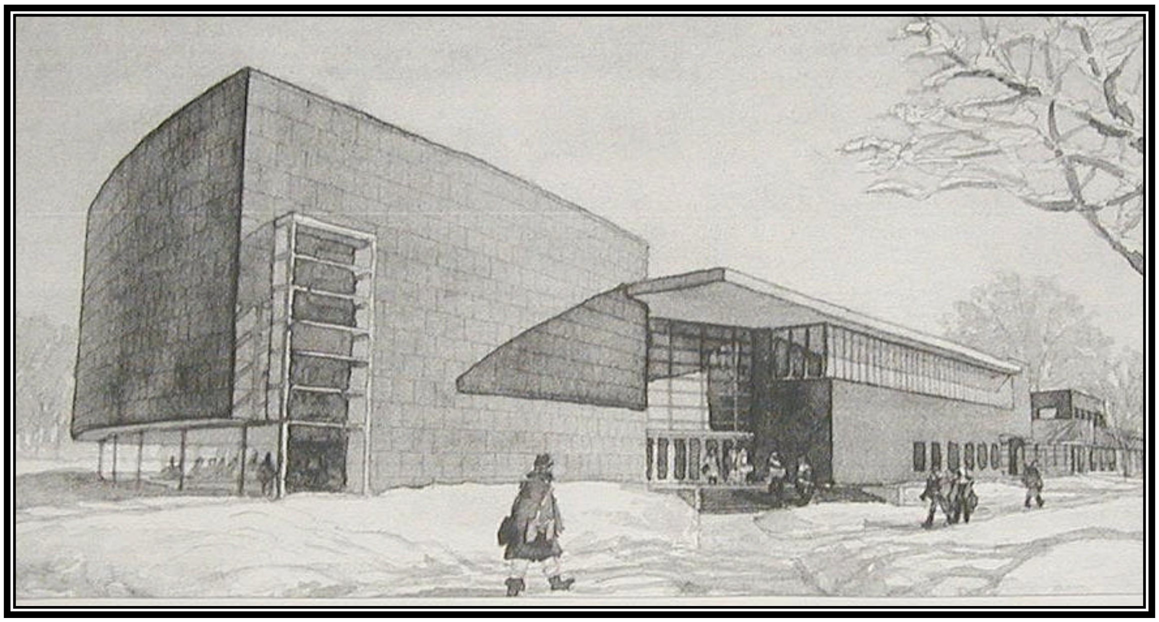
GRINNELL COLLEGE CAMPUS CENTER

Green Design Workshop Report



Rendering of Campus Center by Cesar Pelli Associates, Architects

Workshop and Report prepared by
The Green Roundtable

D R A F T

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EXECUTIVE SUMMARY

Grinnell College is undergoing a series of exciting changes on campus. Amidst the various efforts to expand the campus facilities and upgrade the central plant, the College has recognized the value of investing in long-term efforts to improve energy efficiency and the impact of the campus on natural resources. The Campus Center is the first effort to incorporate a rigorous approach to sustainable design into the College's building process. One of the priorities of the College and the design team is to use the LEED™ Rating System for Green Buildings as a tool to optimize building performance and address concerns for the environmental impact of its buildings.

The biggest challenge to implementing sustainable design strategies is creating an integrated design process and overcoming the learning curve associated with sustainable design. This requires a high level of coordination from the outset of a project and a more inclusive decision making process. The first step in an integrated process is a charrette, or brainstorming workshop, which allows the design team and owner to make the most of collective expertise. Recognizing this, the College hosted a one-day workshop, which was meant to focus the College and team on the LEED™ criteria and develop a plan to implement the rating system in the most efficient way possible. In the evening prior to the workshop, a presentation was given looking at the integrated design process, methods, tools and some practical issues that affect the decision making process.

The ideal time to begin this process is at the start of a design, rather than part way through when critical design decisions have already been made. Beginning this analysis in the middle of a design process, as is the case with the student center, provides some of the benefits that the college is looking to achieve, but also means that significant efficiency strategies are no longer attainable.

However, this is a learning curve for all involved, and the College has future opportunities to capitalize on this learning process and integrate these concerns earlier on in future projects for maximum efficiency. The college and design team are accomplishing a great deal by addressing these issues even in this phase, and will further improve the existing design by engaging in this process. The Campus Center will achieve significant measures of sustainable design, such as improved energy and water efficiency, and more importantly will serve as a model for students and the larger community of what a building can be.

The ultimate goals of the one-day workshop were to:

1. Inform and educate charrette participants about energy and environmental implications of designing and constructing the Campus Center, while clarifying the term “integrated approach”, so that they could effectively use the LEED Green Building System to help define a high performance building.

2. Identify economically viable and doable strategies that Grinnell and the design team could implement in their new building and, in doing so, attain a LEED rating and, perhaps, “go beyond” the rating.

3. Develop a work plan relating to the LEED strategies to guide the team in implementing the decisions made by the College.

As a result of the discussions and brainstorming, some immediate next steps were identified. These are either time critical efforts that must be implemented immediately, or will inform the cost-benefit analysis of LEED credits, and therefore determine a direction for the design.

Following the Immediate Next Steps is a documentation of the process of the workshop and then the actual LEED™ Workplan itself, which outlines what tasks must be done by which party in order to certify the Campus Center with the United States Green Building Council.

IMMEDIATE NEXT STEPS

The discussion and brainstorm sessions throughout the workshop yielded some specific strategies that are worth immediate follow up. They are time critical and will either save money, safeguard the health of the campus environment or improve the quality of the building in the long run.

Although all the recommendations in this report pertain directly to the Campus Center project, there are obvious ties to overall campus operations and master planning that the College could consider as it continues to expand and operate. These are beyond the scope of this work, but are noted to be of value to the campus and larger community. For example, metering and monitoring of current energy use in existing buildings will help inform efficiency efforts of overall operations. Also, a campus-wide water management plan to keep water on site either for usage (for flushing and irrigation) or to be treated simply through constructed wetlands, would maintain the health, availability and low cost of water.

A detailed work plan listing all actions and next steps is included at the end of this report, and contains the information below. The following recommendations are highlighted in this section due to their time-sensitive urgency, and decisions need to be made about their implementation as soon as possible.

Energy Conservation Measures and Renewable Energy Potential

The most immediate next step, which is highly critical to the long-term performance of the building, is Energy Modeling. In order to be used effectively, energy modeling should commence immediately, and be updated in multiple iterations as the design team responds to the feedback of the simulation. This allows the design team to make adjustments in the design to maximize the efficiency of the building envelope and mechanical systems. A whole building simulation demonstrates how the building will perform throughout the year in different conditions and uses. It incorporates all data that effect the efficiency of the building, such as: all energy loads (lighting, heat, plug loads, motors, etc.), all characteristics of the building enclosure (roof, walls, foundation, windows) and usage factors (hours of operation, types of different operation). This process will involve the architect, MEP engineers, input from lighting and kitchen consultants, and an energy modeling expert. It is recommended to involve the local utility company, as they will often offer financial incentives or technical support for energy modeling. *(see the LEED™ Workplan in the Appendix, Energy Credit 1 Optimizing Energy Performance for details)*

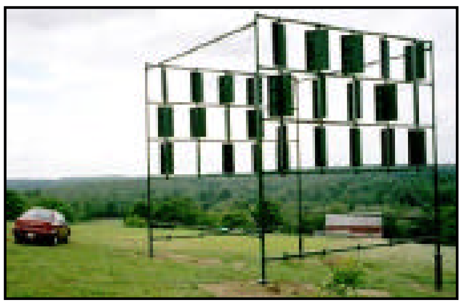
In order to create a realistic and informative energy model, the data fed into the software must be accurate. The energy load assumptions should be based on current usage patterns at the College, taking into account high-efficiency equipment upgrades.

Achieving a high degree of energy efficiency is difficult and requires a comprehensive coordination of all factors acting on the building. The first step in energy efficient design is the siting and massing of the building. This is coordinated with shading, prevailing winds and solar access. The development of the building skin and glazing relate directly to the electric lighting design, and this in turn relates directly to the loads being mitigated by the mechanical heating and cooling system. It is important to keep in mind that the energy modeling simulation will give feedback about the design of all the discreet elements, but changes to <u>parts</u> of the system (such as the glazing) should never be made without taking into account how that change affects the other parts of the system (such as the mechanical systems). It is also important to keep in mind that some upgrades that carry first cost increases (such as window and wall insulation) may simultaneously result in first cost savings of other parts of the system (such as eliminating the need for perimeter heating). This is only an example, but as the project progresses and the design team focuses on energy efficiency, the most important factor is understand how the building systems are interrelated.

Renewable energy is not an urgent issue in and of itself, but the strategy to obtain funding may be time sensitive and involve other offices at the College. If the college is interested in incorporating either solar or wind generation into the Campus Center project specifically, consideration might be given to a focused fundraising effort. An alumni campaign to earmark a donation for a highly visible technology such as solar ports or a wind turbines also affords the donor a federal tax credit.

Above: Solar ports over parking lots: protect cars and parking surface and generate electricity

Below: Windwalls, a new kind of renewable energy generation mechanism, and a traditional turbine



Materials, Resources and Existing Building

The existing Darby Gym will be demolished in order to make way for the new Campus Center. In order to divert tons of waste material from landfill, and gain as many LEED™ credits as possible, there is potential to salvage much of the building materials either for use on campus, or to recycle at other sources off campus. Valuable materials such as the Lamella beams, new wood floor, concrete and brick may have uses immediately within the campus, or if not, can certainly have value with outside vendors. This will require some hunting and research to find local recyclers or other potential users, and may be a good activity for interested student groups. Landfill diversion may provide cost savings in reduced tipping fees, or materials such as concrete, which can be ground on site for use in sub-base / rubble fill, can be substituted in lieu of virgin materials purchased from an outside source. Students interested in Green Campus initiatives may be useful in doing some of the initial leg-work and research to find local resources. Additionally, the College may be interested in investigating the cost/benefit of deconstruction vs. demolition either for the entire building, or portions. This is an issue for the College and the General Contractor to discuss.

Water and Site

Although the cost of water to the College is not presently a matter of concern, there are many other compelling reasons to manage water on site. Water quality and stormwater dynamics in the region will be improved with some attention to retention or collection strategies. The next step in this process is a cost/benefit analysis of various strategies recommended in the Charrette Process section of this report to determine if they are appropriate for this project. This analysis primarily involves the landscape and civil engineering consultants.

WORKSHOP PROCESS

The ultimate objective of the day's work was to end up with a better understanding of the Center's LEED™ rating. However, because the LEED Rating System is a tool developed to meet a wide range of projects, it is best used after the team gets a deeper understanding of the project's overall issues. It was critical to begin the work session by taking a step back and developing an understanding of the forces shaping the decision making process, and the flows of energy and materials that need to be dealt with in the building.

"Every building is an outcome, not an object" *(Reed).* Although the Campus Center is one building, it exists within the context of a campus of buildings, a team of people, a particular schedule, a flow of products and energy and is a predecessor for future buildings in a long-term process. Therefore, it is important to start the brainstorming process with some basic understanding of the forces that are shaping this particular project. First the participants discussed the main motivators for this project. Activating forces were understood as those objectives of the project, desired outcomes of what this building will accomplish or create. Restraining forces were defined as those which affect the decision-making process that is part of design and construction. The resulting final decisions will be a resolution of those opposing forces.

ACTIVATING FORCES

Efficiency (LEED™)
Value (life cycle)
Education (into the future)
Responsibility
Create Understanding
Create "ownership"
Inspirational (architecture)
Campus community

RESTRAINING FORCES:

Inertia
Perception of $ (first cost vs. lifecycle)
Lack of communication/interaction
Perceived risk/managing risk
Schedule (perception)
Expectations of what is normal
Previous decisions
Perception of aesthetics
Availability of technologies
Codes
Predisposition to reject (insufficient data)

After discussing what these intangible forces were for the project, the group focused on all the flows of energy and mass which are the basis of what the building and its systems need to manage. All building systems, such as mechanical, electrical, plumbing, envelope are designed to manage flows of energy or mass. Once the attributes of those flows are understood and defined, design criteria can be set for the building systems that are managing them. Participants identified the following flows:

IN
Air
Art supplies
Cleaning chemicals
Dust
Electricity
Equipment and Furniture
Fertilizer
Food
Gas/Fuel
Grease/oils
Information
Mail
Materials (bldg)
Office supplies
P.B.T.'s (persistent bioaccumulative toxins)
People
Rainwater
Salt (road)
Steam/chilled (energy)
Sun
Table ware
Temp variation
Vehicles (hydrocarbons)/ transportation
Water
wind

OUT:
Air
Art
Art waste
Cleaning chemicals
Combustion products
Exhaust
Fertilizers
Food waste
Grease/oils
Heat (energy)
Hydrocarbons
Information
Landscape waste
Light
P.B.T.'s
People
Salt
Sewage
Steam
Stormwater
Waste (% recycled)
Water (grey/black)

Objectives of the program and building:

Center point for campus community
Shared values
Culture, unified
Intellectual community
Ownership of bldg (connects to) understanding
Deeper understanding
Way to accomplish
Wider range of solutions
Connect to cycle of life
Exciting
Beautiful
Inspirational

Comfortable
Functional
Efficient (maintainable, durable, energy, resource, water)
Promote rich life
Productive
Value (life cycle costs)
Responsible
Educational
Demonstrative commitment to sustainability
LEED™ score / Model of Green Design

BREAK OUT SESSION & BRAINSTORMING

The participants were divided into three groups to discuss issues, strategies and criteria for decision making: Energy, Materials and Site. These discussions lay the foundation for the decisions made later when reviewing the LEED™ Rating System. The LEED™ Matrix/Workplan in the Appendix contains the full list of activities to be undertaken to achieve the LEED™ rating, the parties responsible and deliverables needed to secure certification.

I. ENERGY

This section focused on setting design criteria for energy conservation in the wide range of loads that exist in the building. Each category lists suggestions for follow up and criteria. The overall strategy is to carefully determine the accurate energy demands various systems have, minimize those demands through careful integration of systems, recover as much heat and energy as possible for reuse and then specify the most efficient equipment to meet the determined load.

<u>Lighting:</u>
Overall goal is to maximize a high quality of daylight and minimize energy needed for electric light.

- Careful needs analysis: Identify FC levels that are required 1. Specifically in relation to task and 2. Type of lighting/fixtures (see table at end of this section). (Arch/Light. Consult).
- Design controls and switching to maximize efficiency and controllability. Integrate controls with other building energy management systems if appropriate. Integrating lighting controls to respond to available daylight will save energy. Integrating daylight controls with other control strategies will insure success (such as time or scheduling controls, or occupancy sensors). Control systems based on FM's experience and success. Several factors are critical to correct functioning of control systems and can be discussed in more depth. (Arch./Lighting/MEP)
- Design/specify surfaces to maximize light quality and reflectivity. Recommended surface reflectance values are: ceilings 80-90%, walls 60-65%, floor 20-50%. (Arch.)
- Maximize daylighting. Ideal light comes indirectly and is bounced in the space, with view glass shaded. Determine if any design adjustments can be made at this stage in specific targeted areas (clerestory light in some areas with a light shelf can provide better daylight and minimize glazing for view windows so that glare is reduced). If not, rely on careful analysis and modeling to determine window sizes/materials and light levels. (Arch.)

- Specification of glazing materials (windows). Optimally looking for the highest k-factor (ratio of visible transmittance to shading coefficient) and daylight factor (ratio of visible transmittance to total solar transmittance). Incremental cost of better quality windows to be determined and factored into overall energy modeling. (Arch.)
- Daylight modeling would give more data as to ideal relationship of daylight to electric light, and therefore opportunities to save energy (Radiance, Superlite, LumenMicro and Lightscape are some software packages). Daylighting studies with computer simulation is ideal, although doing daylight studies separately from overall building energy modeling yields results for a single instant in time, whereas overall modeling yields results in different seasons and conditions. Ideally a program like Radiance is used in conjunction with whole building simulation. Physical modeling using light meters is a necessary minimum. (Arch/Light. Consult)
- Design systems with feedback so that Facility Management will be able to monitor lighting conditions of the building and adjust accordingly in the future, including lighting energy consumption and lighting operation hours by zone.

Suggested light levels:

Category	Description	Recommended Illuminance (fc)
Orientation and Simple Visits		
	Public Spaces	3 fc
	Simple orientation for short visits	5 fc
	Working spaces where simple visual tasks are performed	10 fc
Common Visual Tasks		
	Performance of visual tasks of high contrast and large size	**30 fc**
	Performance of visual tasks of high contrast and small size, or visual tasks of low contrast and large size	**50 fc**
	Performance of visual tasks of low contrast and small size	100 fc
	Performance of visual tasks near threshold	300 Œ 1,000 fc

Source: IESNA Lighting Handbook, 9th ed., p. 10-13

Motors

Electric motors including those for: mechanical systems, refrigeration, elevators, etc. The goal is to optimize life cycle efficiency. Other criteria are:

- Specify motors with low static pressure (MEP)
- Use natural ventilation when possible (MEP/Arch)
- Reduce CFM/GPM (MEP)
- Investigate more efficient elevator technology (Arch)
- Optimize motor horsepower for refrigeration (MEP)
- Use cold, outside air for refrigeration (MEP)
- Base plug loads on data from existing conditions and efficient equipment (College/MEP)

Cooking equipment

The kitchen is a major area of focus. The College will be aggregating services previously divided in separate facilities, and will be able to reduce energy and water waste significantly. Kitchen consultants and MEP engineers should make additional efforts at heat and moisture recovery to find ways to boost efficiency and capture/reuse waste.

- Maximize efficiency of equipment (EPRI), Gas Research Institute (Kitch. Consult/Arch/MEP)
- Locate and aggregate equipment (especially in kitchen)
- Heat recovery (MEP)

Laundry

- Efficient equipment (both for water and energy) (Arch./MEP)
- Water discharge – (see/coordinate w/site runoff, graywater strategies) (Arch/Landscape/MEP)
- Heat recovery? Look into the possibility. (MEP)
- Moisture recovery for humidification? (MEP)

Cooling
- Electric lighting reduction is key to reduce cooling load (Arch/Light. Consult/Elect.)
- Building envelope (all of this depends on energy modeling simulation): quantity and orientation of glass/solar loads, solar heat gain coefficient, shading (bldg shades itself, interior shading, and vegetation), roof color and insulation, air tightness, occupancy sensitive controls (quality), demand controlled ventilation, zoning, *water vs. air taking on workload of thermal comfort, set points- manage humidity, location of equipment and heat rejection. (Arch./GRT or other modeling consultant)

Domestic Hot Water
- Calculations of quantity of hot water needed should be done (Plumbing)
- Heat recovery (from ware washing and refrigeration) (MEP)
- Consider point of use – locate multiple Elect. HWH (MEP)
- Water conserving equipment (cost premiums vs. life cycle savings?) (arch/kitchen consultant)
- Solar preheat water (with air or water) (MEP/GRT)
- DHW and Dishwashing 50% of 'virgin' BTUs to heat water per meal served

Heating
- Heating – Goal is a peak 50% reduction, annual 40% reduction from 90.1-99 (MEP)
- Insulation on roof, wall, foundation optimized (incremental cost analysis part of energy modeling) (Arch)
- design envelope to be air tight (Arch)
- calculate real loads (MEP)
- minimize ventilation/recover heat (MEP)
- Control system for efficiency (MEP)
- (see cooling) emphasize that energy modeling is most important tool to use. (Arch/MEP/Energy)

Ventilation
- Ventilation – process, people: kitchen, optimize LCR and people, base on realistic occupant count
- Kitchen: size properly/minimize
- Revisit design to optimize
- Variable speed hood control.. heat recovery
- Make up air? Transferred?
- Occupancy and hood operation - coordinate relationship, load 'simultaneity'
- Non hood ventilation – heat recovery, demand controlled ventilation

Energy Modeling
Whole building energy simulations tools include DOE-2, Energy Plus, BLAST and Energy 10. These consider all aspects of impact on building energy use including solar gains, impact on HVAC equipment sizes and reduction of electric lighting energy. Check with local utility for available subsidies for the cost of energy modeling. Building simulations can be one of the most effective tools to give feedback and design direction that results in the best payback to the owner.

II. MATERIALS

First priority for managing materials flows is to salvage as much as possible from the existing building either on site or through recycling facilities. Cost estimation and analysis of materials quantities, and recycled/recyclable content will inform LEED™ credit potential.

Objectives of material specifications :

- Aesthetic – specific character in different areas
- Health and safety: IAQ, comfort
- Durability/ Understand LCC

Strategies for 'green' materials can vary. One approach is to focus on making all visible materials as 'green' as possible, in order to make a statement of perception. Another approach is to focus on making the materials purchased in the most volume to be as 'green' as possible thereby making a quantitative impact. Other approaches focus on local impacts of materials (indoor air quality), or global impacts (natural resource depletion and public health). It was determined that for this project, there are no absolutes as a strategy, rather the approach is to work with the aesthetic direction and the most durable products and try to keep them all as healthy and efficient as possible

Waste reduction
- identify markets or recycling facilities for demolition materials (or on-site uses such as crushed concrete or brick)
- Analyze cost options for deconstruction vs. demolition
- Identify potential reuse in new building of specific materials (trusses of existing building become trim pieces in new)

New materials
- Upcharge for certified wood?
- Prioritize ease of maintenance
- Locate storage for recycling inside and outside the building
- Calculations for % recycled content
- Spec alternatives for materials that off-gas volatile organic compounds
- Distribute questionnaire to product reps

III. SITE (WATER AND LANDSCAPE)

Site issues include lighting, materials, vegetation (and maintenance) and habitat.
Night illumination is an issue already being dealt with across the campus with an emphasis on maintaining a high quality of perceived illumination. The objective of water management is to safeguard quality and quantity. The potential of developing the old railroad track overtime as a constructed wetland element throughout the campus was discussed – this is beyond the scope of this project, but may tie in directly if this strategy is of interest. It can revive an historical water channel, provide a corridor for habitat and animal migration and help clean and re-inject runoff to maintain the health of the water table. Some storage and retention options on site are very low cost, such as a constructed aquifer (crushed 3" stone or concrete under parking or other surfaces) which also makes use of waste material. Special attention to water management on campus may help resolve issues relating to the local golf course's use of water.

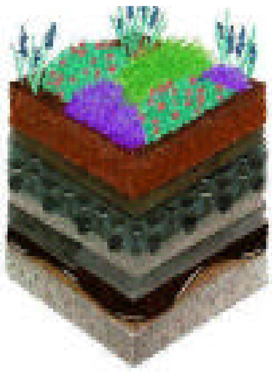
Stormwater and runoff reduction
- Calculate runoff (landscape/civil) and also calculate water budget for building use (flushing, irrigation anywhere on campus?)
- Investigate/verify ultimate destination of runoff. Cost benefit analysis of strategies: 1. keep it all on site in either cisterns, Rainstore™, constructed aquifer (cheapest solution- possibly reuse concrete from Darby) for reuse. 2. Process through site by constructing wetland strip by old RR as constructed wetland or other means(Arch/Landscape)
- main criteria - don't send runoff down storm sewers.
- minimize turf grass (use alternative grass, or other vegetation as aesthetically appropriate) (Landscape)
- use collected rainwater or stormwater runoff to reduce potable water for flushing toilets
- Green Roof system of interest? Possibly just as a demo area? (side benefit is exterior rooftop lounge area) Cost benefit analysis (Arch/GRT)

Minimize toxins:
- minimize pesticides and herbicides (plan to eliminate) (Fac. Man.)
- promote use of integrated pest management (FM)
- life cycle analysis of alternative sport grasses (landscape)
- address program, use of grass areas to see if alternatives are possible (arch.)

Water quality:

- bio retention, oil/water separation, vegetated swales
- constructed treatment wetland
- extended detention, wetlands, pre-treat water before entering Arbor Lake
- gravel/plastic storage under parking
- living roof (pilot area? Add to out door "living room" concept?)
- railroad wetland
- raingardens

Accessible green roof installed.
Detail below.



water conservation:

- plant a diversity of native species, establish a planting program
- this strategy ties into and informs masterplan issues
- water use in kitchen (calculate) and conserve, reuse
- reuse water for flushing, add two stage toilets if successful in dorms
- waterless urinals (pilot?)
- explore composting toilets (optional pilot of limited number)

waste

- determine how much saved from kitchen compost (instead of disposal) and explore food composting options

habitat

- increase connectivity (for mobile organisms such as birds and insects)
- RR as a corridor
- Backyard habitat program – integrate with curriculum
- Food for habitat? (site water protects trees from squirrel damage?)
- Accommodating biodiversity
- Stream restoration

Landscape waste:

- Campus wide issue
- Minimize turf grass
- Mulch and reapply leaves
- Close the recycling loop

CONCLUSION

As shown in the following LEED™ tally sheet and workplan, there are an estimated 30 credits that the team considered relatively easy to attain under the current design. Additionally, there are 20 additional points that are possible, but may incur some additional up front cost. The minimum required credits are 26 and there are enough potential credits that certification is a recommended strategy. The cost of additional strategies that will insure a higher LEED™ rating will depend on the results from energy modeling and other cost/benefit analysis.

APPENDIX

Workshop Agenda

LEED Matrix
workplan and documentation requirements

WORKSHOP AGENDA

January 28, 2003

Presentation
Green Roundtable Team does a general presentation on Green Design approach and implementation to set the stage for the workshop

January 29, 2003

Activating and restraining forces for Campus Center
Group comes to a common understanding of the motivating and restraining forces that define this project and shape the decisions that need to be made.

Inputs and outputs
Group discusses flows of energy and materials that will enter and leave the campus center to better understand how to determine design performance criteria.

Project aspirations
Discuss the underlying drivers of the project, and its desired outcome to better inform the decision-making process relating to LEED™.

Break-out groups: setting criteria
Participants begin to set criteria and performance objectives in the areas of Site, Energy and Materials.

Report back
Break-out groups report back and discuss functional implementation strategies that could be applied to meet criteria set in the groups.

Strategies
Implementation strategies to achieve high performance/LEED™ Rating are discussed.

LEED™ walkthrough
Participants focused on LEED™ credits specifically and reviewed each one to determine preliminary rating, barriers and opportunities.

LEED™ Credit Matrix and Workplan

The following matrix is structured in order of LEED™ Credit. Each credit has a party responsible assigned, a strategy to achieve the credit and a deliverable required to obtain certification of that credit.
This matrix is a 'living' document that will change over time. Cost information will be updated as analysis is completed.