGA's, especially in the first year dorms where first-year students tend to engage in most UGA/floor activities. This could be an easy way for reps to educate and inform students about the environmental programs and issues on campus, and Dartmouth could benefit from having the priorities of ECO reps revamped to have education and awareness number one.

First-Year Student Appliances

It is important to target all students, but perhaps the most effective way of educating a campus to become more environmentally-conscious is through targeting first-year students. The idea of targeting first-year students would be to educate them so that for four years at Dartmouth, and then beyond, they make lifestyle choices that positively contribute to the environment. Targeting first year students starts before they arrive on campus.

Since every first-year student is required to live in a dorm, and most first-year students purchase appliances for their rooms, it would be beneficial to Dartmouth for energy efficiency purposes to send incoming first-year students a list of Energy Star approved appliances or provide a list online. The use of these appliances could have immediate energy savings as our survey indicates that a strong majority of students would use energy efficient appliances if a list was supplied. [iv]

Personal refrigerators are a common appliance in most dorm rooms, yet can also be the most problematic in terms of energy efficiency. Therefore, we have provided a policy for personal refrigerators that we think the College will benefit from if implemented.

Orientation Session

A mandatory environmental seminar offered during orientation week would help acquaint new students with the greener aspects of campus. During orientation first-year students generally seem eager to acquaint themselves with their campus. Our vision of this orientation includes representatives from the ENVS department, ECO, and SPARC providing students the opportunity to learn about the environmental programs that exist on campus. It would be ideal that the information presented be in terms of how students and their behavior can positively or negatively impact the environment and how they can make a difference through simple choices (for an example of providing relevant information to students about the environment, see Poster Proposal)**.** Again, the role of the Sustainability Coordinator would prove valuable in organizing an Orientation event and thus making Dartmouth a more environmentally-conscious campus. In our discussions with the leaders of ECO and SPARC, both seemed enthusiastic about the idea of an orientation to target students.

There is a need at Dartmouth for increasing the environmental awareness of the student body. We have made some recommendations for how Dartmouth can improve ECO, most of which stem from the Sustainability Coordinator. ECO already provides a solid base for a program that over time could have the potential of the REP program at Harvard. For the immediate future we have made some recommendations for educating the student body and these primarily involve targeting first year students and the importance of doing so before their Dartmouth experience even begins. We have also referred to two other proposals, the Personal Refrigeration Proposal and the Poster Proposal, which are detailed in the next sections. We strongly believe these proposals can have an immediate impact on energy use and education and can be implemented in the near future. Education and awareness are essential components to achieving an environmentally-conscious student body, and achieving this will require a joint effort of faculty, staff, and students committed to making the environment a priority.

The "Living Green" Poster Proposal

While there has certainly been a sustained effort over the years to raise student awareness of day-to-day resource use in dorms, there are stronger steps that can be taken to further this goal. Frank Roberts, the director of FO&M, believes that awareness is the

[iv] A list of ENERGY STAR approved appliances can be found at <http://www.energystar.gov/index.cfm?fuseaction=find_a_product>

most logical step to take in attempting to decrease electricity use on campus. His vision for doing this involves an electronic readout or monitor in the entryway of every dorm that shows students electricity use of their dorm, broken down between system use (fans, etc.) and personal use, consisting of computers and refrigerators. The idea is to make the students conscious of the amount of electricity that they are using.[5]

Unfortunately, such a system would cost thousands of dollars per dorm. But there is an alternative that could provide the same basic information to students, as well as other information that would not only raise awareness, but also educate students about the precise effects they are having on electricity use and the environment.

An informative poster placed in the entry or lobby of each dormitory on campus could help to significantly raise student awareness of important resource issues. The poster should be placed prominently in the lobby, along the lines of the intramural sports championship plaques that are currently in dorm lobbies. The idea is that the information should not be considered simply another announcement that is posted on the bulletin boards, but instead a more permanent fixture of the dorms that helps inform students on how to make good choices and be responsible. A simple analogy is that the environmental posters would be much like having a poster of the food pyramid in food court, to help inform students' choices.

The information on the poster would ideally be updated each month, with that dorms recent electricity and heating use, along with waste production. Most of this information is available through FO&M. Having the information updated every month would allow students to compare their use with the average use of students in their dorm in past years.

The information on the poster can be broken down into two parts: a feedback / comparative part and an educational part. The feedback / comparative section would include the updated information on that dorm's use of electricity and heating, and compare it to past years. The educational section of the poster would show students how to make better decisions that could reduce the amount of electricity used or waste produced.

Feedback / Comparative

-Electricity use by dorm and by average per person, for the last month

-Waste production

- Volume of waste being trucked and cost for disposal, be it at landfills or incinerators

-While current waste disposal is not measured by dorm, this might be possible. If there is motivation to do so, it should be coordinated between the ECO intern and FO&M.

-Heating use

-Students are not able to do anything about their heating use, but the knowledge may nonetheless be helpful.

-Showing an estimate of how much each room uses, and perhaps how much that translates to in terms of consumed fuels. It is also possible to show what that amount of heat in a volume the size of the dorm should be generated, thereby attempting to get at a measure of heat-waste.

Educational section

-Average electricity use of appliances

-Computers (desktop vs. laptop), fridges, lamps

-Compare this to Energy Star appliances

-Cost of electricity in dollars as well as gallons of oil burned per kWh

-CO_2 emissions associated with each kWh of electricity used

-Pounds of waste produced by Dartmouth each year

-inform about what is recyclable

-show energy savings from recycling (per aluminum can, etc.)

-Heating information for each building can be found at ORL website, for most efficient use: <http://www.dartmouth.edu/~orl/res-ops/heat/index.html>

The existence of such a poster would obviously require constant effort in each dorm, especially to update the information. Such effort could either come from the undergraduate advisors of the particular dorm or from the ECO representative from that dorm. The UGA would be an ideal choice, as it would be somebody who is in constant contact with the students of that dorm, and so could help to inform them of the correct choices that can be made to help reduce electricity use and waste production. Furthermore, UGA's are paid by the College, and so theoretically would be compensated for the effort of maintaining the posters. In paying for electricity and trash removal, FO&M has a vested interest in increasing awareness and student responsibility of environmental issues.

The source of the information would need to be separate from the UGA's, as it would need to be compiled monthly and broken down per dorm. Once a system is set up to acquire the information, this effort would be minimized, but nevertheless someone is needed to research the environmental impact of each dorm. ECO reps could most likely do this, as they are already familiar with the numbers that would be researched. We recommend that the ECO intern compile and update the information from FO&M on a regular basis and email the information to the UGA's, who could then update the posters.

One of the bases behind this poster proposal is that energy efficiency technology will allow students to decrease their energy consumption. By educating students not only about behavior that can decrease energy use but also technological choices, Dartmouth could make living in a sustainable manner an easier decision for students to make.

The College must also make the same decision, and as it is already aware of options for doing so, there is no excuse not to make a deliberate push for energy efficiency. The following section details and analyzes current use, as well as looking for ways in which the College could become more sustainable in its practices. Both students and the College need to make a shift towards increased energy efficiency. The College has the dual role of being able to make the decision easier for students as well as being a role model for the attitude it holds towards efficiency.

Case Study: The University of South Carolina's Energy Use Awareness Program:

The University of South Carolina has led the way in installing meters to measure energy use throughout their residential buildings. In their West Quad, individual electric meters are in every apartment in the resident hall, so students can compare their energy use with their neighbors. The University hopes to establish an energy "allowance" for each unit. If students use less energy than their allowance, they will receive credit for the school's bookstore.[6]

Suggestions and Recommendations: Energy-Saving

Additionally, student responses clearly indicate that dormitory heating systems need to be reworked or fixed. It is revealing that 88% of students surveyed utilized their dorm windows as a thermostat rather than the actual thermostat itself. Using windows to control the temperature of a room is an immense siphon of energy, so retrofitting the radiators and the heating systems around campus would be imperative to energy conservation.

76% of the students surveyed would like to see more windows and bigger windows installed in dormitories. The fact that students far and away prefer natural light to artificial light indoors should be considered in future building projects.

In order to promote more sustainable living habits and practices around campus, the survey indicated that offering rewards for energy saving efforts in the form of monetary and food offers would be effective. These offers, combined with student notification of environmental issues via blitz, posters, and UGA events would engender more energy-conscious decision-making at Dartmouth.

Also, as previously mentioned, the "Rent-a-Refrigerator Program" should be instituted by the College. A majority of the students felt that the program would be a good idea, and furthermore, would more than likely use it. The program would save Dartmouth a great deal of energy, as well as save both students and the College money in the long run both in energy conservation and in disposal fees. Also, the survey indicated that it would indeed be helpful to circulate a letter to students listing energy-efficient appliances. 73% of students surveyed felt the list would be a good idea. Also, implementation of such a program would benefit the College at very little expense. The only costs incurred would be paper fees and postage, while the purchase of energy efficient appliances by students, no matter how small the number, could only save the College money. The list should recommend the appliances that are as competitive in price as possible to the regular-efficiency appliances, as some students indicated that they would purchase efficient appliances only if they are similarly priced to normal appliances.

III. PERSONAL REFRIGERATOR PROPOSAL

Personal student refrigerators cause a variety of problems. From an energy perspective, they are often inefficient. Compounding this problem, students living

together may all have personal refrigerators, because they own them from previous living arrangements.

Disposal of these appliances poses an even larger problem. Currently students have few disposal options. Reasons people leave refrigerators behind are undoubtedly varied but more than likely, two of the central factors are that graduating students are traveling too far away to make bringing their refrigerator with them infeasible or that the refrigerators no longer work or are in bad repair. Consequently, many refrigerators are abandoned after 4 years – abandoned for ORL to dispose of them at $40 per unit, excluding time and transportation costs.[7] Monetary costs of the disposal issue aside, disposal is creating unnecessary waste. Many of the refrigerators still work. The incoming first-year class represents a large potential demand for these refrigerators – and those that abandon their refrigerators would likely be happier to sell them. A proper, college-facilitated framework for transferring refrigerators between these two groups would solve the market failure and reduce waste.

Our student refrigeration proposal can be broken down into two interlocking but separate parts*:* a registration component and a rental program. In general, both parts attempt to phase in current students while making participation mandatory for all incoming students. The system should thus achieve complete participation within 4 years.

It is understood that the project will require time and monetary commitments from the appropriate College office. To this end, the program has been devised in such a way as to be as automated as possible and to hopefully generate enough revenue to offset most costs. Automation comes at a price, however, and significant upfront investment may be needed to ensure the program operates as successfully as possible in the future. In this regard, an online database may be thought of as a third component to the program.

Registration Component

Starting with the class of 2009, any student who wishes to use a privately owned and previously unregistered personal refrigerator in any College owned housing will be required to register it with the Office of Residential Life (ORL). Required registration information will include the student's name, ID number, the make and model of the refrigerator, its size, and whether it is Energy-Star compliant. All refrigerator registrations will require a $50 deposit. In addition, non Energy-Star compliant refrigerators will also be assessed a one-time $50 fee.

Registration is optional for all other students and no fee will be required, regardless of the unit's Energy-Star status. Once a unit is registered, it will be issued a durable, non-removable tag (preferably something with a barcode that is linked to the refrigerator's information).

Starting with the class of 2009, in order to be eligible for registration, personal student refrigerators must meet ORL's current physical size regulations of three cubic feet.[8] Furthermore, in order to be eligible for registering a personal refrigerator, a student must not have registered any units previously or must have demonstrated that the units were disposed of in an appropriate manner – either by selling them to the "Refrigerator Transfer Program" (RTP), by selling to another individual and completing the "Transfer of Ownership" form, or by paying for disposal and completing the "Proper Disposal" form.

Any refrigerator may be transferred to another student. Such transfers may be for a number of terms or they may be permanent. Both individuals in question will need to complete the appropriate transfer form to update ORL's records. Transfers made to those outside the College will be allowed so long as the student provides the name and address of the new owners.

Any student wishing to dispose of a registered refrigerator must follow all state and federal guidelines in doing so. At a student's request, ORL will properly dispose of a registered refrigerator for $50. If the student wishes to dispose of a registered unit on his or her own, a receipt or other paperwork indicating proper disposal must be provided, at which point the deposit will be returned in full. Any student leaving a refrigerator in his or her room without transferring it to someone else (including the RTP) or arranging for proper disposal will face a $50 fine in addition to forfeiting their deposit.

The purpose of the RTP is to lease personal refrigerators to students on a "per term" basis. If properly implemented, RTP has the potential to reduce waste and disposal costs. It offers an opportunity to break the wasteful cycle in which departing seniors leave behind or trash working refrigerators only to have incoming students buy expensive and unnecessary new ones. Furthermore, by leasing refrigerators on a per-term basis, RTP should act to reduce living situations in which multiple students, all living in the same room, all have their own refrigerators.

Pre Class of 2009: Students enrolled before 2009 will have the option to sell their current personal refrigerators to the RTP. Refrigerators will need to be clean and in good repair. They will need to meet current ORL standards with regard to size limitations. All sales will be at RTP's discretion. Energy Star certification is preferred. If the RTP approves a sale, the student will be compensated $20 per refrigerator. Free registration is required.

Class of 2009 and onward: Students owning registered refrigerators will have the option of selling them to the RTP. Refrigerators will need to be in good repair. If RTP approves the sale, students will receive their full deposit back, plus $20 for the refrigerator.

Leases will work on a first-come, first-serve basis. All students in the class of 2009 onward currently living in College owned housing will be eligible to lease a single refrigerator on a per term basis provided they do not already have a personal refrigerator registered in their name. A student currently leasing a refrigerator has the option to extend a lease into the next term, provided they are still living on campus. Lease prices will be $10 per term. Failing to return a refrigerator at the end of its lease, returning it unclean, or returning it damaged will result in appropriate fines.

Facilitating the Program

In order for this project to work at all, it must be easy, both for students and for administrators. Many of the so-called forms mentioned above could be contained within an online database. Registration could be completed online, as could transfers. More importantly, incoming first-year students could browse a real-time list of current inventory. Incoming students could select a refrigerator to lease based on make, model, and age, and they could do so before ever reaching the campus. This service will require time and cost to construct, but it is critical to the project's success.

The RTP component of the project is designed to create a win-win situation for College and students. The same cannot be said of the Registration Component which students may try to avoid. To deal with this problem, penalties must exist. For the Class of 2009 onward, having an unregistered refrigerator will result in a $50 fine. If eligible, the student will then have the option to register the refrigerator. If not eligible, it will be the student's burden to prove that the refrigerator was disposed of properly or transferred to an individual not living in student housing. Clearly visible refrigeration tags should make is easy to determine which students are in violation, especially over periods such as interims

Figure 4.1: A Whirlpool EL03CCXMQ Energy Star Compliant Fridge

How Other Schools Deal with Refrigerators:

Many schools encourage their students to rent their refrigerators from an outside company. However a few schools also run their own rental programs, so that they control the quality of refrigerators. Brown is currently considering a bulk-purchasing program, which may be a good option for universities interested in implementing a significant refrigerator replacement program.[9]

However some schools, like Boston College, not only rent out refrigerators/ microwave units to their students and take several hundred units out of service as part of a regular replacement program, but also participate in a refrigeration donation program. In coordination with the Institution Recycling Network (IRN) and the North Star Foundation, BU refrigerators were sent to needy recipients in Central America and the former Soviet Union.[10]

IV. STRUCTURAL ASPECTS OF GREEN LIVING AT DARTMOUTH

We have thus far looked at the behavioral aspect of more energy-efficient living on our College campus. While education and awareness are integral and crucial parts of reducing the College's footprint, it is prudent to also pay attention to the existing physical plants – the dormitories, in our specific study – and carefully analyze the various aspects of living as students and the buildings interact with each other. Our goal was to identify areas within residential life and operations where Dartmouth can do more to save energy. We understand that these measures have to be cost-effective in order to be worth the effort.

It was our conclusion that while ORL and FO&M are doing a good job at keeping Dartmouth in line with environmental standards, there is still room for improvement. It may be advantageous for the administration to better publicize its conversation efforts. We can certainly envision prospective students and families being interested in the steps being taken by Dartmouth toward a greener, more sustainable institution.

Lighting

ORL uses fluorescent light bulbs in almost all dormitory hallways, kitchens, bathrooms and others public areas such as study lounges. Currently T-12 and T-8 light bulbs are in use, where a lower number indicates higher energy efficiency in terms of light emitted per watt. In the future ORL plans to have thinner and more efficient T-5 bulbs replace the existing fixtures.

A striking and seemingly obvious sink for electricity is this public lighting in dormitories. The hallways are always well-lit, thanks to the light bulbs being on 24-hours a day, 365 days a year. We understand that there are regulations requiring certain levels of illumination in such areas, but it is our contention that the current facilities are above and beyond what is required, and there can be savings in this area.

Firstly, there are no public switches to these lights. ORL considered installing a dimming system connected to motion sensors but concluded that the $10,000+ price tag was not worth it. Instead, having switches that could at least turn off *some* of the lights

will allow the custodial staff as well as students to make the decision for themselves. The issue here is ensuring that the base illumination satisfies emergency lighting requirements.

Secondly, the use of motion sensors should not be ruled out for hallways:

> Automatic, motion sensor-type lighting switches shall be permitted within the means of egress, provided that the switch controllers are equipped for fail-safe operation, the illumination timers are set for a minimum 15-minute duration, and the motion sensor is activated by any occupant movement in the area served by the lighting units.[11]

Motion sensors cost up to $200, which includes the labor and installation charges. Keeping in mind that this is a one-time cost we can calculate the time required for this upgrade to pay for itself. At an estimated cost of about eleven cents a kilowatt hour of electricity here in New Hampshire, a little more than 1,800 kilowatt hours of saving will translate to $200.

A 40 Watt fluorescent bulb kept running for one year uses 350.4 kilowatt-hours. If we assume that a motion sensor will save on average five minutes every hour (will probably work out to be higher in lounges and kitchens, lower on first-floor hallways) we save about 29.2 kilowatt-hours per bulb per year. A motion sensor controlling four bulbs will, based on these estimates, save 116.8 kilowatt-hours of electricity in one year, and hence take three years to have paid for itself.

Savings could be a lot higher in bathrooms if the lighting were controlled by motion-sensors. Unfortunately this is because students often neglect to turn of the lights in such areas, and perhaps there are better ways to educate the users instead of compensating for their behavior.

Lighting At Other Schools:

Saving energy consumed by lighting requires either reducing the amount of energy required by the light source or reducing the amount of time that the light remains on. Dartmouth's light fixture replacement program in 1993-1997 was successful in both improving lighting levels for students and lowering lighting costs, however that is just the first step in reducing the amount of energy required. Daylight sensors can be installed in order to shut off artificial lights when daylight levels are adequate. Tufts University in 2001 upgrading their lighting in many of their residential buildings to include motion sensors and they foresee future financial savings.[12]

Denison University's Barney-Davis Hall is another prime example of a building updated to include sensors which monitor outside light levels and adjust indoor light levels up or down to maintain a constant level of lift in the room. Additionally Barney has been wired to house a 5- kilowatt photovoltaic solar panel system in the future. The photovoltaics will eventually power Barney's lighting system with less reliance on fossil fuels.[13]

Manufacturers and distributors of a wide variety of technology related to occupancy sensors include: The Wattstopper @ http://www.wattstopper.com, Sensor

Switch, Inc. @ http://sensorswitchinc.com, and Leviton @ http://leviton.com. Occupancy sensors are often combined with light level sensors that control the level of artificial light in a room. These light level sensors can also be used on their own as a way of cutting down on unnecessary light when there is enough ambient light. Such products are also made by The Watt Stopper and Sensor Switch, as well as by Electronic Lighting Incorporated @ http://www.elinet.com.[14]

Tufts University: Energy Saving Results of Building Renovations:

Occupancy Sensor/Lighting Project Summaries **# of sensors**

Building	Installed Cost	Rebate	Net Cost	kWh Savings	$ Saving	Pay-back	Wall	Ceiling	Status	Comments
Anderson	$17,205	$6,600	$10,605	98,107	$9,811	1.1	49	44	Completed 5/01	Occupancy sensors w/some T-12 to T-8 conversion
Dental	$57,619	$14,775	$42,844	216,398	$25,968	1.6	212	125	Completed 9/01	Occupancy sensors only
Cabot	$4,026	$1,740	$2,286	13,660	$1,366	1.7	27	1	Completed 11/01	Occupancy sensors only
Mugar	$8,167	$1,440	$6,727	1 6,454	$1,645	4.1	18	12	Completed 11/01	Occupancy sensors only
Cabot Hall of Flags	$2,589	$0	$2,589	29,784	$2,978	0.9	0	0	Completed 1/02	Incandescent to compact fluorescent
Facilities (520 Boston Ave) -- 2nd floor	$4,290	$1,502	$2,788	10,850	$1,085	2.6	12	5	Completed 1/02	Occupancy sensors only
Halligan	$37,767	$11,565	$26,202	90,102	$9,010	2.9	46	34	Completed 1/02	T-12 to T-8 conversion & occupancy sensors
Olin	$49,858	$11,353	$38,505	109,314	$10,931	3.5	22	39	Completed 1/02	T-12 to T-8 conversion & occupancy sensors
Bray	$7,050	$1,690	$5,360	14,806	$1,481	3.6	14	14	Completed 2/02	Occupancy sensors only
Eliot Pearson	$9,948	$1,749	$8,199	24,927	$2,493	3.3	24	13	Completed 2/02	Occupancy sensors only
Bromfield Pearson	$19,209	$6,289	$12,920	36,069	$3,607	3.6	31	8	Completed 3/02	T-12 to T-8 conversion & occupancy sensors
Dowling	$29,241	$6,690	$22,551	67,752	$6,775	3.3	78	58	Completed 3/02	Occupancy sensors only
Eaton	$23,703	$5,591	$18,112	51,984	$5,198	3.5	73	17	Completed 4/02	Occupancy sensors w/some T-12 to T-8 conversion
Pearson/ Michael	$37,762	$10,157	$27,605	95,817	$9,582	2.9	22	37	Completed 7/02	Occupancy sensors w/some T-12 to T-8 conversion
Total	$308,431	$81,141	$227,290	876,024	$91,930	2.5	628	407		

Bathrooms

All bathrooms at Dartmouth have been replaced with 2.5 gallon per minute shower-heads, toilets with efficient 1.6 gallon flushes. 8 years ago, these showerheads and flushes were installed, along with new aerators in the sinks. In this respect we find

that ORL is not left with much room to retrofit the existing infrastructure. They are currently experimenting with installing toilets that have a half- and full-flush option.

The only suggestion worth considering is that of timers and/or motion sensors in sinks (along with lighting, as discussed in the lighting section). Automatic faucets are useful in saving water, but installation will be expensive and is perhaps not the most cost-effective idea for dormitory-bathrooms, although worth considering in high-use public buildings. In residential buildings, timers to control the lights will definitely be helpful. Once again though, this is a matter of educating and reminding residents to turn off the lights, as stickers next to the switches have attempted to do. Perhaps a more effective strategy will involve posters on the doors: as a person opens a door to exit the bathroom, he or she will face a large and clear poster (next to the posters explaining the hand-washing process) suggesting they turn off the light.

Windows

All residential buildings on campus have been fitted with storm windows, and many now have double-paned windows (a bare minimum in a place like New Hampshire—even California now requires it of all new buildings) that are more efficient at heat-preservation, namely the Gold Coast, Ripley-Woodward-Smith cluster, the Choate cluster, the River Apartments and the Lodge dormitory. Windows are inherently linked to heat-management in the rooms, and it is important to consider that the best, most efficient windows are useless if they are left open to compensate for a heating system that the resident is unable to control for his or her needs.

Electricity

Through FO&M we were able to collect data about heat and electricity usage on campus, broken down per building. Using these numbers and numbers available from ORL's website regarding occupancy numbers, we calculated averages for electricity use. While we would have liked to compare heat use across different campus buildings as well this task was impossible as it is difficult to accurately measure heat flux in a building. FO&M can not confidently state numbers for many dormitories when it comes to heat.

Below is a simple break up of all the different dormitories. We present this to start our discussion on electricity use:

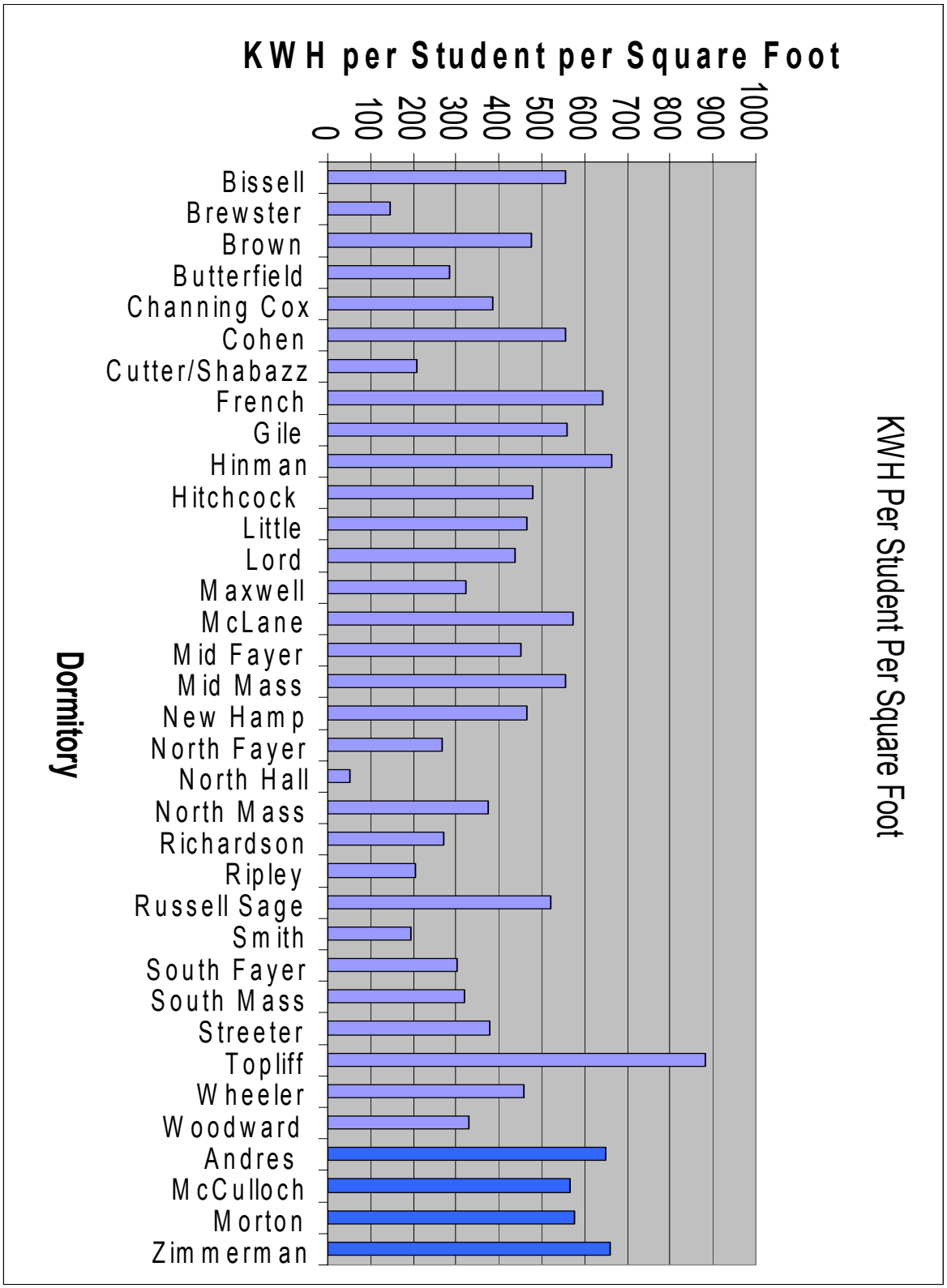

KWH per Student per Square Foot
0
100
200
300
400
500
600
700
800
900
1000
Bissell
Brewster
Brown
Butterfield
Channing Cox
Cohen
Cutter/Shabazz
French
Gile
Hinman
Hitchcock
Little
Lord
Maxwell
McLane
Mid Fayer
Mid Mass
New Hamp
North Fayer
North Hall
North Mass
Richardson
Ripley
Russell Sage
Smith
South Fayer
South Mass
Streeter
Topliff
Wheeler
Woodward
Andres
McCulloch
Morton
Zimmerman
Dormitory
KWH Per Student Per Square Foot

Figure 4.2

The electricity numbers are kilowatt-hours, averaged using the total use during each of the four most recent years for which data is available: 2000-2003. It is important to clarify what the vertical axis is showing. A dormitory's use of electricity depends on various factors, one of which is the number of residents. The higher the number of beds, the higher total use will be, all else being equal. Yet, showing electricity per student (by taking total use and dividing by the number of beds in the given dormitory) is not sufficient, since the area available to each student is clearly a factor (Discussed below with Figure 2). Therefore, the vertical axis is showing the electricity consumed by a resident over a given square foot of area. This combined average calculation should effectively eliminate these biases.

Intuitively, one might be able to convince oneself that a resident in a large single-room will on average consume more electricity than the same resident in a smaller room. Yet, upon further consideration, this does not seem like an obvious conclusion for college students. To test whether or not area does indeed affect electricity consumption we present the following graph of each dormitory from the previous chart, but this time showing the per-student electricity consumption versus the area per student.

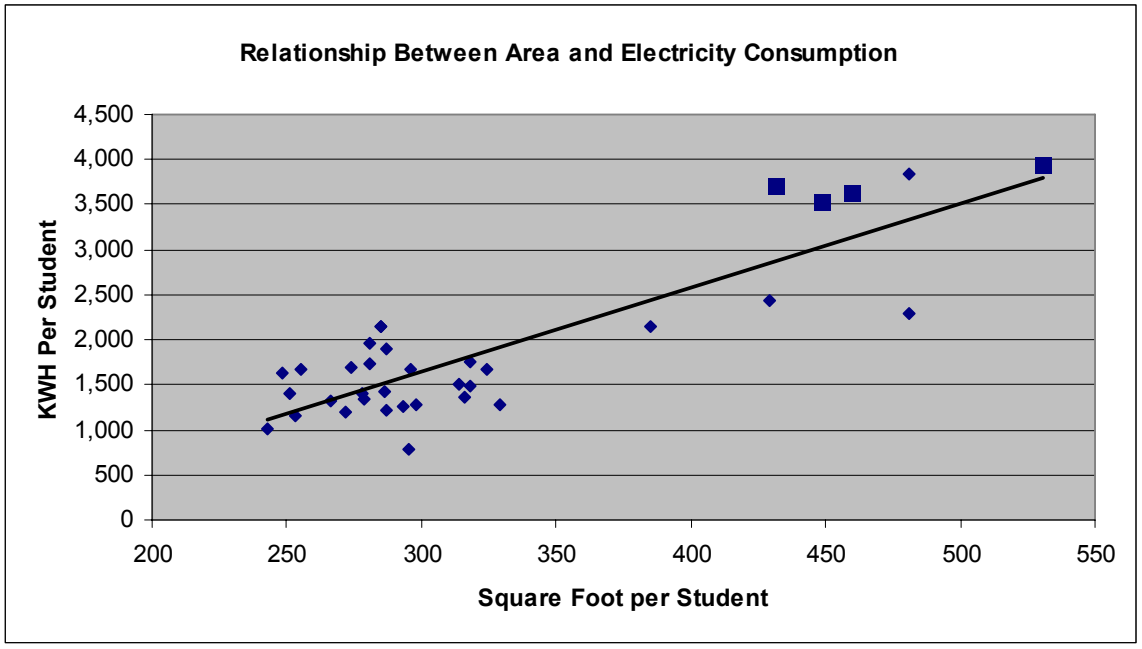


Figure 4.3

The figure above illustrates that a resident tends to consume more electricity when the resident has more area at his or her disposal. This is not necessarily *always* true, of course, but such is the trend. It would in fact appear that when a resident has an average of more than about 350 square feet electricity consumption increases significantly. Four particular instances (data points beyond 350, small diamonds) are Maxwell, Channing Cox, Cutter/Shabazz and Brewster. The former two being apartments with kitchens and living rooms etc, and the latter two being affinity houses, it would appear that more sociable living environments among smaller groups of people tend to have higher electric consumption. The four data points beyond 350 presented as squares show the East Wheelock dormitories – indicated separately since those are the most recent dormitories that the College has constructed. They represent ORL's latest vision and demands – and

are among the highest in electricity consumption while giving the highest area per student.

It is worth considering that perhaps there is an ideal room-size/available lounge space. In the document highlighting ORL's core values and requirements from the new dormitories, these numbers tend to be towards the high-end. For instance, a single is required to be around 140 square feet. With forty to sixty residents per floor, plus two study rooms and two lounges and a kitchen on each floor, and bathrooms where the idea is that no more than six residents on average share the same fixture, we would estimate a per student area significantly higher than 350 square feet – suggesting a higher than average electricity consumption. In fact, this design suggests consumption higher than is observed in the East Wheelock cluster.

Projects for Further Investment:
The Success Story of Vending Machine Upgrades at Other Schools:

Vending Machines are scattered through out Dartmouth's campus, often sitting for long periods of time in inactivity yet constantly draining energy. Dartmouth should be encouraged to continue their instillation of energy-efficient soft-drink machines, in light of the success of campus wide changes at other universities. The University of Vermont has attacked this problem by investing in "Vending Misers" for their machines. It is used on all eighty-soda machines and has reduced the amount of kilowatt-hours the machines use by almost half, saving UVM $9,655 per year. The Vending Miser is a sensor that turns off the lights and the compressors on a vending machine containing non-perishable items when no one has walked by for a certain amount of time. The miser also turns idle machines back on when someone does walk by. The drinks stay cold even when the machine is idle since it is also equipped with a temperature sensor.[15] Princeton University also installed USA Technologies "Vending Miser" throughout its campus. Since then, Princeton has seen a 40% reduction in vending machine energy consumption, saving about $10,000 a year.[16]

We have now looked at student life as it exists at Dartmouth from a structural perspective as well as a student perspective. More can always be done, and in fact is being done. Renovations, retrofitting and refurbishments line the future of existing dormitories at Dartmouth. The next section will discuss these plans.

V. FUTURE RENOVATIONS

As stated above, ORL has already made significant efforts to retrofit existing dorm buildings to make them more energy efficient. Their work is limited by their budget (fed by student rent and money from summer programs) and available time. The Dartmouth Plan makes it especially hard to perform extensive renovations since there are only ten weeks to work at any given time. However, ORL plans to renovate and retrofit residential buildings in the future. The most urgent needs are handicap accessibility and updated safety features, such as sprinkler systems.

ORL has scheduled three projects for this summer: Bissell, Cohen, Amarna, and the Ledyard Apartments at 19 East Wheelock Street will be renovated. After the completion of the new McLaughlin dorm cluster, Hitchcock will undergo total

renovation. Also at this time, ORL will tear down Hinman in the River cluster to make room for new graduate residence halls, and the Tree Houses will most likely be sold.

In the Choates cluster, Bissell and Cohen will be renovated this summer (2005), as Brown and Little were renovated summer 2004. Project goals include maintenance, comfort, and energy efficiency. Efficient appliances and lights will be put in when possible. The buildings will receive new roofs, sprinkler systems, kitchens, carpets, and ceilings in the common areas. ORL will paint the walls and put in an accessible bathroom, to accommodate the building for handicapped freshman. The College plans on tearing down the Choates cluster in ten or more years, so these renovations will make the buildings livable until then. The cluster is not expected to last 100 years, unlike other Dartmouth dorms[17].

In June, ORL also plans to renovate College-owned Amarna, the affinity house on East Wheelock Street across the street from Kappa Kappa Gamma sorority. Housing 12 students, the house now has only 3 bathrooms. ORL will put in more bathrooms and a new kitchen, make the house handicap accessible, and tear down the existing garage. These changes will make living in Amarna more comfortable for students. Kitchen appliances such as the refrigerator will be Energy Star compliant, and all new bathroom fixtures including toilets will be water efficient[18]

Just up the street from Amarna sit the Ledyard Apartments, at 19 East Wheelock Street. These will also undergo substantial renovations beginning in June. ORL will replace the building's plumbing and electrical wiring, put in a fire alarm and sprinkler system, and install thermal pane windows, urethane spray foam insulation, and a new heating system. Oil fired hot water will move through baseboards to heat the rooms, which will have semi-instantaneous control with a thermostat. This will replace the existing steam radiator system. The new system will be easier to control and should cut down on wasted heat. The new thermal pane windows will help keep heat in the building and decrease energy usage.

Upon conclusion of the McLaughlin residence cluster project, during summer or fall of 2006, ORL will renovate Hitchcock hall. Plans are still preliminary as the project is young. Architects expect that building will be gutted and rooms will be built in six to eight person units or smaller suites. These units might become affinity residence areas, for new groups or for existing groups that have shrunk in size and no longer take up entire houses. The heating might be replaced, possibly with the radiant floor system that will be installed in the McLaughlin cluster. Ideally there will be kitchens on each floor, and the building will become handicap accessible. ORL estimates this will be a twelve-month project, amounting to five or six million dollars.

After McLaughlin is built, ORL will tear down Hinman dorm in the River cluster. Tuck Business School will use this space for graduate housing. The Tree Houses, which were purchased for the fall of 2001, will most likely be removed at this time and relocated. The College will sell the houses, possibly to the Hanover affordable housing group to be relocated somewhere in the town[19].

Since most of the College's residence halls were and are built to last 100 years or more, ORL will be constantly renovating and retrofitting these buildings to keep up with current technologies, energy efficiency, cost efficiency, student comfort, and basic maintenance. ORL must plan their projects carefully. Because students are always living on campus and the demand for rooms is overwhelming, most renovations are done during

the summer term when fewer students are on campus. With only ten weeks to complete a project, and a set budget, there is only so much ORL can do. However, once the McLaughlin cluster is completed, there will be more time for ORL to undertake more substantial renovations.

ORL's future renovation plans seem thoughtful in relation to maintenance and energy efficiency, considering their budget and time restraints. However, we believe ORL can be even more focused on improving energy efficiency in dorms. We suggest that ORL continually update existing dorm features, such as lighting, appliances, and heating systems as technology evolves to keep energy use at a minimum while sustaining student comfort. We strongly urge ORL to install lighting sensors in all dorm kitchens, lounges, and hallways. This would save electricity and money. Ideally, the upcoming June renovations would include installing motion sensors for lighting in the buildings.

Since Hitchcock will be gutted, ORL can essentially start from scratch and create an innovative and energy efficient living space. Hitchcock offers an opportunity for ORL to use new technology to create a model of energy efficiency in residential halls. "Green Building" plans such as these will receive support from the College and student body, since energy efficiency undoubtedly results in money savings. We would like to see Dartmouth aggressively explore their options for energy saving technology as seen at other schools and stated in this report. Hopefully this report will provide inspiration, motivation, and information for ORL to seriously look into changing Dartmouth's residential ecological footprint.

VI. APPENDIX 4A: ENVS 50 SURVEY: ENERGY USE IN RESIDENTIAL HALLS

Please answer every question that you can:

Yes/No/Maybe

1) Do you know who your ECO rep is? If so, do you find him or her to be a useful resource?

2) If a "Rent-a-Refrigerator" program was available, would you be willing to pay $20 a year to rent a personal refrigerator as opposed to buying your own and paying a $45 disposal fee?

3) Would you be more likely to purchase energy-efficient appliances if a list was provided through the school?

4) Do you know what the SPARC Program is? If so, have you made an effort to actively try to follow its guidelines to save energy?

5) Would rewards (monetary, food, etc.) provide you with enough incentive to curb your energy consumption habits?

6) Do you use your window to control the temperature of your room during the year (especially during the winter)?

7) Do you know who to contact in case something in your room malfunctions? If so, would you contact them?

8) Do you use your waste warrior to recycle paper, plastic, or any other recyclable material?

9) Knowing that air conditioning systems use lots of energy, would you choose to have air conditioning in your dorm room?

10) Would you like more windows in residence halls?

11) Would you prefer to use daylight in place of artificial light?

Short Answer:

1) Do you feel that dormitory architecture should focus more on aesthetics or energy efficiency?

2) Do you feel like your room is a comfortable and healthy living environment? Please explain why or why not.

3) How would you like to be better informed on environmental issues? Blitzes, posters, UGA event at start of term, etc?

4) What would be a good incentive for you to reduce energy consumption? Money rebates, free food, etc?

5) What would you like to see changed in dorm rooms and residence halls?

6) How do you think Dartmouth students can use less energy in the dorms?

Rating Student Habits

Grade on a scale of 1-10 (10 being very conscientious 1 being never thinking about it):
How conscientious are you about...
1) Turning off lights when exiting a room?
2) Limiting length of showers?
3) Recycling cans?
4) Recycling glass?

5) Recycling plastic?
6) Recycling paper?
7) Turning off lights when exiting restrooms?
8) Turning off your computer when not in use?
9) Closing windows and doors during winter months?

VII. APPENDIX 4B: ENVS 50 SURVEY RESULTS

YES/NO/MAYBE QUESTIONS				
	Yes	No	Maybe	Don't Care
Q.1(a) Knows who eco rep is	13	49	3	5
Q.1(b) Finds him/her useful	3	2	1	
Q.2 Would use "Rent a Refrigerator"	45	16	6	
Q.3 Energy efficient appliance list	48	13	7	
Q.4(a) Knows what SPARC is	16	49	1	
Q.4(b) Made efforts in accordance	6	4		
Q.5 Rewards as incentive	38	19	9	1
Q.6 Window used to control temp.	55	12		
Q.7(a) Knows who to contact if malfunction	49	15	3	
Q.7(b) Would contact them	45	1		
Q.8 Uses waste warrior	47	20		
Q.9 Would have air conditioning	24	37	5	1
Q.10 Want more windows	51	12	3	1
Q.11 Prefers daylight	62	3		2

SHORT ANSWER				
Q.1 Bigger Focus	Energy	Aesthetics	Both	
	27	19	21	
Q.2 Comfortable/ Healthy	Yes	No	Comfort/not health	"Ugly"
	57	5	5	1
	Need fresh air	Need more windows	Dirty/Unsanitary	Needs Retrofitting
	7	8	6	4
	Good natural light	Clean	Spacious	Bad water
	9	10	11	1
Q.3 How to be better informed	Posters	Blitzes	Website	Events
	30	26	1	7
	UGA events	Not blitz	Don't care	
	13	4	8	

Q.4 Good Incentives	Knowledge	Money/Not free food	Free Food	Money
	10	3	20	45
	Gift certificate	None	Eco conscious/local foods dinner	
	3	4	4	
Q.5 Changes Wanted	Heat Control	More Study Areas	Better Bathrooms	Prettier
	16	2	4	4
	More windows	Better Windows	Retrofitting	Energy efficiency
	3	4	5	3
	Communal cookware	More Noise Control	Cleaner Water	No idea
	2	1	1	7
	Waste warrior/floor	Eco-friendly	Mandatory Recycling	
	8	2	2	
Q.6 How to use less energy in dorms	Turn off Lights	Turn off computers	Limit # of Refrig.	Recycle
	33	22	5	3
	Use natural light	Avoid phantom loads	Less window open	Less Heat
	1	2	4	5
	Don't know	Reduce hot water	Make pay for energy use	Other
	4	1	1	5
	Limit showers			
	4			

IIX. APPENDIX 4C: ECO INTERNS[20]

ECO Interns work behind-the –scenes with different campus offices under the guidance of ECO advisors. These paid internships offer students experiential learning, the opportunity to affect change in the institutional and 'higher up' decision making circles, and the chance to prevent waste on campus before it starts. Internships require approximately 10 hours per week. Hours are largely self-scheduled and self-directed.

General responsibilities for each intern:
1. Attend ECO meetings and events (meetings occur every other week)
2. Write a weekly report of activities, including a log of hours, to be sent to the ECO account as well as the intern's advisor
3. Help Reps with theme weeks as they pertain to your area of sustainability
4. Help with big ECO projects of the term--Earth Week, dinner discussions, etc
5. Participate in at least one project or event outside of your area of sustainability

6.Write an article per term related to work they are doing or other environmental issues
7.Write an end of term report
8. Be self-motivated, full of energy and optimistic

Coordinator (Tucker Foundation; supervisor: Tracy Dustin-Eichler)

- Dream, set goals, come up with new ideas and new directions
- Be organized, responsible, and motivated
- Organize and run ECO Rep meetings
- Meet weekly or biweekly with other ECO interns, motivate and guide
- Meet weekly or biweekly with your advisors from Tucker and FO&M
- Know what everyone is doing and maintain communication between ECO interns, the Tucker Foundation, The Office of Residential Life, and FO&M
- Maintain and promote the ECO Update Blitz Bulletin
- Serve as a connection to other environmental groups on campus
- Open up the intern application process for the next term's interns
- Do whatever it takes to make Dartmouth sustainable

Residence Hall Rep Head (FO&M; supervisor: Linda Hathorn)

- 4, each responsible for dorm reps in ~12 dorms across campus
- Recruit and motivate ECO-Reps
- Network with dorm and floor reps, keeping them informed of work other interns are doing, distribute ECO updates, relay weekly rep head meeting info
- Answer questions, offer energy and time, issue funds for ECO-Rep projects
- Respond to SWWAT calls
- Work with UGA's on educational programs
- An additional, independent project is assigned by the Coordinator, varying from term to term

Composting Intern (supervisor: Linda Hathorn)

- Encourage and train students to compost properly in dining hall waste bins
- Work with DDS employees to improve the composting system
- Search for new ways to reduce non-compostable waste in the dining halls
- Promote an ecological awareness through personal interaction, campaigns, advertisements, and training programs for students
- Assist in planning and design of future Dartmouth dining halls to promote composting
- Publicize the locations of non-DDS composting bins
- Look for new places to locate bins
- Evaluate the current system and brainstorm improvements
- Set up and run Compost Fairying program
- Create fun ways to teach people about composting
- Organize trips to tour the compost facility

FO&M Energy Intern (supervisor: Linda Hathorn)

This intern works with FO&M to maintain, implement, and provide for growth of energy conservation in the Dartmouth community.

Duties include:

- Creating and maintaining databases and spreadsheets to track energy consumption and utility use at Dartmouth College. Examples could include steam use, electric use and water use.
- Research potential energy conservation and renewable energy projects, perform simple payback analysis, and recommend measures that should be taken.
- Work with the Resource Working Group on energy conservation campaigns.
- Study buildings after energy conservation measures have been installed to verify effectiveness.
- Communicate energy conservation information to the community.
- Provide energy data and charts to other members of ECO for theme weeks in the Residence Halls.

Recycling Intern (Dartmouth Recycles – FO&M; supervisor: Linda Hathorn)

- Coordinate Recycling in the administrative and academic buildings, including:
    - Any problems that come up with the waste warriors or recycling
    - Keeping students informed about recycling issues
    - Working on ways to improve the system
- Keep the campus up to date about the ever changing recycling methods on campus
- Work on improving recycling beyond the dorms and throughout the campus, particularly in public areas like Collis and the Library.
- Create New Recycling programs if possible!

SPARC Intern (supervisor: Linda Hathorn)

- Coordinate the monthly SPARCS (Save Power and Receive Cash) competition between residence halls
- Decide on the prize for the winning dorm that conserves the most energy that month
- Educate students on energy conservation and on ways they can reduce their consumption
- Research new and innovative ways that Dartmouth can reduce its energy consumption

IX. APPENDIX 4D: REP HEAD ACTIVITY SUMMARY[21]

Beginning of term:

- Divide residence halls and clusters between dorm rep heads
- Retrieve rosters of ECO reps from past term, email and ask if they are on for current term
- Recruit ECO reps by blitzing community directors, UGA's, emailing old ECO reps (from past rosters), and asking friends
- Email ECO reps, introduce yourself, attach ECO rep sign (blitz "ECO" for sign)
- Meet with fellow ECO rep heads to determine "Theme Week" themes, divide themes amongst interns – OR – decide on a "Theme" for the entire term. Themes are specific environmental issues that you feel should be focused on through posters, awareness, and action.
- Table for volunteer fairs

Once a week:

- Check waste warriors and recycling centers of dorms for overflowing and general upkeep (if overflowing, empty or email reps)
- Keep list/mental note of floor/eco reps who are doing their job (for raffle)
- Maintain communication with ECO Reps through a weekly or biweekly blitz
- Maintain communication with ECO advisor and coordinator
- Work on theme week (create posters, blitz reps, etc.)
- Attend Intern meetings every one/two weeks; set regular meeting time early in term

Ongoing: (suggested)

- Plan Collis Community hour
    - Decide on topic, contact Collis Reservations (will take care of posters, food, tech equipment), find speaker(s), blitz campus
- Determine any special projects you'd like to accomplish (rep social, film festival, etc)
- Answer any ECO questions/concerns from dorm reps
- Head SPARC contest (energy-saving contest between clusters)
    - Determine prizes, create posters, spread awareness of contest

End of term: (suggested)

- Compile list of outstanding ECO reps, enter into raffle drawing
- Buy prizes (gift/food certificates) for raffle
- Organize end of term clean-up, poster and blitz, and possible collaboration with a donation service
- Compose summary of term activities, blitz to "TECO"
- Email final list of reps to "ECO" at end of term to maintain records for next term

***Spring term only:**

- Decide on ECO Mug Design, blitz students
- Table for Dimensions Activities Week for prospective student

X. APPENDIX 4E: HARVARD'S RESOURCE EFFICIENCY PROGRAM

Summary

A specific program Dartmouth may wish to imitate is the Resource Efficiency Program (REP) found at Harvard. In order to promote the education and engagement of students in matters of sustainability, students are paid to spread environmental consciousness to both their peers and faculty members. Each dormitory has a student representative working four hours a week, and there are two additional student captains who work ten hours each week. The representatives focus on spreading messages of conservation while collecting and sorting recyclables. REP captains work to coordinate efforts of the representatives, and focus on education programs that tout the benefits of sustainability. Specifically, the goals of REP are to:

-Coordinate between student and faculty groups
-Work towards helping the campus achieve environmental goals
-Reduce the consumption of water and electricity in dormitories
-Educate community about issues of sustainability
-Make environmentally friendly behaviors convenient
-Increase awareness regarding downstream effects of everyday choices[22]

It is critical that a similar program at Dartmouth not focus merely on tangible aspects of conservation like recycling, but that it works to adjust the culture of our community.

History

REP began in 2002 when student environmental groups came together with the Harvard Green Campus Initiative (HGCI) and Harvard's versions of ORL and FO&M with the joint goal of educating students about energy conservation and environmental citizenship.[23] This cooperation was facilitated by the HGCI, and although Dartmouth does not have a parallel organization, a similar venture might be possible through the upcoming sustainability director. In Dartmouth's case, this program should begin with a similar meeting of groups with the joint interest of reducing energy use and waste in our dorms. Any venture without input from each of these groups may not fully reach its potential.

Organization/Funding

The organizations involved in REP combine their resources to cover the $90,000 per year cost of paying student representatives and captains, along with a program manager to implement dorm-based environmental education programs. Also contributing to the budget are several private and public sponsors, in addition to grants, including one from the EPA.[24] If a similar program were adopted at Dartmouth, it would require a

budget of $40,100 to cover a $7.50/hour wage for 35 representatives (1 for each dormitory, including apartment buildings) to work 4 hours a week along with $8.00/hour for 2 captains to work 10 hours a week. Included in this budget calculation is a full staff for 30 weeks during the Fall, Winter and Spring, along with 1 captain and 10 representatives for 10 weeks in the Summer. Dartmouth may choose to not hire a manager as Harvard has, because environmental education programs could be handled by the sustainability coordinator. This program does not need to be started from scratch, as we already have the ECO program on which to base any program similar to REP. We are recommending that ECO be slightly reorganized to provide more incentive and accountability to dorm representatives.

Success

In one year, REP caused dorm recycling to increase by 26%, resulting in savings of $50,000 in trash services. REP also helped electricity use to drop by 3%, which equates to an annual savings of $45,000. Heating costs were also reduced by $8000 annually. Education programs through REP have helped environmental consciousness become more mainstream among Harvard undergraduates, using both individual and dorm-wide awards to recognize those displaying exemplary performance.[25] While ECO has been somewhat successful in its conservation goals, we believe a program in which representatives are paid will greatly increase the effort involved, easily compensating for the program's costs. Another benefit of REP is that it has provided the administrative organization to conduct a comprehensive environmental habits survey, as well as to test new lighting and plumbing equipment.[26] ECO representatives are currently too disorganized to conduct any such surveys or tests.

XI. APPENDIX 4F: RESIDENTIAL BUILDINGS DATA: ANNUAL AVERAGE STEAM AND ELECTRICITY USE

Dorm	Number of Beds	Total Area (in square feet)	Area Per Student (square feet)	Average Annual Steam x100Lbs	Steam/Area	Steam/Student	Average Annual Electricity (in KWH)	Electricity/Area	Electricity/ Student	Electricity per Square Foot per Student
Andres	82	37,674	459	15,630	194.4	194.4	298,576	7.93	3,641	649.87
Bissell	74	21,100	285	12,791	0.639	182.1	158,332	7.5	2,140	555.55
Brewster	26	10,000	385	5,704	0.57	219.4	56,080	5.61	2,157	145.66
Brown	77	21,100	274	9,238	0.438	120	130,421	6.18	1,694	475.99
Butterfield	55	17,800	324	9,502	0.534	172.8	92,186	5.18	1,676	284.52
Channing Cox	68	29,200	429	13,998	0.48	205.9	166,065	5.69	2,442	387.10
Cohen	74	21,100	285	5,573	0.264	75.3	158,332	7.5	2,140	555.55
Cutter/Shabazz	26	12,500	481	10,737	0.859	413	99,628	7.97	3,832	207.13
French	98	25,000	255	21,959	0.878	224.1	164,116	6.56	1,675	643.59
Gile	112	29,800	266	15,523	0.521	138.6	148,278	4.98	1,324	557.44
Hinman	101	25,000	248	14,066	0.563	139.3	164,116	6.56	1,625	661.76
Hitchcock	111	32,500	293	10,406	0.32	93.7	140,315	4.32	1,264	478.89
Little	75	21,100	281	14,152	0.671	188.7	130,421	6.18	1,739	464.13
Lord	78	19,600	251	14,139	0.721	181.3	110,119	5.62	1,412	438.72
Maxwell	68	32,700	481	11,474	0.351	168.7	155,210	4.75	2,283	322.68
McCulloch	76	40330	531	19,307	254	254	299,475	7.43	3,940	564.35
McLane	87	25,000	287	17,141	0.686	197	164,609	6.58	1,892	573.55
Mid Fayer	107	30,700	287	9,605	0.313	89.8	129,572	4.22	1,211	451.47
Mid Mass	111	31,700	286	5,579	0.176	50.3	158,566	5	1,429	554.43
Morton	67	28875	431	13,158	196.4	196.4	248,858	8.62	3,714	577.44
New Hamp	120	39,500	329	13,828	0.35	115.2	153,417	3.88	1,278	466.31
North Fayer	56	17,600	314	7,657	0.435	136.7	84,194	4.78	1,503	268.13
North Hall	19	5,600	295	5,234	0.935	275.5	14,893	2.66	784	50.48
North Mass	68	21,600	318	10,284	0.476	151.2	119,463	5.53	1,757	375.67
Richardson	63	19,900	316	9,593	0.482	152.3	85,243	4.28	1,353	269.76
Ripley	45	11,400	253	4,895	0.43	108.8	51,560	4.52	1,146	203.79
Russell Sage	119	32,400	272	28,071	0.866	235.9	141,270	4.36	1,187	519.38
Smith	47	11,400	243	5,011	0.44	106.6	47,510	4.17	1,011	195.51
South Fayer	63	17,600	279	7,632	0.434	121.1	84,653	4.81	1,344	303.42
South Mass	68	21,600	318	9,568	0.443	140.7	101,471	4.7	1,492	319.09
Streeter	67	19,800	296	7,897	0.399	117.9	112,003	5.66	1,672	378.39
Topliff	174	48,400	278	26,438	0.546	151.9	245,343	5.07	1,410	882.53
Wheeler	106	31,600	298	17,436	0.552	164.5	136,792	4.33	1,290	459.03
Woodward	47	13,200	281	8,503	0.644	181	92,228	6.99	1,962	328.21
Zimmerman	84	37674	449	15,906	189.4	189.4	295,687	7.85	3,520	659.28

5

SUSTAINABILITY CENTER

I. PROPOSAL FOR SUSTAINABILITY CENTER AT DARTMOUTH COLLEGE

It's Monday afternoon, and a class of Hanover elementary school fourth graders are walking towards Dartmouth's North Campus for a tour of the Dartmouth Sustainability Center. They arrive, greeted by a full-time student coordinator who takes them around the building, explains how the composting toilets work, shows them the solar heated water tank, and offers them a snack of carrots from a farm a few towns away. She tells them about the recycled carpeting and couch materials, and shows them the energy star computers which Dartmouth students are using in the student study lounge and offices upstairs. She points out how few light bulbs there are in the building because it is designed to use day lighting, and tells them how the light bulbs they do use are special LEDs and barely use any energy at all.

She takes them out back to the community greenhouse where faculty and students are growing tomatoes and other plants, and points out the grass-covered roof that helps insulate the building. The students stop to read a sign explaining how the wood used in the building comes from Dartmouth's very own sustainably managed forests, and head inside to look at the student research displays and the current photo exhibit of a student's work from a leave term in Alaska. Jim Merkel, Dartmouth's Sustainability Coordinator, then meets with the kids in the downstairs lounge to answer questions and show them how to calculate their ecological footprints. They leave with some handouts on what they can do at home to live more sustainably, and head home, excited to tell their parents about composting.

Later that evening, a Miniversity class meets in the Sustainability Center kitchen to learn about vegan cooking. Afterwards a bluegrass band is slotted to play on the small stage downstairs, and students will come to do work, listen to the music, read the eco-network bulletin boards on the walls, and have dessert from a local bakery. Tuesday morning a studio art class on green building will meet here for a discussion of the building design, and later that night the Green Magazine students will meet in their office space upstairs to work on their next issue.

This scenario can become a reality here at Dartmouth. A Sustainability Center has the potential to improve the quality of life for both students and the community. In the minds of hundreds of students and faculty here, the time has come to realize that potential.

There are numerous ecologically minded students here at Dartmouth, and many more that would benefit from the integrated living and learning space that a Sustainability Center can offer. Interest has not only been constant, but it has grown in recent years. This growth

reflects not only a trend of increased environmentalism at Dartmouth, but more importantly a national and global trend towards increased awareness of the effect that daily life has on the environment. Despite this increased interest, Dartmouth has yet to provide its students with a physical space and facility that reflects its commitment to sustainability. Such a center would not only meet the needs of many current students, but more importantly educate those who do not even know about how their lifestyles impact the environment. Dartmouth's support for this project would represent an extraordinary commitment to sustainable living, and distinguish itself as a leader in environmental issues and support for its students' interests. The following proposal for such a space reflects months of research of the best and most viable option for a sustainability center at Dartmouth.

Mission Statement

A sustainability center at Dartmouth College will undoubtedly evolve over time, but it is imperative that the following principles remain central to the facility's purpose.

i. It is an experiential and interactive learning space.
ii. The physical structure is itself an educational tool.
iii. The facility offers a social space reflecting interest in sustainability, in accordance with the Student Life Initiative (SLI).
iv. It fosters relationships between students and community members with interests in sustainability and environmental consciousness.
v. It broadens and diversifies the scope of the student community interested in sustainability.

Expressed Need

A sustainability center at Dartmouth College is long overdue. Dartmouth as an institution is no longer at the forefront of green building and more importantly lacks a physical space that serves as a living experiment in sustainability and environmental consciousness. Numerous peer institutions such as Middlebury have already established spaces and programs in which students can obtain practical and useful knowledge about sustainability in their own lives [see Appendix 1]. This attribute of a green community is integral to the Dartmouth experience. As Scott Stokoe puts it, "This history and tradition of environmental stewardship is one of the main reasons why many students choose Dartmouth over other schools"[1].

The Dartmouth community currently lacks a facility in which students with overlapping worldviews can strengthen their student and community networks and further the causes of their respective groups. For example, the Green Magazine, the Dartmouth Local Foods Project, Students Fighting Hunger, Organic Farm, Environmental Conservation Organization, Environmental Studies Division, among others, lack common meeting places and resources that would strengthen their networks and development. Recently, students have taken the initiative to overcome this obstacle by creating the "Environmental Roundtable", which consists of leaders of these and other groups. The roundtable currently meets weekly to foster communication and create partnerships among these groups. A sustainability center will be a shared forum and social space for these groups.

A sustainability center would also serve a purpose that existing student spaces do not fulfill. The current student-oriented facilities, like Collis and Robinson Hall, are at their maximum capacity in terms of providing space for student groups. Fairchild Hall, as the

Physical Sciences hub to the campus, is primarily utilized for academic purposes and does not promote environmental awareness to the rest of the campus.

The Sustainability Center will influence and guide student behavior in many ways, but it will be a residence. In order for the building itself to serve as an educational tool, it must be visible and accessible to the public, and therefore having the sustainability center exist as a residence would restrict its utility. As a residence, the community that could benefit from the center would become more limited, and perhaps exclusive. Instead, visitors to the facility will be offered alternative, more sustainable practices that they can incorporate into their residential lives.

Vision

The sustainability center will have many functions. It will be a two-story building about the size of La Casa. There will be a foyer in main entrance where student work such as studio art projects, photo essays or engineering models are exhibited. The foyer opens into a large social space with couches, tables and a small stage that will serve as a venue for meetings and performances. To the left, there will be a large kitchen and dining area that will host weekly Miniversity cooking classes and community potlucks. There will also be an Organic farm stand off of the kitchen that sells local produce. On the second floor, there will be two classrooms holding about twenty students each, and at least five offices for aforementioned campus organizations, the Sustainability Coordinator and student interns. There will also be a computer lab/group study room. Out back will be a community greenhouse where students and faculty can grow their own produce.

The sustainability center will be located north of Burke Hall, near the intersection of College Street and Maynard Street.[2] In this location, the center will be a highly visible and accessible part of campus once the McLaughlin cluster is completed. This site is ideal in that it allows for the center to be built from the ground up, and allows for the incorporation of sustainable systems in its design and construction. It is commendable that Dartmouth has chosen to comply with LEED standards for all newly constructed buildings, however for the sustainability center, the College should take progressive steps to promote more visibly sustainable systems. For example, the facility could include the following systems:

- An Eco-roof, or living roof
- Photovoltaic water heating
- Composting toilets or Living Machine Wastewater Cycling
- Rainwater catchments for re-use
- Passive solar heating and day lighting
- Native (or no-maintenance) landscaping

These are examples of ways in which this building can close resource loops and minimize energy use. Additionally, the furniture, building materials, appliances, office and cleaning supplies should continue to exemplify and build upon Dartmouth's commitment to green purchasing. All aspects of building design, purchasing and programming decisions will be considered in terms of their ecological and social impact as well as their long-term economic viability.

History

The first proposal for a Sustainability Center dates back to 1999, and efforts to establish such a space at Dartmouth have resurfaced several times during the subsequent

years. While none of these proposals has been successful, the recurring support for them is evidence that they have not failed due to lack of long-term interest or dedication among the student body, among individual administrators, and faculty.

The first proposal was an indirect response to the Student Life Initiative, which notes the following:

> It is vital that the Dartmouth out-of-classroom experience match and support the academic mission of the College. The residential and social life of students at Dartmouth should be an integral part of a comprehensive learning environment and contribute significantly to each student's intellectual and personal growth and well-being.[3]

This vision of "a 'green' building informing the liberal Arts Process"[4] is one that has been carried through the history of the various proposals. The Center is intended to be an interdisciplinary space that serves a need as yet unfulfilled for the Dartmouth population.

The factors which have stymied the project share a broad range of ideas. The earlier proposals failed to figure out the logistics behind the dream of a Center, and without specifics, the proposals had nowhere to go. Later proposals ran into issues of circumstance: the housing crunch and economic crises of the past few years have seriously hampered any movement on the project. Perhaps the greatest detriment to the proposals' success was the lack of administrative support. This is not to say that individual administrators, as well as faculty members, have not been extremely significant in moving the proposals forward throughout the years. Scott Stokoe, the manager of the Dartmouth Organic Farm, has played an important role in each of the proposals' developments, aiding students in reworking and better understanding the history of the project and past proposals. Scott is the most consistent player in the movement, but not the only one. But despite these administrators and faculty members making efforts on their own time and of their own accord; designing and implementing a Center has not yet been made a job priority for anyone.

Perhaps the most in-depth of the proposals was the most recent. In 2005, Social Entrepreneur Fellow Megan Boyar '03, with the help of both faculty and administrative advisors, submitted to the EPA a proposal to fund a Center at Dartmouth that would "work within the College to place the institution on a trajectory toward sustainability and to generate a trendsetting model for other academic communities" (2). This proposal emphasized the importance of economic, social, and environmental sustainability. Unfortunately, the EPA denied funding for the project, and therefore it was not brought to the attention of Dartmouth College.

While a Sustainability Center has never been approved, smaller projects have been actualized by the College that have touched on the growing need to cater to the many environmentally-conscious faculty, students, and staff here at the College as well as acknowledge the ever-growing importance of finding means of incorporating sustainable living into the average American's daily life. ECO's model dorm room and the East Wheelock Think Tank are two projects which indicate a willingness to take a step towards the Center. However, neither of these projects has been particularly successful, for differing reasons.

ECO's model dorm room is just that: a model. It was originally designed to be the first of many, but it still remains the only one. That project has not grown over the past few years, and thus has not fulfilled its role of aiding students in incorporating sustainability into dorm life, despite an increasing interest from new students over the years. The East Wheelock Think Tank, the work of Megan Boyar '03 and Lynne White Cloud of the Tucker

Foundation, was intended to be the first step toward a Sustainability Center. The Think Tank, located in McCullough dorm in the East Wheelock Cluster, was a place where its residents, all concerned with issues of sustainability, were to come together and work out a plan to incorporate a Living Center into campus. The idea for this project was forward-thinking and a first step towards progressive lifestyle changes and toward a permanent Center. However, because the concept of a Think Tank was only a half step towards the idea of sustainability, falling well short of the ideals of a social space that attract students to a permanent Sustainability Center, it was difficult to find students who wanted to live there, and the experiment did not live up to its goals. This is evidence that new initiatives need their own missions, identities and resources to survive and thrive on this College campus, which is notably small and personal. The failure of these efforts also indicates the difficulty in attempting a step by step approach to implementing a plan for a Center at Dartmouth. A successful Sustainability Center needs to be designed and implemented by the College in one large step, not a series of half-steps. Even overwhelming student interest cannot create something lasting without College support. Dartmouth, guided willingly by students, needs to assume an enthusiastic leadership role for this project.

Support

There has been continued student and faculty support for the establishment of a sustainability center at Dartmouth, as demonstrated by the twelve proposals submitted from year to year. These proposals are convincing, but overall individual efforts for a sustainability center tend to lack continuity. This should not be surprising given a 4 year turnover rate for all students. Additionally, the small-scale nature of the many different environmentally conscious student groups can make them less effective in creating widespread support for a cause. A need exists for a broader coalition of these groups which, working together, could create stronger networks among students as well as impact progressive environmental change at Dartmouth. Students have attempted to create such coalitions in the past, but without support from the College for such a project, such efforts are short lived.

In two weeks of petitioning for student support for a sustainable living center, close to 300 Dartmouth students indicated that they support such a facility. Among those, many students expressed important sentiments as to why they support such a concept. Student statements from previous proposal by Scott Stokoe demonstrate the wide range of recent student support.

> "Visiting a sustainable living center at Dartmouth would enrich my understanding of the world in a way that could influence my environmental attitude. By seeing this sustainable living center and participating in the implementation of it, I would gain greater understanding of my place as a human contributor in my ecosystem. This wouldn't be just another extracurricular activity; it would be a life experience"
>
> *- Liz Gannes, Class of 2004, Linguistics major*

> "At Dartmouth I have started taking Environmental Studies courses for the first time. In my classes I've seen pictures of sustainable living centers and heard about them, but have never had a chance to see how one operates. As I have become increasingly aware of environmental issues I have been trying to live a more sustainable lifestyle, and I believe that participating in a sustainable living center is the natural next step for any conservationist. It could be one of the most practical and applicable resources at Dartmouth and an amazing educational resource"
>
> *- Katherine Schuerman, Class of 2005, Environmental Studies major*

> "I think a Sustainable Living Center is an excellent opportunity for student life; it could provide students with the chance to live cooperatively and environmentally safely. It would provide insight on applicable issues like energy resources such as solar panels, waste disposal and compost, which students could experience firsthand. I think these issues are not just practical but certainly relevant in the areas of natural sciences as well as social sciences"
>
> - *Sylvia Chi, Class of 2005, History major*

> "The Sustainable Living Center proposal appeals to me greatly because the idea of knowing how one's world could work better through first hand experience and practice is very noble. I would love to be a part of such a holistic approach to college living. I also know that having a resource like the sustainable living center would be an incredible educational resource for Dartmouth because it could show the solutions in practice."
>
> - *Callie Thompson, Class of 2005, Studio Art Major*

> "A lot of things at Dartmouth are done behind the scenes, so that students don't know, for example, how food gets to their plate or how buildings are built. A sustainable living center would help students live with the environment, and not just in an isolated capsule"
>
> - *Scott Anderson, Class of 2005, Linguistics major*

Another important part of the sustainability center's utility is the faculty. Professors from many different departments have shown an interest in teaching classes in such a facility.

> "This is a great idea and I would love to hold my International Development class in such a place. Although I do not teach courses on the environment, I am aware of the waste, pollution, and increasing damages to our living conditions. [This] proposal is very worthy and sounds very attractive to me."
>
> - *Misagh Parsa, Professor of Sociology*

> "Your Sustainable Residential Center sounds interesting. A community center with a green orientation sounds like a nice addition to Dartmouth. In terms of using classrooms in such a building, if the classrooms were modern "smart" classrooms, clean, and had variable sizes and seating arrangements, I could imagine teaching classes in there. Additional greenhouse space on campus for teaching would be a wonderful addition. That way we could separate out greenhouse space that we use for teaching/outreach from the research greenhouse space."
>
> - *Rebecca Irwin, Professor of Biology*

> "I'm a strong supporter of the concept and have been involved with some past efforts to move the College in this direction. My teaching interests around sustainability are focused on agriculture. This means my interests are more centered on what happens outside the building, with plants and soils. The value of a Center in my opinion is in linking energy, water and food production concepts to produce a more holistic view of sustainability for the College. The Center would be a statement of the College's philosophy toward the environment and how it views concepts about sustainability as a part of a liberal education. I would welcome such as Center."
>
> - *Ross Virginia, Professor of Environmental Studies*

Support for sustainability is an idea that must be integrated in one's own lifestyle. Dartmouth students have incredible opportunities to explore facets of reason, analysis and critical thinking during their time here, and with that intellectual growth should be an opportunity to experience groundbreaking alternatives to students' lifestyles. Those students

involved in environmentalism through the academic, social or extracurricular elements of the College are exposed to the practical and progressive models of sustainable existence, but environmentalism should, and can, be more of a priority for the Dartmouth community at large. A sustainability center will garner more awareness for green living through both its open, social atmosphere and its visible, working systems. Thus, it is the goal of a sustainability center to exist as a living model for *all* students to incorporate a more environmentally conscious attitude into the far-reaching Dartmouth community, both in Hanover and worldwide.

Funding

The estimated costs of the center's main visibly sustainable features are as follows:

- Eco-roof will cost $15 sq/ft[5]
- PV cells collecting solar energy will cost $7-$10 per watt installed. [6]
- Daylighting components will cost $.25-$4 sq/ft
- Underfloor air distribution system will cost $6-$8 sq/ft[7]

Monetary Savings

Among obvious environmental benefits, the center's visibly sustainable features will also save the College money, and over time, pay for themselves. Many of the systems implemented in the building are designed to save energy, causing the College to rely less on its power plant and outside energy providers. For example, the eco-roof will last three times longer than a standard roof, reducing its maintenance costs. The eco-roof will not exceed temperatures of 77 degrees F in the summer, compared to 140 degrees F of a standard roof. The reduced temperatures will allow the center to function without air-conditioning or energy consuming desk fans. The PV power generation system can generate 14,000 kilowatt-hours per year. At 10 cents per kilowatt-hour, the PV cell system will cost the College additional money over what it would pay for electricity. However, this additional cost should only be weighed along with the fact that the building will use significantly less electricity than an ordinary College building. Furthermore, the visual reminder and educational value of having renewable energy supply the building with electricity is the essence of the sustainability center and therefore a necessary component. The savings from the efficiency of the other technologies should cover their increased construction and instillation costs, paying for themselves within five years. With the center, the College should be willing to experiment with newer technologies that, while they are not necessarily as established or economically efficient as traditional technologies, represent and embody ways of living more sustainably, and with less environmental effect. The sustainability center is a statement.

Government Rebates and Financing

In addition to the money saved from reduced energy, the sustainable features of the center are eligible for government rebates and other financing options. For example, funding for the eco-roof is available through the EPA's Clean Water Act Section 319. Also, State tax credits will apply to the energy saving components of the center.

Capital Campaign Allocation

The College's $1.3 billion Capital Campaign is a possible source of funding for the sustainable living center. In particular, there are 2 divisions of the fund that could be allocated to the center, the $4 million Outdoor Life and Learning fund, and the $10 million

Technological Innovation Fund. The sustainability center's emphasis on environmental issues will make it eligible for support from the Outdoor Life and Learning fund, while its energy-saving technological features will benefit from the Technological Innovation Fund.[8]

Location

Location is an important aspect of the sustainability center as the success of the facility is largely dependent on where it is placed. There are several elements that are necessary for the space, which the center will fill. In particular, the space should:

- Be zoned for an educational facility
- Allow for the construction of a new building
- Be visible to the campus
- Be accessible to students, faculty, and the Hanover community
- Fit the building
  - Size
  - Aura

Upon a great deal of research and discussion with Marty Redman with Residential Life, Judy Brotman with the Town Hall, Paul Olsen with Dartmouth Real-estate, Lynn White Cloud with Tucker Foundation, and Jack Wilson with Dartmouth Facilities and Planning, we have come to the resolute conclusion that the ideal location for this sustainability center is between Burke Hall and the parking lot below Dragon [see Appendix 2]. The following section supports constructing the sustainability center in this space and also present evidence showing why other locations are unfit for this facility.

Numerous places were presented as potential locations for the sustainability center. However, Hanover zoning is strict and the only zone which permits an educational facility is the Institutional Zone. According to the Town of Hanover's Zoning Ordinance:

> The Institutional Zone permits the following uses:
>
> Recreation and Outdoor;
> Education;
> Child Day Care Agency;
> Church;
> Hospital;
> Residential Institution;
> Office;
> Government Use: limited to office, public safety, education, recreation, parking; Medical Center;
> Warehouse;
> Use accessory to permitted use.[9]
>
> The Downtown Zone permits the following uses:
>
> Downtown Commercial;
> Downtown Lodging;
> Downtown Residential;
> Downtown Civic;
> Use accessory to permitted use.[10]
>
> The Single Residence Zone includes the following uses:
>
> Single Family Dwelling;

Open Space Subdivision;
Accessory Dwelling Unit;
Use accessory to permitted use[11]

The Rural Residence Zone permits the following uses:

One-family dwelling;
Two-family dwelling;
Forestry;
Agriculture;
Recreation and Outdoor;
Produce Stand;
Governmental Use: Limited to education, recreation;
Planned Residential Development (PRD);
Neighborhood Retail Sales in PRD;
Continuing Care Retirement Community;
Use accessory to permitted use[12]

Within the Institutional Zone several possible locations were discussed including: between Burke Hall and Dragon; behind Richardson and southwest of the observatory; between Moore Hall and the soon to be Kemeny Hall; the tree houses; the Choate House; and North Hall.

Among these spaces, the only one that fulfills all the five major elements of location list above is the space between Burke Hall and Dragon.

This location allows for building a new facility. Secondly, this space is visible to the public, especially once the McLaughlin Cluster is built. Third, it is accessible for students, faculty, and the community. Fourth, the space fits the building by size and aura. It is relatively small and thus would not overwhelm a small building. This location is also nicely tucked into a wooded area, giving it the aura of sustainable living.

All of the other potential options within the Institutional Zone lack one of the five essential elements. The location next to the observatory is not visible to most of the campus. The space between Moore Hall and the soon-to-be-built Kemeny Hall is quite large and would overwhelm the building, and would not suit the aura of a sustainability center. A third option is the tree houses, which will be removed soon. The major drawback of this location is that it is not visible to the campus and not easily accessible for students, faculty, and the community. As a result, fewer people would use this facility. The Choate House and the North Hall locations would suggest a renovation of an old building. This would not allow the building to be designed and constructed as a truly sustainable building. In addition, these buildings are better suited for other purposes.

If this location is not possible, there are alternative that could still make the idea of a sustainability center a possibility, though with different functions. This would be a second-best option but it would allow the sustainability center to be located in a different zone. For example, the sustainability center could function as a more commercialized center. In this case, it would be a dining or retail facility and a possible residence space could be located on the second floor. This would allow the sustainability center to be located in the South Block, Sergeant Block or the space that is currently Lyme-Angler. However, there are many logistical issues that would arise if the center were more commercialized. Food and beverage licenses would be needed. Taxes would also increase substantially. Rent would be high. Thus, while the community would benefit from a more commercialized center, it would lose its ties to the College and require a much greater commitment from alumni, students, and faculty.

Alternatively, if the center were located in a Residential Zone, it would become more of a living center than a student center. In a Single Residential Zone, the center would need to be incorporated into an existing multi-family residence house like Panarchy, Rivercrest, Foley House, or another off-campus residence. While still beneficial, a negative aspect of this would be the implication that the sustainability center would be more exclusive to the people who lived there. While weekly meals and social events could be provided, the educational element would be underrepresented. Another possible residential zone is the Rural Residential Zone, which includes the Dartmouth Organic Farm. If the sustainability center were located on the Farm, it would not be visible to the campus and it would not be accessible for many students. It would become more of an exclusive center for people who were living there.

Therefore, after weighing all the factors of these various locations, it is clear that the space between Burke Hall and Dragon is the most ideal space for this center. It is in the Institutional Zone so it can function as an educational facility. It is an empty lot, ready for a small building to be constructed. This location is accessible to students, faculty, and the public. In addition, it is visible to the campus, which is an important aspect of the facility. Finally, the aura of the space is perfect for a sustainability center.

Implementation

From Proposal to Construction

Upon acceptance of this proposal, plans need to begin for the design, construction and realization of the Sustainability Center. Design plans should consider visibility and educational value of the green aspects of the facility as priorities.

A committee should be formed immediately to oversee the conception and construction of this building. Dartmouth Sustainability Coordinator Jim Merkel and a faculty member or the College Architect Jack Wilson should chair the committee. Other members may include faculty, staff, alumni and students who have shown dedication to the proposal and who can offer expertise in some aspect of the building design and function.

Our recommendations for potential [non-student] candidates include:

Larry Litten—*Institutional Research*
Scott Stokoe—*Dartmouth Organic Farm*
John Gratiot—*Facilities Operations and Management*
Ross Virginia—*Environmental Studies*
Barry Scherr—*Provost*
Lee Lynd—*Thayer School of Engineering*
Benoit Cushman-Roisin—*Thayer School of Engineering*
Marcelo Gleiser—*Physics*
Karolina Kawiaka—*Studio Art*
John Vogel—*Tuck School of Business*
Priscilla Sears—*English, Liberal Arts, Women's Studies*
Andy Harvard—*Outdoor Programs*
Bill Hochstin—*Materials Management and Purchasing*
Adam Keller—*Executive VP*
Andrew Friedland—*Head of Environmental Studies Program*
Elizabeth Ashworth—*Director of Facilities for Tuck School of Business*
Ken Baker—*Tuck*
Anne Arquit Niederberger '84—*Environmental Consultant*
Karl Steyaert '93—*Sustainability Coordinator in Scotland*
Dan LeBlanc '93—*President of Dartmouth Environmental Network, Green Building Consultant*

Bill McDonough ‘73—*Green Architect*
Malcolm Lewis Th ‘71—*Thayer Alumnus, Green Architect*
Bill Mansfield ’54—*Works in Sustainability in Higher Education*
Edie Farwell ‘83–*Director of the Cobb Hill Sustainability Institute*

This group will coordinate the conceptual and logistical planning for the sustainability center—from design ideas to construction contracting. In accordance with the socially inclusive nature of the center, though, the committee should organize opportunities for both students and Upper Valley community members to participate in the visioning and brainstorming sessions for the design and function of the center. In particular, students should partake in class work and independent study projects in the building and systems design and maintenance. Architecture, engineering, environmental studies, sociology, and studio art students, for example, could learn from and contribute their skills to planning and construction processes. Already, there is an architecture class that is designing a sustainable living center for a class project.

From Building to Self-Sustaining, Interactive Learning and Social Space

The College sustainability coordinator will be in charge of “staffing” the sustainability center. One full time leave term student or post-graduate intern will work closely with the sustainability coordinator on event programming, educational programs and materials, preparing and rotating the center’s exhibition space, and managing the local foods snack bar. This position offers invaluable planning skills to student or recent graduate participants, maximizes student involvement and minimizes operation costs. It can be funded under the student programming budget or a new sustainability budget, to be handled by the sustainability coordinator. A part time internship opportunity for an enrolled student can also be offered on a term-by-term basis for specific programming projects such as coordinating community greenhouse gardening classes, vegan cooking classes, composting workshops, or scheduling student and community concerts, book-readings, and other social events.

Area residents should be able to visit the center as a social space and a green building educational resource. Along with maintaining a regular exhibit space for student art and displays detailing relevant academic projects, the center’s interns should generate and accumulate a sustainable building and living literature. They can gather and circulate books, pamphlets, posters and labels that explain green building, the sustainability center’s ecologically sound features, and the lifestyle choices people can make to decrease their ecological footprints.

In terms of building maintenance, the center can be cleaned like any other College facility, but with only the most ecologically sound materials, such as Seventh Generation cleaning products. Water and waste systems will be unique on campus and so any repair and maintenance work may need creative attention. FO&M may want to seek special training for some staff members in maintaining green building features like composting toilets, living machine waste systems, photovoltaic water heating, green roof, and other systems.

Monitoring and assessment mechanisms will serve to keep the center in line with its changing ecological, economic and social contexts. The building should undergo a thorough life-cycle analysis. Its water, waste and energy use should be able to be easily monitored so that the College can track the long-term environmental and economic cost savings of green design features. Additionally, some form of feedback—a suggestion box plus a yearly online survey, for example, will help the managers keep programming and building use in line with community interests. Yearly assessment may help the center match the changing needs of the Dartmouth and Upper Valley community.

Promotion

Finally, it is imperative that Dartmouth celebrate the success of the sustainability center project. Admissions officers should gloat about the center and tours should stop through. Students, faculty, staff and community members should have free and open access to the facility. With this project, Dartmouth is truly living up to its green image, and should fully promote this and other projects that exemplify Dartmouth's leadership and commitment to campus sustainability.

Conclusion

This proposal is a culmination of all the past visions for a Center. In the past, the Sustainability Center initiative has lacked continuity from proposal to proposal. Many times, an upperclass student has submitted a proposal and then graduated before receiving a response about the project, and this has hindered the initiative because students have not be able take suggestions from the administration to improve a proposal, nor successfully build off of each other's work. However, this proposal has the opportunity to continue through two group members from the Class of 2006, Christina Jimenez and Joe Killefer. They have been an active part of the proposal's development throughout the term, and their knowledge of the process and the vision for the Center can carry on this project successfully for the next academic year. There is sincere hope that this proposal is accepted and enacted by the College, and continued student support and involvement will aid that process.

II. APPENDIX 5A: SUSTAINABLE LIVING CENTERS AT OTHER SCHOOLS

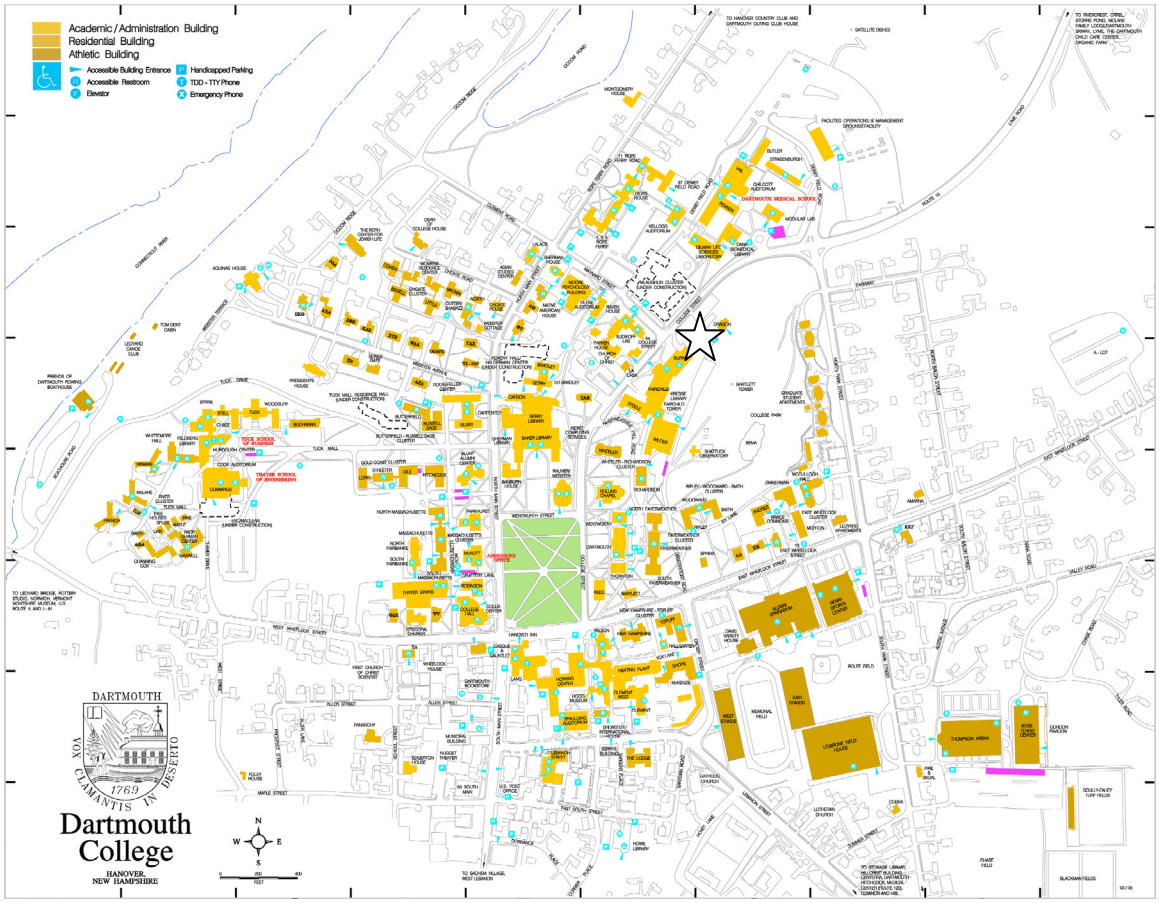
Other institutions currently have environmental centers of varying scope and visibility. While some centers are actually living centers, others are simply offices created for the purpose of being a hub of environmental activity by providing resources for students to take action on campus while educating local communities through speakers, pamphlets and informative websites.

The McLean Environmental Living and Learning Center (MELLC) at Northland College in Ashland, Wisconsin is an extremely visible landmark promoting sustainability at both the individual and institutional level.[13] This green dorm houses 114 students while employing several green technologies including PV cells, a windmill providing 23 kW to the dorm, furniture made from recycled materials, passive solar water heating, composting toilets and two greenhouses. The MELLC concept came to fruition through the joint working of college staff and students, and at a price of $4.1 million it was more cost effective than a standard dorm of comparable size.[14]

Living centers also exist in the form of affinity housing at both Middlebury and Carleton.[15] At these schools, students interested in living sustainably promote their ideals through eating locally and organically, composting, and exploring the use of other energy saving technologies in the house. In comparison to the MELLC at Northland, the houses themselves are not built in a green manner. However, with inhabitants interested in promoting a sustainable lifestyle the community is directly educated through dinners, speakers, and other informative events at the house.[16]

The University of Colorado, Boulder and the University of Texas, Austin both have environmental centers in the form of offices, readily accessible to students on campus. These offices are geared toward educating the campus through reports, speakers, and the organization of sustainability focused events such as recycling drives, student petitions for wind power and composting in dining halls, and dorm energy competitions.[17] Here students have access to reports, general information, and lists of contacts from other students to staff to NGO representatives, all serving to better inform the campus in all environmental matters while providing a starting point for students with ideas for environmental action.[18]

III. APPENDIX 5B: CAMPUS MAP



http://www.dartmouth.edu/~maps/docs/map0503.pdf

☆ - Location of proposed Sustainability Center

6

IMPLEMENTATION: WHAT WE CAN LEARN FROM PEER INSTITUTIONS

I. THE IMPORTANCE OF ADMINISTRATIVE LEADERSHIP

The creation of the Sustainable Coordinator position is a step towards developing the organizational infrastructure necessary to effectively address environmental issues at Dartmouth. However, environmentalism must be integrated across departments and programs, as its lessons apply to the entire campus community. Real environmental change will only occur at the College if the administration takes a leadership role in building the institutional structures needed to establish a more sustainable campus community. High-level administrative commitments to finding funding for environmental programs, and to promoting communication across university divisions are invaluable for the successful implementation of such programs. In addition, Dartmouth must commit to adjusting campus culture and to promoting a broad set of goals to synchronize environmental efforts. By encouraging consistency and coordination across institutional branches, an effective environmental policy will help Dartmouth facilitate the integration of environmental values into all facets of the College.

As a highly visible academic institution, Dartmouth must increase its efforts to provide a model of environmental citizenship for its students and for academic institutions that may seek to follow Dartmouth's lead. To help Dartmouth reach this goal, we have explored the administrative structures, policy commitments and environmental programs found at several environmentally progressive institutions. We hope that these examples will help Dartmouth develop the foundation necessary to effectively and efficiently facilitate broad-based institutional change.

II. THE ROLE OF ADMINISTRATION

A particularly striking example of administrative progressiveness was found at Middlebury College. Since 1965,[1] with its establishment of the first environmental studies program in the US, Middlebury has continued to be an institutional leader in the area of environmental affairs. This tradition has resulted in Middlebury's association with exemplary environmental practices. A previous Dartmouth study even found Middlebury to be the most 'green' of five elite New England institutions with environmental studies programs.[2] A reason for this distinction can be linked to administrative leadership from the president to the sustainable campus coordinator.

In 1994, then Middlebury president John M. McCardell Jr. prepared a visionary declaration for the college. In it, he stated six "Peaks of Excellence" as defining characteristics of the institution, one of them being environmental studies and awareness. According to campus sustainability coordinator Connie Bisson, this idea and the action it has

spurred, has lead to a culture of environmental consciousness among both faculty and students. The following are results of the implementation of this environmental "Peak"[3].

Environmental Council

1995 saw the creation of the Middlebury Environmental Council (EC), a committee made up of faculty, administration and students for the purpose of educating the student body, administrators, and the community at large on college environmental matters through formal reports and informal assessments[4]. The EC meets every other week throughout the academic year and functions much like Dartmouth's Resource Working Group (RWG). However, the EC differs in that undergraduates may participate as active members of the EC. The EC also allows other staff and faculty members outside of the Council to participate in their meetings. The president himself has sat in on EC gatherings and has personally asked for environmental audits of the college.[5] By expanding to include students and other conservation minded staff, the RWG would increase its visibility on campus and among administrators, perhaps taking a more active role as a tool of the administration in environmental matters.

Office of Environmental Affairs

In 1997 the Office of Environmental Affairs (EA) was created, guaranteeing the administration's commitment to supporting future environmental initiatives. The EA includes a director who works with the administration, and a sustainable campus coordinator who works with staff and students. Through the EA environmental working groups are created, grants are given to students and staff for the development of environmentally minded projects, and educational publications including the "Blue Green Newsletter" and State of the Environment reports are disseminated.[6] Such an office at Dartmouth would certainly increase its image as a green institution while becoming a hub of easily accessible information concerning the Dartmouth community and the environment.

Sustainable Campus Coordinator

Hired in 2001 as Middlebury's Sustainable Campus Coordinator, in her own words, Connie Bisson prevents environmental action items from "slipping through the cracks."[7] Bisson is able to connect students and staff with similar interests, who may not otherwise be able to interact. Aside from serving as an important liaison, Bisson also serves on several committees and prepares reports and provides research for the EA.[8] When Dartmouth's sustainability coordinator arrives, it is critical that he makes every effort to communicate frequently with both students and faculty.

Carbon Reduction Initiative Working Group

The Carbon Reduction Initiative Working Group (CRIWG), founded in 2002, further displays Middlebury's administrative commitment to sustainability. The group was created to investigate steps Middlebury could take toward reducing carbon emissions, with the eventual goal of making the college carbon neutral. The school's Treasurer chairs this committee, providing a direct link between the group and college administration.[9] Should Dartmouth wish to portray itself as a progressive institution, visibly involving administration in environmental projects such as the CRIWG would surely bolster its green reputation.

Environmental Grants

Supported by discretionary funds from the president of the college himself, the environmental grants program serves as an example of Middlebury's administrative commitment and leadership in environmental matters. Managed by the EC and granted a budget of $65,000, the program has sponsored over 40 student and staff projects of a wide range: from a campus shared bike program to a study on the potential use of hybrid cars in Middlebury's facilities fleet, and even a program proposing heating an organic garden by the use of heat created from the biomass of compost piles.[10] A similar grant program at Dartmouth would allow students with conservation minded projects the means by which to more readily serve the community. Beyond making Dartmouth a more attractive option to interested students, such a program would tangibly benefit the campus through sustainability projects.

III. SUCCESSFUL POLICIES AND COMMITMENTS

In order for dormitory energy conservation projects to take hold, there must be an overarching plan unifying and promoting environmental consciousness. By adopting a commitment to sustainability, Dartmouth can advance its reputation as a progressive institution, while setting an example for its students to be conscientious and forward-looking global citizens. Currently, given the links between energy use and global climate change, "the role of policies to promote the adoption of energy-efficient technologies is a matter of great importance."[11] Our College must continue to promote the idea that a significant amount of education takes place outside of the classroom and make environmental consciousness a core element of the Dartmouth education. A comprehensive document outlining Dartmouth's efforts towards sustainability is also necessary to maintain consistency despite turnover of both students and faculty. In drafting an effective environmental policy, specific examples Dartmouth should look to include the 'Blueprint for a Green Campus' adopted by the University of Colorado at Boulder, the 'BIG" program developed at Brown University (the most environmentally conscious Ivy League Institution), and the environmental leadership taken by Tufts University with the commitment to meet or beat the goals of the Kyoto Protocol as well as in their role as the lead signatory to the Talloires Declaration.

In the case of Colorado, the 'Blueprint for a Green Campus' is an environmental action plan that synthesizes policies from fellow universities, student survey data, and national environmental priorities to develop solutions for a variety of issues the school faces. A critical aspect of the document is that it is not static, but updated annually to assess progress, recognize new issues, and discuss shortcomings.[12] While CU's impressive list of environmental achievements[v] certainly do not require the existence of any such blueprint, its effect on campus goals and attitudes cannot be undervalued. Individuals at the highest levels of Dartmouth's administration must realize that in today's global environment it is imperative that we progress beyond traditional expectations. As a forward-looking institution, Dartmouth must promote environmental values through public leadership and visible

[v] Since the adoption of the 'Blueprint for a Green Campus' in 2000, students voted to increase their fees by $1 per semester to buy wind power, alternative fuel vehicles were purchased by facilities management, and lighting upgrades were initiated in both residential and academic buildings. These measures along with several education programs caused energy use to drop by 2.2% between the 2002-2003 fiscal year and the previous year: *CU Student Union, Blueprint For a Green Campus – 2003 Update*, 2003 <http://ecenter.colorado.edu/greening_cu/2003/page2.html>.

dedication to building a more sustainable community. By aligning all of our institution's efforts towards one set of environmental goals, great things can be accomplished. Therefore, the adoption of a commitment to sustainability must be made a priority.

Brown: Progressive Environmental Policies at Dartmouth's Peer Institutions

Although the implementation of environmental policy may seem easier at large universities like CU, which have very different funding opportunities and better economies of scale, some of Dartmouth's "peer institutions" also have very progressive commitments. Brown for example, initiated the 'Brown is Green' (BIG) program in 1990 out of concerns over "rising energy costs, low participation in the campus recycling program and other wasteful campus behavior."[13] The BIG program is based on seven core principles designed to coordinate and unify Brown's environmental efforts and promote further investment in resource conservation.

The Seven BIG Principles[14]

1. The University should, within limits of capital availability, invest in any resource conservation project that has an expected return on investment (ROI) greater that the current borrowing rate.

2. For all renovation and new construction projects:

- The choice of architects, engineers, and consultants should be based in part upon their demonstrated expertise in resource conservation design.
- Architects and engineers shall submit a detailed life cycle cost analysis of resource conservation options for each project, and shall certify that all options that satisfy the ROI policy (#1 above) have been analyzed.
- Engineering proposals prior to construction and change orders during construction will be reviewed for impact on the efficiency of any plumbing, electrical or HVAC system.

3. Purchasing choices of items with significant resource impact should favor resource-efficiency except when special need is demonstrated.

4. Decision-makers should be made aware of and consider the economic and environmental costs of their decisions.

5. Conserving energy in University buildings should be a priority, with the following goals:
- Whenever possible, heating systems should be upgraded to allow: more uniform system control (i.e. adding more zones) and increased occupant control over room temperature during non-setback hours of operation; lighting systems should provide illumination as efficiently as possible. Unnecessary illumination (e.g. when areas are unoccupied; lit with adequate daylight) should be eliminated wherever feasible.

6. Improving resource efficiency in University communications should be a priority.

7. Resource efficiency and environmental considerations should be incorporated in student orientation and employee training

Although Dartmouth may generally comply with principles similar to these, we believe it would be beneficial to spell them out in a cohesive document to both unify conservation efforts and promote a more environmentally conscious culture.

Brown's success with the BIG program is largely due to support from individuals at the highest levels of the administration. For example, in January 1991, Brown President Vartan Gregorian showed the depth of university support for environmental efforts when he personally appointed a Brown is Green committee to advise and encourage the implementation of sustainable policies.[15] In developing the guiding principles for the BIG program, the committee focused on the continued promotion of environmental investment despite challenges due to institutional structure and political factors. By encouraging consistency and coordination across administrative units and over time, the BIG program has effectively brought coherence to Brown's conservation efforts.

Tufts: International Environmental Leadership

Another of Dartmouth's peer institutions, Tufts University, has proven to be a global leader in environmental policy, playing a critical role in the development of the Talloires Declaration, and subsequently making a commitment to meet the targets of the Kyoto Protocol. First, Tufts initiated the Talloires Declaration, an international agreement between university leaders that promotes environmental awareness and sustainability. "In 1990, Jean Mayer, Tufts President, [convened] 22 university presidents and chancellors in Talloires, France, to discuss environmental sustainability."[16] The conference focused on the "role of universities and, in particular, the role of university presidents, in environmental management and sustainable development,"[17] and resulted in the formulation of a 10-point action plan for the incorporation of sustainability and environmental literacy into campus teaching, research, operations and outreach. As of March 2005, 314 universities globally had signed the Talloires Declaration. Of the 314 signatories, 121 are US Institutions, including Middlebury, the University of Colorado and Brown.

In developing the Talloires Declaration, the founders hoped that it would help universities "envision institutional sustainability, garner support, and coordinate efforts" thereby providing a powerful means of linking good intentions and concrete change.[18] Thus, as Dartmouth works to develop its own sustainability strategy, it should look to learn from the Talloires' insights regarding successful development and implementation of environmental policies. The declaration lays out four critical steps for the establishment of a more sustainable campus community: 1) the formation of an environmental task force; 2) leadership from key administrators - especially in the arena of policy funding; 3) the institutionalization of environmental policies and procedures; and 4) the development of effective monitoring, evaluation, and reporting systems. Furthermore, Dartmouth can also learn from the challenges that other universities have faced in their efforts to implement the declarations' guiding principles. Most importantly Talloires signatories have found that, "competing institutional priorities and lack of integration across functional areas" [19] are major barriers to implementation. Clearly, academic institutions working to achieve a variety of institutional goals simultaneously face significant financial and human resource constraints. Overcoming these structural challenges at Dartmouth requires the prioritization of sustainability issues at all levels of the administration. Signatories have found that the realization of Talloires goals requires the modification of organizational decision-making structures, leadership from university administrators, and broad-based stakeholder commitment to the new sustainability policy.

In addition to Tufts' Talloires efforts, "in April 1999, Tufts University's president pledged that the university would meet or beat the goals of the Kyoto Protocol in university operations, reducing carbon emissions 7% below 1990 levels by 2012. This goal was recently reaffirmed in March [2001] by Tufts' new president Larry Bacow."[20] Tuft's commitment to

the Kyoto energy saving targets required careful research, the formulation of a clear climate policy as well as continual monitoring and assessment to ensure effective implementation. In 1998, the Tufts Climate Institute (TCI) was created to help Tufts assess their current energy efficiency, determine the feasibility of meeting Kyoto emissions targets, and to help with the implementation of emission reduction policies. TCI used an emissions inventory to determine that meeting the Kyoto goals was achievable with the use of a multi-pronged strategy including: increasing electrical efficiency, increasing heating efficiency, purchasing a portion of [their] power from green sources, fuel switching from oil to natural gas in some boilers and leveling demand for fuels.[21] Subsequently, in May 2001 TCI facilitated the formation of an Energy Affairs Council (EAC) comprised of stakeholders from across the Tufts community. EAC successfully coordinated the efforts of university leaders helping to "increase university investment in additional efficiency measures, raise awareness about energy efficiency, and begin detailed discussions at all levels about how to reach Tufts' goals."[22] Finally, TCI has carefully examined every step of the implementation process, translating lessons learned into more effective policy implementation. As a progressive academic institution, Dartmouth has the responsibility to take action to help alleviate climate change. Throughout this proactive process Dartmouth will both increase energy efficiency and provide a positive model for other academic institutions and businesses to follow.

As Dartmouth works to improve its own energy efficiency, the lessons learned at Tufts offer a valuable perspective on the institutional structures required to catalyze institutional change in energy policy. First, effective climate change action requires a strong partnership with the universities operations division. Questions such as "who installs it, who maintains it, what happens if there are problems, and who will pay for repairs,"[23] are central to the implementation of energy saving initiatives. Therefore, a strong partnership between policy-makers and campus operations is critical to successfully addressing these logistical details. Additionally, funding must be earmarked especially for energy saving programs, as problems with shortages in funds can place emphasis on immediate pragmatism rather than life cycle cost decision-making. "In most cases the technology exists to curb energy use, improve efficiency… The problem most often lies in successfully and pragmatically implementing the solution given the range of competing priorities, financial constraints, timing considerations (the academic calendar can pose huge constraints), lack of familiarity with technology, and existing problems that the status quo already solves."[24] Economically speaking, it makes sense to finance any project which yields a rate of return that is above the cost of borrowing. However, when budgets are tight, organizations usually cut funding for "good citizen" investments that are seen as ancillary to core responsibilities. This practice must be avoided for Dartmouth students and observers to gain faith in our school's efforts. Finally, and perhaps most relevant to improving energy efficiency at Dartmouth, the development of an effective energy savings strategy requires commitment, persistence and a willingness to admit past mistakes.

Conclusion

Strong environmental policies do not necessarily translate into effective implementation. However, as in the case of the University of Colorado, Brown and Tufts, environmental policies can help facilitate institutional change by securing the commitment of key university decision-makers and stakeholders. In addition, over-arching policies facilitate the integration of environmentalism into all facets of the institution. By promoting consistency and coordination across all departments and offices, an effective environmental

policy will help Dartmouth translate ideas and rhetoric into meaningful energy savings and campus sustainability.

IV. ENGAGING STUDENTS

When adjusting the administration and drafting environmental commitments, it is critical that student input be considered. Student involvement will be critical for most conservation measures, especially those regarding dorm life. Students must be willing to behave in a more sustainable manner. They would be much more likely to do this if involved in policy-making procedures. Undergraduate groups must be given the opportunity to develop their own initiatives while also lending a voice to administrative processes. However, it is still highly important that the administration take a leadership role, to ensure efficiency and consistency in project implementation.

Administration/Student Dialogue

A good example of how undergraduates can be involved in environmental decision-making is provided by Colby College. Environmental leadership comes from the President, under the guidance of the Environmental Advisory Committee (EAG). In 2000, the EAG was established to advise the college community on issues related to environmental stewardship on campus and in the region. Currently environmental priorities are developed with input from the Physical Plant Department, the Environmental Studies Department, and a multitude of consultants and student organizations.[25] The president's office then works with the EAG to establish a budget and ensure completion and effectiveness of projects and initiatives. Continued commitment is ensured through the cooperation of the EAG, the Environmental Studies Department and student groups committed to enforcing environmental policy and commitments. Dartmouth would benefit from having a defined, working relationship between administration, faculty, students, which should be facilitated by the new sustainability coordinator.

Student Initiatives

At Colby, students are involved in the development of environmental initiatives in a number of ways. First, any member of the Colby community can propose an environmental initiative for the EAG to consider.[26] In addition, the Colby Green website gives the EAG an online presence for both on- and off-campus audiences. Through this site the EAG effectively raises awareness about ongoing environmental initiatives, promotes environmental consciousness, shows prospective students and external audiences that Colby is actively addressing environmental concerns, and demonstrates the dynamic nature of Colby's environmental policies and programs.

In addition, Colby's student body at large shows commitment to sustainability. Several groups work with the EAG for environmental impetus on campus. These include: Colby Climate Coalition, Colby Environmental Coalition, Colby Outing Club, Colby Environmental Studies Club, and the Colby Mountaineering Club.[27] These groups have coordinated with the EAG to develop several ideas for "Green Living and Purchasing" in an extensive list of "Sustainable Living Tips" for laundry, dining, and recycling, computer use and other activities.[28] Additionally, the students in the Environmental Science department

play a major role in the green work on campus. Some student-initiated projects include: an environmental attitude survey, a greenhouse gas inventory, and a building-by-building energy use profile. Dartmouth would benefit from consolidating the many environmental advocating groups in our community under one umbrella, improving communication and helping to coordinate each organization's efforts and goals.

Conclusion

Developing a similar model of student involvement in campus sustainability efforts would be beneficial to Dartmouth's environmental movement. Simple measures like promoting conservative practices for an individual's energy use, recycling, and reducing consumption could easily be encouraged among the student body. The expansion of green projects would help promote awareness and responsibility at the student level, as peers often most effectively motivate other peers. In addition, administrators must work with student groups to push Dartmouth culture in a more sustainable direction. Institutionalizing coordination processes between groups will be difficult, but better student-administration communication will undoubtedly generate ideas that will help make Dartmouth more energy-efficient.

V. FINDING FUNDING

While there is little doubt that conservation-minded projects have many benefits, this is rarely enough to justify their induction. Barriers are often present, most notably those involving funding limitations. Even when proposed environmentally friendly initiatives are shown to eventually pay for themselves in cost-savings, a lack of initial funding can be prohibitive. However, Dartmouth has the opportunity to learn from the financial structures that other institutions have developed.

Harvard provides a particularly striking example of a "peer institution" that has effectively found funding for sustainability projects. To overcome financial limitations, Harvard created the Green Campus Loan Fund (GCLF). This fund offers interest-free loans for projects involving building design, operations, or student behavior that have a payback period of five years or less. By repaying the loan with saved costs, departments can upgrade efficiency and environmental friendliness without having to pay any capital costs.[29]

The GCLF is overseen and promoted by a single coordinator, but is supported by the Harvard Green Campus Initiative (HGCI), a cross-departmental organization of faculty dedicated to promoting and enacting conservation measures. The GCLF also involves an independent evaluation committee, including members with extensive knowledge relating to safety, finance, engineering, maintenance and environmental impact. This committee and the HGCI provide oversight and critical assistance to possible projects. The cooperation between the HGCI and the GCLF allows the HGCI to help applicable ventures become recognized for GCLF support.[30] Harvard has benefited greatly through this partnership, and any similar program Dartmouth considers must provide the means for integration of fund administrators with project coordinators.

History

Adoption of the GCLF was made easier by the success of a previous project called the Harvard Resource Conservation Incentive Program (RCIP). The RCIP was run from 1993-1998, during which interest-free loans went to a total of 35 conservation projects out of

the $1.5 million fund. A total of $2.6 million was lent, resulting in an estimated five-year savings of $4.5 million and an annual reduction of 8.8 million pounds of carbon dioxide. Following the program's five-year run, the Harvard School of Public Health conducted a study of its effectiveness, and found that some of the barriers to increased use of the fund included a lack of information about what projects qualified, as well as a lack of staffing and time. To overcome these barriers, the study suggested that in the future, similar programs would need more aggressive management and marketing, improved communication between fund administrators and project initiators, and the provision of technical assistance to assure fund criteria are met.[31]

With the recommendations made concerning the RCIP in mind, the GCLF was proposed as a $3 million interest-free revolving loan fund. Following a year of lobbying to the central administration, the proposal was approved, and an additional $150,000 per year was allotted for administration. While initially run by a full time manager, the fund was integrated into the HGCI, requiring less time once the infrastructure was in place.[32] We envision that a similar fund at Dartmouth could be administered by the sustainability coordinator's office, and we certainly do not expect the fund to be as large as Harvard's due to our smaller budget. However, if the administration is committed to attaining the benefits of conservation and efficiency, it must be willing to allot the necessary funding.

Success

According to the HGCI website, "GCLF projects are projected to save the University $889,000 per year, with an average project return of investment of 27.9%." Most of the projects involved lighting or HVAC upgrades, and the highest return-on-investment came from behavior-change initiatives. In addition to the financial benefits, the GCLF has also brought a reduction of environmental impact, including an over 14.5 million pound reduction in carbon dioxide emissions.[33] As long as initial capital is available, there is no reason to think of environmental friendliness and financial responsibility need to be opposing goals.

Aside from its monetary and ecological gains, the GCLF has provided many unquantifiable benefits as well. The GCLF has served to legitimize Harvard's interest in the environment, and causes Harvard to be seen as a leader through its commitment to sustainability. The GCLF also provides a forum in which different departments and offices can pursue joint projects.[34] When weighing the costs and benefits of the creation of a similar fund, Dartmouth must recognize the many gains beyond the financial realm.

Conclusion

The many benefits of Harvard's loan program demonstrate how future funding programs can work at Dartmouth. However, in order for a funding program here to reach its potential, it is critical that we learn from the mistakes of Harvard. Harvard's program has shown the necessity of engaging facility managers in the GCLF approval process to incite them to use it. Careful planning and management is critical in this funding structure, in order to teach financial managers how to repay loans through utility savings. Also, it is vital that high-level administrators are involved in the search for fund-eligible projects, to set standards for whole departments to strive towards sustainability. Finally, for the maximum gain of any fund to be realized, it is vital that project managers take into account the public relations benefits that can accrue through the initiation of environmentally friendly ventures.[35]

VI. REALIZING THE BENEFITS OF IMPLEMENTATION

Financial Opportunities

In each of the six universities discussed in this section, environmental initiatives have actually saved money. Sustainability stresses efficiency at all levels, paralleling goals of financial responsibility in this aspect. Waste reduction and energy conservation have clear monetary benefits when long-term gains are considered. While we realize that much of the low-lying fruit has already been plucked, we are confident that many opportunities still exist for Dartmouth to advance green ideals without financial losses.

Green Marketing Advantages

For the full advantage of environmental awareness to be realized, Dartmouth must make a concerted effort to advertise itself as an environmentally progressive institution. Colby provides a good example of this, as its "green" image extends far beyond the campus community. Colby's efforts to conserve energy and build with environmentally conscious methods have been recognized and awarded by external entities including the Governor of Maine and the New England Environmental Protection Agency.[36] Furthermore, because Colby's "green presence" is evident in its policy and practice, it attracts students and faculty committed to the principles of sustainable living. To improve Dartmouth's "green" image, a website should be developed which provides easily accessible information about green building and other environmental campus projects and policies. Additionally, a greater effort should be made to inform students about the importance of environmentally conscious living, with the end goal of incorporating sustainable behaviors into the daily habits of all Dartmouth students.

Improving Community and Environmental Consciousness

Dartmouth would also benefit from the development of a commitment to sustainability, which would serve to strengthen and unite the Dartmouth community through the clear definition of a set of shared ideals. This widespread effect was seen at Middlebury following President John M. McCardell's declaration of environmental studies and awareness as one of six "Peaks of Excellence." The college's sustainable campus coordinator, Connie Bisson, has testified to the presence of a community of environmentally conscious students, staff, and administrators at the institution. This unifying green consciousness has allowed Middlebury to advance campus-wide goals of sustainability in an exemplary fashion. With an explicit commitment to environmental goals by high-ranking administrators, Dartmouth can also foster such a consciousness.

Reputation as an Environmental Leader

Dartmouth is widely recognized as one of the top colleges in the nation, a reputation that it works hard to maintain. However, in order for Dartmouth to be recognized as an environmentally progressive institution, more must be done to advance a culture of sustainability across the entire college community. In addition, proper administration must be developed so that conservation initiatives can be achieved. In an article analyzing environmental performance, Herremans and Allwright explain, "environmental strugglers are differentiated from environmental leaders not by their attitudes but by their inability to implement actions. Generally they report to a lower authority within the university's governance or are decentralized with no umbrella committee to organize their activities."[37] Due to a lack of commitment from senior leadership, environmental "strugglers" tend to lack

financial and human resources necessary for effective implementation of environmental policies. The potential for environmental leadership exists at Dartmouth. It is up to this administration to take action to ensure that our College does not get left behind with other environmental "strugglers," emerging instead as a strong leader in this increasingly vital global realm.

APPENDIX A: LIST OF FIGURES

MEET THE AUTHORS

ENVS 50 reports have always been written by Dartmouth students; less often have they been written specifically *for* Dartmouth students. While this year's report makes architectural, operational, and administrative suggestions, it primarily emphasizes that the behavior and lifestyles of the residents—the students themselves—requires the most change in order for Dartmouth College to achieve both a higher level of residential energy conservation, and recognition as a model institution of environmental awareness.

This is a daunting challenge, as people's habits and attitudes do not change quickly or easily. However, our research, survey results, petition signatures, and discussions with other students, faculty members, operational managers, and administrators give us hope that there is an emerging trend and interest on the Dartmouth campus to meet that challenge. We believe a growing desire to change exists, and nowhere is that desire epitomized more than in the optimism of this year's ENVS 50 class. We realize that principally it is ourselves who must both desire and carry out the advised behavioral alterations recommended in this document; we embrace this task.

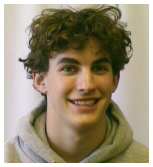
Below, we have attempted to express our own personal beliefs, goals, and motivations surrounding this project (for full responses, see Appendix [?]: Personal Paragraphs). Here we invite you to read about our passions and feelings; what has driven our efforts on this report. To introduce these expressions, we quote a passage from *Earth in Mind* by David Orr, who we feel would have advocated not only the appropriateness, but also the necessity of such 'personalism' in tandem with the facts, figures, and professionalism of the report we here present. We hope this prompt and our quotes will also stimulate you the reader to contemplate your own response. Orr writes:

> "For all of our information and communication prowess, we talk too little about our motives and feelings in relation to our occupations and professions. I recall, for example, a conversation in which a group of distinguished ecologists and environmentalists was asked to describe the sources of their beliefs. In trying to describe their deepest emotions, as if they were the result of carefully considered career plans, these otherwise eloquent people descended into a pit of muddled incoherence. But as the conversation continued, deeply moving stories about experiences of the most personal kind began to emerge. Most of us have had similar experiences. But we tend to talk about "career decisions" as if our lives were rationally calculated and not the result of likes, fascinations, imaginative happenings, associations, inspirations, and sensory experiences stitched into our childhood or early adult memories. I believe that most of us do what we do as environmentalists and profess what we do as professors because of an early, deep, and vivid resonance between the natural world and ourselves. We need to be more candid with ourselves and our students who have chosen to study biology or the human place in the environment because of a similar resonance."

--David Orr, *Earth in Mind*, "Love", p. 4

OUR CLASS

Kyle Aarons 05



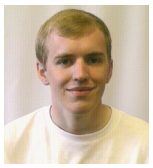
I often ask my friends and family why they seem to refuse to do the simple things to slow the degradation of our environment: turn off lights when they leave a room, throw their newspaper in a recycling bin instead of a trash can, turn off the water as they brush their teeth...The most common answer is that they believe the state of the environment is out of their control, any action they take will make no difference anyway, so why bother? While this attitude seems negative, I can't help but agree with them. Action on the part of individuals does have seemingly insignificant effects, but the alternative is continuing the trend of making decisions with no consideration for the environment. I don't care that my individual actions are minute, I only care that continued collective inaction will lead to a world I don't want to live in, and I refuse to be a part of its creation.

Another reason I suspect people often fail to act in an environmentally responsible manner is that their actions are often far removed from any negative consequences. If students choose to have three refrigerators in their rooms, they are not the ones that have to deal with the increased electricity costs. The administration, on the other hand, IS directly connected to its environmental behavior. If Dartmouth reduces energy use, its electricity bills go down, if it increases reuse and recycling, its waste removal bills go down. Environmental friendliness is not some abstract ideal that we should get around to when we have the time and money; it is a tangible goal with real financial benefits. This report seeks only to recommend policies and technologies that improve conservation and efficiency, and there is little reason why Dartmouth should not choose to pursue these goals, given the financial gains that accompany them.

Lisa Borowsky 05

My sister first exposed me to a mountain biking trail at age 12 in a suburb of Atlanta. It was not until 4 years later that I revisited these trails and developed a love for the natural world. Blurred by a life in a city and little or no education of life beyond them, these trails became my haven – my place to explore, to run, to walk, to think, to relax, and to share with others. These trails became a refuge. Intertwined with an historical old saw Mill, a pond, and a creek, these trails seemed at the time to have it all. I came to Dartmouth somewhat unaware that one could study the environment in college. There was no such thing as environmental studies at my high school. I had managed to live my first 18 years being unaware of where my water came from, how my energy was supplied, and of how my behavior had environmental consequences. After coming to Dartmouth, I soon learned that I had grown up not only without an "environmental consciousness," but without the knowledge that there was such, and I was dismayed. Why had I never been exposed to such pressing issues in all my years of school? Why had accounting, computer programming, and financial management taken such precedence at my high school that not a single course taught students about the environment? How can one reduce their energy, waste, and overall impact on the environment if they have no idea how to do so? (One is not inclined to self teach a topic they are unaware of.) After my first year at Dartmouth, I returned home and went back to those original trails on the creek, but in only one year they had changed. Trash that had been either carried downstream or deposited at those sites covered sections of the banks. The creek was not clean, nor was the river it connected to. In fact, that river - the Chattachoochee – was heavily polluted and in danger. How had I not known? Why did I still not know the facts? I wanted to learn the facts and the consequences our actions have on the environment.

Daniel Bryan 05



While an Environmental Studies major at Dartmouth College, I would much prefer to be called a conservationist than an environmentalist. My interests lie with human welfare,

not in necessarily preserving "nature." I am personally just as happy, if not happier, in a building made of steel and concrete, than I am outside. This said, while I may not have the best aesthetic appreciation for the environment, I recognize that humanity derives many benefits from what is commonly referred to as the natural world. Solutions to the world's environmental problems are found only in trade-offs, and optimal outcomes will only occur when balanced, interdisciplinary approaches are taken to deal with them.

Susan Dain-Owens 05

My parents raised me to appreciate and respect the environment, and more than anything I love spending time in the outdoors. Ever since I was little my family has gone on countless hiking, camping, and kayaking trips together. My dad works for an environmental conservation organization, and so I have been exposed to environmental issues all my life. I am proud that my dad works to protect the environment and hope to follow in his shoes. Through coursework at Dartmouth I have learned a lot about what makes up what we call “nature”, and what threatens biodiversity and ecosystems throughout the world. The amount of oil the United States uses compared to the rest of the world is astounding, as is the amount of waste we produce. This class has been an opportunity, however small, to make a difference and promote an earth-friendly lifestyle. With our suggestions, I hope Dartmouth College will take on the responsibility to become a truly "green" campus. This encompasses not only structural dorm features but also student behavior. Our goal is to create a campus community that is energy efficient and that leaves as small an environmental footprint as possible. This is only one small step towards decreasing pollution, material waste, and carbon dioxide emissions - but if Dartmouth can set a precedent, other schools will follow. It is with enthusiasm and optimism that I have worked on this project, and truly believe Dartmouth can emerge as a leader in energy efficient campuses.

Brooking Gatewood 05

The human brain is wired to make decisions that benefit the self and the immediate kin group in the short term--hence many of our tragedy of the commons environmental problems. At the same time, humans are social species that thrive in groups and whose culture works to steer the group to make choices that benefit the group in the long term. Living sustainably is a cultural choice that must be made with the interest of a greater family in mind, and this choice is made on emotional and not rational grounds.

What Orr is pointing to here is simply that our culture has become so obsessed with the rational mind that it hates to admit the emotional motives behind our scientific curiosity and desire to better the world for a posterity we will never know. We need to embrace our love for the mysteries and elegance of the natural world, and recreate a culture that nourishes this kind of emotional attitude while at the same time nourishing the rational, scientific thinking that allows us to find innovative ways to preserve and protect our planet's resources. We need to recognize that emotions and feelings are powerful drivers behind the ecological ethic we hope to spread within our culture and not hide them behind the smokescreen of reason.

Green building, then, is about more than cost-savings. It is far and away more logical, rational and cost-effective than standard building techniques, but it is also about creating spaces that make sense to the social and emotional human being. We can admit that a building constructed with love and logic is more livable, more sustainable, and more powerful than the sterile and stale facilities we usually inhabit. And perhaps most importantly, visibly green buildings in their very presence remind us of the ecological ethic that we must all embrace if we care at all for the future beings of this planet.

Vanessa Green 05

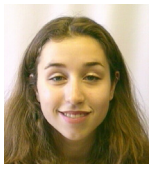
As a child, growing up in Colorado, I took nature’s beauty for granted. My childhood was defined by hiking, camping, climbing trees, canoeing, birding, and watching the seasons repetitively turn - the comforting smell of the first spring rain, the greening of the grass,

the purplish pink buds on the plum tree in our yard, summer fields covered in gold, red and lilac wildflowers, black thunder heads looming over the Rocky mountains, hillsides speckled yellow and orange as each aspen groove turned, the first glint of white dusting the peaks in late September, and the sparkle of the snow the morning after big winter storms. Now, as I watch the world change rapidly around me, I realize how lucky I was to grow up in a time and place where I could interact so closely with the natural world. It saddens me that children in future generations may not have similar opportunities to find such solace in their relationship with nature. Because the future of the global environment will depend on decisions made by individuals in my generation, I believe that I have a responsibility to educate myself and my peers about global environmental threats and ways in which individuals can facilitate change. I believe that as a progressive institution of higher education Dartmouth has a similar responsibility. As a premier academic institution Dartmouth must take a leadership role in addressing the most pressing global environmental issues. Therefore, I am proud to be a member of Environmental Studies 50, a group of students charged with helping Dartmouth find concrete ways to make an environmental impact

Benjamin Grinnell 05

The buildings we reside in are a large reflection of what and where we are as a society. The evolution of human habitats has been exponential. In each successive building era, from caves and mud huts to modern suburban mansions, it seems more and more resources have been consumed. But now, we are at a crossroads. We can continue to consume and build without much regard for anything else, or we can build to fit needs while at the same time, wisely and efficiently use resources. The latter must be the way of the future."

Jill Harris 05



So much of this liberal arts education is focused on teaching us how to think and very little time and energy are expended on helping students learn how to Do. This class is unique in its focus on application; the students who sit next to me in the ENVS 50 classroom will make impacts during their lifetimes and it's exciting to think that I am a part of their beginnings as the proverbial movers and shakers.

It's pretty straightforward to explain why this specific class is important; it's more difficult for me to explain why the field of environmental studies is important to me. I remember the Before: I was interested in engineering and wanted to build things that helped people; problem solving was cool. And I live the After: building is less important to me than protecting and it is so painfully obvious to me that this planet is worth it. What I find more elusive is the transition from Before to After - when did I become a tree-hugger? And how can I win over other people? Whatever form my life takes, getting people to see the importance of THE PLANET is my goal, and environmental studies at Dartmouth is one step in that direction.

Christina Jimenez 06

My feet were cold and glistening from the grass's dew, and stirred me out of a sleepy daze. With the sun blazing into my eyes, it took me a few long seconds to regain focus on the task at hand. I picked up a small paper container and made my way through the crowd of harvesters. As I crouched down in between the tomato plants, I carefully wrapped my fingers around the cherry red fruit. Amazed by how the tomatoes seemed to pluck themselves off the vines with the slightest bit of encouragement, I realized how much I was enjoying this early morning harvest at the organic farm. I watched the growing crates of produce sitting outside of Scott Stokoe's car with admiration and experienced a newfound respect for those who dedicated themselves to the farm during its short, but productive, growing season.

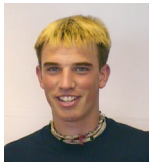
I took my first Environmental Studies course during my first term at Dartmouth. I haphazardly stumbled into Environmental Studies 2 with my roommate, who dropped the class the first day. I, however, became enthralled in the material immediately. There was so much more than the simple mix of geography and biology I expected the course to cover. After nearly three years, two of those three as an Environmental Studies major, I have broadened my understanding of the environment and all of its components, as well as experienced a truly interdisciplinary approach to learning. I have learned to examine environmental issues, policies and case studies through a constructively critical eye, and to think holistically and realistically. Students at Dartmouth have the incredible opportunity to find and pursue their academic passions, and personally, the Environmental Studies department has created an outlet for that passion and allowed me to realize the ways in which my peers and I will change the current perceptions of "environmentalism" at Dartmouth and eventually, the world.

Jaclyn Johnson 05

I have grown up with a love for the environment. I was born and raised in a small town at the base of the Rocky Mountains in western Montana, and the outdoors is something that went hand in hand with my childhood. My fondest memories are of taking walks along paths and creeks in the woods, walking along dirt roads and eating wild strawberries, raspberries and huckleberries, and hiking to waterfalls with family and friends. I absolutely love the smell of fresh air and knowing that no loud cities are for miles. This type of experience is something I want to pass down to my children and generations to come.

With this interest, environmental studies is a natural fit. So many environmental problems exist that are endangering the environment. I think it is important to create change and create more awareness about the issues at hand. The next generation of kids, deserve to enjoy such great places as I am able to. It is projects like our ENVS 50 class that will help take those little steps to ensuring a natural environment for years to come.

David McCune 05



For me studying the environment has always been tied closely to my faith. Growing up in the church led me to see the majesty of the mountains, or the wonder of a sunset, the mystery of a butterfly, and the whole of nature as God's creation. As divine handiwork, it made sense that this beauty should be cared for; that we as humans should be good stewards of the plants, animals, and natural resources that we can now so easily effect with technology. Here at Dartmouth I studied engineering for 3 years before realizing I wanted to major in ENVS my senior fall. Studying engineering left me with practical skills however without direction of how to use them although I occasionally catered thoughts of being involved in international rural development one day, using engineering, agriculture, and my faith to sustainably improve communities. The interdisciplinary nature of ENVS provides both the scientific knowledge and social awareness necessary to frame this vision with an ethos of sustainability. For now, studying energy use has given me experience in research and group work while continuing to reinforce this mindset of sustainability. So really, studying ENVS for me, whether it be energy use in dorms or third world agriculture, comes down to stewardship and the responsibility we have to our children to preserve and protect the wonders of creation.

Layne Moffett 05

The Earth is a beautiful place that should be well taken care of.

Marilyn Nyanteh 05

In the Fall of 2003, I had the opportunity to spend three months in the city of Salvador, Brazil as part of a Language Study Abroad program. During the first few weeks of the program, some of my fellow students and I would go to this beach close to our Language School. We would play in the gorgeous blue ocean water, and spend the rest of our afternoons laying on the sand, practicing Portuguese, and just truly enjoying the experience of living in Brazil. Those afternoons made up some of my fondest memories of my experience living abroad. Those afternoons ended, however, once some friends and I saw the sewage pipe which led human waste into the water of that beach. After that realization, I would only go as close to the sidewalk which looked over the beach. I would gaze down at the people below me, and I would think about everything I had ever learned about water pollution. I knew that in certain countries, using the ocean as a means of disposing urban waste is an acceptable norm. Yet viewing the disregard for human health and safety just stunned me. I had read of such occurrences in books, and had learned of such things in my ENVS classes, but seeing something like that with my own eyes, really made me realize the necessity for advocates who could effectively argue against negative environmental practices. And I see such advocacy in the peers who have co-written this report with me. As we work to persuade Dartmouth to implement our recommended policies, we strengthen our own skills as future fighters for the environment. I want to do something about that beach one day; I realize that a class grants me a knowledge that will allow me to do so.

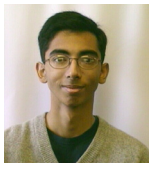
Arthur Peterson 05

Environmental Studies to me is about a lifestyle of accountability, and learning how actions have effects that are broader than one might think. Students at Dartmouth have the privilege of being able to live nearly any lifestyle they choose, without being burdened with environmental concerns. I feel that despite this privilege, or even because of it, we have a responsibility to not only learn about what we can do to minimize the effects of our actions, but to take the steps to live in a way that takes accountability for all of our actions. Live Green.

Christine Prentice 05

There's something about growing up in New Jersey that really awakens you to the problems of urban, and later suburban, sprawl. Watching small farms sold off and turned into same-sized plots of land for houses, old vegetation cut away to be replaced by landscape design - it really made me start to wonder about the nature of the connection between people and place. So in college, I ended up with a major in Anthropology modified by Environmental Studies and spent the last four years dissecting and analyzing and redefining words like "ecology" and "sustainability." But, for me, what it comes down to is a need to reaffirm and articulate the importance and sway of land in our lives ... and really, a love for trees

Vaibhav Rajan 05



In a world where materialism and consumerism take priority over almost everything else, there are issues that are regrettably sidetracked. I believe that the environment is one of them. I am not a tree-hugger, and in fact I shirk my fair share of responsibilities when it comes to conservation, recycling or turning off the lights. But the bottom line for me is that I am not out to save the world. The world is bigger, greater and more complicated than anything we can hope to save. Saving the environment is, as far as I am concerned, an arrogant and presumptuous stance. Anything that has come out of 14 billion years of deep time, and has done a decent job of living through 4 billion years of tumultuous change isn't exactly in danger of suddenly losing to us, the latest dominant species on the planet. It is just the opposite - it is our existence that is on

the line. And that's why I believe in a greener approach to today's corporate and industrial lifestyle. The spotted owl, the humpback whale and some obscure bacterium don't mean much until I realize that killing them can lead to killing us; Earth will outlive us, but I think my grandchildren, their grandchildren, and their grandchildren also have a right to see the beauty that is nature. Every effort towards making sure they do get to see it is a noble effort, and there is no better place to start than our immediate surroundings - where I live, what I love: Dartmouth College.

Jessica Reiten 06

Life was all about contradictions growing up in Orange County, California. The public school recycling programs told you what the numbers on the bottom of colorful glass and plastic bottles meant, but there was no where receptacles dispose of them properly. My father and I would go backpacking each summer in Yosemite National Park and sit in awe of nature's majesty and creations--respect the fragility of our surroundings--yet we drive back home in our high-emissions SUV to our energy inefficient air conditioned house.

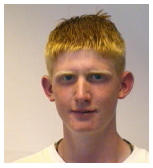
When we talk about reducing, recycling, reusing, and saving the environment are we brave enough to follow through with what we demand? Am I?

I chose to be an Environmental Studies major because I want to be informed about all the ways in which humans are failing in their treatment of the environment, and about what can actually be done to influence change. But more importantly, I chose to be an ENVS major because I didn't want to be a hypocrite—I care about the health and usage of our environment immensely, and I want to be able to live an informed, sustainable lifestyle. I want to be a part of why Yosemite can remain healthy and beautiful, and not just one of those people who talks about it.

Allison Smith 06

Coming into Dartmouth I did not know what I wanted to major in. I had several ideas and decided to take courses in each of these and choose to major in the one I felt most connected to. In my first semester I took ENVS 2 as well as some other courses. I was extremely frustrated with the things I learned here about what was going on in the world with regards to the environment, and even more so with the fact that things I did every day contributed to the escalation of the problems. I abandoned the study of the environment then for 5 terms as I looked for some other topic to major in where I felt a connection. Those 5 terms took me all over, but I realized ultimately I have a deep connection with the land and my frustrations with what I learned only confirmed for me that the environment did strike a deep passion inside me to create change because it is one thing all of humanity-and all other organisms for that matter-share in common. Our actions affect everyone else when it comes to the environment. Resources are scarce and no one human being has more of a right to a quality life than any other. Majoring in Environmental Studies, to me, is about respecting the sacredness of each individual life.

Zachary Strong 05



Growing up near the Front Range of the Rocky Mountains in central Montana, flyfishing during the summer wasn't just recreation; it was a way of life. My dad taught me how to catch trout in what must be some of the cleanest, clearest streams and rivers in the world. Opening my ENVS 2 textbook for the first time as a sophomore at Dartmouth, then, I expected to see pictures of crystal currents, maybe a cutthroat exploding out of an eddy behind a rock, and pools of glass reflecting overhanging pines and the full spectrum of a drawn out sunset. Instead the book revealed another side of Montana—a side my Dad had never shown me. I saw pictures of streams that were orange with toxic mining tailings, green with algal bloom from farm run-off, coffee-brown from soil and bank erosion due to deforestation and human development. This was not how a stream—especially not a Montana stream—was supposed to look. I decided something

needed to be done; I decided to major in ENVS. The more classes I took, the more issues I was exposed to—and the more I began to realize they are all connected, and equally important. Reducing energy consumption in Dartmouth's residential halls may not directly reduce stream pollution, but it will reduce greenhouse gas emissions, an issue at least as globally pressing. And trout do need cold, as well as clean water, after all.

Meagan Walton 05

I grew up in Calgary Alberta a city surrounded by prairies except to the west. To the west are the Rocky Mountains, which from a distance portray the most amazing skyline. It is a skyline of rigid edges and glistening snow caps against an orangish-purple sky colored by the setting sun. It is a 45 minute drive and I am there, in the middle of these monstrous mountains surrounded by unchartered territory and summits that challenge any human being to conquer. During each summer ever since I can remember my family would go to the mountains and camp in Jasper Park, where I have some of my fondest childhood memories. However, it wasn't until I left for college that I realized how much I missed the Rockies and how in a sense I seemed to take them for granted. Now when I return home for the summer I go to the mountains with my friends and every time I go I return with a story to tell. Whether it is reaching a peak in the middle of August in snow up to my hips, cooling off in a glacier lake, seeing a mother moose with her baby, or the nervous feeling of hearing a growl deep in the woods, I always return with a memory that keeps me going back. Yet perhaps the one thing that no story can compare to is the view from the top of a mountain. The work to reach the summit is laborious but the reward is indescribable and unique to all. On top of a mountain for as far as I can see, I am surrounded by land untouched by man and feel so small in a world with so much to explore. This is why I am an ENVS major and why this project is important to me. While energy use may not be directly related to reaching a mountain peak, it is however related to human consumption because it is human consumption that is threatening one's stories of the wilderness and the natural world itself.

Brooke Wehrenberg 05

My Dartmouth experience began with a three day uphill climb, carrying a pack and a large plastic bag of fragrant compost, and with every stop I thought, "wow, I can't believe I am doing this. I am so glad I go to Dartmouth." I returned from my DOC trip and bragged to all my friends what a great place Dartmouth was, a school that embraced the natural environment and brought together such an incredible group of diverse students. Over the course of my four years here I have come to see that Dartmouth truly is a living institution, one that is shaped by all its members. The greatest legacy I can leave behind is a better Dartmouth and I think that the environmental studies department and this project is really contributing towards a better Dartmouth.

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