A Survey of Green University: Challenges and Opportunities

Pornphisud Mongkhonvanit¹, Thakrit Panklib², and Sumit Kumar Bhalla³
Siam Technology College, Thailand
¹pornphisud@siamtechno.ac.th, www.siamtechu.net
²drthakrit@siamtechno.ac.th, www.siamtechu.net
³mr.sumit@hotmail.com, www.siamtechu.net

Abstract - Universities can play a significant role in forging the path to a sustainable future. By their nature, universities are focused on research, teaching and services whereas institutions tasks are to provide training to the world's future leaders. As universities’ mission and activities are not directly tied to financial or political gain, they have the capacity to test systems and technologies, and to advance innovative solutions for global challenges in ways that companies and municipalities cannot. Academic staff members are generally considered authorities and have the capacity to actively contribute to solutions at various stages and levels. As we demonstrate to the public, staff, and students that we are responsible and willing to take the lead in creating a more sustainable tomorrow. In other words, we have the ability to manifest sustainability not only in theory, but also in practice which can apply in university campuses.

Keywords - Green University, Sustainable, Environment, Energy Conservation

I. INTRODUCTION

Universities provide training to tomorrow’s leaders. We have the opportunity to create cultures of sustainability for today’s students, and to set their expectations for how the world should be. At the same time, we are creating healthier, cleaner, safer, and more productive workplaces for university employees and students by providing real world examples of environmental, financial, and social successes. This study reflects both the challenges and opportunities of campus sustainability with focus on the environmental aspects of sustainability, and it offers key tactics and lessons such as benefits, planning and surveying of successful green University which is an example to inspire innovation and creative action in universities. They develop the tools and techniques needed to implement innovative green technology and methodology. Through comprehensive sustainability plans that integrate curriculum offerings, research initiatives, student engagement opportunities, and collaborative partnerships, educational institutions can realize the concept of “campus as teacher.” In the process, green campuses provide students opportunities to develop green job skills that prepare them to be top candidates in an increasingly competitive job market.

II. BENEFIT OF GREEN UNIVERSITY

What is a green university? There are several principles that frequently reoccur in Green University definitions such as protecting the environment, lowering operating costs, improving the health and quality of the learning environment, and integrating learning opportunities with the built environment. Ultimately, university boards and their university communities are in the position to define “Green University” for themselves. A process can be an important step in developing a successful, lasting, and locally responsive Green University. Why
green our university? Some benefits will address unique issues faced by each board or community but other benefits are more universal.

A. Energy Efficiency
With demonstrable operational cost savings and reduction of environmental impact, energy efficiency should be the first consideration for any Green University. Significant cost savings can be achieved from available and by using relatively efficient technologies. Emissions from energy use also represent one of the largest impacts to any university which can have on the environment.

B. Financial
A green University (depending on the green features pursued) can add 5% to 10% to the initial cost. This scale of incremental cost can be quickly recovered from lower operating costs that will continue over the life of the building.

C. Promoting Environmental
By engaging and inspiring students, the building itself can educate the next generation about their role in conserving resources and reducing waste. Green University will also support the emerging green building industry, and enhance awareness of sustainable design in all sectors of the economy.

D. Demonstrating Environmental
Sustainability and expect from the public institutions to act responsibly with regard to climate change and other factors affecting the environment. The building of Green University is a tangible way for the education sector to show what can and is being done with respect to: Energy conservation, Reducing greenhouse gas and smog emissions, reducing water use and improving water quality, diverting material from landfill, saving topsoil and native species habitat, and promoting active transportation.

E. Supporting Student
Green University can support student achievement in three ways: 1) They can save money from operations that can be redirected to the classroom. 2) They can provide teaching environment that are more conducive to learning through improvements in acoustics, lighting, temperature, and air quality. 3) They can engage and inspire students by demonstrating both simple and complex ways to bring about innovation and change.

III. GREEN UNIVERSITY SURVEY
As part of this paper’s goal to provide information that can assist those universities who are beginning their journey of campus greening, this section provides a compilation of various case studies of exemplary campus greening initiatives from around the world.

A. Australia: University of New South Wales (UNSW)

Fig 1. Tyree Energy & Technologies Building, University of NSW, Sydney

University of New South Wales (UNSW) each year educates more than 50,000 students from over 120 countries in eight faculties. Identified issues; indoor environmental quality, energy consumption, water conservation, and carbon emission.
1) Outcomes

- Environmental Management: The head Contractor, Brookfield Multiplex is ISO 14001 certified ensuring that sound environmental practices are involved in all decision making processes associated with the design and construction of the building.

- Waste Management: The construction waste management plan and agreements with waste contractors ensured over 80% of the construction waste being recycled or reused.

- Tri-generation: A tri-generation plant is installed not only to service the TETB but also to export both electricity and chilled water to surrounding buildings. This ensures that the tri-generation system operates for longer hours and maximizes the benefit of the reduced carbon emissions provided by this method of power and chilled water production.

- Energy Efficiency: Air conditioning load is reduced by linking the air conditioning controls to motion sensors and carbon dioxide sensors in all spaces. An underground labyrinth and bore water is also used to pre-cool/warm incoming outside air.

- Energy Production: In addition to the tri-generation system, it is also furnished with 1,000sqm of photovoltaic panels which will produce up to 150KW of electrical energy.

- Water re-use: An existing bore feeds into a storage tank which also collects rainwater from the roof. This systems feeds into the campus bore water system which is then treated and returned to buildings as non-potable water. This is used in TETB for toilet flushing, laboratory water, and makeup to the evaporative cooling systems. Fire system testing water and run-off from hardstand area is also returned to the aquifer through the percolation chamber.

B. Canada: University of British Columbia

Fig 2. University of British Columbia, Vancouver Campus

The Vancouver Campus of the UBC educates more than 47,000 students each year in hundreds of academic programs through 12 faculties and 14 schools. Identified issues; the urban population explosion, unprecedented demand for housing, amenities and necessities in the coming decades, increased consumption of natural resources, although working hard to find and implement solutions, the public, private and not for profit sectors are largely working in isolation, not benefiting from each other’s discoveries.

1) Outcomes

- North America’s greenest building by being net positive on energy, water self-sufficient, having 100% access to daylight and superior natural ventilation amongst many other sustainability features.

- It will be an international center for research, partnership and action on sustainability issues (CIRS), including green building design and operations, environmental policy and community engagement.

- CIRS is used as a platform to test and showcase the technical performance and usability characteristics of the building’s technologies and systems, and to generate new knowledge about how to construct and maintain sustainable buildings using building itself as the lab.
C. Denmark: University of Copenhagen

![Image](Fig 3. University of Copenhagen, Denmark)

The University has about 1,000,000 sqm premises on four campus areas in central Copenhagen. The University consists of 8 faculties and more than 100 departments and research centers. It has more than 7,000 employees and over 37,000 students. Identified issues; considering its size and research profile, recognizes its green responsibility and wishes to become one of the greenest campuses in Europe.

1) Outcomes
- The university aims to reduce its energy consumption and greenhouse gas emissions by 20% between 2006 and 2013.
- Improving thermal performance of existing buildings, energy smart installations in buildings, facilitating energy smart conducts by employees and students, and energy efficient purchases.
- The energy savings projects are expected to result in annual reduction of 1,700 tons of CO$_2$ emissions and annual saving of DKK 4.6 million.
- By 2013, at least 75% of all purchases via agreements to require sustainability.
- The University develops an annual Green Campus Action Plan.
- Partnered increasing the Green Lighthouse, Denmark’s first carbon neutral public building, which provides for its total energy needs with 35% of solar energy and 65% of district heating with heat pump. 76m$^2$ of solar cells on the roof power the building’s lighting, ventilation and pumps.

D. Kenya: University of Nairobi

![Image](Fig 4. University of Nairobi, Kenya)

The University of Nairobi, the only institution of higher learning in Kenya, has so far offered academic programs and specialization in approximately 200 diversified programs on its seven campuses in the capital city. Identified issues; the environmental audit highlighted, University does not have an Environmental Policy to guide its operations. The measurement culture at the University is weak as far as resource use and waste generation are concerned, although there is a procurement policy which is informed by the Government, environmental considerations do not seem to be important in the procurement of goods and services for the different University units, the University does not have an asbestos management plan despite having buildings with asbestos roofing, no recycling takes place at the University, there has been no air quality or noise monitoring at any site in the University, there is need for staff awareness and training in environmental matters.
1) Outcomes

- The University developed environmental policy in 2009; and a maintenance policy for all assets owned by the University in 2010 main streaming environmental considerations.

- All units of the university, as well as to some degree the students have embraced environmentally sustainable practices.

- The University intends to appoint a Standing Environmental Policy Steering Committee and allocate budgets for environmental management as stated in the Environmental Policy.

E. Turkey: Middle East Technical University (METU)

The Middle East Technical University (METU) is located on a 4500 hectare Campus about 20 km from the center of Ankara; it includes 3,043 hectare of forest area and the Lake Eymir; ETU runs about 206 programs serving over 24,500 students including more than 1,700 students from over 85 different countries. Identified issues; the disappearance of wilderness, degradation of biodiversity and extinction of species due to urbanization and other human processes.

1) Outcomes

- The area with non-irrigational plants now covers 3,000 hectares. Plants that require irrigation cover 800 hectares, and are located within the built environment of the Campus where they form a beautiful landscape along the pedestrian network. The remaining 500 hectares consist of lakes and ponds.

- The METU green area helps purifying Ankara’s air, filters wind and noise, stabilizes the microclimate; i.e. makes the city much more sustainable and livable.

- The built environment in METU has been created in line with sustainable design principles and includes the use of local construction materials. One of the buildings under construction is designed to include photovoltaic panels that will provide energy for the operation of the basic equipment within the building.

F. USA: Princeton University

The university’s main campus in Princeton Borough and Princeton Township consists of approximately 180 buildings, spanning more than four centuries, on 500 acres. The university follows a residential college system and 98% of the undergraduate students live on the campus; The University’s more than 1,100 faculty members educate more than 7,500 students each year in 34 departments and 46 interdisciplinary certificate programs. Identified issues; environmental impacts, responsibility as a major research university to contribute to shaping the national sustainability agenda, to promote the development of sustainability on its campus, and to prepare its students.
1) Outcomes

- The university aims to reduce its greenhouse gas emissions to 1990 levels by 2020, while expanding its campus by 185,000 m².

- All non-laboratory buildings are expected to be 50% more energy efficient than required by regulations. Implementation of its Energy Master Plan has resulted in annual savings of $1.7 million in energy costs and 10,000 metric tons of CO.

- The university will provide incentives to the faculty and students to reduce the number of cars coming to the campus by 10%.

- All residence halls have low-flow water fixtures, which are estimated to have cut water use from 2006 by 30%.

- The university purchased 29% less paper in 2011 than in 2008. A total of 83% of the paper purchased in 2011 was of 100% post-consumer recycled chlorine free paper.

- Various resource conservation initiatives have increased sustainable food purchases to about 66%, and about 59% of the food served in the dining halls comes from within 250 miles radius.

- In the past one year more than five acres of wood lands were restored with 215 new trees and 197 new shrubs.

G. China: Tongji University, Shanghai

Tongji University has four campuses, with the total area of 1,501,281 m², and 420 buildings where around 39,000 students study every year in 29 faculties. Identified issues; the need to take responsibility as a major research university to contribute to shaping of the national sustainable campus agenda. The need to promote sustainability on its campuses in terms of energy use, research, education, student engagement, and social service.

1) Outcomes

- Campus energy management system (CEMS) is established to monitor and report energy use of the whole university and 182 buildings have online monitoring.

- In total of 91 courses have been developed that include sustainability in their curricula.

- Various initiatives on sustainability have effectively stimulated student interest in sustainable design; they have successfully designed a bamboo solar house and a container solar house showing good sustainable concepts in Solar Decathlon in 2010 and 2011.

- Building retrofit of total area of 296,647 m² is on progress since 2009, which includes the use of sewage source heat pumps, water recycling projects, vertical and roof greening, etc. in addition to energy and water efficiency measures.

- One of the retrofit projects included renovation of an existing abandoned car parking building, which was originally planned to be demolished, into an office building of five stories and 68,000 m². The building, for Architectural Design & Research Institute (ADRI), is now a demonstration building with a 630KWp BIPV system and a center of education on energy conservation and renewable energy technologies.
IV. CONCLUSIONS

While the opportunities to explore such green possibilities are evident, some questions remain whether the combination of conservation and renewable energy will be enough to stabilize, if not, reduce greenhouse gases. It is anticipated that human behavior, including politics, may prove to be a bigger stumbling block than a lack of technological advances. Colleges with a substantial push from their students are anticipated to continue reporting an increased focus on sustainability. Universities have long been agents of change catalysts for social and political action as well as centers of learning. Universities not only educate most of the world’s leaders, decision makers and teachers and advance the boundaries of knowledge, but as major employers and consumers of goods and services, they play a significant economic role nationally and globally.

REFERENCES

(Arranged in the order of citation in the same fashion as the case of Footnotes.)


