Eco-Campus: The Application of the Eco-City Model to the Development of Green University and College Campuses

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Eco-campus: applying the ecocity model to develop green university and college campuses

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Abstract

Purpose – The purpose of this paper is to argue that Richard Register’s ecocity model offers a strategic framework to help guide sustainability initiatives in North American higher education (HE) institutions.

Design/methodology/approach – This conceptual paper examines the theory of the ecocity and investigates the implications for its proposed building strategies for university and colleges, as institutions seek to create more sustainable campuses. The paper examines previous efforts to achieve sustainability and how the concept of the eco-campus can be practically and productively applied.

Findings – There is no single campus that has fully embraced every facet of sustainability, but numerous HE institutions are strong leaders in diverse areas. The eco-campus model provides concrete principles that proactively address HE institutions’ ecological footprints and develops sustainable community practices.

Social implications – Sustainability is a pressing social issue. As world leaders in research, innovation, and education, universities and colleges are key places to address this global issue and foster progressive action within current and future generations. The eco-campus approach represents an opportunity to initiate a cultural paradigm shift, whereby university and colleges become global leaders in sustainability.

Originality/value – While sustainability is now a cornerstone of research and teaching, North American HE institutions are faced with the challenge of realigning institutional practices, processes and resources to fully institute sustainability on campus. The eco-campus model provides an innovative guide around which to hinge the development of sustainable institutional practices, structure progressive action, and foster meaningful change.

Keywords North America, Sustainable development, Higher education, Framework, Ecocity, Environmental stewardship

Paper type Conceptual paper

1. Introduction

Universities and colleges are important sites of transformation as centres of discourse and vehicles of social change. As world leaders in research, innovation, and education, they are key places to address global issues and foster progressive action within current and future generations (Moore, 2005; Clarke and Kouri, 2009). Sustainability is one issue that has become a central focus of teaching and research within universities. Concern for the environment and sustainability within institutions of higher education (HE) has grown since the early 1970s when academics recognized that ongoing degradation of the environment had ominous social and economic consequences.
North American universities and colleges have responded by developing degree programs and courses that teach ecological literacy and principles of sustainability. Academic research has grown to incorporate an interdisciplinary curriculum involving the environment, economics, and society – the three pillars of sustainability (Gibson, 2006). However, while sustainability is now a cornerstone of research and teaching, North American HE institutions are faced with the challenge of realigning institutional practices, processes and resources to fully institute sustainability on campus.

In many respects, university and college campuses are microcosms of the broader complexities, environmental issues, concerns and challenges in North American towns and cities. Institutions of HE can have significant environmental impacts on- and off-campus, including air and water pollution, waste, the use of hazardous chemicals and habitat degradation (Dahle and Neumayer, 2001). Campuses also have indirect impacts through the import of materials such as construction supplies, food, energy sources and paper. The extraction and production of these materials can have resounding environmental, social and economic impacts (Clarke and Kouri, 2009). Finding a model around which to address these issues and hinge the development of sustainable institutional practices would help to structure progressive action and foster change. This paper argues Register’s (2006) innovative ecocity approach can be strategically applied on a smaller scale to guide sustainability initiatives in HE. Through the application of structured sustainable strategies, universities and colleges can actively build an eco-campus that fosters ecological and social awareness while reducing the institution’s impact on the environment.

2. Sustainability initiatives and institutional change
Sustainability is as a popular concept that has influenced the attitudes and practices of HE and greater society. Public concern for sustainability arose in North America in the early 1970s with the awareness that degradation of the environment detrimentally affects international goals of prosperity and economic justice (Clougston and Calder, 1999). The subsequent environmental movement has challenged governments, corporations and institutions, including universities, to be more socially and environmentally responsible. As the educators of the majority of society’s leaders, universities and colleges have a profound responsibility to increase the awareness, technologies, and tools necessary for a sustainable future (Wright, 2002; Clarke and Kouri, 2009).

The university is an important site to implement sustainable development, in part, because the autonomy of the governance structure and local politics are less complex than they are at the scale of the city. With a smaller scale and more structured administration, universities can better reduce the cumulative effect of local environmental problems, an area where cities sometimes struggle. For example, the Heart of the City project in the Strawberry Creek area of downtown Berkeley was conceived in 1997 but to date has not eventuated (Ecocity Media, 2011). The plan was to restore the existing urban fabric with a public plaza, pedestrian streets, social housing adjacent to the main transit station, solar greenhouses and rooftop gardens. A total of 40 small businesses and organizations joined a coalition with over 100 citizen groups to explore and facilitate the idea. Ecocity Builders organized two small international conferences in support of the project and sought to amend Berkeley’s city planning laws (Ecocity Media, 2011; Downtown, 2009). However, the complexity and political
complications of city development has thwarted its development. Practical and bureaucratic limitations have similarly prevented the Los Angeles EcoVillage from developing (Downtown, 2009).

Campuses across North America have made attempts to achieve a systemic commitment to an environmentally, socially and economically sustainable landscape that has not been achieved at a citywide scale. For example, the majority of buildings at the University of Colorado have been retrofitted for energy efficiency, and the university purchases renewable energy credits, carbon offsets and local foods. The university spends 19 percent of its food budget on local and organic foods, and donates surplus equipment to low-income schools (University of Colorado at Boulder, 2010; Sustainable Endowments Institute, 2011). Other universities, such as the University of Arizona and University of British Columbia, have supported greener transportation alternatives in recognition that commuter transportation to and from campus has led to congestion, air quality and noise problems. Full-time UBC students receive an 85 percent discount on unlimited public transit passes. The campus has car-sharing programs and a bicycle co-op. Furthermore, the roads in the centre of the UBC campus are closed to vehicle traffic (University of British Columbia, 2011). Amherst College (MA) and Stanford University (CA) have reduced carbon dioxide emissions and air pollutants released due to the burning of oil and natural gas to heat water and control building temperatures. These universities have enforced operational procedures such as carbon dioxide reduction practices, emission control devices, sustainable building construction, and local food purchasing (Sustainable Endowments Institute, 2011).

The influence and resources that universities can apply to issues of sustainability place them in a unique position to become key leaders in the promotion of sustainable development. HE institutions represent a large economic engine: American institutions have an operating budget of over $200 billion, which is larger than all but 20 of the world’s economies (Eagan et al., 2008; Betts, 2001). The combined endowment assets of the 322 American and Canadian schools surveyed by the College Sustainability Report Card (Sustainable Endowments Institute, 2011)[1] totaled more than $325 billion. The American HE sector represents approximately 3 percent of US GDP and 2 percent of the workforce (Eagan et al., 2008; Clarke and Kouri, 2009). Furthermore, the university is positioned with immense social capital in the value of its social networks and influence. In Higher Education in a Warming World (Eagan et al., 2008), David W. Orr states:

[...]

Given the social, economic and cultural capital of HE institutions and their role in educating the next generation of leaders, the institutional practices present on campus should lead the sustainability movement by being ecologically sound, socially just, economically viable and humane for present and future generations (Nicolaides, 2006; Clougston and Calder, 1999).

3. Levels of institutional commitment to sustainability

The 1990 Talloires Declaration formally recognized the commitment of HE to provide leadership and support in addressing the unprecedented scale of environmental degradation. It provides a ten-point action plan for colleges and universities to promote
sustainability through teaching, research, operations and outreach (Shriberg and Tallent, 2007). For the first time, HE institutions were expected to orient curricula around issues related to the environment and sustainable development. They also became obligated to alter physical operations and honour commitments made in signing national and international declarations of sustainability (University Leaders for a Sustainable Future, 2001).

The 432 universities that have signed the Talloires Declaration to date have undertaken diverse routes in an attempt to become world leaders in developing, supporting, and maintaining sustainability (University Leaders for a Sustainable Future, 2001). There is no single campus that has fully embraced every facet of sustainability, but numerous HE institutions are strong leaders in diverse areas. The College Sustainability Report Card 2011 highlighted the achievements of eight schools that have undertaken enormous measures to achieve a more sustainable campus (Table I).

While these examples exemplify strong sustainable practices, this institutional commitment is not uniformly present across North America. The process of changing the institutional landscape is often slow, complex, and contested. The concept of a “sustainable university” has faced political setbacks, bureaucratic roadblocks and general unawareness and disinterest (Sustainable Endowments Institute, 2011; National Wildlife Federation, 2008; Velazquez et al., 2006). Lozano (2006) states many universities are still ignorant of sustainability’s principles and have done little or nothing to incorporate them into education, research, and outreach. For example, College of the Ozarks (MO) has minimal policies and initiatives relating to campus-wide sustainability. The College Sustainability Report Card (Sustainable Endowments Institute, 2011) awarded the college an F because at the time of the survey it had not made any public steps to address resource efficiency, conservation, green building policies, or alternative forms of transportation. The one area that the school has made some progress is in the cafeterias: 2 percent of its annual food budget is spent on local items, such as local milk and ice cream. The Green Thread Dining Services program claims to be committed to local, organic, and natural foods. It advocates a commitment towards reducing the institution’s environmental footprint while delivering “exceptional operational results” through green buildings, waste management, responsible procurement and energy and water conservation. However, the college does not provide any examples of concrete programs or results (University of the Ozarks, 2011).

The most common weakness is that HE institutions lack a coordinated approach that can accurately assess campus initiatives and provide well-grounded strategies for success to overcome institutional barriers (Shriberg and Tallent, 2007). Campuses often excel in traditional operational measures, including recycling and energy/water conservation, but are struggling to successfully implement challenging projects, such as a large-scale shift to alternative transportation or energies (National Wildlife Federation, 2008; Sustainable Endowments Institute, 2011). Numerous barriers are hindering the implementation of sustainable practices. These obstacles include inadequate financial resources needed for initial investment and a prevailing social culture of inaction. Rigid conservative attitudes of faculty and administration and the lack of expertise and tradition can hinder change (Nicolaides, 2006; Thomas, 2004). Students and staff it uninterested or too busy to participate in sustainability programs, as the change creates extra work in addition to the institution’s daily activities...
Brown University (Providence, RI)
The Brown is Green (BIG) Campaign coordinates initiatives within four primary foci: research and teaching, university commitments, student groups and initiatives, and community collaborations (Brown University, 2011). Brown has promoted alternative transportation by offering parking discounts to carpoolers, ride-matching, a shuttle to off-campus destinations and free access to local public transit. Bike racks and showers have been installed to encourage cycling, running, and walking to campus. The university has also installed water-saving technologies, such as dual-flush toilets, and vegetated roofs for stormwater management (Sustainable Endowments Institute, 2011; Brown University, 2011).

Dickinson College (Carlisle, PA)
Dickinson’s approach to sustainability encompasses environmental, social and economic systems within a strategic plan to sustain valued resources (Dickinson College, 2011). The campus features a biodiesel plant, and central energy boilers were recently converted to burn waste and vegetable oil. The college installed a swimming pool filtration system to capture evaporated water for reuse. Dickinson spends 50 percent of its food budget on local items, including vegetables and herbs from the campus farm and hormone-free dairy products (Sustainable Endowments Institute, 2011; Dickinson College, 2011).

Luther College (Decorah, IA)
The Campus Sustainability Council focuses on programs ranging from local water metering on campus to regional cooperation. The college has undertaken energy conservation measures such as energy management systems, electric metering, energy-efficient lighting, temperature setbacks and vending machine sensors (Sustainable Endowments Institute, 2011). Luther has been converting used fryer oil to fuel some of the grounds equipment since 2007. In 2008 the school commissioned a study on the feasibility for a biomass boiler, and it now generates geothermal energy on campus. The school has converted a large barn into a reuse store that hosts monthly reuse sales to sell items no longer needed by the college (Luther College, 2011).

University of Minnesota (Minneapolis, MN)
Launched in 2009, the university’s conservation program It All Adds Up has reduced carbon dioxide emissions by 25,000 tons and saved the university more than $2.25 million. In its first year, the program collected 10,000 pledges from students, faculty and staff committing to energy-saving behaviours such as turning off the lights and using the stairs instead of an elevator (University of Minnesota, 2011). The university fleet includes approximately 200 alternative-fuel vehicles, and the U-Pass and Metro Pass offers students and employee a discounted transit pass. The school estimates that it has reduced more than 50,000 vehicle miles and saved more than 2,000 gallons of gasoline daily (University of Minnesota, 2011).

Oberlin College (Oberlin, OH)
Oberlin aims to be carbon neutral by 2025. The college has installed two solar arrays and heats three buildings with geothermal pump systems (Sustainable Endowments Institute, 2011). The “Campus Resource Monitoring System” in 18 residence halls and ten student houses allows students to monitor energy and water use, especially during inter-dorm conservation competitions (Eagan et al., 2008). Oberlin’s endowments are currently invested in renewable energy funds, community development loan funds, and on campus eco-efficiency projects (Oberlin College, 2011).

Table I.
Top eight schools of the 2011 College Sustainability Report Card
Many people lack relevant and comprehensive information on sustainable development and consequently are unaware of their misconceptions and how to incorporate sustainability into their work and lifestyle habits (Thomas, 2004; Nicolaides, 2006). In order to overcome these barriers, the first step should be to make sustainability explicit in the universities’ academic and research policies, institutional mission, and planning. The office of sustainability at the University of New Hampshire is located prominently in the central campus administration and clearly outlines the university’s strategy to address climate change and greenhouse gas emissions. Chancellors of four schools in the University of Wisconsin system (Green Bay, Oshkosh, River Falls and Stevens Point) have outlined clear strategies to achieve their mission of becoming energy independent by 2012 (Eagan et al., 2008). Cornell University (NY) has included sustainability components in its master plan and ten-year strategic plan (Sustainable Endowments Institute, 2011). For sustainability to be most effective, it needs to become a part of everyday life on campus, not an abstract concept that does not relate to the institution’s activities. This will help resolve any discrepancies between the attitudes and behaviours of students and staff. Staff training is a key aspect to altering people’s perceptions of social, environmental and economic implications of institutional practices (Lozano, 2006). Small groups of committed individuals should begin initiatives and, if successful, build on this instilled confidence and momentum throughout the entire university. For example, small students groups played a key role in building sustainability initiatives at Queen’s University (ON). The movement on campus began with the efforts of students dedicated to environmental and social justice. In response to their successes, a growing number of student groups formed, and in 2008 an official Sustainability Office was created (Queen’s University, 2011).

Institutional benchmarks and successes of sustainability programs need to be shared, such as financial savings, enhanced public relations and greater student

| University of Wisconsin-Madison (Madison, WI) | UW Madison has issued bonds totaling $48 million USD to invest in energy conservation projects over the last four years. Water-saving technologies include weather-informed irrigation and high-efficiency laundry systems. The university calculates that it has reduced campus greenhouse gas emissions by 16 percent since 2006 (Sustainable Endowments Institute, 2011; University of Wisconsin-Madison, 2011) |
| Pomona College (Claremont, CA) | Pomona has heavily promoted transportation alternatives: the Green Bikes Shop is a student-run bicycle shop that provides 60-80 students with a bike for an entire semester free of charge, as well as free maintenance and repair services (Pomona College, 2011). A website coordinates carpool groups, and employees are offered cash incentives to commute by environmentally preferable means. More than half of the vehicles in Pomona’s fleet are 100 percent electric (Sustainable Endowments Institute, 2011) |
| Yale University (New Haven, CT) | A particular strength of Yale’s sustainability model is sustainable building design. The university mandates that all new construction and renovation project designs meet LEED Gold standards or higher. A total of 14 buildings are currently LEED certified (Yale University, 2011). Yale has installed dual-flush toilets and greywater systems to conserve water, as well as vegetated roofs and swales to manage stormwater (Sustainable Endowments Institute, 2011) |

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**Table I. Eco-campus: applying the ecocity model**
recruitment (Nicolaides, 2006). These programs provide employment and training opportunities as well as fairly paid work. By using local goods and services wherever possible, initiatives promote community partnerships and ethical purchasing (Downey, 2004). Investments in resource efficiency and clean energy will yield returns and savings that will compound over the years (Eagan et al., 2008).

A school’s implementation plan needs to be specifically tailored to the institution and sensitive to its culture, opportunities and strengths (Shriberg and Tallent, 2007). The definitions and interpretive approaches to sustainability have varied significantly among universities depending on the institution’s perspective and interests. The strategies are concerned with the management of extant systems and how to make them work efficiently and fairly (Downtown, 2009). The ecocity model provides a useful guiding framework to proactively address institutions’ ecological footprints and develop sustainable community practices.

4. Eco-campus: modeling the ecocity

Richard Register’s ecocity concept represents a holistic vision of the city as an organic ecological society in harmony with nature. The theory incorporates ideas about housing, urban planning, transportation, health, energy, economic development and social justice. Register (2006, p. 1) argues that “cities are by far the largest creations of humanity. Designing, building, and operating them has the greatest destructive impact on nature of any human activity”. Cities must become more central in the global agenda of sustainability due to their sizeable ecological footprints from the amount of energy and resources necessary to support the urban population and loss of sensitive habitat (Beatley, 2000). Ecocities propose a fundamentally new approach to building and living in cities, towns, and villages, a potentially more cohesive vision for human settlements. They present new opportunities to apply innovative green technology to areas such as public transit, district heating, building and design, as well as encourage major lifestyle changes in reducing resource consumption and unnecessary waste. The built environment needs to become as trim and resource-efficient as natural ecological systems invariably are (Register, 2006). The framework offered by sustainability cannot only be a matter of concern at the governmental level; rather, all institutions need to take an active role in achieving the goal of sustainability.

University and college campuses resemble cities on a smaller scale, thereby enabling the strategic application of the ecocity theory. Parallels between campuses and cities include an independent governing body, diverse-use infrastructure, a security force and legal system, a unique history and culture, and an independent communications network. They generally strive to produce aesthetically pleasing features through building design and landscaping, including parks, outdoor recreation facilities, garden plots and tree-lined streets. Both have structured housing, utilities, sanitation, land usage and transportation systems that service over 60,000 people in particular institutions (Eagan et al., 2008). HE institutions employ a stratified sample of society ranging from academic professors and professionals to custodial staff and construction workers. The financial influence and environmental impact also mirror that of cities on a smaller scale. Operations can generate greenhouse gases and waste as well as contributing to sprawl, inefficient resource use, and social, environmental and economic injustices (Betts, 2001). While these parallels are not all encompassing,
HE institutions, like cities, outsource the remainder of their needs to either state or provincial governments, or larger municipalities.

Campuses can incorporate Register’s ecocity concepts to focus on developing more economically, socially and environmentally sustainable practices. Much of campus’ existing building stock was constructed in an era of inexpensive energy with little regard of efficient heating, cooling, lighting or ventilation. HE’s built environment in the USA in 2008 consisted of more than 240,000 buildings with five billion square feet of floor space (Eagan et al., 2008). The building strategies follow ten principles in order to restore damaged urban environments, revise land-use priorities, promote social responsibility and create compact green cities (Register, 2006; Roseland, 1997). The principles can be applied to retrofit existing campus infrastructure with innovative appropriate technology. They also provide a reference for developing institutional assessment tools that identify and benchmark leaders and best practices. This will communicate common goals, experiences and methods while providing a directional tool to measure progress toward the concept of a sustainable campus (Shriberg, 2002). The ecocity model represents an ambitious checklist on how to redesign consumption, purchasing, transportation, design, construction and purchasing policies. It integrates diverse elements of university or college structures: education, economics, safety, health, the natural environment, mobility, the social environment, government and politics, recreation and culture (Downtown, 2009). This complements Register’s (2006) overarching ecocity goal to create environmentally friendly, diverse, and secure communities (Table II).

In particular, the eco-campus represents an opportunity to guide the implementation of innovative environmental measures in areas such as public transit, heating, design and construction. The expansion of university and college campus has had a similar environmental impact to that of city development: loss of sensitive habitat, damaged productive farmland and forestland, and high economic and infrastructural costs (Eagan et al., 2008). The eco-campus can also become a model for the external community by gathering and sharing effective ideas and practices. Universities can promote a positive image to the greater society that is increasingly concerned with the environmental movement.

1 Revise land-use priorities to create compact, diverse, green, safe, pleasant and vital mixed-use communities near transit nodes and other transportation facilities
2 Revise transportation priorities to favor foot, bicycle, cart, and transit over autos, and to emphasize “access by proximity”
3 Restore damaged urban environments, especially creeks, shore lines, ridgelines and wetlands
4 Create decent, affordable, safe, convenient, and racially and economically mixed housing
5 Nurture social justice and create improved opportunities for women, people of color and the disabled
6 Support local agriculture, urban greening projects and community gardening
7 Promote recycling, innovative appropriate technology, and resource conservation while reducing pollution and hazardous wastes
8 Work with businesses to support ecologically sound economic activity while discouraging pollution, waste, and the use and production of hazardous materials
9 Promote voluntary simplicity and discourage excessive consumption of material goods
10 Increase awareness of the local environment and bioregion through activist and educational projects that increase public awareness of ecological sustainability issues

5. Sustainable universities: from concept to practice

The ecocity model can be adapted to colleges and universities to meet the growing number of university leaders who value sustainability and are instituting structures to broaden and maintain engagement campus-wide (National Wildlife Federation, 2008). This movement has transformed existing campuses and moved from experimental to mainstream. Over three-quarters of the North American schools graded by the College Sustainability Report Card (Sustainable Endowments Institute, 2011) have full-time staff dedicated to sustainability. More than half of the schools have an office or center that is focused on guiding and achieving campus sustainability goals. In accordance with Register’s (2006) ecocity principle to work with businesses to support ecologically sound activity while discouraging pollution and waste, over two-thirds of schools have adopted policies and contracts to purchase a variety of environmental and ethical items, including paper products, electronics, local foods and appliances. Of the 667 American schools surveyed by the Campus Environment 2008: National Report Card on Sustainability in Higher Education, the majority continues to set and review campus-wide goals for energy conservation, building environmental performance, natural habitat protection and waste reduction. This commitment mirrors Register’s (2006) ecocity strategy to promote recycling, innovative appropriate technology and resource conservation while reducing pollution and hazardous wastes. For example, California Polytechnic State University in San Luis Obispo, CA, has developed a master plan that clearly articulates campus sustainability goals and targets. The university has reduced energy use per square foot of building space by approximately 15 percent. The campus has purchased solar photovoltaic (PV) array and is constructing a cogeneration facility. The university has diverted 70 percent of solid waste from landfills and is committed to on campus composting facilities to handle campus dining food waste (California State Polytechnic University, 2010; National Wildlife Federation, 2008).

The ecocity model can structure and facilitate the greening of physical operations, thereby encompassing facilities management, emissions reduction, resource conservation, transportation, ecological restoration and sustainable landscaping (Beringer et al., 2008). The model suggests using technologies that can be strategically applied to retrofit previously built campus infrastructure. For example, the Green Team at the College of Charleston (SC) renovated dormitories and other campus buildings in 2006 within three categories of alternations: low or no cost, moderate, and expensive or labour-intensive. The purpose was to involve every member on campus regardless of economic status. For example, low or no cost options were placing water bottles in toilet tanks and refrigerators, checking pipes for leaks, outlet plugs, heating, ventilation and air conditioning (HVAC) system filters, and water heater insulation jackets. Energy Star appliances, nontoxic cleaning products, and programmable thermostats could be installed at a moderate cost. Expensive or labour-intensive building retrofit measures included Non-VOC paint, ceiling insulation, storm windows, tubular skylight, waterless urinals and recycled carpeting (Zimmerman and Halfacre-Hitchcock, 2006). Register (2006) cautions against sites with extensive impervious surfaces, such as concrete parking lots and rooftops because they can generate high levels of stormwater runoff and contribute to a heat island effect. The ecocity principle discusses how to restore damaged environments, particularly creeks, shore lines, ridgelines and wetlands. Vegetation can mitigate these measures by directly shading heat-absorbing surfaces and indirectly through evapotranspirational cooling.
(McPherson, 1994). At the University of Alabama, porous pavement, retention ponds and vegetated swales are utilized to manage stormwater. Drexel University (PA) has developed green roofs and collects rainwater for toilet flushing to reduce stormwater runoff (Sustainable Endowments Institute, 2011).

Energy efficiency, recycling and resource conservation are major elements of the ecocity model that colleges and universities across North America have made concerted efforts to address. Schools have reported lighting, water, HVAC, and information technology energy upgrades (National Wildlife Federation, 2008; Sustainable Endowments Institute, 2011). Many schools have implemented efficiency design standards, LEED certification and audits to analyze retrofit opportunities. Comprehensive efficiency initiatives across entire campus have been launched to conserve resources. For example, Texas A&M University’s “Campus-wide Metering, Retrofits and Continuous Commissioning Program” reduced energy consumption by 33 percent and saved more than $50 million USD in electricity and water costs over ten-years (Eagan et al., 2008). Tufts University (MA) reduced the energy consumption of the ubiquitous cold drink vending machines on campus. Vending misers reduce the power input by 46 percent without compromising the products within. With a passive infrared sensor, the vending machine powers down when not in use while monitoring the ambient temperature to cool the machine at appropriate intervals. Furthermore, the university has invested in alternative energy by purchasing renewable energy credits and installing solar panels and solar hot water systems on campus buildings. Overall, the university has reduced greenhouse gas emissions by 27 percent from 2005 levels and aims to achieve a 75-85 percent reduction from 1990 levels by 2050 (Tufts University, 2010; Sustainable Endowments Institute, 2011). About 79 percent of the schools evaluated by the College Sustainability Report Card (Sustainable Endowments Institute, 2011) identified the sources and tonnage of their carbon emissions.

In accordance with ecocity design guidelines, campuses can convert to zero or lower-carbon energy sources by installing onsite generation and switching to lower-carbon fuels such as natural gas and biofuels. Universities should target the biggest energy consumers first: Eagan et al. (2008) suggest that laboratories, swimming pools and older buildings are usually the worst. Campuses can take measures to replace inefficient fume hoods, steam traps, fans and motors, as well as upgrading the efficiency of boilers and chillers. Reducing the need for heat, light and air conditioning can cut the energy requirements of each building. For example, implement thermostat setbacks that make adjustments for day, night, weekends and holidays. Retrofitting insulation, upgrading insulation, and weather sealing building exteriors, and increasing the use of daylight and natural ventilation further limits energy demands. Harvard University (MA) has completed green renovations to historic buildings on campus and earned LEED platinum certification on their Blackstone Office project. The building includes a ground-source cooling system, energy-efficient fixtures, Energy Star reflective roof and sophisticated ventilation controls. Construction and demolition waste was 99 percent recycled. More than half of the schools surveyed by the College Sustainability Report Card (Sustainable Endowments Institute, 2011) had at least one LEED-certified green building or were in the process of constructing one. About 79 percent had adopted campus-wide green building policies that specified certain minimum performance levels, however only 24 of schools reported having at least one Energy Star-certified building.
Renewable energy is a primary method to reduce pollution and hazardous waste while promoting resource conservation. Campuses opt to purchase megawatt-hours of renewable energy in the form of Renewable Energy Certificates (REC’s). This is an inexpensive way to reduce campus emissions and support the development of clean energy and usually the local economy (depending on the location of the energy generation site). However, REC’s should be an interim strategy while planning facilities to produce solar, wind, biomass, geothermal, and other renewable forms of energy generation on campuses (Eagan et al., 2008; Betts, 2001). In 2006, Monmouth University (NJ) installed a 454 kW solar electric system that covers 33,000 square feet on the roofs of four campus buildings. The assembly produces 468,500 kWh and saves $150,000 USD in costs annually. Wright Community College in Illinois uses sunlight to heat water for its cafeteria and science labs. The passive solar heater, installed in 2007, is mounted on a ten by 25 foot awning and produces up to 400 gallons of hot water a day. St Olaf College (MN) erected a 1.6 mega-watt wind turbine on college farmlands adjacent to the campus. It replaces one-third of the school’s energy needs and saves $300,000 per year in utility costs. Mt. Wachusett Community College (MA) replaced electric heat with a biomass electric heating plant in 2003. By using woodchips, it provides 85 percent of the entire campus’ heating needs. Richard Stockton College (NJ) has a large closed-loop geothermal HVAC system that was installed in 1994. Since then it has reduced the college’s electricity consumption by 25 percent and natural gas consumption by 70 percent (Eagan et al., 2008; Sustainable Endowments Institute, 2011; National Wildlife Federation, 2008).

The ecocity model provides strategies that promote voluntary simplicity and discourage excessive consumption of material goods. Almost every campus in Canada and the USA has initiated a diversified recycling program (Sustainable Endowments Institute, 2011; National Wildlife Federation, 2008). Institutions are recycling paper products, metals, plastics, construction waste, food scraps and landscape trimmings. For example, the Warren Wilson College (NC) recycling program has grown to process trash and over 25 different recyclables since 1981. The campus composts all pre- and post-consumer food waste from campus dining, offers reused materials through the campus Free Store and Surplus Program, and sells hand-crafted notebooks made from waste paper. Pacific University’s (OR) recycling centre processes paper, cardboard and other recyclables on campus. The centralized location reduces the number of trips garbage and recycling trucks are forced to make (National Wildlife Federation, 2008). About 98 percent of the schools surveyed by the 2011 College Sustainability Report Card devoted at least a small portion of food budgets to purchasing from local farms and producers. About 70 percent had campus community gardens and farms from which dining halls sourced vegetables, herbs and other foods. Fair trade coffee, cage-free eggs, hormone and antibiotic free milk were other methods taken by schools such as the University of Connecticut to promote sustainable diets University of Connecticut, 2007; Sustainable Endowments Institute, 2011).

North American campuses have complemented resource conservation and recycling efforts with green landscaping and grounds management. Schools have integrated native landscaping, pest management, invasive species removal and the provision of food and shelter to attract wildlife. Michigan State calls its campus a “5,000 acre arboretum” (Eagan et al., 2008). Campuses have allocated portions of land for natural areas, such as forest, wetland, nonagricultural fields and prairie. This has provided
campuses with a variety of benefits: carbon sequestration, reduced stormwater and pollutants, increased biodiversity, groundwater recharge and enhanced stream and water quality (National Wildlife Federation, 2008; Sustainable Endowments Institute, 2011). Seattle University (WA) has maintained the university’s 48 acres without the use of any pesticides since 1986. Weeds and pests are controlled through building healthy soil, native plant selection, biological controls and the use of insecticidal soaps and vinegar. The campus maintains a wildlife refuges as well as a 12,000 square foot ethno-botanical garden that was formerly turf grass (Seattle University, 2008; National Wildlife Federation, 2008). Arizona State University has adapted the campus landscape for a desert climate by planting species that are drought tolerant and adapted to harsh desert conditions, thereby requiring minimal water and fertilizers (Eagan et al., 2008).

Register (2006) advocates a revision of transportation hierarchies to favour foot, bicycle and public transit over cars. In general, more than half of North American schools have instituted bicycle-sharing programs, offering an alternative to those who drive short distances to campus. The University of Arizona has made campus bike-friendly with over 11,000 bike parking spaces and safe bike routes. In 2007, students at Willamette University (OR) founded a bicycle repair co-op and rental program that is free to university students and staff (Eagan et al., 2008). Campuses have also promoted car-sharing programs and reduced-fare passes for public transit. The University of California Los Angeles organizes a vanpool program and offers discounted parking passes to commuters who carpool or use electric vehicles. The university operates a free shuttle system with buses that operate on natural gas (Sustainable Endowments Institute, 2011). Schools’ fleets have been converted to alternative-energy including hybrids, electric carts and vehicles fueled with biofuel and other flex-fuel. Students at Appalachian State University (NC) voted in 2005 to build a “closed-loop” processing system for biodiesel fuel. This includes solar-thermal water heating and a solar PV system to meet all necessary electricity and hot water needs, as well as a greenhouse with aquatic habitats to treat wastewater. An 80-gallon processor converts waste vegetable oil to biodiesel and then blends it with regular diesel to fuel campus vehicles (Eagan et al., 2008). The University of Washington’s award-winning transportation program offers a variety of transport options to cut the school’s carbon footprint. The U-Pass provides unlimited access to public transit, discounts on bicycle and pedestrian safety equipment, emergency ride home program, and merchant discounts on items ranging from ice cream to theatre tickets. Car and vanpooling is subsidized, and parking discounts are available for drivers who commute by more sustainable alternatives most of the time. The UCAR program offers hybrid vehicles at an hourly rate to individuals conducting university business. More than three-quarters of the campus commutes using an alternative to driving alone (University of Washington, 2011; National Wildlife Federation, 2008).

In many HE institutions, students are a driving force behind campus sustainable development. This takes the form of interest groups, sustainable residences, pledges, jobs, and career fairs (Beringer et al., 2008). Many schools have Eco-Reps or other similar programs to promote voluntary behavioural change on campus. Student orientations now include an awareness and educational component, such as zero-waste meals, discussions, and active volunteer projects. Schools offer green residences where students reduce their resource consumption and learn strategies first-hand to live sustainably (Sustainable Endowments Institute, 2011). For example, students residing in Columbia
University’s (NY) GreenBorough House can experiment with sustainable living. Student groups have worked to develop a green purchasing program, energy-saving competition, the distribution of efficient lightbulbs, and a community garden. At Indiana University, a conservation competition resulted in 2,530,958 gallons of water savings and an 800-ton carbon emissions reduction. Engineering students of Johns Hopkins University (MD) work on recycling and biodiesel projects on campus as part of their Engineers for a Sustainable World program (Sustainable Endowments Institute, 2011).

These programs ensure that future generations will have the chance to gain a deeper understanding of social, economic and environmental issues beyond theoretical knowledge. Students learn from everything around them, and these activities form a complex web of experience and learning (Cortese, 2003). Education, fieldwork and research, on campus amenities, and university operations all affect the university experience. The focus on the university itself engages students in understanding the “institutional metabolism” and impact of materials, goods, services and daily activities (Cortese, 2003, p. 19). Students can be made more aware of their ecological and social footprint and become actively engaged in the practice of sustainable living.

6. Conclusions
While there is no single system that will simultaneously deliver social justice, economic success and ecological sustainability (Low et al., 2005), colleges and universities are striving to find the best combination of imperfect mechanisms to guide future development. The ecocity building sequence starts with the community foundations and a local focus on land use patterns. It provides a map and guide to promote ecological sustainability, regeneration, economic success, and social justice (Register, 2006). The HE campus is the ideal location to apply Register’s innovative ecological principles and establish comprehensive across-the-board stewardship in both educational and operational areas. Sustainability is a broad and general topic that needs to be better integrated into the economy, society, politics, culture and overarching structure of the university. HE institutions should view this as a unique opportunity to become innovative green leaders. Universities and colleges are major places to build social culture, and should not be under-estimated as the ideal ground to educate, motivate and model sustainability.

Note
1. The College Sustainability Report Card 2011 evaluated the 300 colleges and universities in the USA and Canada with the largest endowments, as well as 22 additional schools that applied for inclusion. The schools are located in all 50 US States, the District of Columbia, and eight Canadian provinces.

References


Further reading


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