Moving Up:
A Plan for the Relocation and Renovation of Kellogg House, the Center for Environmental Studies

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The Problem

This project presents us not with a planning problem, but with a planning opportunity: the impending expansion of academic facilities encompassed by the Stetson/Sawyer project, set to begin in June 2007, will encroach on Kellogg House and require its relocation. This necessity fortuitously provides the opportunity to revitalize the Center for Environmental Studies and to create a space that embodies the program's character and its values of environmental stewardship and sustainability. Ideally, to be truly sustainable, Kellogg would be a stand-alone building in the sense that it could produce its own energy, heat its own water, and otherwise supply its energy needs without the use of fossil fuels.

Our clients in Facilities – Bruce Decouteau, Senior Project Manager, Stephanie Boyd, Interim Director of Facility Operations, and Irene Addison, Associate Vice President for Facilities and Auxiliary Services – have given us an extremely flexible mandate. When we met with Bruce and Ken Jensen, Mechanical Maintenance Supervisor in Facilities, on November 2nd, we asked them to explain their goals for this project. Ken hoped we would take the opportunity to create a space that reflected the goals and character of our program. When pressed for more specific instructions, they requested that the end result of our project be a list of environmental features that we would recommend installing in the renovated Kellogg House. Specifically, they mentioned solar hot water, solar electricity, geothermal heating, and making the building as stand-alone as possible, to serve as an educational tool exemplifying independence from fossil fuels – goals that seem to dovetail very nicely with our team's own hopes for the new Kellogg!

Our other set of more unofficial, but no less important, clients are the community currently housed in Kellogg. Karen Merrill and Sarah Gardner, the Director and Associate Director of CES, respectively, have clear requests for improving the building. Their overarching objective is to include green design features and simultaneously enhance the building's educational function. Karen's highest green feature priority is to improve the efficiency of the building's heating system, including generation and retention of heat. She notes that the temperature of the building is often at an extreme – either too hot or too cold – making it an uncomfortable place to work, but this problem will likely be fixed in any case with necessary updates to the building's ventilation systems. Her top programmatic priority is to create a seminar room that is larger, lighter (particularly with daylight), better ventilated, equipped with computer technology, and which opens onto an outdoor classroom space. She believes that an improved seminar room will draw more professors and their students into Kellogg for classes and hopes that this space will be located in the new addition. The room could potentially function as a study room at night. Despite these desired increases in size, however, Karen emphasized that a major virtue of Kellogg is its cozy, home-like atmosphere and that the renovation must be careful not to turn Kellogg into a more institutional building, such as Oberlin's environmental studies center.

Sarah seconded most of Karen's opinions and added her own priorities, the first being a reading room that students actually use. She would like us to investigate techniques for attracting students to the space beyond those who already come. Both Karen and Sarah would love to host Log Lunch in the new addition to bring more of the community to CES, although it would require a larger kitchen and gathering space than currently exists. Sarah's top green priorities are to install a steel roof covered with photovoltaic panels (which easily clamp onto steel roofs) and a solar hot water system, as well as incorporating passive solar design. She also enthusiastically supports a native, no-mow landscape surrounding the house, and maintains that Kellogg's outdoor spaces should look different from the rest of campus. On the whole, Sarah's concise philosophy is, "If it's simple, instructive, and works, put it in!"

Combining our clients' goals with our goals, we do have an ideal, overarching vision of how we would like a renovated Kellogg House to look, feel, and operate: it is our opinion that for CES to be moved and substantially renovated without becoming a principal example of environmentally-sustainable design would be, to put it bluntly, embarrassing and disingenuous. Thus, along with our clients in CES, we recommend that Kellogg be a zero carbon, LEED-Platinum building. The technical implications of these goals will be discussed in the sustainable design overview (p. 11).

Our greater goal is to see Williams increasingly commit to green design in new building construction, and we believe that such a commitment can and should start with this project. As Steve Klass, Williams's Vice President for Operations, phrased this belief, "Williams has the oldest environmental studies program in the country. It's time for us to become a leader in this field again."[1] In the end, we hope to minimize Kellogg's negative environmental footprint as much as possible, incorporating many features that can be used as educational tools to encourage the spread of green design across campus. In addition, we would like to see the building become an even more welcoming, community-oriented space than it already is, encouraging a greater number and wider variety of students to meet, study, cook and spend time there.

As the technology and the knowledge to achieve these goals exists, the main challenge of this report is to evaluate and prioritize our recommended changes based on the technological, educational, political, and financial efficiency or feasibility of each possible solution. At Williams College, a building project with this kind of commitment to green design has not been attempted in the past; therefore, the Kellogg House project is at once exciting and daunting.

This report is divided into four parts. Part I begins with a description of the physical site of Kellogg's location and relocation, the history of Kellogg House, and a profile of the community currently using the house. Part II delves into our research plan and the results of that research: the many available technologies in sustainable design and case studies of where these technologies have been implemented successfully. Part III includes a summary of our community research, the analysis of these results, and an overview of the law and policy applicable to this project. Finally, in Part IV, we will outline our final technological recommendations, and in Part V we discuss some architectural considerations and recommend a set of principles to guide the Kellogg House project as a whole.

PART I

Physical Site Description

Students relatively unfamiliar with Kellogg House will often use phrases such as "Oh the one down that hill behind Stetson?" when asked about its location. Indeed, the current site is less than ideal, sitting north of the towering Stetson Hall and several feet lower than its access road, Sawyer Library Drive.

While the site includes a charming, small vegetable garden cultivated by students and is surrounded by many interesting native

Figure 1. Kellogg's steep path.

[1] Steve Klass in interview, December 5, 2006.

plant species, it is not very visible and difficult to access, particularly during inclement weather, when navigating the steep path from the west becomes precarious. Another disadvantage of the current configuration of the site is that the front of the house faces east, a direction from which few people approach from far enough away to appreciate the entire façade. Students rarely use that entrance, approaching instead from the west and northward through the awkward conjunction of the old and new wings which houses the kitchen; we suspect that this organization is less than inviting for those unfamiliar with Kellogg.

Figures 2. Front façade of Kellogg.

Once inside the building, one is faced with trashcans on the left and a copy machine to the right. Sandy Zepka, the Administrative Assistant for CES, mentioned the fact that this location was inadequate for a copy machine, as the moisture there occasionally ruins the paper.[2] This entrance is disorienting and many who visit the Center, including students there to see professors, are left wondering where they can find directions.

Indeed, the physical site for this project includes the building itself, as much as its current and future sites on campus. As it stands, Kellogg house is approximately 7,800 sq feet. This multi-

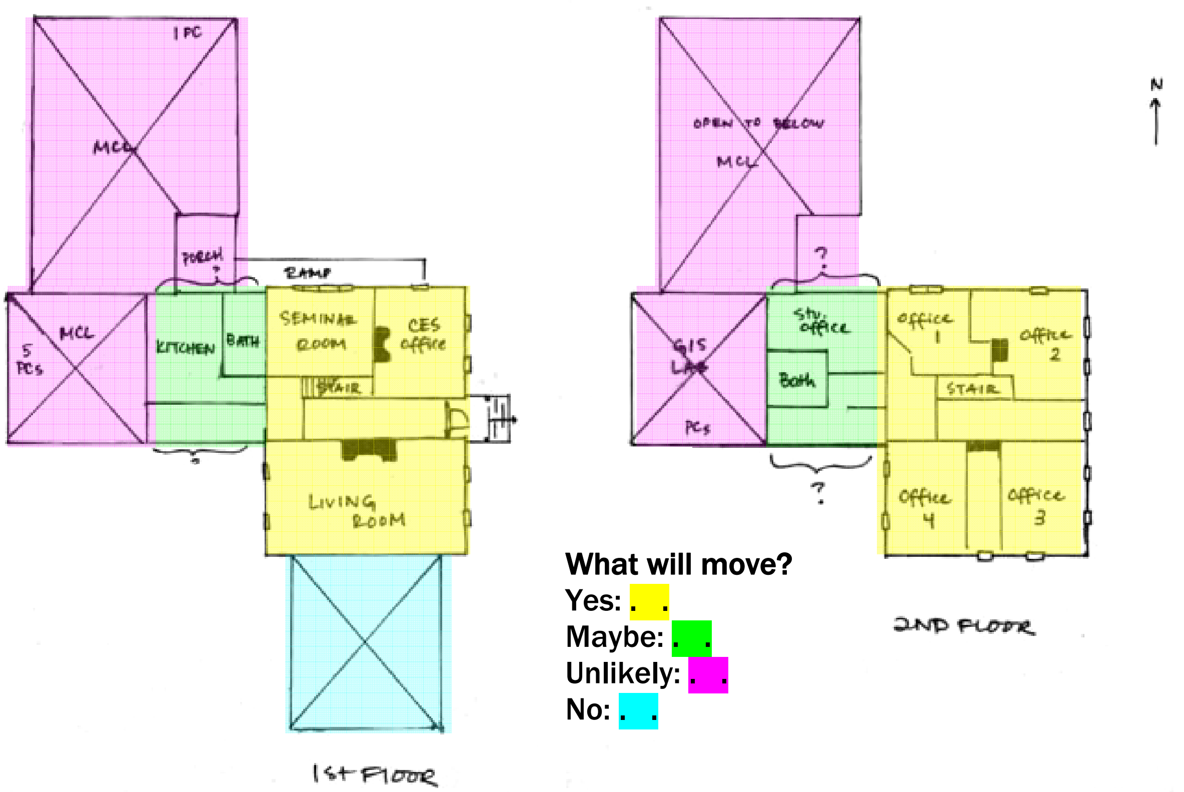

Figure 3. Current Kellogg House Plans and Relocation

use facility is home to nine faculty and staff offices, a kitchen, the Matt Cole Library, a seminar room, a living room, a GIS lab, a basement, and a structurally unsound attic which is currently not safe enough for book storage. The two additions to the house include a small southern wing containing four faculty offices and the Matt Cole Library on the west end of the building.

The main feature of the house is the spacious, warm, and inviting living room, located to the right of the current main entrance. There is a large couch, three arm chairs, two large tables, and a central fireplace that students can use. Lining the walls are shelves upon shelves of reading material available to the student body and community. One of the more striking features of the living room is a large mural of old Williamstown covering nearly the entire southern wall. The rest of the first floor of the original part of the building (in yellow above) contains Sandy Zepka's office, a cramped, stuffy seminar room alternately used for classes and dining, and a steep staircase to the second floor.

The first floor additions include the kitchen, Matt Cole Library, and faculty office wing, as mentioned. Contributing to its homey atmosphere, the kitchen is painted in a dark red tone and houses a refrigerator, dishwasher, other kitchenware, tea, coffee, and recipe books—all available to and often used by student chefs. In addition, the first floor bathroom opens off of this space.

The Matt Cole Library addition is a large space, though taken up mostly by towering stacks, and houses a handful of long study tables, computers, and armchairs. While the MCL is often empty during the day, it is a popular place for CES regulars to study at night. The faculty office wing, to complete our tour of the first floor, is home to four relatively small offices opening off an almost claustrophobic hallway.

The most visible access to the second floor is the steep staircase in the original part of the building, though there are also stairs and elevator leading from the MCL to the GIS lab. In all, the second floor houses four faculty and one student office, the GIS lab, and another bathroom. These faculty offices are spacious and clustered at the east side of the building, while further down the hall is the student office, currently used for storage. Farther west, the GIS Lab contains four computers on individual desks and an island in the middle used to store maps.

Figures 4-6. Matt Cole Library stacks, kitchen, and seminar

Besides the physical layout, another important aspect of the building is its current electrical, water, and heating systems. To paraphrase Laura Cavin's description of Kellogg's building systems in her thesis: As it currently stands, Kellogg House used 27,180 kWh in 2003 and 26,254 in 2004. Most of this energy is used for lighting and computers and most light fixtures contain compact fluorescent

[2] Interview with Sandy Zepka, Nov. 29, 2006.

light bulbs. In 2005, the college bought electricity from the Fenner Windpower Project in Fenner, New York to supply the needs of Kellogg at an additional $1,800 per year, reflecting the cost of "renewable energy" permits. The total cost of electricity used by Kellogg is $4, 290 annually.[3]

The heating systems in Kellogg comprise steam-heated radiators and radiant flooring. Anyone who has visited Kellogg House in cold weather realizes that the house is heated with old, noisy radiators. The Matt Cole Library addition has radiant heat in a concrete slab floor. Both systems are connected to the college's steam system. Within Kellogg house there are three zone controls, though there is no way of measuring how much steam Kellogg House uses. The college calculates that data solely based on square footage and not on other factors, such as insulation and other energy-related features. Directly related to heating, the Matt Cole Library's walls contain six inches of fiberglass insulation for an optimal R-value (a measure of a material's insulating qualities, where higher values mean more insulating) of 19, and the roof has 9 inches of insulation for an R-value of 30.

The new site for Kellogg House lies northwest of its current location. It will sit west of Sewall and south of Goodrich houses, abutting the south side of Sawyer Drive. This site fortuitously allows the house a more visible placement on campus, and its higher elevation and greater amount of insolation for gardening or solar panels are additional advantages. Moving Kellogg house and profiting from the southern exposure of the new site will be possible with the removal of Seeley House and some trees (but Hank Art approves).

Figure 7. New site for Kellogg House.

Site History

Kellogg House was built in 1794 where Hopkins Hall now stands to serve as the President's house. Beginning in 1872, Kellogg embarked on a series of migrations northward, first to the site of Stetson Hall, and then to its current location down the hill and facing east. After being home to four presidents, the building went on to house professors and student boarders. It underwent a renovation in 1978, from

Figure 8. Kellogg House in 1860. (Williams College Archives)

[3] Cavin, Laura. (2005) *Relocation, Renovation, and Redesign of Kellogg House*. Unpublished Undergraduate thesis, Williams College, Williamstown, Massachusetts, USA, p. 17

which point it has been the Center for Environmental Studies. Matt Cole library was added by enclosing the east porch in 1982 and moved into additions on the west end of the building in 1995. At this point, the old library was converted into four faculty offices.

Like Kellogg, this is not the first occasion on which the Center for Environmental Studies has moved due to larger building projects on campus. One former home, the Van Rensselaer house, was demolished to make way for Sawyer Library, requiring that CES move to Park Hall at the intersection of Park Street and Whitman. The Park Hall location established CES as an independent facility, which allowed the development of community events held on site.

Figure 9. Kellogg House in 1900. (Williams College Archives)

In order to get a better sense of Kellogg's historical significance and what kinds of modifications it has undergone over time, Andy Burr, a talented and knowledgeable local architect, guided us through the house to see if any original features had been preserved.[4] Burr pointed out several features on the exterior that have remained largely original, for example, the Georgian dentils along the top of the house, and Georgian or Greek Revival main entry way. Happily, this entryway will become the main entrance once the building is relocated and rotated 180 degrees, reviving some of its historical charm. Also, while he said the shutters were historically accurate, they were incorrectly nailed to the siding instead of being hinged. Though we obviously don't use the shutters anymore, they are an important device to help the house retain its historical integrity. The shutter hardware (the 'S'-shaped brackets) is also original.

Figure 10. Original shutter hardware.

[4] Guided tour with Andrus Burr, Tuesday 14th, 2006.

Burr suggested that the house would originally have been painted an earth tone, such as a deep red or ochre, as white was an expensive color. The wood siding on the house has mostly been replaced, as evidenced by the smoothness of each plank. Older boards, hewn by hand, have a wavier texture. Many of the boards on the current east side are original. The configuration of the seminar room windows is not original, but nonetheless shows the craftsmanship style of the 1920s.

Figure 11. Siding hewn by hand.

Once inside, it was apparent that practically nothing of the old house remained. The walls surrounding the living room and even the chimney are not the original pieces, though the chimney, he suggested, might also be from around the 1920s. On the second floor, he surprisingly found unusually thin closet doors in Sarah Gardener's and Karen Merrill's offices that are likely to have been part of the original house. Even the hardware was of some historical significance.

Figure 12. Sarah Gardner's 18th century office door.

In the attic, Burr gave us a better sense of what actually was worth saving of the house. He noted the number of large logs used as supports and framing, mentioning that the house must have been constructed similarly to how a barn was built. Interestingly enough, in the attic and the basement, he was able to approximately date the logs used as beams. If a circular saw was used, evidenced by subtle round marks on the side of a beam, then it was likely to have been cut around the 1860s, while if it was a thick, uneven, tree log then it is an original support beam for the house. In the basement there was a variety of both kinds, most likely due to the fact that the house has been relocated several times.

Community Profile

The community context of Kellogg House encompasses several groups. Academically, it includes environmental studies faculty and staff with offices in the building, student concentrators and others who study here, and classes that meet in the seminar or living rooms. There are eight faculty members who have offices in the building. These include Kai Lee, Sarah Gardner, Karen Merrill, Drew Jones, Charlie Benjamin, William Fox, Roger Bolton, and Carrie Greene (Program Coordinator). Additionally Sandy Zepka, the administrative assistant, has an office on the first floor. Sandy is an integral part of the community and knows many concentrators personally. There are currently 8 senior concentrators and 13 junior concentrators. There is a core group of about 10 students who study at Kellogg House every night, and they are primarily sophomore, junior, and senior concentrators and their friends. Charlie Benjamin's two environmental studies classes meet in the living room. One class is a seminar with 15 students and the other is a tutorial. Not all of the students in these classes are concentrators. Additionally, Glen Shuck's Religions of North America class meets in the seminar room. This small class is comprised mainly of non-environmental studies concentrators.

Student organizations including Greensense, Education Reform and Advocacy (ERA), and Students for Social Justice (SSJ) also call Kellogg home for their weekly meetings and storage in the student office. Greensense has approximately 20 active members at each meeting, most of whom are concentrators. Both SSJ and ERA have about 10 members, few of whom are environmental studies concentrators. Williamstown community members also use the facility, including hunters who apply for licenses here and those that attend CES cookouts and other events.

Potential Kellogg community members include Williams students that are unfamiliar with the current space but that may be drawn in by improvements in the building's study spaces or design interest, as well as Williamstown residents or students who may visit the building if it assumes new functions, such as Log Lunch, or if it becomes an educational tool in sustainable design, available for tours and other similar activities.

PART II

Research Plan

The research for this project falls into three general categories: (1) sustainable technologies and materials, (2) education and funding, and (3) social and functional design. These areas reflect the primary approaches of our Facilities and Kellogg clients to this project: designing a sustainable building, achieving a practical and comfortable programmatic configuration within it, and getting the building actually built and functioning as an educational tool. This research organization allows us to address the questions: What green features will the building include? How will the building function as a unified system? How do the building's users and non-users want it to work socially and practically? What kind of interactions and atmosphere will the organization of spaces promote? Where will the resources and political will come from to build the structure? And how will the final result function as an educational tool?

Our research into sustainable technologies and approaches to making Kellogg function as an educational tool included reading case studies, researching the available technologies online and in printed sources, and assessing the technical feasibility of each. We drew upon the resources of those involved in the world of green design and energy efficiency, including meeting with Mike Tillou[5] and listening to Marc Rosenbaum[6] speak at Williams' Building Green in the Purple Valley conference in November, to supplement this research with greater technical and practical understanding. We investigated the nature of the political and financial advantages and obstacles that might arise during the design and construction of a successful space by meeting with Vice President Steve Klass, Irene Addison, and Stephanie Boyd to discuss the attitude towards green building among the college's administrators. Finally, our research also included developing drawings of alternative plans for the renovated Kellogg to explore the potential relocation of the current kitchen and Log Lunch, focusing on social and function design rather than the accommodation of green features.

Another essential aspect of our research was a survey of two samples of the student community—users and non-users of Kellogg House (Appendix 1)—to determine what features would make Kellogg House more attractive to student use and which green features interest students. In addition, we surveyed the faculty who have offices or teach classes in the house and other faculty associated with the Environmental Studies program familiar with Kellogg. As

[5] Mike Tillou is a physical engineer in Williamstown with expertise in designing energy-efficient building systems.
[6] Marc Rosenbaum is a physical engineer in Meriden, NH with expertise in designing energy-efficient building systems.

previously discussed, we interviewed Sarah Gardner and Karen Merrill, as well as Drew Jones and Sandy Zepka, as they are the individuals most familiar with the house and have the strongest opinions on how to improve the building to promote the well-being of the environmental studies program.

Overview of Sustainable Design

Green building—or green architecture, sustainable architecture, and the like—is the practice of designing and constructing buildings with the intention of minimizing their negative environmental impacts through their life cycles. As architecture, however, it also focuses on its users' needs, providing them with smarter spaces that provide financial and intangible value, as well as health benefits. This approach largely centers on the use of mechanical features to reduce the building's energy and water demands, which may be simply super-efficient versions of traditional systems or alternative and newly-developed materials and technologies. Throughout this report, we use the term "sustainable" to describe design features that have minimal adverse environmental impacts.

A recent steep rise in the popularity of green design follows growing concern about rising energy prices and energy security, as well as global warming and other environmental problems to which buildings contribute significantly. "According to the World Watch Institute, buildings in the US account for more than 40% of our overall energy consumption, 33% of carbon dioxide (CO_2) emissions, and 50% of chlorinated fluorocarbons (CFC) production. Our buildings consume 25% of harvested wood, 17% of fresh water, and the waste from construction and demolition accounts for 40% of the volume in landfills."[7] The potential to reduce these alarming statistics is great, however. For example, the Florida Solar Energy Center claims that the energy use of almost any building in Florida could be cost-effectively reduced by at least 15-30%. Furthermore, with a skillful sustainable approach, it can be reduced up to 75% where the most efficient technologies are used or where the buildings are very inefficient at the outset.[8] It is important to keep in mind that these savings reap both environmental and financial benefits.

The growing recognition and understanding of these benefits has contributed to increases in the numbers of homebuilders and architects practicing green design and the amount of green buildings being built: "Preliminary results of a McGraw-Hill Construction/National Association of Home Builders (NAHB) survey indicated that there was a 20% increase in 2005 among those in the home building community who are focusing their attention on green, environmentally- responsible building, which is expected to increase by another 30% this year."[9] Higher education is, perhaps unsurprisingly, a hotbed of green building relative to other sectors. Sustainable architecture projects are growing at a faster rate at schools than elsewhere, and "[a]n overall building boom in the higher education market, along with pressure from stakeholders for green building, are primarily responsible for the continued growth in this market"[10], according to an article on green building trends in the journal *Business Quarterly*. One incentive somewhat unique to colleges and universities is the fact of their being long-term owner/operators who thus take higher interest in the building's long-term operating costs. As generators of new ideas, full of creativity and

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[7] http://www.p2pays.org/ref/13/12182.htm
[8] http://72.14.209.104/search?q=cache:XErmQEThlg8J:www.fsec.ucf.edu/BLDG/index.htm+how+much+could+building+energy+use+be+reduced&hl=en&gl=us&ct=clnk&cd=5
[9] http://www.greenbiz.com/news/news_third.cfm?NewsID=30948
[10] http://www.asla.org/businessquarterly/greenbuilding.html

supplemented with a healthy dose of youthful vigor, higher education campuses are not only pressed by their constituents to build greener buildings, they now recognize sustainability as an issue that they can capitalize on in demonstrating their leadership and that can affect prospective students' attraction to the school.[11]

Measuring Sustainability

With this rapid rise in attention given to sustainable design has grown the need to be able to distinguish truly efficient and environmentally-friendly projects from mere "green-washing." To that end, in 1993 the U.S. Green Building Council devised the well-known voluntary point-based system of LEED (Leadership in Energy and Environmental Design) standards, which rank a building's "greenness" and has since continuously developed, refined, and expanded it. Briefly, the ranking system takes into account site selection, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, and innovation and design process.[12] Various points towards a ranking between Certified and Platinum are available for myriad items under each of these headings, and significant documentation is required to prove one's fulfillment of each point. Other less visible ranking systems, primarily for residential projects, have been developed, including those by the U.S. EPA and DOE, Energy Star Homes (www.energystarhomes.com), and the National Association of Homebuilders (www.nahb.org).[13]

While there is currently no standard rating system for zero-carbon buildings, they are essentially buildings that produce no net carbon emissions in their operation, or, in other words, generate as much energy (from renewable sources) as they consume. The daunting goal of producing such a building is made possible first by drastically reducing the building's energy demand through passive solar design, super-insulation, and energy efficient technologies, among other methods. Next, one generates energy to meet the demands of the house on-site with solar panels or wind mini-turbines. If these systems produce enough energy to meet the needs of the building, which typically requires that one store the energy with batteries, the building is deemed stand-alone. The more common approach, however, seems to be systems connected to the grid that export power generated on site when demand is low and import power when demand is higher than generating capacity. If the building has a net import of energy, its users purchase this as green power or purchase carbon offsets, which theoretically, and, debatably, offset the carbon emissions associated with the generation of the imported power.[14]

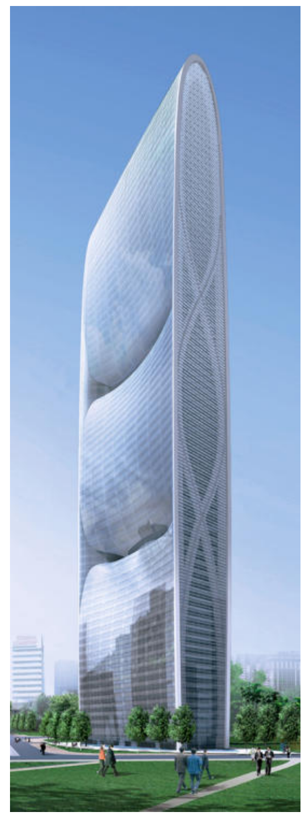

Figure 13. Guangdong Tobacco Tower ("Zero Energy Tower") by Skidmore, Owings, Merrill

Adding environmental considerations into the process of designing a socially and aesthetically functioning space complicates an already complex task: "Like architecture as a whole, sustainability involves addressing a wide spectrum of issues, sometimes, seemingly,

[11] Ibid.
[12] Bohlin Cywinski Jackson. "Green Building Outline". September 26, 2006.
[13] http://www.youthbuild.org/site/c.htIRI3PIKoG/b.1300113/k.717C/Green_Building_Initiative.htm
[14] http://en.wikipedia.org/wiki/Zero_energy_building

conflicting ones."[15] Successful sustainable design requires that these considerations inform the entire project—from conception to implementation on site—as incorporating green features later in the process typically results in less efficient configurations and forfeits the use of non-technological approaches such as passive solar design. As is fitting for a Center for Environmental Studies, we and our clients approach this project with the sustainability of the building as one of our chief goals.

While the various aspects of any building, particularly a green one, overlap, we have attempted to divide them into four main categories as a means to present them in a more organized fashion. These categories speak to the questions: What is the building made out of? How does the building work? What is the building's relationship to its surroundings? The Materials section directly addresses the first of these, the Energy and the Water sections discuss how the building works with its two primary operational inputs, and the Landscaping section details the outdoor living space that should be in harmony with the building itself. Because the interior of Kellogg contains few historical features and is unlikely to be anywhere near as efficient a space (in terms of insulation and other aspects) as it will need to be to reach the demanding targets set for this project, we assume that it could be gutted and thus that the following information will generally apply to the original, relocated part of the house as well as to the new addition.

Technologies for Sustainable Design

Materials

There are myriad sustainable materials that one can incorporate into building renovation and new construction. Virtually every aspect of conventional construction has a sustainable counterpart, which is often similar in performance but different in cost depending on the specific material. The characteristics of a sustainable material in this assessment include recycled content, ability to be reused or recycled, efficiency (in production or consumption, which may include proximity of materials to the construction site), and low toxicity or general promotion of good indoor air quality in addition to having few or no negative environmental impacts. Rarely does one material embody all of these characteristics, and, consequently, one must devise a means of valuing a given characteristic versus another. This solution will depend on the prioritization of the facility users' goals (energy efficiency, education, indoor air quality?) and the availability of materials in a particular location or for a specific architectural requirement, structural or design-related. To that end, a material should also be considered for its beauty or educational value and interest.

There is perhaps no material that embodies sustainability as well as simple re-use, requiring no use of virgin materials and little or no energy or water inputs. Salvaged materials, such as the use of discarded street signs to make a fence, are also visible and creative sources of educating the public on sustainable practices and are often highly visually stimulating and delightful. Even more mundane items reclaimed from salvaged yards, such as sinks, cabinets, or wood for framing, can serve this purpose if noted as such in the building and may cost far less than new materials. Aside from not using any materials at all, using existing materials is the second most sustainable option and should be looked into for this project as the demolition of Sawyer, the Stetson addition, and the non-relocated parts of CES will result in several tons of waste which may be recycled but would be more efficiently re-used in the Kellogg project if feasible.

Starting with the building skeleton, there are several alternatives to conventional wood structures. First, one can use certified lumber, which is harvested using sustainable practices, such

[15] Sassi, Paola. Strategies for Sustainable Architecture. Taylor and Francis: New York, 2006.

as selective logging, where only mature trees are removed from a forest, allowing younger trees to grow. The lack of clear-cutting involved in this process also reduces the effects of timber harvesting on wildlife habitat destruction and erosion, among other environmental issues.[16] Pressure-treated wood is often employed to frame buildings due to its durability, but because the pressure treatment of timber is typically a toxic process, one can instead choose woods based on their natural resistance to decay; species with relatively high resistance include cedar, white oak, and sassafras. The pressure treatment of wood using borate in place of conventional chemical treatments such as inorganic arsenical, pentachlorophenol, and creosote is also a burgeoning technology.[17] To eliminate another source of toxins, one can opt for a soy-based adhesive used to supplement the binding of wood frames, instead of conventional chemical alternatives. Recycled or reconstituted wood that is made by laminated wood chips or strands together and gluing larger pieces together is one alternative to using new lumber.[18] Finally, to complete the frame, it is necessary to choose sheeting, which can come from recycled or reconstituted materials, such as newsprint fiberboard and other products produced with agricultural byproducts and wood waste.[19]

There are also several options to choose from when adding a roof to our building. Slate, clay, and cement roofing is durable but heavy, and used slate tiles are also available for reinstallation.[20] Metal roofing, particularly steel and aluminum, is largely made from recycled materials—for aluminum, often up to 100%—and can be recycled in the future. They are also long-lasting and lightweight. Other options include less durable asphalt shingles that incorporate recycled paper and reclaimed minerals in their manufacturing, and recycled plastic roofing just coming on the market,[21] while recycled rubber molded to resemble slate is a durable and strong yet lightweight alternative.[22]

There are even more options when laying the floor of our building. Fly ash concrete, which uses the residue ash produced in coal burning, can be used for the foundation, flooring, pillars, and other structural and surface elements. This use of fly ash keeps it from entering the waste stream and reduces the energy and water consumption used in processing virgin materials, while also averting pollution from that processing. Furthermore, fly ash improves the quality and performance of concrete, including increased strength and reduced corrosion of reinforcing steel.[23] Syndecrete is another concrete flooring alternative that comes in a variety of colors and is made from natural minerals and recycled materials, containing up to 41% recycled content, including scrap wood chips, plastic regrinds, and metal shavings from all sort of post-consumer items.[24]

There are several alternatives to more conventional flooring options, as well. As with framing, one can employ certified timber for wood floors. Another wood option is bamboo, which is a highly renewable material, one of the fastest growing plants on earth, with a growth cycle of three to five years. It does not require replanting and grows without fertilizers or pesticides. It also performs well, being durable, harder than red oak and maple, and possessing a tensile strength

[16] http://greenriverlumber.com/pages/green.html
[17] http://www.greenbuilder.com/sourcebook/WoodTreatment.html
[18] http://www.greenbuilder.com/sourcebook/EngStruct.html
[19] http://www.greenbuilder.com/sourcebook/EngSheet.html
[20] http://www.usedslate.com/vermontrecslate.html
[21] http://www.greenbuilder.com/sourcebook/Roofing.html
[22] http://oikos.com/products/moisture/ecostar/
[23] http://www.greenbuilder.com/sourcebook/Flyash.html
[24] http://www.syndesisinc.com/index-syndecrete.html

superior to steel.[25] Cork is another environmentally-sound choice for flooring, as the cork oak tree is not cut but stripped of its bark, which is ready to be reharvested in nine years. It is also considered a recycled product since the flooring is made from the waste of cork wine stopper manufacturing, and pigments, varnishes, and adhesives used in its production can come from water-based, solvent-free substances with no VOCs (Volatile Organic Compounds).[26] VOCs include a variety of chemicals emitted as gases from some solid and liquid substances including paints, solvents, wood preservatives, cleansers, air fresheners, glue, and dry-cleaned clothing. The concentration of them is typically two to five, and up to ten, times higher indoors than outside, and they can have short- or long-term adverse health effects on humans and animals, among them, eye, nose and throat irritation, cancer, headaches, and nausea.[27] Marmoleum, which is natural linoleum



Figures 14-16. Bamboo, cork, and marmoleum flooring.

made from materials including linseed oil, rosins, wood flour, and natural pigments with a natural jute fiber backing, is another option that is biodegradable and can be non-toxic and antistatic, thus promoting healthy indoor air quality. This flooring is also richly colored, soft, quiet, and stain-, damage-, and wear-resistant.[28] Alternatively, if it is carpet one desires, there are "green" versions of that, too. Carpet padding can have recycled content from old padding or reclaimed carpet fibers, while recycled carpet derives from recycled plastic from post-consumer plastic soft drink containers. Natural carpets made from grasses, cotton, and wool with minimal treatment are also available. Finally, an unnatural but similarly sustainable choice for flooring is recycled-content tiles, made from waste glass such as vehicle windshields and light bulbs.[29]

Materials similar to these options for flooring can be used for work surfaces such as counters, table-tops, and backsplashes, as well. There are a number of products on the market that incorporate recycled materials into tiles and other surface materials, including Eco-Terr, made derived from glass, and Eco-Cem, a cement product strengthened with cellulose fibers.[30] Other variations on this idea are Durat, a Finnish product made from recycled plastics and which is itself entirely recyclable[31], and shetkaStone, a product made from one hundred percent recycled waste paper, plant, or cloth fibers, which can be reincorporated back into the manufacturing process at the

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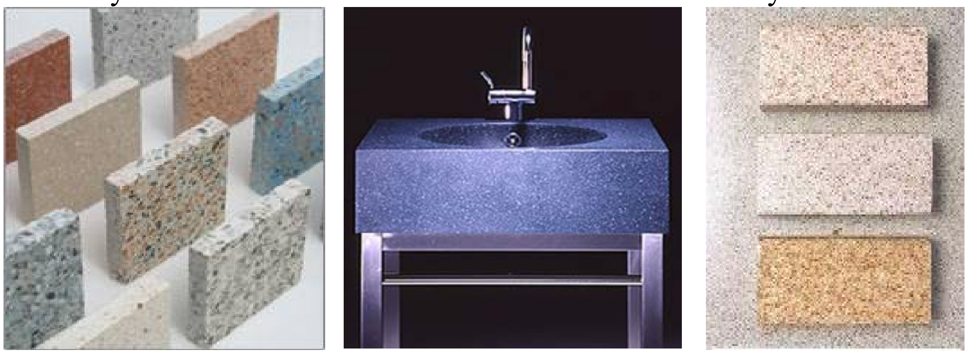
[25] http://www.bambuhome.com/html/whybamboo.html
[26] http://www.corkfloor.com/benefits.html
[27] http://www.epa.gov/iaq/voc.html
[28] http://www.upstatehouse.com/archive/article.php?issue=39&dept=57
[29] http://www.greenbuilder.com/sourcebook/FloorCoverings.html
[30] http://www.coveringsetc.com/
[31] http://www.durat.com/

end of their its cycle.[32] All of these materials come in a wide variety of colors and finishes.



Figures 17-19. Eco-terr, Durat, and shetkaStone countertops[1].

As for other finishes in the building, particularly paints and wood varnishes, there are a variety of less or non-toxic substances available on the market that do not contain VOCs, which are typically used to extend the shelf life of paint. There are even natural plant or mineral-based finishes and adhesives available that, as do low-biocide and low-VOC paints, cost more than their conventional counterparts[33] but are available from standard manufacturers, such as Rodda's Horizon line of nearly no-VOC, washable, mold- and mildew-resistant paints.[34]

Energy

One of the greatest opportunities to improve the sustainability of the renovated Kellogg House is to reduce the amount of energy that the building consumes by retrofitting the existing building with some of the latest and most effective energy saving components and designing the addition to be as energy efficient as possible. Energy in this sense includes both electrical power and direct fuel-based energy for heating air and water.

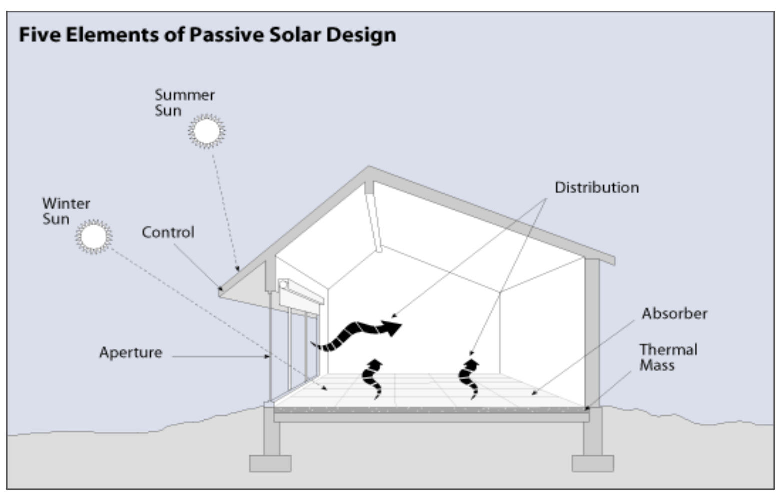


Figure 20. Diagram of passive solar design elements.

While the original Kellogg House was not designed with solar energy benefits in mind, passive solar heating and day-lighting could be gainfully employed in the addition as the relocation to a sunnier spot allows. Passive solar heating and day-lighting involves capitalizing on southern light, having south facing windows and/or a thermal mass to absorb, store, and distribute heat. At night, the heat energy absorbed by the mass throughout the day, such as a Trombe wall and special floors, continues to radiate heat into the building throughout the night.[35] This approach to design can drastically lower the energy demands of the building but obviously must be adopted from the start of the design process and involve advanced

[32] http://www.shetkastone.com/
[33] http://www.greenbuilder.com/sourcebook/FinishesAdhesives.html
[34] http://www.roddapaint.com/ps_horizon.asp
[35] A Sourcebook for Green and Sustainable Building, Passive Solar Heating
http://www.greenbuilder.com/sourcebook/PassSolGuide1-2.html#heat

understanding of the site's solar and climatic conditions.

Nearly all buildings will require some mechanical heating and lighting systems, however, some of which are significantly more efficient than others. One of the most important elements in Kellogg house is lighting, not only because of the amount of energy it takes to light the building, but also because of its requirements for atmospheric and practical effects in gathering or study spaces.[36] Bulbs with a high color rendering index, directed at the wall, can create a sense of spaciousness, and installing dimmers, switching options, and motion detectors that turn on manually but turn off automatically allow users to achieve the degree of lighting they desire and to turn it off when not needed, saving electricity.[37] Different kinds of lights and their placement contribute to the warmth or attractiveness of a space. For example, brightly lit reading room with lights facing the wall does not only feel more spacious, inviting and pleasant to be in, but also more conducive to studying. Energy efficient bulbs, compact fluorescent lighting, CFLs, as they are commonly known, should be employed in place of incandescent or other conventional bulbs because they use far less energy and last five times as long as traditional bulbs, which waste 95% of their energy as heat rather than light.

One option for producing electricity to power such lighting is a photovoltaic system, commonly known as solar panels. There are two main types of PV systems, stand-alone and grid-face. The first requires batteries to store power for times when demand is greater than generation, particularly when the sun is not shining, and does not require purchasing power from an electric utility as long as energy needs are met by the total PV generation. Alternatively, the grid-interface system, or 'parallel' system, purchases power from a central utility when demand exceeds generation and exports energy back to the grid in the opposite case.[38] To generate electricity for Kellogg's current needs of approximately 27,000 kWh would require about 2,500 to 5,500 square feet of south-facing roof space for a 30kW system,[39] which is larger than what the addition's roof space will likely provide, while the original building's roof will face east and west. Therefore, a parallel system would probably be required for this project. (The use of solar hot water systems is discussed in the Water section of this report.)

Another alternative energy source growing in popularity is geothermal heat pumps (GHPs), used to heat and cool spaces and heat water. GHPs use the constant temperature of the earth as the exchange medium instead of using outside air temperature. Below the surface the ground remains at a constant temperature and though there is variation depending on latitude, a properly selected geothermal system takes advantage of the warmer temperature below through a ground heat exchanger. Geothermal systems are configured either as closed horizontal loops buried in the ground, in which circulate an exchange medium of water or antifreeze, or as vertical wells several feet below ground that use water extracted as a heat source or heat sink.[40] The appropriateness of either system depends on site characteristics such as the presence of bedrock prevent the drilling of a vertical well. Both systems are unaffected by outdoor air temperature and can reach efficiencies as high as 300%-600%. A typical geothermal system has the lifespan of a quarter of a century for the indoor components and 50+ years for the ground loop.[41]

[36] http://www.clean.ns.ca/default.asp?mn=1.21.52.61.88
[37] Oinko's Green Building Source, Energy Efficient Light Patterns, http://oikos.com/esb/50/lightingpatterns.html
[38] A Sourcebook for Green and Sustainable Building, Photovoltaic Systems
[39] www.consumerenergycenter.org/**pv**4newbuildings/archdesign.html
[40] http://www.toolbase.org/Technology-Inventory/HVAC/geothermal-heat-pumps
[41] U.S. Department of Energy, Geothermal Heat Pumps http://www.eere.energy.gov/consumer/your_home/space_heating_cooling/index.cfm/mytopic=12640

Another means for warming space is radiant floor heating, which is considered a great approach for several reasons, primarily being that it heats the occupants from the ground up, not the air floating around a given space. This approach reduces the overall need for heating and the rapid heat loss of air to colder surrounding areas. It also promotes better indoor air quality, since no dust is blown around and humidity is retained, unlike with forced hot air, and energy is not lost through ducts. Aesthetically, radiant heating is also a good option because it is practically maintenance- and noise-free, unlike traditional heating systems, including the older radiators in Kellogg![42]

There are two major types of radiant floor heating, hydronic and electric. A hydronic system circulates hot water through tubes buried in the floor.[43] One advantage to the hydronic system is that it can be heated from a variety of energy sources, including wood-fired boilers, standard gas or oil-fired boilers, solar water heaters, or a combination of all these sources.[44] An electric system works in the same way except with electric heating elements, such as buried cables coated with electrical insulation, or fabric mats with the cables woven into warm the floor.[45] Electric systems are less expensive to install and can be used to heat different sized spaces effectively. A hydronic system, on the other hand, works better in larger areas. In both cases, a thermostat is used to control the temperature of the floor.[46]

An important element related to heating is the efficiency of the windows used, which will determine how much heat and light enter the building and how much heat it retains. Windows are typically a source of heat loss, but there are several different types of energy efficient windows available with multiple panes, a variety of insulating gases to fill the space between them, different glazes with distinct heating and lighting qualities, and a variety of frames of more or less insulating materials.

The most important elements to look for in a window are the U-factor, the solar heat gain co-efficient, visible transmittance, and air leakage. These values will aid in choosing a window based on insulating or cooling needs. The U-factor is the rate of heat loss of a window assembly. Better, more insulating windows (including the frame) have lower U-values.[47] The inverse of the U-factor is the R-value, which is a measurement of insulation. A higher R-value indicates greater resistance to heat flow and thus a better insulating value. The solar heat gain coefficient is the fraction of solar radiation admitted through a window, therefore how much solar heat it transmits. This number is important especially when considering passive solar design. For example, on the south side of the building, the windows should be able to gain enough heat as to make the room comfortable, not scorching hot. The visible transmittance rating, finally, measures the amount of visible light transmitted by a window. The higher the visible transmittance,

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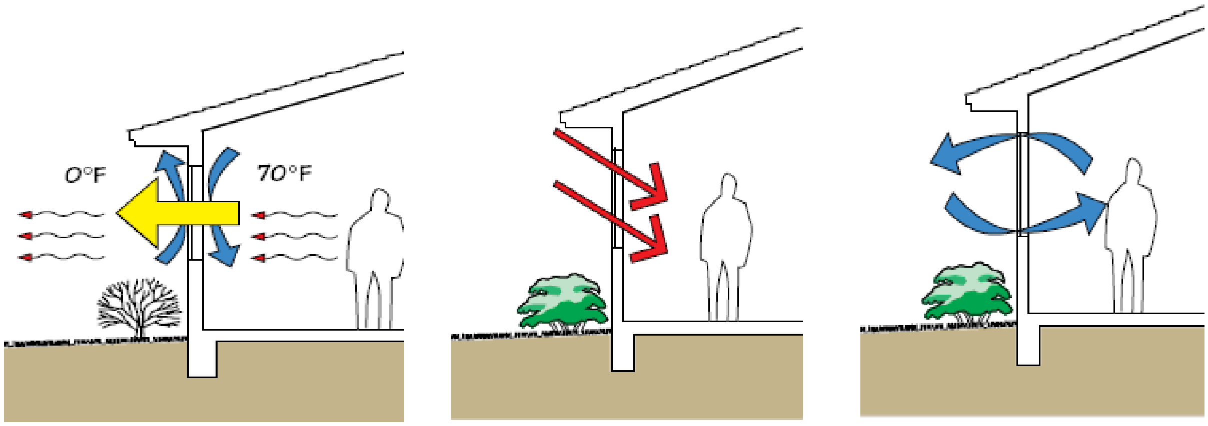
42 http://www.greenbiz.com/sites/greenerbuildings/news_detail.cfm?Page=1&NewsID=33201
43 Oikos Green Building Source, Electric Radiant Heat, http://oikos.com/esb/48/radiantheat.html
44 U.S. Department of Energy, Energy Efficiency and Renewable Energy http://www.eere.energy.gov/consumer/your_home/space_heating_cooling/index.cfm/mytopic=12590
45 Oikos Green Building Source, Electric Radiant Heat, http://oikos.com/esb/48/radiantheat.html
46 Oikos Green Building Source http://oikos.com/esb/48/radiantheat.html
47 Efficient Windows Collaborative, Glossary. U-Factor entry, <http://www.efficientwindows.org/glossary.cfm#ufactor>

the more light that is transmitted; therefore, a high rating is ideal in order to maximize day-lighting capabilities.



Figures 20-21. Solar heat gain coefficient, Visible Transmission Rating, and Air Leakage.

Another critical consideration in promoting the efficient use of heat energy is the insulation of the building, since an efficient heating system is wasted when a building's envelope fails to prevent significant heat loss to its colder surroundings. In addition to conventional fiberglass batting insulation, alternative methods are increasing in popularity, such as straw bale. Straw bale is currently trumpeted as an inexpensive and environmentally friendly building material. While little is written on its insulative capabilities, it is apparently able to insulate better than the average insulation. For example, studies by the Canada Mortgage and Housing Corporation have shown that bale homes typically use 25-40% less heating and cooling energy than their frame-walled equivalents.[48] Even better perhaps is soy-based spray foam insulation, which is able to seal the building by expanding to fill all cavities during the drying process so that the envelope is airtight and heat is not lost through small spaces typically present in insulation systems.[49] Unlike oil-based insulation, soy based foam insulation is non-toxic. Furthermore, one inch of spray foam insulation can have an R-value of between 4 per inch and 7 per inch, making it a super-efficient form of insulation.[50] An inch of fiberglass batting is just shy of an R-value of 4 per inch, not counting the R-value loss due to less-than-seamless installation.

In addition to lighting and heating, Kellogg will also require the installation of a ventilation system in its renovation, and there are a variety of system modifications that can enhance the energy efficiency of this element. A variety of sensors are available to run the ventilation system only when occupancy or air quality requires it and can be used in conjunction with a system that can be switched on in individual rooms or zones throughout the building.[51] These include carbon dioxide sensors, which switch on the system when CO_2 levels reach a certain threshold, occupancy sensors, which turn it on whenever an individual is in the room, and window sensors that disable the system when windows are open and allowing fresh air into the building. Since the purpose of ventilation systems is to maintain good air quality, it seems most efficient to use the CO_2 sensor alone. Occupancy sensors may run the system more than is necessary for healthy air quality, even with the

48 The Ontaria Straw Bale Coalition http://www.strawbalebuilding.ca/strawbales.shtml
49 Bio Based Insulation http://www.biobased.net/
50 Mike Tillou meeting, December 4, 2006
51 Oregon Department of Energy—Conservation Division http://www.oregon.gov/ENERGY/CONS/BUS/DCV/DCVarchitects.shtml

complement of window sensors. Another energy saving technique for ventilation is to install heat recovery technology to transfer heat from outgoing air to colder air coming into the building. This approach cuts down on energy needed to heat the incoming air. In addition, the ventilation system can be connected to a geothermal system for dehumidification, and, were cooling desired, the geothermal system could accomplish that concurrently. In a climate like Williamstown's, where high temperatures occur for a short amount of time, a system of this kind could be more cost effective than a conventional HVAC system in terms of operational costs.[52]

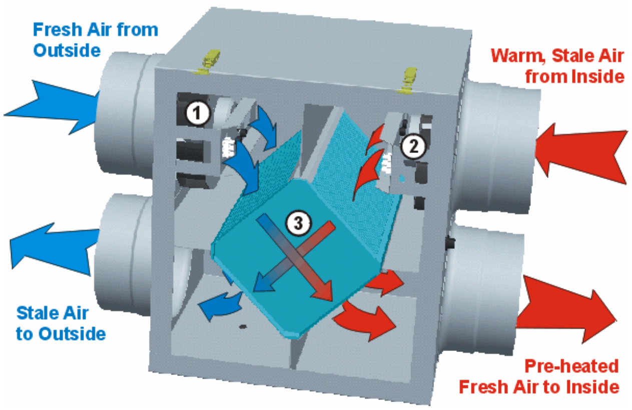


Figure 22. Heat recovery of ventilated air.

Water

While Kellogg's water use is relatively low—only necessary for bathroom purposes and the kitchen sink and dishwasher—there are several ways it could be made more efficient. In the renovated Kellogg House, reducing the impacts of our water use will depend on two dimensions of conservation: reducing the volume of water consumed, and reducing the electricity demanded to heat the water, primarily for the dishwasher. When the house is relocated, it is likely that the kitchen and at least one of the bathrooms will be rebuilt, allowing for the possibility of renovated and re-piped facilities and making a wide range of technologies and practices feasible.

The main possibilities for reducing the volume of water used in Kellogg are to reuse gray water and runoff and to reduce the amount drawn by faucets and toilets. Runoff from the roof could be collected using a Freerain system which filters and stores rainwater. The 172 gallon tank in a Freerain system also has a pump and connection for a hose so that the water can be easily used for irrigation.[53] Additionally, the toilets could receive their water supply from "grey water" draining from the kitchen and bathroom sinks. It is often difficult to reuse gray water because it cannot be legally stored unless filtered and treated correctly to avoid the growth of microorganisms[54]. Brac Systems makes a filter that can be installed simply and allows for reuse of gray water in toilets[55]. It should be further noted that gray water is not actually gray, to prevent misconceptions of the unattractive system the name suggests!

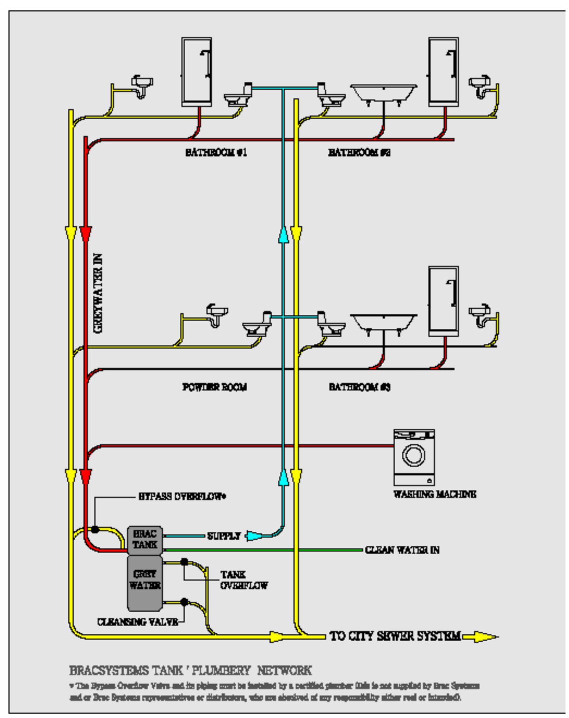


Figure 23. Diagram of Brac System

[52] Ibid
[53] Gusto Systems website. www.freerain.co.uk. Accessed on 20 Nov. 2006. See additional discussion of Freerain system on p. 26.
[54] Oasis Designs website. http://oasisdesign.net/greywater/misinfo/index.htm#storage Accessed on 22 Nov., 2006.
[55] Brac Systems website. www.bracsystems.com Accessed on 22 Nov., 2006.

Another way to further reduce water consumption would be to filter and reuse the black water (i.e. flushed toilet water) as well. The Living Machine is a water treatment system that uses traditional and natural wastewater treatment processes. Black water is first flushed to a septic tank to allow solids to settle out and be anaerobically digested. Next the water passes through a series of aerobic tanks, many containing tropical plants, which provides biological filtering, and then continues on through a clarifier to a green house where it runs through gravel beds which provide mechanical filtering[56]. This type of system requires a lot of space, monitoring, and maintenance of plants and tanks. It also requires energy to keep the room containing the plants and tanks at a constant temperature of fifty-five degrees Fahrenheit. These drawbacks mean that a Living Machine may not be feasible for such a small building as Kellogg House.

Composting toilets are an additional option for reducing water consumption that at first seemed very exciting, yet may not be well-suited to Kellogg House. These toilets have the benefit of not requiring water, but they do require maintenance, and the "compost" that produced by them is not compost at all, but rather EPA Class B waste that must be irradiated or buried in a site with restricted public access for two years. They are, furthermore, very expensive (costing between $4,000 and $6,000).[57] Composting toilets do not make much sense in areas where a sewer connection is available, except as an educational tool. For these reasons, low-flow toilets flushed by runoff or grey water may be a more appropriate technology to choose for this project.[58]

Reducing the volume of water drawn by faucets and toilets, on the other hand, is possible through well-established and easy technologies. The former is very simple with the installation of aerator faucet heads, which mix air in with the water flow to make the flow appear and feel stronger. These faucet heads are already used widely around campus and cost less than $10 each. Reducing the consumption of water by Kellogg's toilets is a slightly more complicated problem, and there are many possible technologies to address it. Low-flow toilets (those with 1.6 gallon tanks) are an obvious first step. Additionally, waterless urinals like those that will be installed in the new student center might be a wise addition, though traffic in Kellogg may not require that we have urinals in addition to toilets. Another option is to purchase dual flush toilets, which average only 1.2 gallons per flush by offering both light and heavy flush options.[59]

Although reducing the volume of water consumed may seem like the top priority from a purely financial standpoint, there is more potential to save money by reducing the electric bill. In 2004, the 32,000 cubic feet of water used in Kellogg cost $281.42, while the portion of the electric bill from heating water amounted to more than twice as much -- $661.00.[60] The dishwasher generates the majority of the demand for hot water in Kellogg, and the current dishwasher is not an EnergyStar appliance. While there is something to be said for not throwing away a functioning dishwasher, there is a possibility that we could save water and electricity by purchasing a newer, more efficient model. Informal interviews have also revealed that the dishwasher does not clean dishes as thoroughly as it should.[61]

[56] Sassi, Paola. Strategies for Sustainable Architecture. Taylor and Francis: New York, 2006, 282.
[57] Phoenix Corporation website. www.compostingtoilet.com Accessed on 1 Nov., 2006.
[58] Both grey water reuse systems and composting toilets are permitted in Massachusetts building code. (Joseph Jenkins. *The Humanure Handbook* (1999). Accessed at http://weblife.org/humanure/appendix3.html#ma on 6 November 2006.
[59] Toolbase Services website. http://toolbase.org/Building-Systems/Plumbing/high-effeciency-toilet. Accessed on 22 Nov.,2006.
[60] Laura Cavin, "Relocation, Restoration, and Redesign of Kellogg House." Williams College, 2004.
[61] Kendall Newman, 11/27/2006

One interesting innovation that we could potentially use to heat water is a device called the Gravity Film Head eXchanger (GFX) developed through a U.S. Department of Energy grant. A GFX is a copper coil that wraps around the drain pipe leaving the dishwasher. Cold water circulated through the coil would be heated by the hot waste water draining out of the dishwasher. This device is capable of transferring 60% of the heat from drain water to cold water. Although it costs $400-600, depending on model, the savings from the electric bill recoup the investment in one to four years.[62]

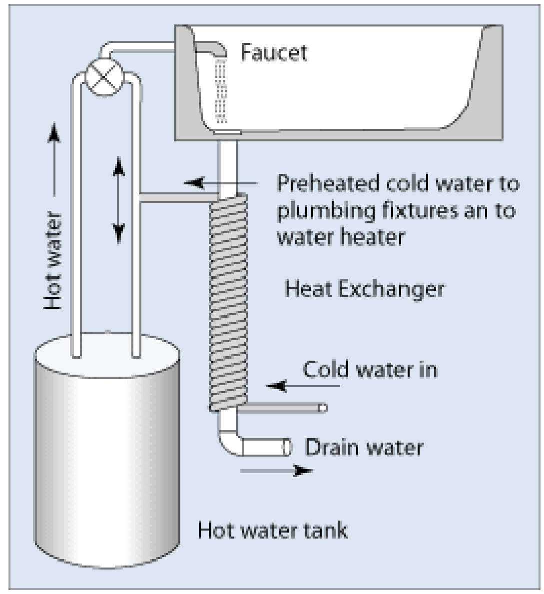


Figure 24. Heat recovery of drain water.

Aside from conservation and heat recovery, and additional exciting hot water technology is a solar hot water system. The type of system we would install would be an active, indirect flat plate collector consisting of two insulated boxes installed on the roof of Kellogg House. The sun heats antifreeze running through tubes underneath the boxes' clear plastic covers, which is then pumped through a heat exchanger to transfer the heat to water. This pumping process, of course, requires electricity.[63]

Landscaping

As the Center for Environmental Studies, it makes sense for Kellogg's mission to extend outside of its walls and inspire the landscaping around it. Laura Cavin's thesis contains several suggestions for this outdoor space. These include maintaining the plants in a "planned disorder" similar to the Forest Garden, planting only native species, fertilizing with compost from the building and using red cedar trees as a wind block on the north west side of the building to improve insulation. She also suggests using the wood from several trees that might be cut down to move the building or provide sunlight to create seats for the outside classroom.

Native plants are an essential part of any sustainable landscape because they provide environmental and aesthetic benefits. They often require little or no watering, pesticides, or fertilizers, compared to non-native species, and they provide appropriate food and habitat for native fauna. They also tend to require less maintenance due to their suitability for the climate, soil, and other conditions in which they exist, reducing financial and temporal costs associated with landscaping. In addition, they provide beautiful and meaningful visual variety in a garden and attract such lovely visitors as butterflies and birds.[64] Reducing the amount of non-native grass cover is particularly important due to the great amount of mowing and fertilizers it requires, both petroleum-intensive strategies.[65] One can instead employ native ground cover plants such as foam flowers, wild ginger, or violets. Gardens can also be created for a specific purpose such as attracting butterflies or growing vegetables or medicinal herbs.

[62] U.S. Dept. of Energy, "Heat Recovery from Wastewater Using Gravity-Film Heat Exchanger. www.eere.energy.gov/femp/pdfs/techfocus_gravity_film_ex.pdf
[63] The cost of specific solar water heating systems can be determined, once you have technical information about your specific system, at: http://www.eere.energy.gov/consumer/your_home/water_heating/index.cfm/mytopic=12910
[64] http://www.extension.umn.edu/pesticides/IPM/pubnplant.htm
[65] www.envirolandscaping.org and Greenscapes at www.epa.gov

Trees and vines can be used for interior temperature regulation not only as wind blocks as Laura suggests, but also as green screens, which are vines growing directly on the building to increase insulation. Furthermore, deciduous trees can be planted on the south side of the building to create shade and reduce cooling costs in the summer while still allowing the sun to enter for passive solar heating during the winter. Fertilizer and irrigation for plants can be provided by compost from the kitchen and runoff water collected from the roof, respectively.

There are several options for materials out of which one can construct outdoor paths, patios, and furniture. One option for surfaces is porous pavement with an underlying stone reservoir that will catch runoff water and release it slowly into the ground. Porous pavement proves problematic in cold climates, however, because the sand or salt used to melt ice clogs the pores. The necessity of unclogging the pores means the pavement requires a fair amount of maintenance. Gravel is another permeable option; however gravel would most likely create plowing or shoveling problems in the winter as well. One option for paving material that is more winter-friendly is interlocking rubber bricks made entirely from used car tires. These bricks are made fairly locally in Geneva, NY by Enviroform and are unaffected by tough winter conditions. They are also easy to install and require little maintenance once in place. Any other products that we may require outside of the building such as bike racks, garbage and recycling bins, garden hoses, outdoor furniture, or a sign for the building can be found made from close to 100% recycled materials (generally plastic). The EPA has a consumer product guide online that provides vendors for every green building product imaginable at www.epa.gov/cpg.

There are several options for storm water management. The first option is to build a green roof. Green roofs are vegetated beds that reduce the amount of storm water runoff and also clean the water that does run off the roof. Green roofs also help insulate the building, reducing heating costs, and reduce the effect of heat islands, possibly eliminating the need for air conditioning.[66, 67]

Table 1. Normalized (per unit area) Heat Flow through the Roof Surfaces of the Test Roof during the Observation Period (November 22, 2000–September 30, 2002)

	Reference Roof	Green Roof	Reduction
Heat Gain	5900 Btu/ft^2 (19.3 kWh/m^2)	270 Btu/ft^2 (0.9 kWh/m^2)	95%
Heat Loss	13500 Btu/ft^2 (44.1 kWh/m^2)	10100 Btu/ft^2 (32.8 kWh/m^2)	26%
Total Heat Flow	19400 Btu/ft^2 (63.4 kWh/m^2)	271 Btu/ft^2 (33.7 kWh/m^2)	47%

Source: National Research Council of Canada

If we were to install a green roof, presumably on roof planes facing directions other than south, an extensive green roof would be the most feasible type for this project as it consists of 3 to 6 inch beds of gravel and hardy light-weight plants, such as sedum, requiring little maintenance after the first year. It is also cheaper than the intensive form, whose deeper beds and larger plants add enough weight to the building that extra support systems must be constructed to sustain them.

Other options for storm water management include the construction of an artificial wetland or wet swale, as explained in detail at www.stormwatercenter.net. A constructed wetland may not be feasible for our relatively small project with limited ground space outside the building. A wet swale is very similar to a wetland. It consists of a small channel or depression lined with native

[66] http://www.montrealmirror.com/ARCHIVES/2004/070804/news2.html
[67] www.nrel.gov/**do**cs/fy04osti/36060.pdf

wetland vegetation which filters runoff water, a feature occasionally used in place of curbs to limit runoff from roads and which could be used in the parking lot closest to Kellogg. In addition, a constructed pond upwind of the building can also provide cooler breezes for the building in the summer time and reduce cooling costs.[68]

Case Studies

Many other institutions are currently successfully using many of the technologies we may install in Kellogg House. We discuss a sampling of these examples, divided into the categories of materials and energy, water and landscaping, and education. Understanding our peers' choices helps to give a better understanding of the possible uses of these systems and their potential for success.

Materials and Energy Case Studies

(1) Adam Joseph Lewis Center for Environmental Studies at Oberlin College

Figure 25: AJLCES atrium.

One of the most impressive aspects of Oberlin College's environmental studies building is their extensive monitoring of energy use and production. The building makes the best use of its location by strategically orienting the building, uses efficient lighting technologies, and produces energy throughout the day from its 690 solar panels, which export excess electricity to the grid during the day and draw from the grid at night.

In terms of heating and air quality, the Center has 24 geothermal wells and an Energy Recovery Ventilator (ERV) to provide fresh-air exchange. Their windows are triple-paned and contain argon gas interiors in order to increase their insulation value. In addition, the building's walls and roof are built with materials with very high R-values in order to make the building retain heat efficiently.

Oberlin's philosophy regarding materials and their acquisition states involves the following criteria for sustainability: recycled or reused content; low energy production, use, and maintenance; local harvesting, production, or distribution; support of creative economic structures and addressing problems in ecological design; and product of service (materials leased until worn out, at which time they are returned for recycling and replacement). They determined that the products that best met these criteria were: regional sustainably harvested wood, interface carpet panels, recycled steel I-beams, energy efficient lighting fixtures, acoustical panels constructed of agricultural straw waste (as this project involved an auditorium). [69] Oberlin lists many of the companies they bought materials from as a way to help other projects get started on their green building campaigns on the AJLCES website (http://www.oberlin.edu/ajlc/ajlcHome.html).

[68] http://mhathwar.tripod.com/thesis/solar/solar_architecture.htm
[69] Materials, Oberlin College http://www.oberlin.edu/ajlc/systems_materials_1.html

(2) Debevoise Hall at Vermont Law School

Vermont Law School's first building underwent a $6.5 million renovation and LEED certification in 2004-5. This project, like the Kellogg project, altered a historical building to fit contemporary needs and update it to better than contemporary efficiency standards.[70] Some of the green features from this project that seem appropriate for Kellogg include: a new ventilating system, which uses five energy-recovering wheels to maintain humidity and heat; high performance fiberglass windows installed inside the existing historic sash; and motion sensing lighting that controls energy-efficient light fixtures throughout the building. Additionally, its insulation is a combination of cellulose and spray urethane foam. Marc Rosenbaum, who worked on this project, stressed the importance of tightly sealing buildings to reduce heat loss. Also, about 80% of construction waste was recycled.[71]

Figure 26. Debevoise Hall.

Water and Landscaping Case Studies

Figure 27. AJLC gardens.

(1) Adam Joseph Lewis Center for Environmental Studies – Oberlin College[72]

The landscaping at this center aimed to construct ecosystems that simulate native Northern Ohio ecosystems and also include plants that produce food for humans. There are six different ecosystems within the constructed landscape.

Figure 28. Living Machine at AJLC

The first ecosystem is a restored wetland. This area contains all native wetland plants and perpetually moist soil. Native fish and painted turtles were added to the system whereas other organisms such as birds and insects have now migrated there on their own. The wetland is not only native habitat but also treats storm water and retains it until it can drain gradually into the water table. The second ecosystem is an emerging forest. A native deciduous forest was created on the south side of the building to imitate the landscape before people colonized the land. Third is a dry land community that houses three endemic cacti in a rock garden. This region is educational as most people do not realize that cacti are actually native to Ohio. Fourth is a circular fruit and vegetable garden. The paths in the garden are made of recycled bricks and building stones. There is heat trapping

[70] 1960s Scholars Lecture Wege Auditorium November 10, 2006.
[71] Vermont Law School press release, http://www.vermontlaw.edu/media/emp_medpre_template.cfm?doc_id=1088
[72] Oberlin College website. www.oberlin.edu/ajlc. Accessed on 15 Nov. 2006.

plastic over the beds to extend the growing season from March until December, and the beds are raised to aid drainage in the clay rich Ohio soil. Strawberries, raspberries, blueberries and organic vegetables are grown for consumption by students. There is also a terraced orchard located immediately north of the building. The orchard's location reduces erosion and insulates the building. There are 50 apple and pear trees which when mature will produce 50 bushels of apples and pears annually. The orchard and the circular garden prove that significant amounts of food can be produced in urban or suburban settings.

The last region is covered by "low-mow" turf. The specific mix of grasses requires less mowing than other commonly used varieties. No fertilizers or pesticides are used. The area becomes dormant in the summer because no additional watering is provided. When necessary, the area is mowed by a battery powered electric mower and edger that are recharged with a PV system.

The storm water from this site drains into the wetland or a 9,700 gallon cistern that is buried to the north of the building. The sewage from this building is treated by a Living Machine which uses tropical plants and conventional sewage treating techniques to treat sewage and make it clean enough to be reused in the toilets and other systems within the building.

(2) Millennium Green Development – Collingham, UK[73]

In this housing development project, completed in 1999, a system called "Freerain" reused rainwater for use in every house in the development. The system is composed of a tank, self-cleaning in-tank filter, a submersible pipe, connecting pipe work, and controls. The tanks come in three sizes (3,500, 4,700, or 6,500 liters) and are made from recycled polyethylene and were placed in the basement or underground to protect them from the sun which may cause the growth of algae.

The rainwater collected from the roof falls through downspouts and a filter into a tank. It can then be applied to appliances (laundry machines, toilets) or pumped to external taps for exterior irrigation. The tank has an overflow outlet that flows to a soak-away in the garden or to the main drain. The tank should overflow three times a year because this cleans the filter automatically. The tank also has a sensor that fills the tank with mains water when there is too little rainwater present.

This system is very low maintenance and can reduce water bills up to 50%. Reviews from users of the Freerain system rave about the money and water saved with such a simple system.[74]

Figure 29. Gusto System (like Freerain)

(3) Willow School – Gladstone, NJ[75]

This environmentally focused elementary school incorporated many ideas of green design into its buildings and landscapes. The hard landscape design focuses on using recycled materials – for example, the benches are made from old stone bridge stanchions and the trees cut to make way for construction were used for furniture. Additionally, all garden clippings are composted, and

[73] Sassi, Paola. Strategies for Sustainable Architecture. Taylor and Francis: New York, 2006, 282.
[74] Paola Sassi, *Strategies for Sustainable Agriculture.*
[75] Ken Druse, *New York Times,* 30 September 2004.

outdoor lighting is directed at the ground to prevent night-time sky light pollution.

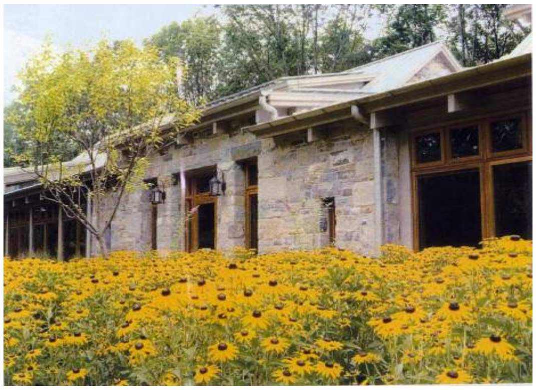


Figure 30. Willow School garden.

The entry garden is composed of all native grasses and flowers. These types of plants are planted in most areas to avoid lawns that must be mowed. Their advantages include the fact that they do not require fertilizers and pesticides because they are endemic to the region. There is also a vegetable garden that uses compost as fertilizer, and the children have a lot of interaction with the garden as it is an important educational tool.

Storm water is well managed at the school. Asphalt has been replaced by more permeable gravel. Traditional curbs are replaced by swales that draw the rainwater runoff into depressions vegetated by maple, oaks, asters, and other native plants that soak up the water. There is also a constructed pond surrounded by wetland vegetation that acts as a retention basin instead of a less attractive rock-lined ditch. The wetland is full of native vegetation that draws native wildlife to the area. Finally, the water from the roof of the buildings is piped to a 54,000 gallon cistern beneath the parking lot. Aquatic plants remove impurities from the building's black water so that it can then also be stored in the cistern and later used to flush the school's toilets. This system conserves a great amount of water for the school.

Educational Case Studies

Whatever green design features we install in Kellogg, educating the building's users about their benefits – and their existence – will be an important facet of the building's design. We will no doubt wish to have signs or placards giving information on the house's more static green design, such as a no-mow, native landscape or passive solar design, but in addition to these educational features, environmental monitoring technology would be a great asset.

The renovation provides us the opportunity to install real-time monitoring of the building's use of various resources. Oberlin College recently embarked on a year-long campus-monitoring study to determine if real-time feedback on resource use reduces demand (this study will be completed in the spring of 2007). The impetus for this study was the result of a smaller study at that school in 2005, which found that dorms with real-time feedback reduced electricity and water use more than dorms with weekly feedback.[76]

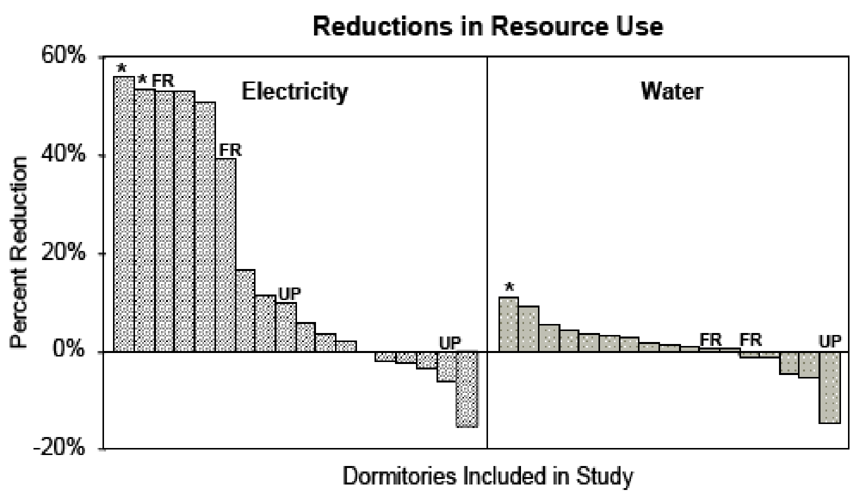


Figure 31: Dormitories indicated with an asterisk (*) were equipped with real-time monitoring devices (Petersen et al.

[76] John E. Petersen, Vladislav Shunturov, Kathryn Janda, Gavin Platt, Kate Weinberger. "Doe s Providing Dormitory Residents with Feedback on Energy and Water Use Lead to Reduced Consumption?" Oberlin College, 15 Sept. 2005.

Lucid Design Corporation, a group with roots at Oberlin, makes interesting, interactive displays showing buildings' real-time consumption of various resources. At Michigan's Alma College, Lucid recently installed a "Building Dashboard" in the lobby of Wright Hall dorm. The dashboard is available both in the building's lobby as a touch-screen and online at http://www.luciddesigngroup.com/clients/alma/bd.php. The dashboard displays water use and energy use for heating, cooling, and electrical appliances for the day, week, month, and year, and in a running graph and a variety of units: electricity, for example, can be measured in tons of carbon dioxide, wind turbines, or hamburgers. This kind of interactive display would be an educational and fun tool to have in the new building that would also raise awareness about resource use.

If solar panels were installed for electricity or hot water, information on how much energy the panels were generating would be another educational feature to include. At Williamstown Elementary School, information on the school's solar panels is posted (in real time) on the school's website. The power produced by the school's solar panels was formerly displayed by Schott Solar, the manufacturer of the PV panels. According to Tom Welch, the school's Technology Coordinator, they have just completed their project with Lucid Design, and will now have a flat screen display showing electricity consumption and production, water consumption, and weather conditions in a main hallway. In order to help the students better understand the measurements, energy data will be converted into its equivalent in 100 watt light bulbs, and the measurements will be broken into class periods. This data will then be archived for students to use in school projects. The option of installing one of these displays at Williams, while relatively expensive, might have paybacks in increased availability of information and would no doubt serve as a valuable educational tool.

At the Ballard branch of the Seattle Public Library, designed by the Stetson/Sawyer project's architectural firm, Bohlin Cywinski Jackson, there are a number of educational features that could be emulated in Kellogg. For example, rooftop scientific devices measure wind speed and direction, sunlight, and the sound of rain. This information is displayed artistically on an LED-display in the library lobby, which is powered by tiny windmills attached to the rooftop monitoring devices. The solar power generated by the seventeen rooftop solar panels and the solar film in the building's south-facing windows is monitored and displayed also.


Figure 32: Solar panels and green roof. Figure 33. Rooftop weather monitors.
(Photos from Seattle Public Library: http://www.spl.org/default.asp?pageID=branch_open_other&branchID=3)

Installing environmental education features such as these is important not only because they are fun and interesting, but also because knowledge of the impacts and importance of the green design features in the building will be crucial to spreading awareness and use of those features. The monitoring features also help to remind people to reduce their energy consumption.

PART III

Community Research

Methodology

We conducted two surveys, one for students, faculty, and staff that currently use Kellogg House and one for students that do not. The latter were distributed at Dodd and Driscoll dining halls during two meals. The former were given to members of Greensense and Students for Social Justice at their meetings in Kellogg and to students studying in Kellogg on a number of occasions. Additionally, the survey was distributed at an Ecology (BIOL 203) review session held there. We left a pile of surveys on the bench outside Sandy's office in Kellogg so that students that use the house but do not participate in any of the above listed activities could access the survey. We distributed surveys for faculty and staff members in their boxes in CES and followed up with email requests for their completion. In total, we surveyed 36 house users and 100 non-house users. The surveys can be found in Appendix 2.

Results

As the survey involved both qualitative and quantitative sections, our results consist of comments and data, the first of which we will begin with here. One word that kept coming up over and over in our study was "cozy" – the results of our study, in general, suggest that preserving this cozy atmosphere and improving lighting in the house are the two main changes desired by users. The results broken down by room are as follows:

Library: In general, people liked the library for its cozy feel, large comfortable chairs, quiet atmosphere, and large tables. They also appreciated the easy access to computers. The major complaint students had about the library was that there are not enough desks, tables, or study spaces in general. Additionally, students disliked the lack of light and outlets for laptops, and noted that the printer never functions correctly.

Kitchen: The majority of the students liked that the kitchen is open to everyone, always has tea available, and has a communal aspect and homey feel. The major complaints about the kitchen were that there are not enough shelves for storage or surface area for cooking. Additionally, students agreed that the cupboard with the pots and pans should not be locked and that more cookware should be available.

Living Room: The living room was consistently praised for its cozy environment, fireplace, and comfortable furniture. Many students like the intimate atmosphere it provides for seminar classes or meetings. The most common complaints were the inadequate lighting and the ugly carpet.

Seminar Room: The seminar room, while praised for its big table, was universally criticized as too small, not homey, and too cold. Overall, it received more complaints than compliments. One student also complained that the clock ticked too loudly! Faculty complained that the blackboard was difficult to use or see and that the room has no audiovisual computer technology.

Offices: The faculty and student offices received few comments because they are not well known among house-users. This fact points to the problem that the offices are hard to find and not often used by students. The faculty like the size of their offices but complain that the rooms are either too hot or too cold. House-users praised the informal atmosphere of the faculty offices and were happy that the student office existed at all. Informal interviews with student groups who use the student office, however, revealed that they most appreciated the fact that they had storage space in the office rather than workspace. In fact, the student office was cited by some as too small and crowded with junk.

GIS Lab: Many house-users cited the GIS lab as a good place to study because of its quiet, cozy, and uncrowded atmosphere. They liked the individual study workstations provided there. A few frequenters were less happy with the age and small number of computers. We will look into getting more and or newer computers for the new reading room in Kellogg. Additionally many people complained that the computers log a user out too quickly, which can likely be fixed by changing the computer settings.

The surveys indicate that the preference for particular characteristics of a study space is largely personal; however the charts below illustrate a few of the conclusive results. In general, current house-users are strongly opposed to assigned carrels or book lockers. Many even commented that they would no longer use Kellogg if such features were added. Other than that, students mostly expressed a strong desire for more daylight in the library.

House–Users Survey

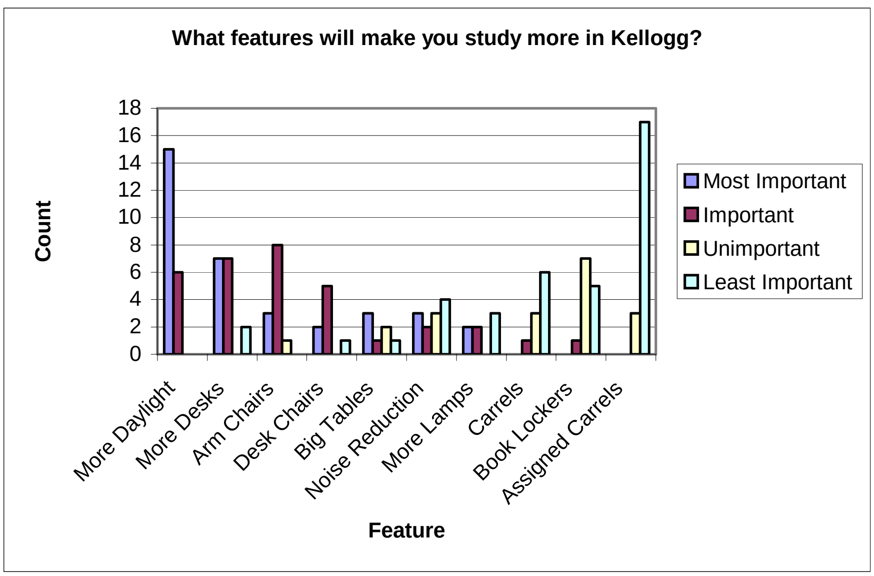


Figure 34: The students that use Kellogg House currently state that more daylight, arm chairs, and desks are the most important study area features. Assigned carrels and book lockers are by far the least important aspects for them. N=36

House users appeared to be excited about the idea of a porch and an outdoor classroom. Most do not care if there is a lawn or not, suggesting that many do not know the negative impacts that a lawn has on the environment, and that educational features will be needed. The following chart details the survey results with respect to outdoor features of the new design.

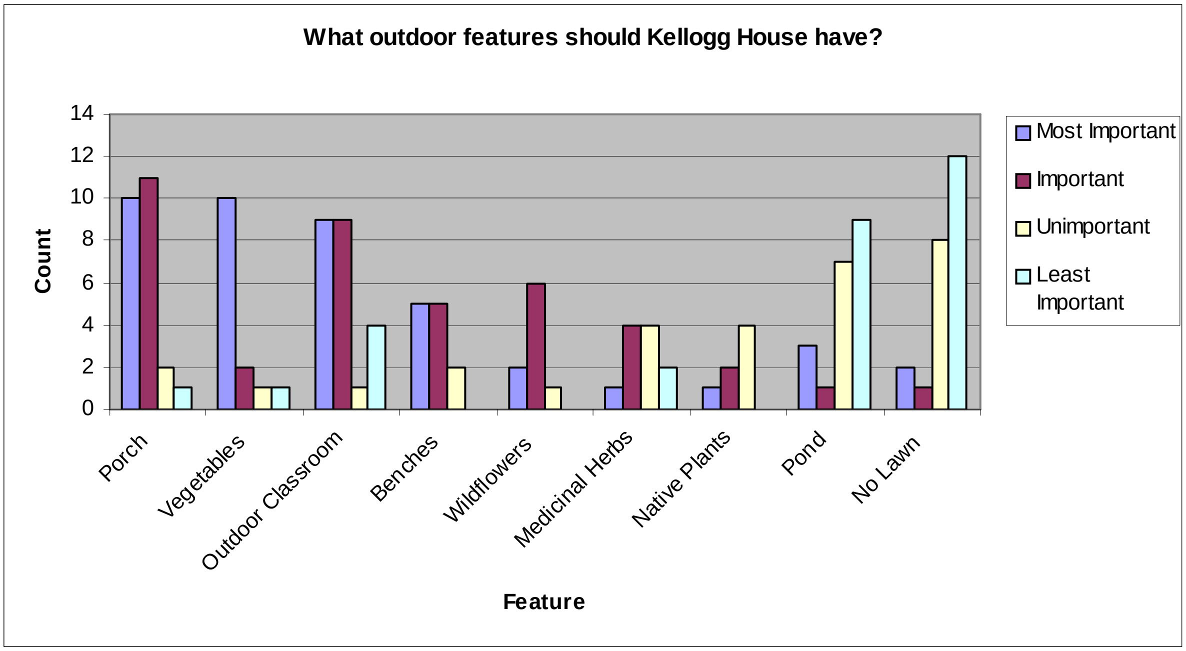


Figure 35: Students that use Kellogg House feel that an outdoor classroom and a porch would be the most important outdoor features to include in the renovation. Pond construction or the use of ground cover instead of grass is the least important aspects for them. N=36

House users were also asked what green features are most important to them and should be part of the new Kellogg. Most people ranked solar panels highly, presumably because they are the most well known green technology. We believe it should be kept in mind that users are likely not tremendously well-educated on the benefits and costs of each feature. For this reason, we will rely most heavily on our own research when deciding which green features to incorporate into the building.

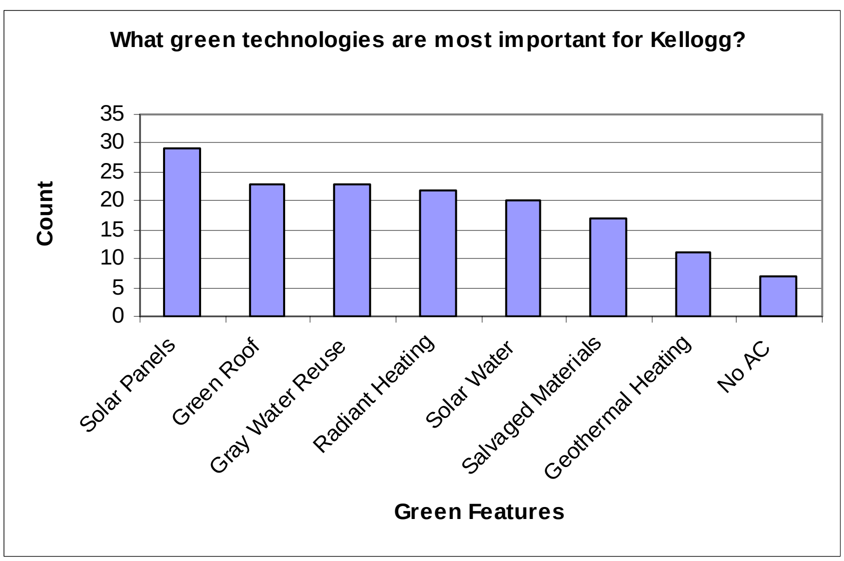


Figure 36: Students that use Kellogg House feel that solar panels are the most important green technology that should be included in the renovation. N=36

We received a few suggestions on how to make more people use Kellogg more often. One student suggested that if students heard more about the building freshman year they would be more likely to use it. It was also suggested that the building be open longer hours and have more study spaces, cooking supplies, computers, and comfortable couches. Many of the respondents stressed that it is the personal and homey feel of Kellogg that attracts users.

About ten students were asked informally if they would like Log Lunch to move to the new Kellogg. Many students were worried about the size that the new space would have to be to accommodate 100 people. They also worried about the need for so many (most likely uncomfortable) chairs. Most thought it would be a good idea as long as the issues of space and kitchen size could be handled well and without compromising the cozy atmosphere of the house. A few were still resistant and worried about the smell and the move from a more central location on Spring Street to a less public location farther back on campus.

In addition to surveying current Kellogg House users, we also surveyed those who do not use Kellogg House, as we were interested in determining how much they know about Kellogg in order to gain insight into how to attract more community members to it. First, we asked respondents to indicate whether they knew the house's location. We found that many students, particularly first years and sophomores, do not even know where Kellogg House is located.

Non-User Surveys

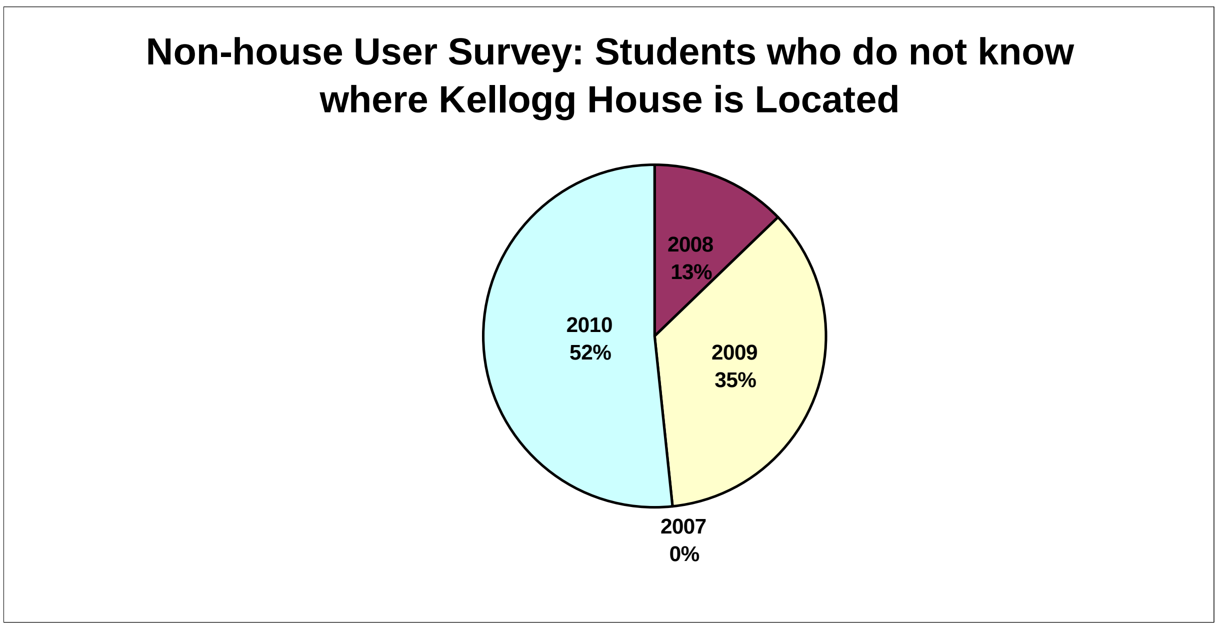


Figure 38: 31 out of the 100 surveyed non-house users do not know where Kellogg is located. The majority are first years. N=31

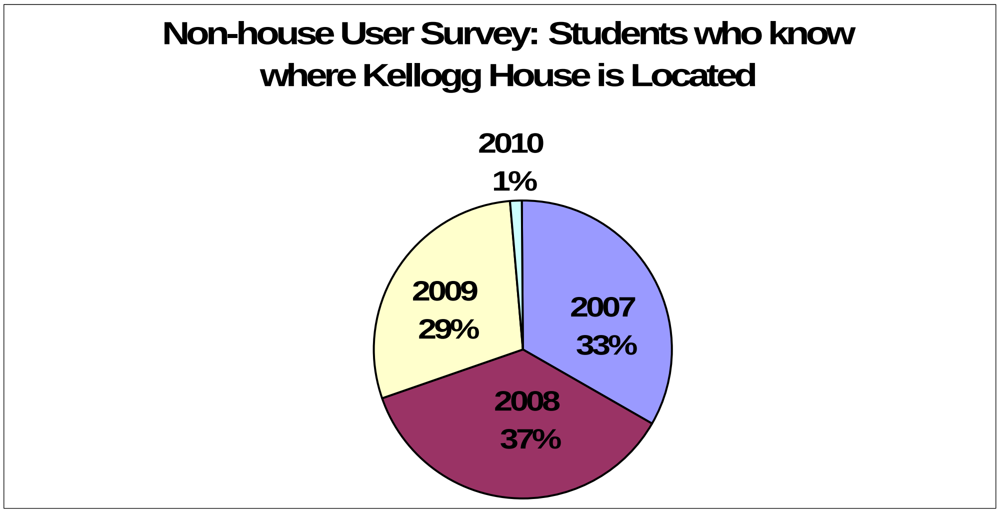


Figure 39: 69 out of 100 non-house users surveyed know where Kellogg is located, however only 1% of this population is first years.

Additionally, most students of all years do not know that they can use the Matt Cole library or CES kitchen.

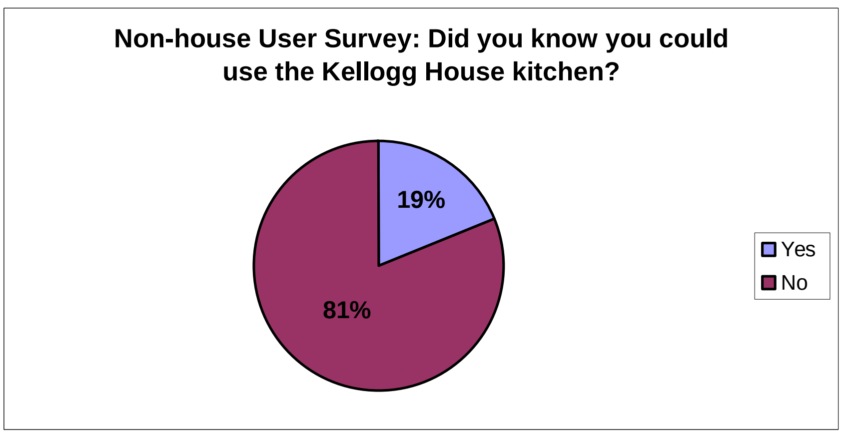


Figure 40: Only 19% of the 100 non-house users surveyed know that they can use the Kellogg kitchen.

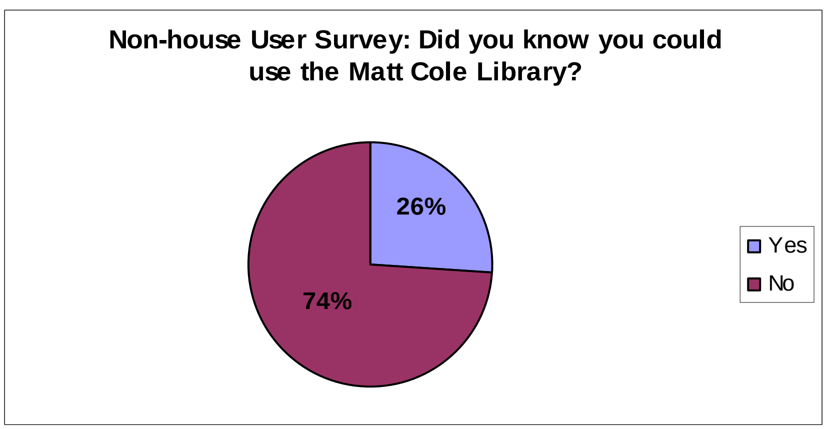


Figure 41: The majority of the 100 non-house users surveyed do not know that they can study in the Matt Cole Library.

We also asked non-users about the most desirable features for a study space. While many of the study space features are attractive to some and unimportant to others, a few aspects do stand out as particularly significant. Most students want a quiet area with comfortable seating but do not care how social the atmosphere is.

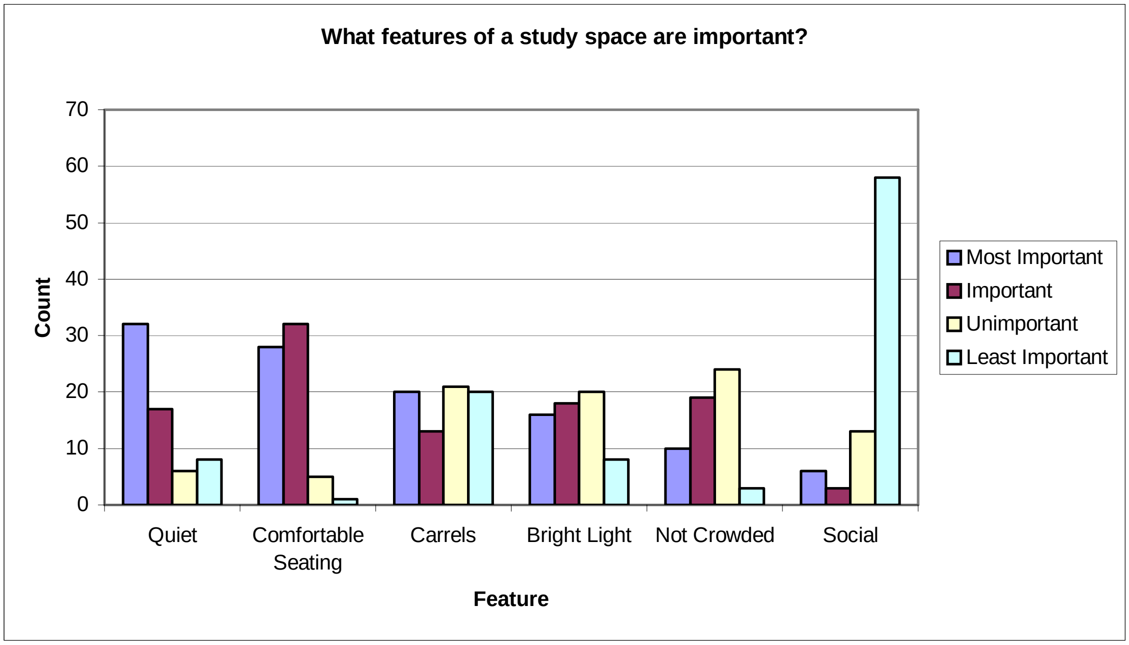


Figure 37: Students that do not use Kellogg claim that comfortable seating and a quiet work place are the most important features of a study space. They cite the social atmosphere (i.e. if their friends are there also) as the least important aspect. N=100

In general, these results suggest that we should focus our efforts on better publicizing the house. It may be possible to increase the number of house-users simply by telling first years about Kellogg's many resources or by having Kellogg "open house" nights with snacks to attract first-time users. The survey results indicate that the reason students do not come to Kellogg House is not due to a lack of resources. Most students (54 of 100 surveyed) do not use Kellogg because they do not think they have a reason to do so. Perhaps if they were aware that the space is a particularly nice place to study they would utilize it more often. Eighteen students (of 100 surveyed) stated that they do not study in Kellogg either because they are not an environmental studies concentrator or because they are not comfortable (socially) in the house.

Law and Policy Research

Building Code

Ken Jensen knows more than we could ever hope to learn about Massachusetts Building Code and how it applies to the redesign of Kellogg. A laywoman's investigation of the code and discussion with Ken has suggested that the steep central staircase will almost certainly have to be replaced and the handicap-access elevator currently in Matt Cole Library will need to be incorporated into the new addition. As far as any environmental features we might be interested in including in the new building, it appears that none are restricted by the code: grey water reuse systems, composting toilets, and constructed wetlands are all permitted.[77]

[77] Joseph Jenkins. The Humanure Handbook (1999). Accessed at http://weblife.org/humanure/appendix3.html#ma on 6 November 2006.

Massachusetts Energy Code for commercial buildings, very generally, calls for:

- Sealing all holes, gaps, and seams in walls, windows and doors.
- Ensuring that insulation is properly installed, without being crushed or damaged.
- Installing the correct size heating or cooling system.
- Properly sealing all ductwork.[78]

The code is divided by region: in Williamstown, the ceiling must have a U value (the rate at which the material conducts heat) of .026, and the walls must have a U value of .12.[79] To meet our goals of a zero carbon or LEED Platinum building we would almost certainly have to exceed what is required by code significantly.

Other Constraints

One major constraint on this project, as much as we may not like to acknowledge it, is the project's budget. Bruce informed us that the budget for the project, including moving of Kellogg House, the demolition of the library and annex, and the building's new foundation, is a tentative $750,000, though he was not certain that this amount was accurate. We plan to make our recommendations without worrying if all the features can be accommodated within this budget, but we will keep cost-effectiveness in mind.

Another hurdle may be the policy and priorities of the college itself. Based on watching past buildings start out with many green features in the design, only to be cut as the project progresses, we worry that the college might need to be convinced that a green building is worth the trouble and expense. Our clients in Facilities, however, have approached this project with an open, helpful attitude that gives us reason for optimism.

President Shapiro does not appear to have a strong personal opinion on green design at Williams: in response to an e-mail asking for his perceptions of the college's priorities in new buildings – i.e. what weight green features should be given against the budget, whether the college had a desire to become a leader in green design, he replied, "Steve Klass [the Vice President of Operations] is very knowledgeable about all of our priorities and you should talk with him. Green elements are very important to all of us."[80] Although it is understandable that he is busy and may not want to say anything that contradicts college policy, we were slightly discouraged that he did not voice any opinion, much less a strong commitment.

On the other hand, we had a very encouraging and informative meeting with Steve Klass, Irene Addison, and Stephanie Boyd. Klass stressed the fact that he believes the time is right for the College to create a strong green building policy that internalizes environmental considerations as a guiding principle of construction, not as features that can be value-engineered out as a project progresses. The three also agreed that an innovative Kellogg House could serve as an effective educational tool and be a model for what could be done in other campus buildings on a larger scale. Klass and Boyd were optimistic about the possibilities of promoting "sustainability" in college building, as it is hard to say you are against something that sounds as positive as "sustainability." As Klass pointed out, it is especially helpful that he can show that many of these "sustainable" decisions will save the college money in the long run. In their opinion, there are good prospects for developing an exciting, innovative plan for Kellogg incorporating many elements of green design.[81]

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[78] *Massachusetts Commercial Energy Code (13).*
[79] Ibid.
[80] Personal communication, Alison Koppe and Morty Schapiro, 17 Nov. 2006.
[81] Irene Addison, Stephanie Boyd, and Steve Klass. Personal communication, 5 December 2006.

Although our final recommendations will not be strictly bounded by the considerations of code, budget, and administrative feasibility – we intend to exceed the energy requirements of the building code and suggest the college to increase the project's budget, if necessary – they are important considerations to keep in mind.

PART IV

Alternatives

Cost

In order to rank alternatives taking into account their various costs and benefits, we first attempted to price some of the main green features proposed for the renovation and relocation in terms of initial cost (relative to the standard alternative) and payback period, listed in order by shortest pay back period to longest.

FEATURE	***INITIAL COST***	***PAY BACK PERIOD***
Energy		
Exclusion of air conditioning	$0	Prevents expenditure
Passive solar design	$0	Immediate
Efficient lighting	$1-7 per bulb	1 year
Straw bale insulation	$2-4 per bale	Inexpensive
Spray foam	$1.25-2.25 per square foot	3 years
Green roof	$10-24 per square foot	5-7 years
Geothermal heat	$2,500 per ton capacity	10 years
PV hot water	$1,550	10-14 years
PV panels electricity	1 kW system $11,000	18 years
Mini wind turbine	$1,400	Long
Radiant floors	$3 per square foot	Undeterminable
Water		
Dual flush toilets	$294	Immediate
Aerating faucet heads	$10 per faucet	< 3 months
Heat exchange	$400-600	2 years
Efficient dishwasher	$500	2-6 years
Rainwater reuse system	$1,000	7 years
Gray water reuse system	$1,500	7-8 years
Composting Toilets	$6,300	25 years
Living Machine	$500,000 +	Undeterminable (but high)
Materials		
Recycled steel roof	$2-5 per square foot	Inexpensive and durable
Permeable paving	$2-3 per square foot	Not applicable
Rubber block paving	$2.25 per brick	Not applicable
Composite frame	$1.60-$2.50 per linear foot	Not applicable
Certified wood frame	10-15% more expensive	Not applicable
Monitoring System	$10,000	Undeterminable

Table 2: The table shows the average initial cost for each feature and the expected payback period (see Appendix 1 for sources).

Cost Estimate Details – Energy

Solar Hot Water Kellogg House's hot water usage is relatively low. One solar hot water panel would be plenty for the house's hot water needs. According to Craig Robertson of Williamstown's Heliocentrics, a one panel system including a 40 gallon collector tank, would cost between $1,350 and $1,500, plus some installation costs that would be determined from a site visit. [82]

Photovoltaic Panels The projected use of electricity use in 2004 for Kellogg House was 30,000 kWh. Chris Kilfoyle of Berkshire Photovoltaics gave us an estimate of $20,000 per 2 kWh photovoltaic panel; therefore, a 30kWh system would cost in the range of $300,000. Mr. Kilfoyle also said the site visit and permit paperwork was included in the price of the photovoltaic system. [83]

Radiant Floor Heating A radiant system normally costs about $3.00 per square foot. Depending on the installation, number and type of controls associated with the systems, and heat source, a hydronic system can cost anywhere from $2 to $6 per square foot. [84]

Cost Estimate Details – Water

Gray Water Reuse System A Brac gray water reuse system costs only $1,500[85] and allows the building to use filtered drain water from the building's sinks to flush the toilets. The toilets are the largest water consumers in Kellogg House which means that after the seven to eight year payback period money will be saved on water bills.

Rainwater Reuse System A rainwater reuse system to catch, filter, and pump water to a hose for irrigation would cost $1,000 and have a payback period of ten years[86]. This system has low maintenance and the filter automatically cleans itself several times a year.

Green Roof A green roof would cost ten to twenty four dollars per square foot[87] compared to an average roof cost of nine to twelve dollars per square foot[88]. A green roof would reduce heat flow by 47%[89] thus greatly reducing the costs of heating and cooling. Additionally there are very minimal maintenance costs, the roof will last longer than a conventional roof, and can act as a replacement for the rain water filtering system.

Living Machine A Living Machine slightly larger than that necessary for our use cost $500,000 at the Darrow School[90] and provides the same savings as a gray water reuse system if the treated water is reused in toilets. The Living Machine requires a great amount of maintenance that can be expensive. Additionally the room with the tropical plants must be kept warm which adds to the

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[82] Phone Consultation with Craig Robertson, Tuesday December 5, 2006
[83] Phone Consultation with Chris Kilfoyle, Sunday December 2, 2006
[84] Radiant Design Institute http://www.radiantdesigninstitute.com/, Warmly Yours Floor Heating, http://www.radiant-floor-heating.com/electric-floor-heating-price.aspx
[85] Brac Systems website. www.bracsystems.com. Accessed on 28 Nov. 2006.
[86] Gusto Products Ltd website. www.freerain.co.uk. Accessed on 30 Nov. 2006.
[87] Green Roofs for Healthy Cities website http://www.greenroofs.net/index.php?option=com_content&task=view&id=26&Itemid=40 Accessed on 3 Dec. 2006.
[88] Hampshire Timber Frame website. - http://www.hampshiretimberframe.com/pricing.htm. Accessed on 3 Dec. 2006.
[89] National Resource Council Canada
[90] Melnik et al. A Feasibility Analysis of aLiving MachineFor ES2. www.adm.uwaterloo.ca/infowast/watgreen/projects/library/f04**livingmachine**.pdf. Accessed on 4 Dec. 2006.

heating bill.

Composting Toilets Composting toilets cost around $6,300 and have high maintenance costs including electricity for fans and periodic pumping of waste.[91]

Alternatives Rating System

From our research we compiled a list of green features to consider for Kellogg House. We once again divided the features into three categories of energy, water, and materials (which includes landscaping here). Taking into consideration the multi-faceted goals of the project we devised a rating system that incorporates environmental impact, educational value, cost, client interest, and student interest. We rated each feature in each category on a scale from one to three, one signifying least attractive and three signifying most attractive. In the cost category, features with a payback period of 0-5 years received a rating of 3, 6-10 years received a rating of 2, and greater than 10 was 1. For features that had no payback period we weighed them by how expensive they were in comparison to the conventional material. To ascertain the rankings for CES client interest, we asked Sarah Gardner and Karen Merrill to rate each feature from 1 to 3, and then averaged their scores. Student interest was determined using our survey results. Environmental impact was determined based on our research into the impact of producing and consuming the material or the resources that would be saved through the feature's use in Kellogg. Educational value was assigned based on the feature's visibility, ability to be monitored, and interactive quality.

We then weighted each category according to how important it is to the overall aim of the project. Environmental impact received a weight of four because the main focus of the renovation and relocation is to construct an environmentally sustainable building. Educational value followed with a three because this building will primarily be used for teaching and as an educational model of green design on campus; furthermore, sustainable design in itself is sustainable only if it is exposed and passed on. We gave cost a weight of two and one half because it influences the feasibility of features' actual installation, which is critical as this is a practical, not merely theoretical, project. Client interest received a weight of two because although we strongly value our clients' opinions, we feel that we have a better understanding of the alternatives' feasibility and impact within the project having researched them thoroughly. Lastly, student interest was weighted the lowest at one because most students have little specific knowledge of green features and are not quite as invested in the project, being only transient users of the space. This weighting results in an equation of 4*Environment + 3*Education + 2.5*Cost + 2*Client + 1*Student = SCORE. The total score possible for any feature is 37.5 and the lowest is 12.5.

[91] Advanced Composting Systems Ltd. Website. www.compostingtoilets.com. Accessed on 19 Nov. 2006.

Alternatives	Total Points
Energy	
Mini Wind Turbine	23.5
Radiant Floors	24
Energy Star Appliances	25.25
Exclusion of AC	25.5
Ultra Efficient Windows	26
Energy Efficient Lighting	26.5
Soy Based Spray Foam Insulation	27.5
Geothermal Heating	28
Straw Bale Insulation	30
PV Panels Electricity	30.5
Passive Solar Design	32.5
PV Panels Hot Water	33
Green Roof	36.5

Alternatives	Total Points
Water	
Aerating Faucet Heads	23.5
Efficient Dishwasher	25.5
Dual Flush Toilets	28.5
Rainwater Reuse	29
Heat Exchange	31
Gray Water Reuse	34
Materials	
Composite Frame	23.75
Recycled Tire Rubber Paving	25
Permeable Paving	25.5
Local Certified Wood Frame	26.5
Recycled Steel Roof	28
Native Plants	35.5

Table 3: These tables show each alternative and the total points they received according to our rating system. For a table showing the points received by each feature for each category see Appendix 3.

Unrated Alternatives

Many components of the new building's interior have such diverse options that compiling the information on availability, cost, and other relevant factors would have been a Sisyphean task. Here, we restate these alternatives and offer considerations for Facilities and the project's architectural firm as they consider the many possibilities for outfitting the building's interior.

The options for flooring in the new building, as mentioned in the "Materials" section, include bamboo, cork, marmoleum, and, additionally, wood harvested from Hopkins Memorial Forest. For countertops and other surfaces, shetkaStone, Eco-terr, and Durat are all good options. The library's new furniture would be another great place to utilize wood from Hopkins Forest, to use natural, recyclable fibers, or to reuse furniture. Additionally, we hope that low-VOC paints and finishes will be used in the building, as in other buildings on campus.

The ultimate decision about which of these options to choose should be based on a balance of numerous considerations, including: the material's cost and potential educational value, whether it can be obtained locally, whether it contains recycled content or can itself be recycled, and, last but not least, its beauty.

Recommendations—Green Features

Time-Sensitive Features

Many features of green design are so integral to the building systems that they must be planned from the beginning of the project. We consider the following features essential components of the initial building design.

Energy:

(1) Our top priority is a **green roof** because it is extremely educational, interesting, beautiful, and energy efficient. The green roof should be located on the north side of the addition, or potentially on the original Kellogg House. Because a green roof cools a building, Kellogg would be a much more pleasant place to be over the summer without having to add a conventional air conditioner.

(2) **Passive solar design** is a simple way of capitalizing on the sun's energy and position to keep the building at a pleasant temperature. Ideally, we want Kellogg to be able to cut down on heating costs and therefore on its reliance on fossil fuels. Likewise, a well-modeled system would also help with the cooling of the building furthermore making a conventional air conditioning system unnecessary.

(3) A **geothermal heating system** would decouple Kellogg's heating system from the burning of fossil fuels. It would be used both for radiant heating, to provide hot water for the building, and as a cooling system in the summer.

(4) **Soy-based spray foam insulation** is the best choice for reducing heat loss from the building and in this way reducing the overall energy needed to heat the building. Also, it makes for a healthier building since we would not use formaldehyde based insulation.

(5) A **radiant floor** substantially reduces the energy used for heating by making inhabitants comfortable at a lower thermostat setting. Again, this feature would cut down on our fossil fuel usage and reduce our carbon emissions.

(6) The **exclusion of traditional air conditioning** is important because if the building is designed well, there should be no need for it. Also, the geothermal system can be used to cool the building in the summer if need be.

(7) **Extremely efficient windows** are crucial for passive solar design and for reducing both heat loss and gain. A custom engineered model is necessary in order to capitalize on the site and on the windows' capabilities and create a working passive solar design for Kellogg house.

(8) **Efficient lighting systems**, while perhaps less exciting than other features, use less energy and help improve the atmosphere of the building. CFL bulbs will help decrease our carbon emissions and our electricity load.

(9) **Solar panels** for both electricity and hot water are important investments to be used for education and to reduce our environmental impact and dependency on fossil fuels. A renewable source of electricity is very important to us and to the mission of the Center for Environmental Studies.

Water:

(1) **Grey water reuse** is important because it can reduce house water usage by 50%. Water conservation is important because of the continued depletion of our rivers and aquifers.

(2) **Dual-flush toilets** are an easy way to reduce water consumption and cost the same as a normal toilet.

(3) **Heat eXchange** is an exciting technology that can save 60% of the energy used to heat

water. Again, we would be able to reduce our fossil fuel consumption and reduce the carbon we emit into the atmosphere.

(4) **Efficient dishwasher** saves almost 50% of the water used by the current dishwasher yet costs the same as an average dishwasher.

Materials:

Aside from using salvaged materials wherever possible:

(1) We believe a **local, certified wood frame**, possibly from Hopkins Memorial Forest, would be the best choice for a wood frame. We want to cut down as much as possible on transportation externalities such as fuel burned to get wood to us. At the same time, we want to make sure that the wood is harvested in a sustainable manner and clear-cutting is not practiced.

(2) **Recycled steel roofs** are cheap, durable, and facilitate installation of solar panels. We suggest the roof on the addition be oriented north-south to maximize energy production of the solar panels.

(3) **Recycled tire block paving** is an ideal option because it requires no maintenance, holds up well in cold climates, and is made entirely from old tires. We chose this alternative over permeable paving because permeable paving does not function well in cold climates. Recyclables are a better option over new materials, as we reduce waste and water, energy, and material put into a new product.

Delayable Features

The following alternatives, while no less ecologically important, could be installed after the building has been constructed and begun operating, if financially necessary.

(1) A small wind turbine to power batteries storing the photovoltaic energy overnight would be interesting, but not essential.

(2) Energy Star appliances would be a wise investment if appliances in the building – such as the refrigerator – need to be replaced later.

(3) Native plants are a must for their low maintenance needs. We suggest native ground cover plants such as foam flowers, wild ginger and Labrador violet instead of turf. Also native evergreens such as hemlock or Eastern red cedar should be planted on the north and west sides of the building for extra insulation. Native deciduous trees such as red maple, flowering dogwood, red oak, or beech should be planted on the south side to provide shade in the summer and sun in the winter. In addition, a vegetable garden should be incorporated into the house's landscape if Forest Garden is not moved close to Parsons, which we've been informed is a possibility for this summer.

Recommendations – Educational and Social

One aspect of the new Kellogg that is very important to our CES clients is making the building an education tool and increasing the number and breadth of students, faculty, and other community members who regularly use the space. To accomplish the first of these goals, it is first essential that we install advanced monitoring systems, the data from which are visible to house users in the building and online. In addition, displays detailing the house's and landscape's many green features should be placed inside and near the house to attract passersby and publicize our efforts towards sustainability.

The second part of the goal can be accomplished by publicizing the building to first-years, perhaps through hosting First Days events or incorporating Kellogg into the mandatory library tour first-years take during this initial week. Many non-house users cited free food as an inducement to use the building; perhaps monthly snack nights could be held if CES values this goal that highly, or healthy snacks might be sold in the kitchen.

PART V

Architectural Considerations

Overview

In addition to being technically efficient, a green building will also be socially and programmatically sustainable. That is to say, it will fulfill its purpose—in this case, generally, social and academic—be spatially efficient, and have an attractive and comfortable atmosphere that suits its users needs and desires. Achieving a final product successful in these ways prevents waste in terms of construction and energy powering unused space, not to mention the need to reconstruct or add on to it, which would consume even more materials, energy, time, and money. Based in part on our research and largely on our interviews and surveys of CES community members, we have formulated a list of guiding principles for the Kellogg Project. These principles can inform the spatial design or serve as a rubric against which plans can be evaluated. They include, in no special order:

1) The minimization of square footage. In order to prevent the waste of materials, energy, and money, it is essential that Kellogg be as small and efficiently planned as possible while fulfilling all essential needs of the building's users;
2) The structural and spatial design of the building so as to optimally accommodate green technological features, particularly in the addition, such as pitching the roof at the ideal angle for solar energy capture by PV panels (42 degrees on the south side, in Williamstown[92]);
3) The preservation of the communal, cozy atmosphere that several current users cite as a beloved and unique aspect of Kellogg House, particularly as embodied in the living room and kitchen; and,
4) The preservation of the building's remaining historic features, including some original siding and doors, including the restoration of period accents, for example removing the attic dormer or approximating the original paint color.

Plans

While we lack a comprehensive understanding of building code requirements and the structural possibilities for Kellogg, we explore four hypothetical plans involving the permutations of two potential scenarios: relocating the current kitchen to the new site and moving Log Lunch to Kellogg House. We consider the latter option both because our CES clients enthusiastically support the idea, and there is also a possibility that the function of the Log will change in the future. Though the College understands the need to provide a venue for Log Lunch[93], if there were plans to alter the Log, incorporating the lunch into the new Kellogg design could forestall future difficulty in finding a new appropriate home for it.

These plans are not to perfect scale but include the major programmatic needs as outlined in the Kellogg House Program draft written by our CES clients last year,[94] including nine faculty/staff

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[92] Cavin, Laura. "Relocation, Renovation, and Redesign of Kellogg House: A Case Study of the Center for Environmental Studies at Williams College". Senior Thesis. January 2005.
[93] Email communication from Irene Addision, Assistant VP for Facilities and Dining Services, Nov. 28, 2006.
[94] Gardner, Sarah & Merrill, Karen. "Kellogg House Program". 6.7.06 draft.

offices, a reading room and study space (Matt Cole Resource Center), a kitchen, one unisex bathroom on each floor, and a seminar room opening onto an outdoor classroom. The plans suggest a variety of configurations of these components and others in some cases, including a front porch and more centralized and navigable staircases. All plans also attempt to provide more daylight in the living room and study spaces and improve the flow of spaces. Though plans for the attic or basement are not included in this report, we hope and recommend that at least the former will be transformed into usable storage for faculty and Greensense, who willingly give up their office space but need storage space. While the attic is currently large enough to serve this function, it is not structurally sound and faculty have been directed not to store books or other heavy items there. Rather than recommend any plan in its entirety, we discuss the beneficial and disadvantageous features of each and make recommendations accordingly.

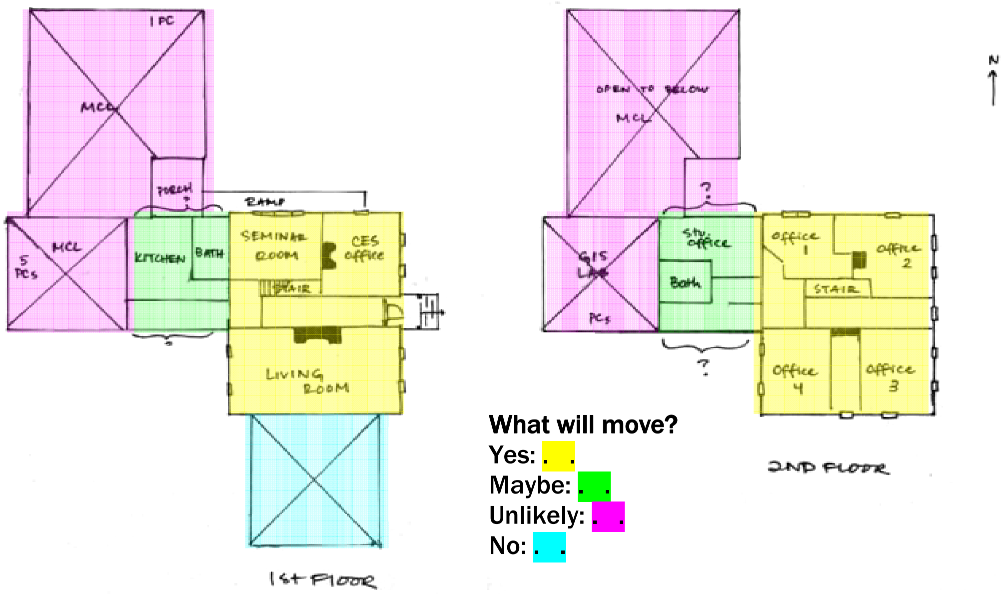


Figure 42. Current Kellogg Plans and Relocation Potential

1. No Log Lunch, New Kitchen

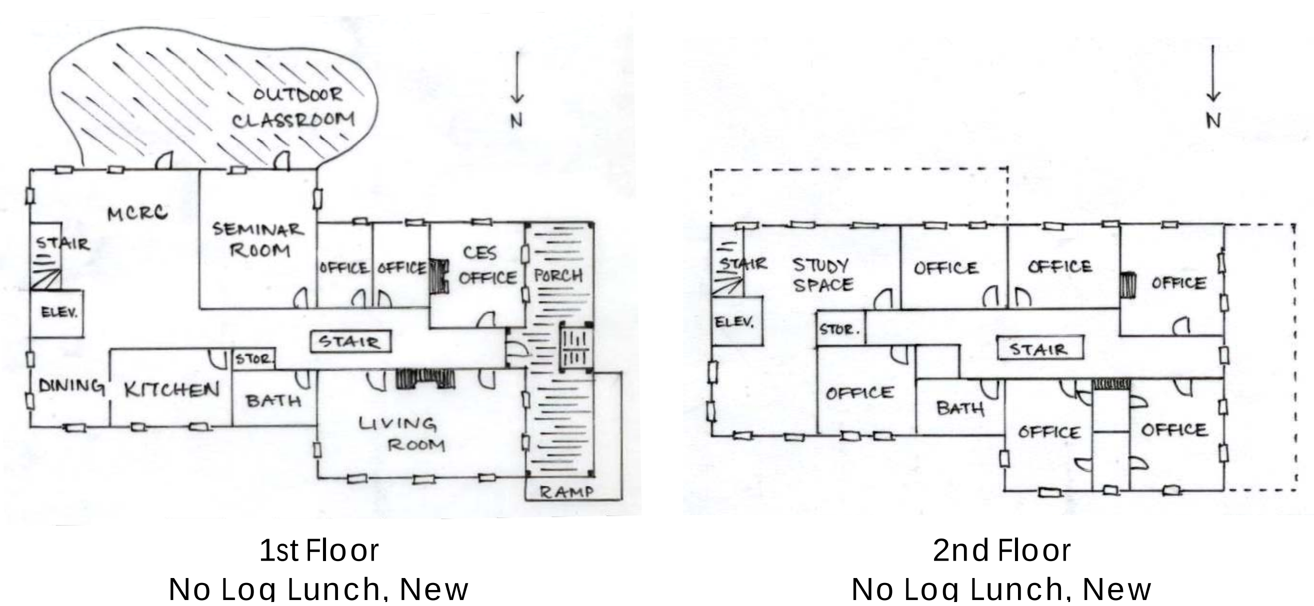
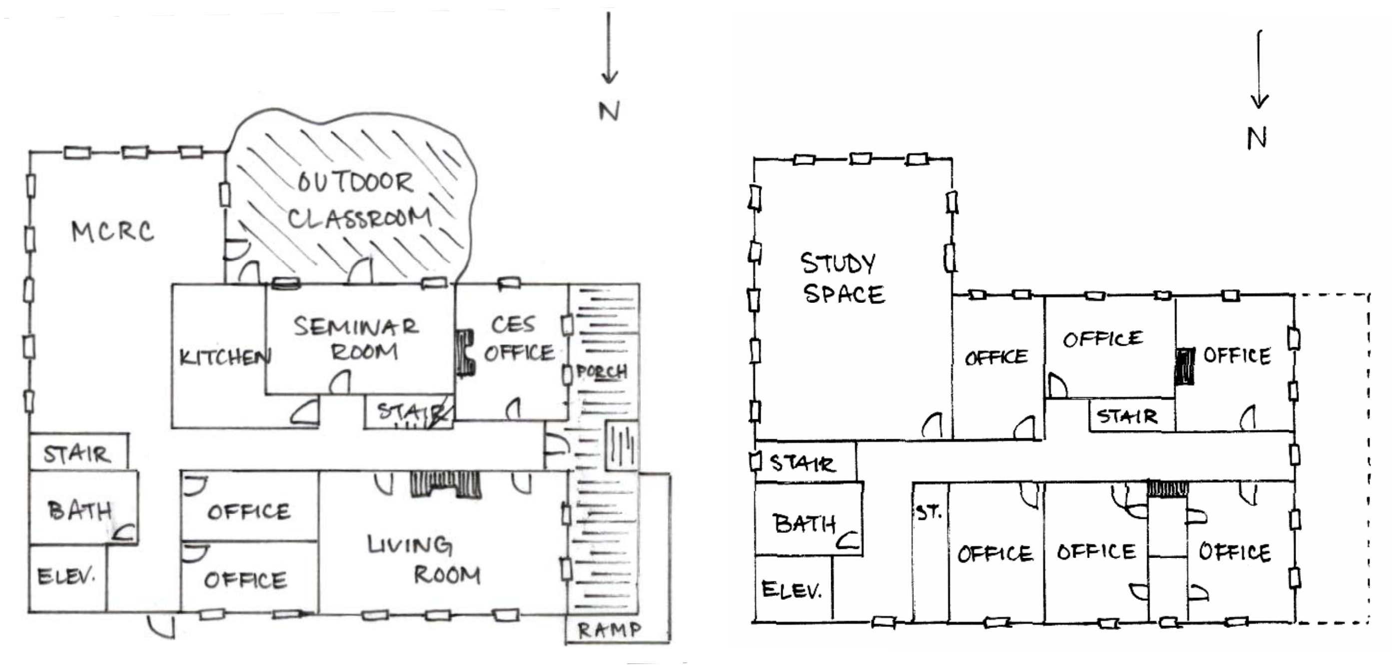


Figure 43. Diagrammatic plan with no log lunch and new kitchen.

We consider the scenario in which the current kitchen and Log Lunch are not relocated to be the most likely outcome for the project, considering Bruce's expectation that moving the current kitchen will not be cost-effective and the increased cost making room for Log Lunch will incur, both in construction and operation of the larger space required for that function. The primary benefit of this plan is its minimally expanded footprint, requiring less material and financial input to construct and less energy to heat and light. An additional small point we like about this option is the ability to view portions of the 1st floor roof from the second floor, which would facilitate educational opportunities surrounding vegetated roofs or PV panels well and generally increase their visibility to the building's users and passersby.

2. No Log Lunch, Old Kitchen



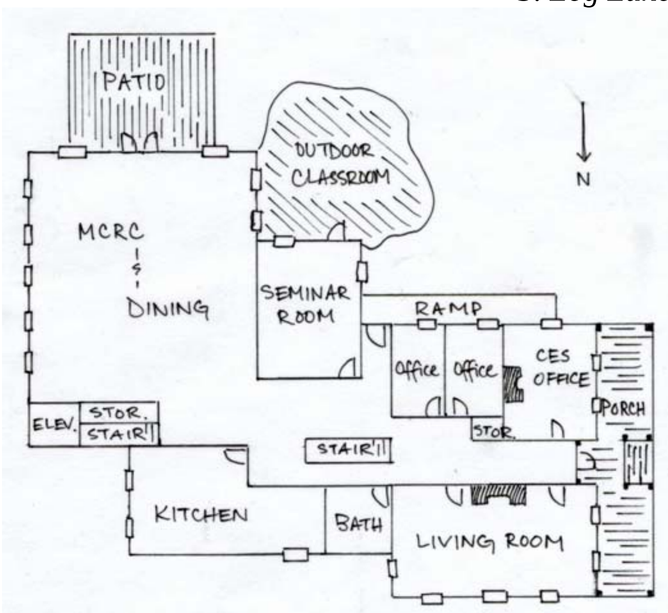
1st Floor
No Log Lunch, Old Kitchen

2nd Floor
No Log Lunch, Old Kitchen

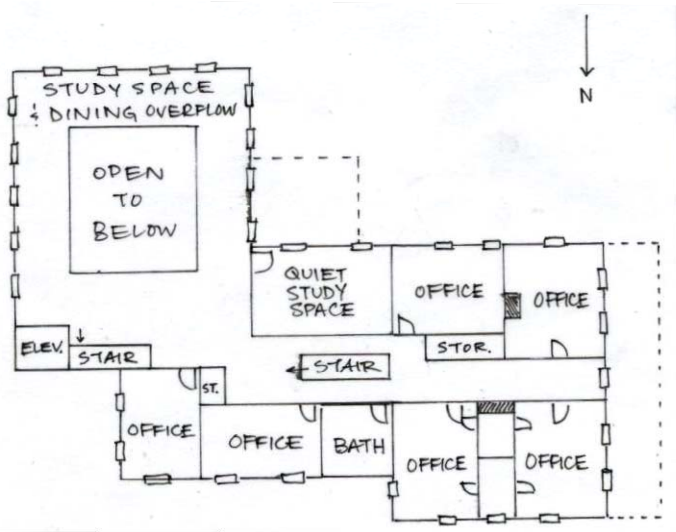
Figure 44. Diagrammatic plan with no log lunch and current kitchen.

Like the first, the scenario in which the current kitchen is relocated but Log Lunch is not results in a building with a small footprint relative to the latter two designs which incorporate space for Log Lunch. However, if the kitchen were to be relocated, it would be helpful to increase the counter and cabinet space in it, for example along the wall abutting the seminar room where there is currently a small, relatively unused table and the door to the bathroom.

3. Log Lunch, New Kitchen



1st Floor
Log Lunch, New Kitchen



2nd Floor
Log Lunch, New Kitchen

Figure 45. Diagrammatic plan with Log lunch and new kitchen.

If Log Lunch were moved to Kellogg House, the scenario in which a new kitchen were constructed would likely present the most sensible option regardless of the feasibility of relocating the current kitchen, since the capacity of the kitchen for people, workspace, and refrigeration would need to be much greater to accommodate preparations for Log Lunch. Benefits of this scenario include the ability to expose the broader community that attends Log Lunch to Kellogg, strengthening its potential as an educational tool, and logistically, increased ease for the students who prepare Log Lunch, since access to the Log is now strictly, and inconveniently for Log Lunch workers, controlled by Campus Safety and Security.

The primary disadvantage of holding Log Lunch in CES is the increased building footprint required to house the necessary kitchen and dining areas for hosting such a large event (approximately 100 people), as well as the increased energy load demanded by extra refrigeration units and multiple appliances. The extra space will consume more energy for heating and lighting, which will likely be scarce if Kellogg is to be an effective zero carbon building. Also, as Log Lunch uses the vast majority of refrigeration in the Log, if the Log does not change, that infrastructure there will continue running at far less than capacity, and we will effectively double the amount of materials and energy consumed than currently for Log Lunch.

Another concern related to hosting Log Lunch in CES arises from consideration of the second guiding principle we mention above—retaining the cozy, communal atmosphere that currently distinguishes Kellogg from other social and study spaces. While Log Lunch would on the one hand expose a broader swath of the community to Kellogg House, it would require not simply a larger, but a more institutional space, particularly in the kitchen. Informal conversation with students who regularly study in Kellogg House also reveals some fear that the space may feel relatively empty at all times other than Fridays, reducing the communal, homey ambience they cherish.

The two-story layout of the Matt Cole Resource Center with the second floor a balcony that opens to the space below reflects an attempt to mitigate some of these issues by reducing the first floor square footage and using the second story as overflow space for Log Lunch attendees.

4. Log Lunch, Old Kitchen

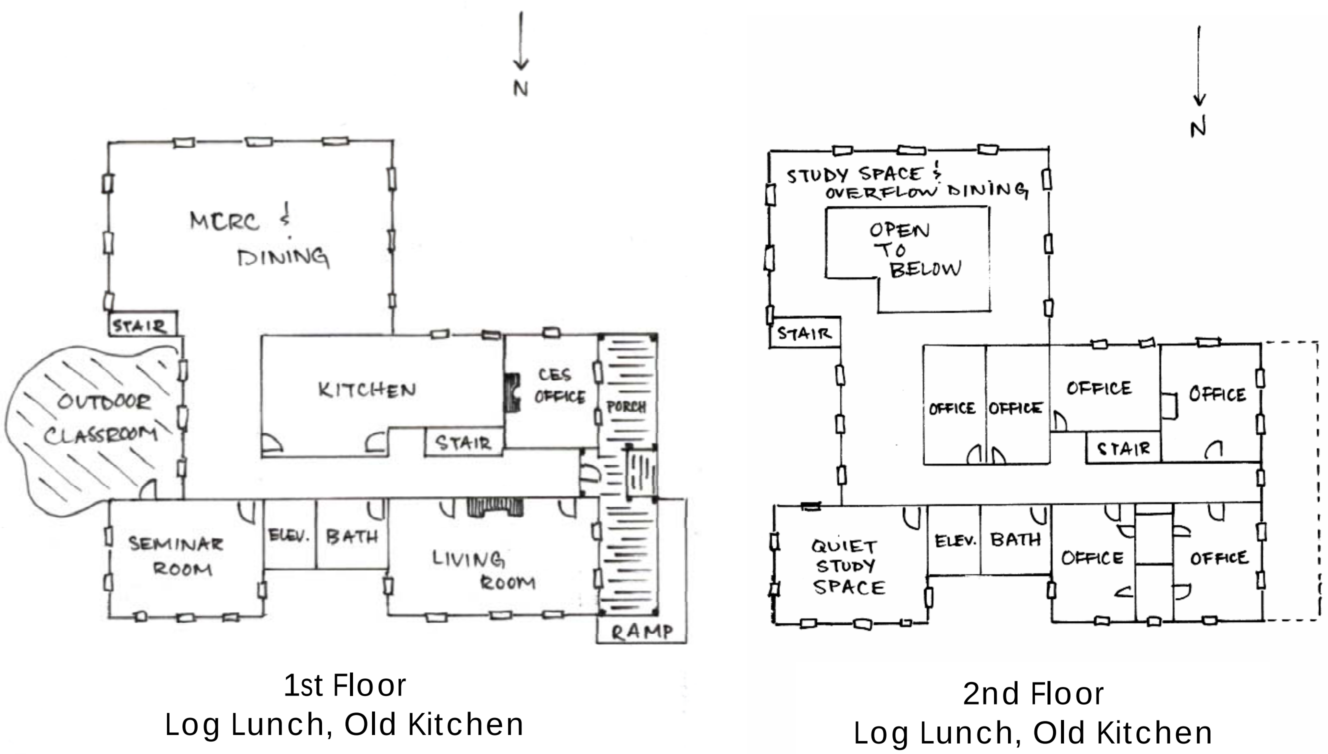


Figure 46. Diagrammatic plan with Log lunch and current kitchen.

The last, and perhaps most unlikely, scenario, in which Log Lunch and the current kitchen are relocated, raises the same concerns as the previous. This plan does, however, provide alternative suggestions for configuring the spaces within Kellogg House.

In conclusion, we do not recommend that Log Lunch be relocated to Kellogg if not required by the unavailability of the Log, due to the great material and energy consumption doing so would require and the difficulty it would create for making Kellogg a truly sustainable, stand-alone building. (If the lunch is relocated, we recommend that it be renamed "'Logg Lunch".)

With regard to relocating the kitchen, while we would like to reduce the consumption of raw materials in constructing a new space, we also understand that if moving the kitchen is not cost-effective, it will consume funds that would finance other sustainable features in the new building. We are neutral on this point in terms of spatial or sentimental considerations and recommend that it be moved if cost-effective.

Recommendations – Project Principles

Taking into account these architectural alternatives, comments culled from house-user surveys and interviews, and our research into sustainable design technologies, we recommend that the following principles guide the Kellogg project:

(1) Employ, without being limited to, those architectural considerations previously mentioned: minimization of the building's size, using a holistic approach to spatial design that optimizes the efficiency of green features that will accompany it, retention of a communal, homey atmosphere, and preservation and/or restoration of the building's historic features.

(2) Consider both capital and operating costs when budgeting for this project. While green buildings do not necessarily have higher first costs, many individual features may cost more than their conventional counterparts but pay off in energy, water, and financial savings.

(3) Ensure that the building committee working on this project is dedicated to sustainability as its foremost goal. They should employ architects with a firm commitment to sustainability and substantial experience in advanced green design and invite the input of additional consulting experts as needed, such as Marc Rosenbaum.

(4) Achieve a zero carbon, LEED Platinum building that functions as an educational tool and reflects the values and leadership of the Center for Environmental Studies at Williams and among the higher education community.

Concluding Remarks

As Marc Rosenbaum, a physical engineer specializing in energy-efficiency, said at Williams' recent, well-attended Building Green in the Purple Valley conference, "there's nothing in the way of green buildings except deciding to build them."[95] We believe that, with strong commitment and careful planning, there are no barriers preventing the construction of an outstanding sustainable Kellogg House. While such success will be reflected in the building's technical, social, and educational functionality, one must not lose sight of the greater goal underscoring any green design project: to reduce the significant negative environmental footprint the average building has, so that we can make progress despite the tremendous uncertainty over what our past, current, and future impacts on the environment will bring.

[95] Marc Rosenbaum. "Leading Edge Buildings." Lecture, 10 Nov. 2006.

Appendix 1
Sources for Cost Analysis

Phone Consultation with Chris Kilfoyle, Sunday December 2, 2006.
Phone Consultation with Craig Robertson, Tuesday December 5, 2006.
Tool Base Services, http://www.toolbase.org/Technology-Inventory/Whole-House-Systems/straw-bale-construction. Accessed on 3 Dec. 2006.
Ibid, http://www.toolbase.org/Technology-Inventory/walls/sprayed-foam-insulation. Accessed on 3 Dec. 2006.
California Energy Commission, Consumer Energy Center, http://www.consumerenergycenter.org/home/heating_cooling/geothermal.html. Accessed on 3 Dec. 2006.
Radiant Design Institute http://www.radiantdesigninstitute.com/, Warmly Yours Floor Heating, http://www.radiant-floor-heating.com/electric-floor-heating-price.aspx. Accessed on 20 Nov. 2006.
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Enviroform Recycled Products Inc. www.enviroform.com. Accessed on 30 Oct. 2006.
Hometips.com http://www.hometips.com/cs-protected/guides/metal_roofs/metalroof_shingles.html. Accessed on 5 Dec. 2006.
Build It Green http://www.builditgreen.org/resource/index.cfm?fuseaction=factsheet_detail&rowid=12 Accessed on 5, Dec. 2006
This Old House website. www.thisoldhouse.com/toh/print/0,17071,401428,00.html. Accessed on 5 Dec. 2006.
Personal Communication with Tom Welch, Technology Coordinator at Williamstown Elementary School. 4 December 2006.

Appendix 2

Kellogg House (CES) Renovation Survey for CURRENT HOUSE USERS

We are students in Environmental Planning working on a redesign of Kellogg House. With the expansion of Stetson Hall to accommodate the new library, Kellogg House (the Center for Environmental Studies) will undergo a renovation with an addition. This survey will assess the design of this new space.

1. Are you a student, faculty, or staff member? (Circle one.)

2. Which of the following features do you use and how frequently?

	>5x/week	2-4x/wk.	1x/wk.	1-2x/month	<1x/mo.
Kitchen					
Living Room					
Seminar Room					
Computers					
Library					
Student Office					
CES (Sandy's) Office					
Faculty Offices					

3. What do you like and dislike about the spaces in Kellogg House? (Describe)

Space	Like	Dislike
Kitchen		
Living Room		
Seminar Room		
GIS Lab (upstairs computers)		
Library		
Student Office		
Faculty Offices		

4. Do you study in Kellogg? Yes / No
5. If yes, how much and where? ____

6. What features would make you study in Kellogg more? Rank from 1 (most important) to 10 (least important):

a. Carrels ___
b. More desks ___
c. Better desk chairs ___
d. More arm chairs/sofas___
e. More daylight___
f. More desk lamps___
g. Noise reduction ___
h. Book lockers___
i. Assigned carrels ____
j. Big tables ____
k. Other (please indicate) ____

7. What outdoor features should Kellogg include? Prioritize from 1 (most important) to 9 (least important).

a. Outdoor classroom/ Study space___
b. Porch (unscreened) ___
c. Wildflower garden___
d. Vegetable garden___
e. Medicinal herb garden___
f. Native plants___
g. Non-lawn land cover (no mow) ___
h. Pond___
i. Benches/ Seating ___
j. Other (please indicate) ____

8. What environmental features would you like in the renovated CES? (Circle your top four choices.)

a. Solar panels
b. Solar hot water
c. Radiant heating (in new reading room)
d. Geothermal heating
e. Green roof (vegetative)
f. Gray water re-use (in toilets)
g. Non-addition of air conditioning
h. Salvaged materials
i. Other (indicate) ____

9. Do you feel comfortable in the building?

10. What would make you visit and use the building more?

☐ I would like to participate in a focus group about Kellogg's redesign.
Email: _________________________________

Please return to box on bench in CES entry.
THANK YOU!

Kellogg House Renovation Survey for NON-HOUSE USERS

We are students in Environmental Planning working on a redesign of Kellogg House. With the expansion of Stetson Hall to accommodate the new library, Kellogg House (the Center for Environmental Studies) will undergo a renovation with an addition. This survey will assess the design of this new space.

1. Do you know where Kellogg House is located? Yes / No

2. Are you a student, faculty, or staff member? (Circle one.)
   Student Year _______

3. Why don't you use Kellogg House? (Circle all that apply.)
   A. I don't know where or what it is.
   B. I know where it is but have never had to go there.
   C. It's too far away. (Where do you live? ___________________________________)
   D. I don't feel comfortable there. (Why? ___________________________________)
   E. The study spaces are not comfortable. (Why? ______________________________)
   F. Other ____

4. Did you know you could use the kitchen in Kellogg House? YES NO (circle one)

5. Where do you normally study? (Circle all that apply.)
   A. Sawyer
   B. Schow
   C. Goodrich
   D. In my dorm
   E. Other ____

6. Did you know you could study in Kellogg House/ CES library?

7. What characteristics are important in a study space?

	Important	Neutral	Unimportant
Nice carrels			
Not crowded			
Comfortable seating			
Bright light			
Quiet			
Social (My friends are there)			

8. Rate the following characteristics of study spaces from 1 (most important) to 7 (least

important).
A. Nice carrels ___
B. Not crowded ___
C. Comfortable seating ___
D. Bright light ___
E. Quiet ___
F. Social (My friends are there.) ___

9. Now that you are aware of the CES study spaces and kitchen, will you be likely to use them?

10. Are there any features that would make you visit Kellogg?

____
____
____
______

☐ I would like to participate in a focus group about Kellogg's redesign.
Email: _______________

Please return to box by exit.
THANK YOU!

Appendix 3

Alternatives	Cost (2.5)	Educational Value (3)	Client Interest (2)	Student Interest (1)	Impact (4)	Delayable?	Total
Energy							
PV panels electricity	1	3	2	3	3	y	30.5
PV hot water	2	3	2.5	2	3	n	33
Passive solar design	3	2	2.5	2	3	n	32.5
Straw bale insulation	3	1.5	2	2	3	n	30
Spray Foam	3	1	2	1	3	n	27.5
Triple paned windows	2	1	2.5	1	3	n	26
Geothermal heat	2	3	1.5	1	2.5	n	28
Radiant floors	2	1	2.5	3	2	n	24
Green roof	3	3	2.5	3	3	n	36.5
Efficient lighting	3	1	3	2	2	y	26.5
Exclusion of air conditioning	3	1	3	1	2	n	25.5
Energy star appliances	2.5	1	3	2	2	y/n*	25.3
Mini wind turbine	1	3	2	2	1.5	y	23.5
Water							
Gray water reuse	2	3	2.5	3	3	n	34
Rainwater reuse	2	3	2	3	2	y	29
Dual flush toilets	3	2	3	1	2	n	28.5
Aerating faucet heads	3	1	2	1	2	y	23.5
Heat exchange	3	3	2.5	1.5	2	n	31
Efficient dishwasher	3	1	3	1	2	y/n*	25.5
Materials							
Certified wood frame	1	2	2.5	3	2.5	n	26.5
Composite frame	1.5	2	2	2	2	n	23.8
Rubber block paving	2	2	2	2	2	n	25
Permeable paving	1	2	2.5	2	2.5	n	25.5
Recycled steel roof	3	1	3	1.5	2.5	n	28
Native Plants	3	3	3	1	3	y	35.5