University of Washington & Green Building:

Converting Existing Properties

UW Climate Partnership

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I. EXECUTIVE SUMMARY

It is imperative that the University of Washington commits to converting all existing buildings to green standards. There are multiple social, environmental and economic reasons that support this. This paper offers an overview of Seattle's sustainability efforts as well as how the UW is performing relative to other national universities. We also offer an array of sustainable technologies that have been proven to reduce environmental impacts. The applications are organized into the five categories that the United States Green Building Council's, LEED or Leadership in Energy and Environmental Design evaluation criteria outlines: site design, energy and atmosphere, water efficiency, materials and resources and indoor air quality. LEED, the national green building benchmark, is commonly used to categorize how 'green' a building is. In addition, we present successful green building case studies and their subsequent cost implications.

The social benefits from green building range from increased productivity to a better quality of life in addition to offering the UW a new competitive advantage. Due to the large amount of property that the University of Washington owns, it has a great responsibility, if not to only its students and staff, to the local and regional communities to mitigate exorbitant energy use and the broader set of associated urban environmental problems. We review two recent reports, the U.S. News and World Report's 2007 Best Colleges and the Sustainable Endowment Institute's College Sustainability Report Card report, in order to evaluate the sustainability initiatives of other academic institutions. Furthermore, the combination of the two reports illustrates the fact that there is a positive correlation between the top academically ranked schools and green building.

The environmental impact of existing buildings is large. By implementing some or all of the many technologies to reduce energy, material and water usage, such as Energystar appliances, dual flush toilets and modular mechanical systems, the UW can greatly reduce its impact while decreasing overall operational costs.

The financial incentives for sustainable innovations in building renovations are scarce, but many case studies, such as the Cambridge City Hall Annex in Cambridge, Massachusetts, have shown that operational costs can be significantly reduced through green building technologies. Our report highlights common areas for cost savings as well as specific suggestions for the UW. Lastly, we offer some short- and long-term goals that the UW should consider.

II. SOCIAL ASPECT

The Effects of Green Building

The concept of green building is becoming more and more widely discussed. Much has been noted about the ways in which existing buildings are negatively affecting our environment. In the United States, buildings account for 36% of total energy usage, 30% of all greenhouse gas emissions, 30% of raw materials use and 30% of our total waste output[i]. Fortunately, it has been shown that building green can help decrease operating and maintenance costs. What is overlooked, however, is the fact that by building green, we can also positively affect our society and our quality of life. Four of the several attributes commonly associated with green building design – increased ventilation, increased temperature control, increased lighting control and increased daylighting – have been positively and significantly correlated with increased productivity[ii] and to better people's health.

These types of benefits have been directly researched in classrooms. Over 21,000 students' test scores from three school districts in San Juan Capistrano, CA, Seattle, WA and Fort Collins, CO, were evaluated and later showed that increased daylighting and improved lighting quality significantly improves student test performance. The study concluded that learning progressed at least 20% faster in math and 26% faster in reading in classrooms with the most day lighting[iii].

The Seattle Effort

Sustainlane Government[iv] is an online sustainability resource center that is recognized as a leading third party source for government sustainability metrics. Sustainlane's 2006 U.S. city rankings rated Seattle as the 3rd most overall sustainable city in the nation, behind Portland and San Francisco[v]. The rankings looked at the nation's largest fifty cities and their people's quality of life. The analysis measured the level of quality by analyzing the degree to which certain city factors encourage fossil fuel dependence: economic sustainability, public transit, renewable energy, and local food. Although being ranked third is complimentary, Seattle was rated *relative* to other cities - not against a progressive benchmark that we should be striving for. There is still much room for improvement in our city.

Fortunately, the state and city officials seem to be aware of and focused on progressing Washington and Seattle's sustainability. On April 8 2005, Governor Christine Gregoire signed a bill into law requiring all state-funded projects over 5,000 square feet, including school district buildings, to achieve at least a LEED Silver certification (Leadership in Energy and Environmental Design), making Washington the first state in the U.S. to do so[vi]. In addition, the city changed some if the zoning to

require all high-rise buildings (taller than 240 ft.) to also be LEED Silver Certified. This new downtown zoning encourages two major policy goals: promoting affordable housing and "smart growth" in the city and the region – both increasing the overall sustainability of Seattle and the Pacific Northwest as well as providing a legislative framework and infrastructural model, in technical and financial incentives, for the rest of the country.

Also in 2005, Seattle Mayor Greg Nickels appointed the Green Ribbon Commission to lead the efforts to exceed the global pollution reduction target of the Kyoto Protocol. The Green Ribbon Commission soon formed a voluntary pact among Seattle-area employers to reduce emissions and help lead this community effort[vii]. Seattle has committed to following the state's guidelines and further assist private businesses and individuals in greening their properties by providing supportive resources and agencies.

Seattle is one of the top cities in the nation for LEED facilities. The City of Seattle is expected to become one of the largest single owners of LEED facilities in the world by 2013[viii]. These green building policies and milestones are credible, but much more needs to be done to make Seattle more sustainable. The responsibility is not only that of the city's agencies, but also the large businesses that operate here and the members of the community. The Green Ribbon Commission currently has eighteen members representing businesses and non-profits including the city of Seattle, Starbucks, Seattle DOT, Seattle City Light, Madrona Venture Capital, Urban Visions and REI. These companies are admirably helping to communicate the message and support legislation, but the businesses and individuals who own and control large areas of Seattle also need to take action.

The State of Washington is approximately 42 million acres with King County covering about 3.2% of Washington or 1.3 million acres. The city of Seattle is a little

over 4% of King County with 58,560 acres. The following table outlines a sample of the property owners in Seattle.

	Acres	Sq Ft	% of Seattle
Seattle	58,560	2,550,873,600	100%
UW total	949	41,338,440	1.62%
Vulcan	230	10,000,000	0.39%
Equity Office	110	4,811,596	0.19%
Martin Selig	76	3,300,000	0.13%
City Owned	69	3,000,000	0.12%
Starbucks owned	5	200,000	0.01%

Due to the size of its footprint, the University of Washington has a responsibility to the city and its inhabitants to reduce its environmental impact. As the table illustrates, the UW owns fourteen times the amount of property as the city of Seattle and fifty times more than Starbucks. To its credit, the UW has already committed to achieving LEED silver certification on all new construction, but it needs to commit to applying the same requirements to its many existing buildings.

The UW Community

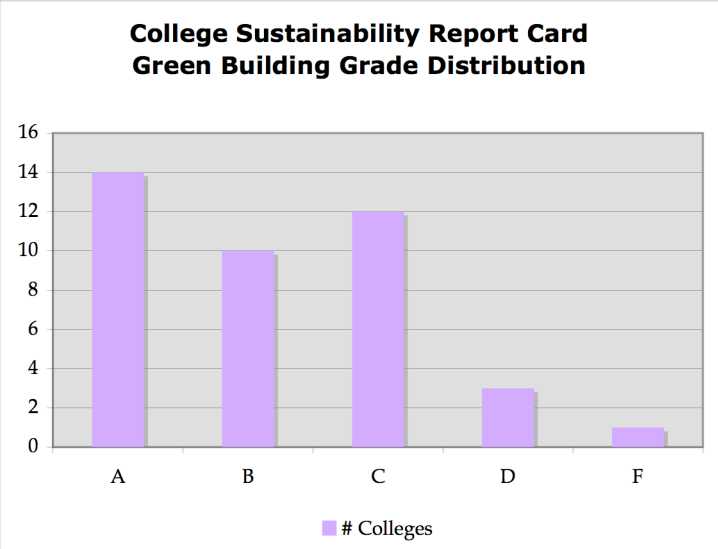
Competition among universities for rankings has always been important partly because rankings greatly affect student application volume, state funding, alumni communities, etc. Sustainability has surfaced as a new metric with which to compare U.S. universities, but it isn't often coupled with the traditional academic ranking metrics, such as class size and SAT scores. As a result, we combined two recent reports in order to see whether there is a correlation between the traditionally-ranked leading schools and the best sustainability schools. Our analysis offers an overall snapshot of the academic sustainability landscape.

One of the two reports that we used is the U.S. News and World Report, which recently released its list of America's Best Colleges 2007. The rankings are based both on quantitative metrics from education experts and nonpartisan views of what matters in education. The metrics include: peer assessment, retention rates, graduation rates, faculty resources rank, class size, student/faculty ratio, SAT ranks, alumni giving rank and the number of freshman who were in the top 10% of their High School class.

The second report that we used to analyze the correlation between traditional rankings and sustainability rankings is the College Sustainability Report Card, which is published by the Sustainable Endowment Institute[ix]. To assess the current reality of how academic institutions manage their resources and focus on sustainability, the publisher researched the policies and programs of 100 leading colleges. The report summarizes and grades college sustainability programs in seven categories: climate change and energy, green building, food and recycling, administration, endowment transparency, investment priorities and shareholder engagement. The green building category is based on the policies and practices of the schools' implementation and use of high-performance green building design in both new and existing buildings. Points are also awarded for participating in the LEED certification program.

As shown in the Appendix, we listed the U.S. News' top 50 best colleges for 2007. We then added those schools' sustainability grades, both overall as well as specifically within the green building category. There are six colleges included in the list that received a sustainability grade, but were not on the U.S. News' list. Similarly, there were six colleges on the U.S. News' list that did not qualify a grade for sustainability.

The University of Washington was ranked as the 42nd best college by U.S. News, received an A in green building sustainability and a B- for overall sustainability. Of the



top fifty-two ranked schools, the distribution of green building grades is as follows:

In addition, nine of the fourteen colleges who received an A in green building also received an *overall* sustainability grade of B- or higher. Furthermore, seven of the top ten U.S. News-ranked institutions received an A- or A for green building and B- or higher for overall sustainability. More importantly, all five top ranked schools by U.S. News received an A and B- or higher for green building and overall sustainability, respectively. Only three – Harvard University, Stanford University and Dartmouth College - received an A and A- in both sustainability categories.

Based on these rankings, there is an obvious correlation between the top academically ranked colleges and sustainability. Although neither report is flawless, the combination of the two gives us a good overview of the sustainability landscape within the academic community. It is important to note that, similar to the Sustainlane's most sustainable cities list, the green building grades are given *relative* to what other colleges

are doing. This means that an A grade shouldn't translate into an 'almost there' mindset. The benchmark for what deserves an A needs to be significantly and continuously raised. With this said, it is important to keep abreast of what UW, it's competitors and it's peers are doing. A brief overview of the green building programs followed at Stanford and Harvard is given below.

Leading the Way

Stanford created a campus wide sustainability initiative through the Woods Institute, an interdisciplinary hub for research, teaching and problem-solving. The areas that are addressed include environmental conservation, energy usage, food and dining, green building, transportation, recycling and water usage. Not only does the initiative include strategic collaborations with private and public institutions for research and guidance, Stanford publishes a monthly newsletter, titled "Working Solutions", which outlines the progress, research and school events that are related to Stanford's initiative on the environment and sustainability. Stanford has created an explicit guide for green building that states their mission, goals and focal points within multiple areas such as energy, water and recycled materials[x]. It is interesting, however, that Stanford has chosen not to focus on obtaining LEED certifications. This point will be further discussed later in the paper.

One of the most inspirational aspects of Stanford's sustainability effort is the group "Students for a Sustainability Stanford", which was created in 2000[xi]. It is a student effort that has evolved in many ways. The members actively educate other students and faculty about sustainability, collaborate with the college President and Board of Trustees on campus goals and lead events such as the Great Annual Energy Bowl and

the Earth Day Festival. In addition, the group heads up the annual Stanford Climate Change Campaign.

Harvard seems to have progressed farthest along the sustainability spectrum. Created in 2000, Harvard's Green Campus Initiative began with only one sustainability employee. The program now employs fourteen full-time employees, over forty part-time employees and is estimated to generate over $5 million of annual savings[xii].

The Harvard initiative includes over ten programs, each focused on addressing a unique aspect of sustainability. Harvard owns over 600 buildings totaling 21 million square feet that costs around $40 million per year to operate[xiii] – reducing their environmental and economic impact is a priority. Harvard Real Estate Services (HRES) has created the Sustainable Buildings Program, which offers multiple services to the university that support high performance building design and upgrades: building assessments, design expertise, LEED certification support, project management support, green campus loan funding and training and education for building maintenance.

To date, LEED or EnergyStar standards have been incorporated into eight building and renovation projects. Other achievements include: over $1.2 million in total energy savings ($714,000 annually); $612,486 in NSTAR rebates; average payback period for the projects is less than two years; and annual Greenhouse Gas emission reductions of over 9.2 million pounds.

Like Stanford, Harvard has a passionate and educated student body that supports the sustainability initiatives. The HRES, for example, offers several internships to students who want to contribute to the projects while earning credits. In addition, Harvard also publishes a Green Campus Newsletter that reports events, achievements and current ways to get involved.

Green building is in the UW's Best Interest

It is hard to believe that anyone who learns about the potential benefits from green building, or sustainability in general, can ignore the call to act. However, it is crucial to modify the dialogues in a way that effectively communicates with the target audience.

For the University if Washington, increasing the health and productivity of its students and staff should be a priority. Fulfilling its responsibility to Seattle of being a positive member of society should also be a focus. However, how does green building and being sustainable directly help the UW as an institution? One way is by giving the college a competitive advantage.

The UW is one of the top fourteen most sustainable campuses and green building and this metric gives the UW the opportunity to compete with the top five academic institutions in the nation. Sustainability topics will only become more and more marketable and will allow for the UW to be included in the same category as Harvard and Stanford. Green building and sustainability isn't only about a better quality of life; it is also an issue of branding and of gaining a competitive advantage.

Furthermore, by undertaking a progressive green building effort, the UW can engage students on an emotional level by educating them and getting them involved with activists who educate the Seattle community as well as in campus events that could include green building case studies, marketing and PR for campus green building. By promoting a forward-thinking mission in addition to academics, culture and sports, the UW can strengthen its student body and recruit more students who want to be a part of a campus like UW.

III. ENVIRONMENTAL ASPECT

The environmental impacts of large urban centers span a wide range of sustainability concerns from our local community to far beyond our region's borders. Consequently, we face regional environmental and political concerns such as water use and quality, land use, energy use, and ongoing operations and maintenance costs. Booming urban centers emit the most carbon dioxide than any other sector of the economy, use a significant portion of energy resources, and contribute large quantities of waste[xiv]. On a national and global scale, the building industry has a tremendous impact on the environment, ranging from alteration of community character to resource depletion to global warming. For example, the 17th Annual Review of Research with The Water Center was held at the University of Washington in February, which helped to shape the dialogue on Seattle's water resource and management. It is a fact that projected future demand exceeds projected supply. Seattle's supply of drinking water is sourced from the melting snow pack of the Cascade Mountains every spring. Projected population growth rates threaten our anticipated supply of water[xv]. Global warming causes decreased snow pack and increasing variability of local supplies. These combined factors prove that water is a rapidly depleting resource in the Seattle area[xvi]. The year 2005 reported a record low snow pack in King County watershed and dire forecasts for stream flows for 2006, prompting a countywide conservation plan[xvii]. Nationally, our dependence on international and nonrenewable resources is increasingly being considered a domestic risk.

The entire range of impacts should be taken into consideration when designing or constructing buildings to help ensure that they have minimal environmental impacts while still fulfilling their programmatic directives[xviii]. The U.S. Green Building Council's

president, CEO and founding chair, Rick Fedrizzi, states that "Buildings are a major contributor to climate change: Annually, they consume 40% of the energy and 70% of the electricity in the U.S., and are responsible for 40% of the nation's CO2 emissions. But LEED certified green buildings have been shown to use 40% less energy than conventional buildings. With numbers like these, we can make a tremendous impact on energy consumption and mitigating climate change[xix]. The environmental benefits of LEED certified sustainable buildings include, but not limited to; enhancing and protecting ecosystems and biodiversity, improving air and water quality, reducing solid waste, and conserving natural resources.

The following sections will describe the environmental benefits of common sustainable or "green" renovations and will be categorized into the United States Green Building Council's Leadership in Energy and Environmental Development criteria: LEED for Existing Buildings, or LEED-EB, five main categories for evaluating the impacts of a building project: site design and planning, energy and atmosphere, water efficiency, materials and resources and indoor environmental quality. Case studies in the following section concerning their the economic incentives will provide qualitative illustrations of increasing existing buildings sustainability by decreasing natural resource use and preserving the integrity of the environment for the future.

A. Site Design and Planning

Site design and planning is traditionally defined in terms of metes and bounds, setbacks and height limits, points of entry and egress, fire lanes and utility connections, etc[xx]. While these definitions are useful and necessary, sustainability requires a broader set of issues to be included that incorporate community health and welfare, economy in

terms of resource utilization during and after development, and environmental impacts with regard to local and regional microclimates and biodiversity. Sustainable site planning identifies ecological, infrastructural, and cultural characteristics of the site to assist designers in their efforts to integrate the building and the site. The purpose is to encourage optimum use of natural/existing features in architectural and site design of campus buildings, such that building energy use is diminished and the environment is enhanced[xxi].

This LEED category examines broader landscape level factors that can opportunistically increase overall building sustainability such as responsible construction practices or increasing large-scale mass transit opportunities. Many advocates of green building believe that the existence of open spaces is vital to creating a positive, livable, energetic urban environment[xxii]. This is especially applicable to the UW Tower because it is a university-owned building that students should be encouraged to enjoy. Within, the current design, the property is substantially 'pedestrian unfriendly'[xxiii].

B. Energy and Atmosphere

It is estimated that approximately 40% of the world's energy demand is due to the development and operation of built structures[xxiv]. This energy usage has serious impacts on the environment; buildings account for about one-third of the emissions of heat trapping carbon dioxide from fossil fuel burning and two-fifths of acid rain-causing sulfur dioxide and nitrogen oxides. Buildings also contribute to other side effects of energy use, including oil spills and river damming which could have deleterious effects on all kinds of Pacific Northwest fisheries[xxv]. Therefore, it has been increasingly important to focus on the energy use of buildings because of its far reaching and cumulative effects.

Increasing energy efficiency in appliances and fixtures by technologies such as motion sensors or enabling automatic shut down can be very effective. Double hung windows that increase natural light and ventilation by opening from top to bottom have shown much success in Seattle. Greg Smith, the CEO of Urban Visions, recently converted an office building at 901 5th Avenue in downtown Seattle. He and his team implemented double-paned, angled-cut windows in the property to increase daylight and energy efficiency.

Another innovation that Greg Smith and his team used to green the office building downtown, 901 5th Avenue, is by using a 'modular mechanical system'. The office building employed one engine to power the building, around 500 horsepower. Every time power was needed, whether it was 50-hp or 450-hp that was needed, the entire engine would power on. The UW Tower could benefit from the alternative that Greg Smith used: replace the one engine with four or five smaller engines that can activate only when needed.

C. Water Efficiency

Sustainable design dictates that water and its relationship to building design, development, and operations are managed carefully. The community requires adequate water in times of drought, and planning should provide for protection from storm waters and floods. At the same time, the biodiversity of each region is dependent on water for maintaining appropriate habitat conditions.

One of the best ways to increase water efficiency and decreasing overall water usage is to replace outdated, inefficient appliances with modern energy saving appliances and fixtures. A common practice in predominantly wet climates, like Seattle, is the use

of storm water collection gardens and jerkwater capacities, most effective when paired together. Innovative technologies like low-flush toilets are universally used in Europe, Australia, New Zealand and Asia, but have not been universally adopted in North America. The UW Tower could easily benefit from such implementations as well as no-flush urinals.

D. Materials and Resources

The construction industry consumes three billion tons of raw materials annually—forty percent of the total material flow in the global economy[xxvi]. Construction materials are "reorganized matter," and this reorganization process creates significant environmental and social impacts. A life-cycle assessment (LCA) of materials is a tool that allows design and planning experts to measure and minimize the impact on both communities and the environment. The best building materials are those that are long-lived, least disruptive to harvest, ship and install, and are also easiest and safest to maintain and reuse such as bamboo.

The materials and resources metric of sustainability can be vastly improved by simply decreasing wastes by recycling post-consumption products as shown by the high success rates of UW Housing and Food Service. Use of biodegradable products and composting together can increase sustainable impact. Incorporating locally produced, recycled, sustainable-certified or less processed woods in the construction of the renovation also records relatively high points on the LEED-EB graded checklist. Materials that could be used in the renovation of the UW Tower could include: low VOC paint, recycled carpets and bamboo floors, where needed.

Greg Smith, from Urban Visions, offered a great insight into reducing overall resource usage. Although not directly related to green building, the UW Tower could commit to using only eco-friendly cleaning products and reducing the frequency of janitorial visits, which could also reduce operating costs.

E. Indoor Environmental Quality

Indoor environmental quality is measured by analyzing the quality of air is the frequency of which the air volume changes in a day. By using low VOC paints and other less harmful alternatives, the quality of home, work and school environments can be improved. And, as stated above, the UW could find that productivity and learning rates increase with such changes.

The crisis of global warming refers to increases in global temperatures resulting from an accumulation of greenhouse gases in the atmosphere. Greenhouse gases include carbon dioxide, methane, and chlorofluorocarbons. These gases trap the sun's heat as it is radiated from the earth, and prevent it from escaping back into space. State and local governments are starting to take actions to reduce greenhouse gases, rather than federal level government, According to the National Academy of Sciences and backed up by an international consensus of scientists, the earth's surface temperature has risen by about one degree Fahrenheit in the past century, with accelerated warming during the past two decades. But not only are we and our children going to reap the consequences of global warming, there is also regional resources that will be increasingly dominated and threatened by global warming like endangered salmon.

IV. ECONOMIC

"That which gets measured gets done." This oft-cited management strategy has been attributed to several business leaders, yet the message remains the same: technologies that benefit the stakeholders of the University of Washington community, and benefit the physical environment where it operates, will most likely be implemented only if its financial benefits outweigh the costs. It would be irresponsible for any organization, particularly a public institution, to pursue alternatives that jeopardize its current or future financial health. A careful analysis of the benefits and costs of any alternative is required to protect both financial stability and future ability to create positive change.

We have identified several successful "green" applications. Dividing these into the LEED categories introduced above, we will provide a snapshot of the benefits gained in each case. Estimated cost savings will be demonstrated using the newly acquired Safeco property site and UW Tower whenever applicable.

Finally, we have identified alternatives in each LEED category that the University can implement at the majority of project sites going forward.

A. Site Design and Planning

For the basis of our study, we are focused on the renovation of existing buildings: integration of site into landscape is established. However, as illustrated above, incorporating "user-friendly" space into interior planning will increase occupants' enjoyment of the facility, and therefore increase productivity.

B. Energy and Atmosphere

"Cash flow and profitability resulting from building green are largely derived through energy savings." [xxvii] For example, in five years Trizec Properties – one of North America's leading commercial office property owner/operators - has reduced energy consumption by 15% from its base year of 2000. To effectively administer its portfolio-wide energy conservation program, Trizec has implemented sophisticated systems to monitor energy consumption, store detailed comparative data and generate reports that aid in the analysis of the energy conservation efforts of every property in the Trizec portfolio. [xxviii]

By calculating savings per square foot reported by Trizec Properties, we estimate the potential University savings as follows:

	Square Feet	Cost Savings	CO2 Emission Reduction*	Reduction in # of Vehicles
Trizec Property Portfolio	37,000,000	$ 16,000,000	690,000	125,000
Safeco Property Site	510,546	$ 220,777	9,521	1,725
UT Tower (stand alone)	279,549	$ 120,886	5,213	944

* Annually, in tons

With this project and going forward, the University of Washington has a unique opportunity to reduce annual operational costs while creating a positive impact the environment of Seattle.

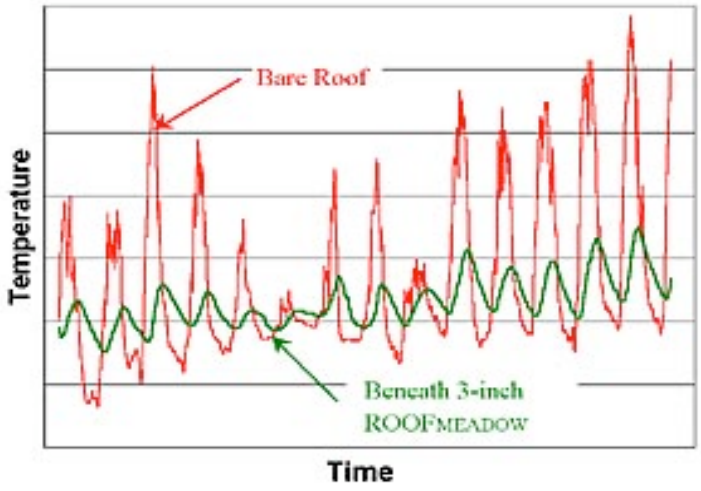
Energy & Atmosphere Alternatives

- Energy Star:

Reducing energy usage by installing Energy Star appliances, computers, printers, light bulbs and programmable thermostats would produce significant savings. For example, a "stand-by" policy would result in significant energy reductions. "When [computer] systems power down during hours of nonuse, the operating cost drops [from $120 per year] to $20 annually."[xxix] In addition, replacing lighting throughout the building with Energy Star qualified light bulbs will result in a 75 percent increase in energy efficiency.

- Green Roofing:

Modern Green Roofs are made of a system of manufactured layers deliberately place over roofs to support growing medium and vegetation. These green roofs provide insulation, reducing energy demand for heating and cooling elements. "A 2003 study commissioned by Seattle's Office of Sustainability and the Environment states that the Seattle Justice Center is saving as much as $148,000 each year due to its green roof."[xxx] It also decreases load demand on the power plant generating energy and reduces CO_2 emissions. The following graph illustrates variability in temperature over time with and without the installation of a 3-inch roof garden. As represented by the green line, variability drops dramatically with the insulation properties of a roof garden, reducing demand on heating and cooling systems.



xxxi

- Clean Energy:

Clean (or renewable) energy is a cost-effective way to meet our nation's growing demand for electricity and natural gas while reducing emissions of air pollutants and greenhouse gases, lowering consumer's energy bills, and improving the reliability and security of our energy system. Of the total energy consumed in America, about 39% is used to generate electricity. Therefore, electricity consumption is an important portion of a consumer's environmental footprint.[xxxii]

Clean energy available for purchase in the Seattle area includes that generated from biomass, hydro, landfill gas, solar, and wind. The price premium to purchase this energy ranges from making a voluntary contribution to an increase of $.03 per kWh.[xxxiii] However, the purchase of this energy subsidizes the operation of renewable energy sources, making it more affordable for the whole market. The University of Washington's purchase of renewable energy could significantly affect the renewable energy market, shifting demand from fossil-fuel energy by reducing renewable energy costs.

- Roof Installed Solar Panels:

While it has been asserted that enough raw energy falls on a typical residential 40x100 foot lot in Seattle to power 50 homes, [xxxiv] the cost-efficiency of solar power usage in the Pacific Northwest is not yet established. By taking advantage of otherwise unused roofs, the University could significantly reduce energy costs over the long-term. Furthermore, the installation of solar roof panels would be a strong climate-conscious statement to the Seattle community, and would provide an exciting educational alternative for University students.

- Combined Heat & Power (CHP):

CHP systems integrate prime mover, generator, heat recovery and electrical interconnection systems. The system reduces fuel and electricity costs, providing effective electrical efficiencies of 50% to 70%, reducing emissions of air pollutants and CO_2.[xxxv]

B. Water Efficiency

Water is a vital element to the earth's ecosystem, and the daily survival of its inhabitants. Yet less than 3% of the earth's water supply is fresh water. Conservation of this limited supply is essential, as is protecting its cleanliness and safety.

Urban storm water runoff in general has been identified as a major problem for water quality nationwide. Urbanization alters the infiltration capability of soil. Instead of forests and meadowlands, we now have rooftops, roads, and parking lots with virtually no ability to absorb storm water. The resulting storm water flows are higher in volume[xxxvi]

Water Efficiency Alternatives

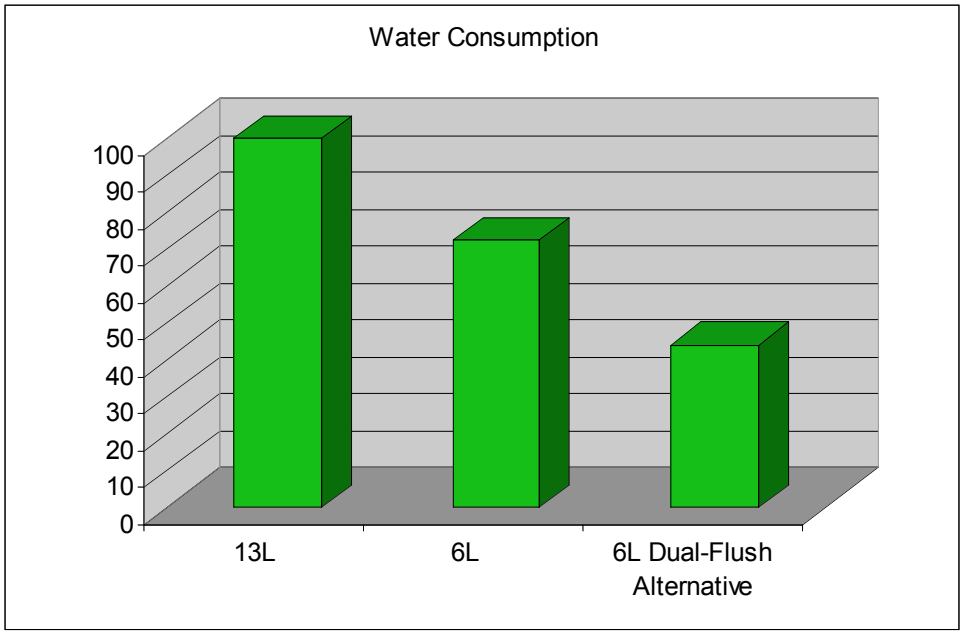
Buildings in King County, including our campus buildings, are connected to the municipal sanitary sewer system of the City of Seattle and King County. Wastes flow in underground pipes from buildings to the West Point wastewater treatment plant. After treatment, the effluent is discharged into the Puget Sound.

- Reduce Waste Water: Install Dual-Flush Toilets:

"The dual-flush toilet, a technology first developed in the early 1980s, takes water-efficiency …further by using 6 liters of water to flush solid waste but only 3 liters to flush liquid waste. While this technology is mandated in Australia and Singapore it is relatively new in North America."

A study conducted by the Canada Mortgage and Housing Corporation calculated a significant water savings can be achieved by replacing existing toilets with dual-flush toilets. Flush volumes were reduced by 56 per cent in office washrooms. [xxxvii]

In reference to the same study, John Koeller, technical advisor to the California Urban Water Commission and a recognized specialist in water-efficient technologies and products, reports "the study also compared dual-flush fixtures with new 1.6-gpf fixtures and showed that the dual flush fixture used 23 to 32 percent less water than these conventional 1.6-gpf fixtures."[xxxviii] The following table demonstrates the savings in water consumption that can be achieved with installation of dual-flush toilets.



* 6L = 1.6-gpf fixture

Installation of dual-flush toilets will result in a financial savings in water costs due to reduced usage while also reducing the future investment and expansion costs for Seattle Public Utilities.

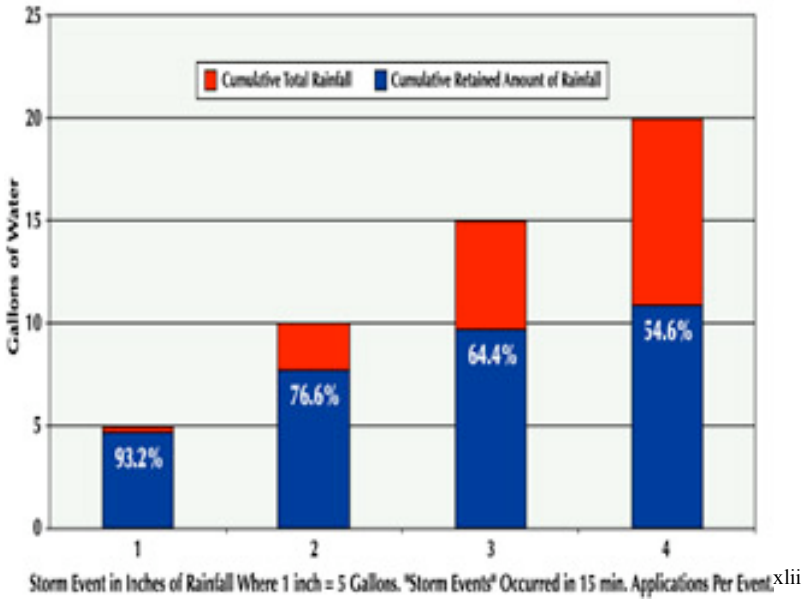
- Reduce Overflow by Green Roofing:

Storm drainage systems are made of underground pipes that collect storm water runoff from streets, driveways and parking lots. At the Seattle campus, the pipes empty the untreated water directly into Lake Washington via the University Slough, near the Conibear Shellhouse, or down at Sakuma viewpoint near the Marine Studies building on south campus.

There are several locations on campus where we still have a few drains that go to combined sewer overflow systems. These systems are designed to drain to sanitary sewer

except during exceptionally high rainfall, when some fraction of the water "overflows" to the storm water system and straight into the lake.[xxxix]

Plants installed in a green roof system utilize about 60% of the polluted rain water before it overflows into sewer systems[xl], saving businesses stormwater infrastructure or stormwater fees.[xli] Savings are also gained in avoided erosion and pollution control costs. The following table illustrates recorded water retention of a roof garden:


[xlii]

D. Materials and Resources

Immediate cost benefits can be achieved by selecting recycled and recyclable materials for renovation and interior design as well as by managing waste from project renovations, avoiding disposal costs.

As a result of reuse and recycling of construction debris, the commercial renovation of Cambridge City Hall Annex, Cambridge Massachusetts – a 32,000 sq. ft. structure – resulted in the following waste reduction and associated economic savings:

Material	Tons	Recycling Cost	Avoided Disposal Cost*	Savings
Brick	531	$22,833	$71,154	$48,321
Concrete	29	$2,407	$3,886	$1,479
Wood	112	$10,640	$15,008	$4,368
Metal	15	$690	$2,010	$1,320
Asphalt Roofing	1	$465	$134	-$331
Totals	688	$37,035	$92,192	$55,157

* Costs that would have been paid if material was disposed

Disposal costs based on local rates in 2003

[xliii]

Assuming similar disposal costs in the current Seattle market, waste management of renovations at the recently acquired Safeco properties could yield $1.72 of savings per square foot:

	Square Feet	Cost Savings*
Cambridge City Hall Annex	32,000	$ 55,157
Safeco Property Site	510,546	$ 880,006
UW Tower (stand alone)	279,459	$ 481,691

E. Indoor Environmental Quality

According to EPA reports, known health effects of indoor pollutants include asthma, visions, hearing, intelligence and learning. Furthermore, most chemicals in commercial use have not been tested for possible health effects. William Fisk, the head of the Environment Department at Lawrence Berkeley National Laboratory, conducted a research effort titled "Health and Productivity Gains from Better Indoor Environments" that outlines some benefits and their corresponding affects on cost. Through reduced respiratory illnesses, reduced allergies, reduced asthma and reduced Sick Building Syndrome symptoms, the potential U.S. annual savings or productivity gain is between $43-$235 billion.

V. CONCLUSION

The City of Seattle is taking action to improve the city's overall sustainability, from changing zoning laws to adding legislation to creating the Seattle Climate Partnership. Seattle, its officials, and many of the leaders in our community are realizing that buildings are a large contributor to our city's environmental impact. By continuing to encourage green building and design, these leaders can increase the degree to which new and existing buildings can positively affect health and productivity, but also decrease environmental and economic costs over time.

The University of Washington has much more to do in terns of increasing its overall sustainability. However, it is clearly making efforts. On March 7, President Emmert signed the American College and University President's Climate Commitment that will ensure the university continues to move forward.

The following is a list of issues related to green building to consider:

- LEED drawbacks

  - Although LEED is a nationally accepted benchmark and certification for green building and design, many leaders are voicing their concerns about the fact that the LEED point system is not appropriately weighted. For example, Stanford has decided to not certify its renovations and new construction as LEED. Seattle and the UW should look into the option of establishing a Seattle green building standard.

- Estimate and report current environmental impacts and focus on transparency

  - The UW is moving toward this goal as illustrated by the President's recent commitment. Although transparency tends to 'wake a sleeping

dog', it will ensure that the UW is meeting its own goals and create a model that others will hopefully follow.

- List and quantify objectives in order to monitor progress

- Publish the objectives to make available to ALL stakeholders

- Collaborate with green building industry leaders to establish an on campus, full-time resource for projects, students and staff
- Immediately define the UW Tower project objectives with consultant DKA Architecture and use the property as a case study to achieve the following:

  - LEED Silver certified

  - Increased awareness of green building and sustainability to the community and the students

  - Use the opportunity to create a best practices guideline for future green conversions

VI. Appendix

College	Campus Location	School Ranking*	Green Building**	Sustainability Ranking**
Princeton U	NJ	1	A	B-
Harvard U	MA	2	A	A-
Yale U	CT	3	A	B+
MIT	MA	4	A	B-
Stanford U	CA	4	A	A-
California Inst. Of Tech.	CA	4	C	C-
U of Pennsylvania	PA	7	B	B
Duke U	NC	8	A	B
Darthmouth College	NH	9	A	A-
Columbia U	NY	9	C	B
U of Chicago	IL	9	D	D+
Cornell U	NY	12	A	B-
Wash U in St. Louis	MO	12	C	C-
Northwestern U	IL	14	A	C+
Brown U	RI	15	B	B
Johns Hopkins	MD	16	B	C+
Rice University	TX	17	B	C-
Emory U	GA	18	A	C
Vanderbilt	TN	18	C	C-
U of Notre Dame	IN	20	F	D-
Canegie Mellon U	PA	21	A	C+
UC Berkeley	CA	21		
Georgetown U	DC	23	C	C+
U of Virginia	VA	24	B	D+
U of Michigan-Ann Arbor	MI	24	C	B+
UCLA	CA	26	A	C+
Tufts U	MA	27	B	B-
U of North Carolina	NC	27	B	C
USC	CA	27	D	D
Wake Forest U	NC	30	D	D
Brandels U	MA	31		
College of William & Mary	VA	31		
Lehigh U	PA	33	C	C-
Boston College	MA	34	C	C-
NYU	NY	34	C	C
U of Rochester	NY	34	C	C-
U of Wisconsin	WI	34	C	B
Case Western Reserve U	OH	38	B	C+
Georgia Inst. Tech	GA	38	B	C
UCSD	CA	38		
U of Illinois	IL	41	A	C
U of Washington	WA	42	A	B-
U of Florida	FL	47	A	C
U of Texas, Austin	TX	47	B	C+
UC Davis	CA	47		
UCSB	CA	47		
George Washington U	DC	52	C	C-
Berea College	KY		A	C+
Bowdoin College	ME		A	B-
Grinnell College	IA		A	C+
Middlebury College	VT		A	B+
Oberlin College	OH		A	C+
U of British Columbia	BC		A	B-

*U.S. News & World Report, America's Best Colleges, 2007

**Sustainable Endowment Institute, 2007 College Sustainability Report Card

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