

Monash University's Gippsland Campus' innovative *going green*-based system for infrastructures education with environmental cultural change applications

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ABSTRACT: Higher education across the world has adopted the movement towards *going green*. Many universities and colleges are in various stages of organising for sustainability. However, no evidence is seen in the literature that one exists for utilising its own university campus as an environmental-learning laboratory for a civil and environmental engineering degree programme. The Gippsland Campus of Monash University in Australia has become an actual sustainability-learning laboratory for its Bachelor of Civil and Environmental Engineering programme. Through this unique relationship between the Gippsland Campus' Bachelor of Civil and Environmental Engineering and the Campus' Facilities and Services Division, students are exposed to the environmental projects undertaken on Gippsland Campus from their concept through to completion, and can evaluate and measure the environmental impact as a result, creating a sense of ownership to the significant improvements on campus, consequently adding to the students' experience while they study for their degrees. The outcomes are greening the Bachelor of Civil and Environmental Engineering, greening Monash University Gippsland Campus and fostering cultural changes on campus.

TALLOIRES DECLARATION

Composed in 1990 at an international conference in Talloires, France, this is the first official statement made by university administrators of a commitment to environmental sustainability in higher education. The Talloires Declaration is an international, voluntary 10-point agreement that focuses on universities' obligations to promote awareness and understanding of sustainability issues through teaching, research and community engagement [1][2]. The 10 points include *Increase awareness of environmentally sustainable development; Create an institutional culture of sustainability; Educate for environmentally responsible citizenship; Foster environmental literacy for all; Practice institutional ecology; Collaborate for interdisciplinary approaches and maintain the movement.* Monash University in Australia officially signed the Declaration. When the Declaration was initiated in 1990, there were 31 signatories; there are now over 350 signatories worldwide signed by university presidents, vice-chancellors and chancellors in over 40 countries.

UNITED NATIONS RESOLUTION

In December 2002, the United Nations (UN) General Assembly adopted resolution 57/254 on the United Nations Decade of Education for Sustainable Development (2005-2014). The resolution was introduced by Japan and cosponsored by 46 countries. Resolution 57/254 named the United Nations Educational, Scientific and Cultural Organization (UNESCO) as the lead UN agency responsible for the Decade of Education for Sustainable Development [3]. The goal of Education for Sustainable Development (ESD), which is the focus of the present paper, is to reorient education in all forms, so that we collectively consider the long-term future of the economy, ecology and equity of all communities in the decisions and actions we make and take. Internationally, it is recognised that education is the primary vehicle to increase the ability of

people to proceed along a path of sustainability. In order to take the necessary steps, education, in all its make-ups, must foster the capacity of individuals to shift their values, behaviour and lifestyles towards one that supports a sustainable future. Higher education across the world has adopted the movement towards sustainability. Many universities and colleges are in various stages of organising for sustainability [4]. Monash University's Gippsland Campus is at the forefront of such a sustainability thrust as shown in the present paper, which is an innovative advanced application to the Talloires Declaration and UN resolution 57/254.

GOING GREEN

The words *sustainability* or *going green* for any given university campus has, in the context of the present paper, the following basic components: improving and maintaining economic efficiency; shielding and reinstating ecological systems; and enhancing the well-being of humankind.

APPLIED GOING GREEN CAMPUS

In this article, the authors define applied *going green* campus initiatives as the programme that applies all the above campus *going green* components to change the Campus to be sustainable, educate students on sustainability and realise cultural changes. An applied *going green* campus here means specifically changes in the way we think, act and educate students. The way that grounds are maintained, buildings constructed, research performed, teach into the Bachelor of Civil and Environmental Engineering, offered at the Gippsland Campus of Monash University, taught [5], and sustainability cultural change aspects implemented. It is believed that the educational side of an applied *going green* campus is an investment in the future. The green investment in the education of students on infrastructures sustainability has a long-term benefit. These students will eventually become leaders in their

community and bring with them the important concepts of sustainability. Campus-applied *going green* has allowed students in the Bachelor of Civil and Environmental Engineering to learn the required curriculum while applying what they learn to real world Campus problems as their big environmental laboratory. This learning model is very well suited to a rural campus environment like the Gippsland Campus and is the way to integrate a knowledge base with local requirements and applications.

GIPPSLAND CAMPUS AS A SUSTAINABILITY LAB

In this article, the authors show that the Monash University's Gippsland Campus has become an actual sustainability-learning laboratory for the Bachelor of Civil and Environmental Engineering. For example, take Monash's energy guide, available for students on the Internet and as distributed booklets [6]. Another example, students are made aware of the how Monash University, Australia, adopted the movement toward sustainability (UN resolution 57/254) by recently announcing the University's commitment to reduce the energy consumption of all Australian campuses, including the Gippsland Campus, by 20% from 2005-2010. This is the largest energy reduction plan sought by any of Australia's universities and an extremely ambitious challenge. Such a plan places Monash at the forefront of Australian universities as a leader in the global commitment to addressing climate change [7]. Monash University's target has two components: a 10% reduction to be achieved through infrastructural improvements and a further 10% reduction from cultural change. The University is encouraging everyone to be more aware of how their office and environment use energy and to help reduce this, while the University will continue to pursue greener alternatives and improve infrastructure. The above measures will help the University achieve its target to reduce energy by a fifth over five years. The Gippsland Campus is leading Monash University in meeting the target among other Monash University campuses. In fact, the Gippsland Campus has total energy savings to date of 11.7% and total additional energy savings expected by the end 2007 of 4.8%, meeting comfortably the University target.

At Monash University's Gippsland Campus, a unique strategic alliance was formed between the Campus' Facilities and Services Division, and the Bachelor of Civil and Environmental Engineering [5][8]. This includes, for example, having the Campus' Facilities and Services Manager as a guest speaker for the infrastructures units of the Bachelor of Civil and Environmental Engineering. The educational rationale of this alliance is to engage students with the Campus' ongoing environmental achievements aiming at the following educational objectives for the benefit of Bachelor of Civil and Environmental Engineering students:

- To develop the skills and knowledge for the design and management of sustainable civil and environmental engineering infrastructure and solutions;
- To develop an ability to carry out such engineering activities in a manner that minimises or eliminates negative environmental impacts;
- To equip students with the knowledge and skills base to identify and implement civil and environmental engineering sustainability changes;
- To develop an appreciation and knowledge of engineering sustainability strategies for identifying and mitigating any negative environmental impacts;

- To develop the appropriate skills in analysis, synthesis, design, project coordination and evaluation of environmental impact assessments;
- To develop students' environmental engineering communication skills for convincing others, by persuasion and by examples, of the necessity for environmental cultural change as applied to the Campus community in the first instance, and the environmental international community at large.

ECOLOGICALLY SUSTAINABLE CAMPUS PLAN

Sustainable design is the method of design civil and environmental engineering projects that comply with the principles of economic, social and ecological sustainability, and includes factors such as sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality and innovative design process. The goals of the sustainable ecological Campus plan include:

- Creating an excellent learning environment based on an international and sustainable competitive campus;
- Applying green buildings and sustainable plan concepts to structure the Campus for a green cultural and green educational environment;
- Reviewing the overall Campus and environment of the community to establish the Campus to be a springboard for green growth.

As an actual teaching illustrative example, students are taught ecologically sustainable design utilising the Campus' new auditorium building. The \$5.5 million new auditorium, currently under construction, set to be completed in June 2008, has been designed to incorporate the above-mentioned environmentally sustainable design elements (see Figure 1).



Figure 1: The Gippsland Campus' new auditorium building expected to be completed in June 2008.

The auditorium space has been designed as a multipurpose venue with the operable walls allowing for flexible room sizes that vary from 100 m² to 750 m². The auditorium's environmental sustainable design features studied by students include:

- A high level of acoustic insulation to ensure that rain noise is minimised and acoustic panels on the ceiling to reduce reverberation;
- Rainwater will be harvested in large tanks located in the basement; this water will be used for landscape irrigation;
- Waterless urinals will be used to minimise water consumption;
- Solar preheating for domestic hot water;

- Skylights in the central corridor zone with motorised louvers for black out/brown out;
- Energy efficient T5 lamps with electronic ballasts used in all fittings;
- Flexible lighting with sensor controls to ensure the maximum utilisation of natural light;
- Ultra-low brightness diffusers used to minimise glare;
- Roof-top ventilation cowls and low speed fans to allow the economy cycle to be operational when external temperature conditions are suitable;
- Independent controlled air conditioning in each separate space to ensure units are only used when areas are occupied;
- A Variable Refrigeration Flow (VRF) mechanical system comprising fan coil units serves each room connected to central heat recovery air-cooled condensing units. Each space is controlled by a separate unit to provide maximum flexibility and ensure that units are only operating when rooms are in use. VRF fan coil units will provide adequate noise attenuation for classrooms and auditorium functions.

CAMPUS ENERGY MANAGEMENT

Students are taught and quizzed in relation to Figure 2, which shows the breakdown of the Gippsland Campus' energy usage. The pie chart diagram guides students to think how to save energy effectively on the Campus by looking further at the Campus' air conditioning and lighting. Students are taught examples of such savings and how the Campus' preheating/cooling has been rescheduled to operate an hour before occupation rather than two hours. Also, the heating/cooling for teaching areas on campus is scheduled only when classes are held, rather than the whole day. Consequently, the Campus' operation of heaters and air conditioning systems will be improved, resulting in a considerable saving of energy and greenhouse gases. Therefore, a 3% energy saving is expected at the Gippsland Campus or 126,000 tonnes of greenhouse gases saved annually. Another Campus *going green* example explained to students is that 10% of the Campus' power needs are purchased from renewable sources. This has reduced the emission of approximately 600 tonnes of greenhouse gases per year. Further energy savings examples taught to students include:

- The Campus' external lighting has been upgraded, resulting in energy reductions of 21,000 kW per annum or 31 tonnes of greenhouse gases. This has resulted in improved safety for students, staff and visitors;
- Additional saving is also accumulated by knowing that the Campus' sports field lighting is only turned on when required while the sports field is in use. Students are asked to come up with additional energy saving measures;
- The installation of motion detectors to operate standalone air conditioning in offices by end 2007;
- The installation of light level sensors in the Campus library by end 2007;
- Ad hoc after hours room bookings: areas/rooms are allocated, with minimum energy use areas taking priority;
- Lighting efficiency: de-lamping hallways and replacing lamps with energy efficient T5 tubes is expected to achieve an energy saving of approx 376,200 kW or a reduction of 543 tonnes of greenhouse gases per year;
- Heating systems: all electric hydronic calorifier heating systems on campus have been replaced by gas-fired boilers with an estimated energy savings of 710,000 kWh or a reduction of 1,025 tonnes of greenhouse gases;

- Programme dual set point for heating and cooling by the end of 2007: heating is set on 21° Celsius while cooling is set on 23.5° Celsius;
- Students' attention is brought to the Campus' energy savings pilot programmes for further study, such as solar hot water to be installed in the cafeteria by end 2007;
- Investigation of the operation of boiling hot water units and hot water services to improve efficiency by end 2007;
- The Campus cafeteria kitchen equipment has been upgraded to more efficient gas operations;
- Further water conservation is achieved by refurbishing the obsolete 140,000-litre electric heating tank, which will complement existing water savings on campus.

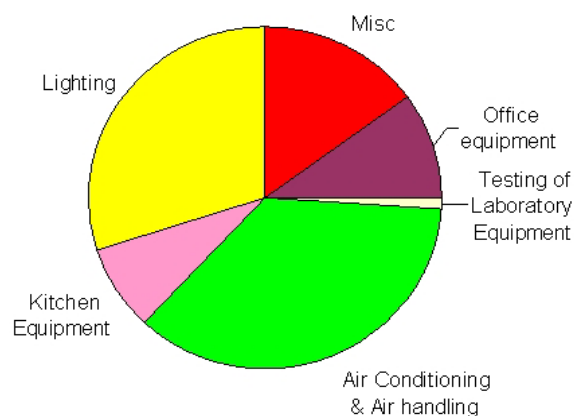


Figure 2: Breakdown of the Campus' energy usage.

CAMPUS WATER MANAGEMENT

Water is the world's most precious resource. Water conservation and management are among the University's top priorities [9]. The University policy on water is discussed with students, including water conservation in the above-mentioned new Campus auditorium building. Students are taught additional Campus measures of saving water such as:

- Flow restriction valves have been installed to all taps throughout the Campus;
- Installation of a 9,000 litre water tank for the washing of fleet and grounds vehicles. This is also used for the washing of all air handling and air conditioning unit filters;
- Harvest of storm water: storm water is being collected and used for toilet flushmeters and other purposes in numerous buildings on campus. A saving of 4.28 million litres of water is expected per annum.

CAMPUS EROSION MANAGEMENT

One of the many teaching examples that students are exposed to is the successful development of Eel Hole Creek Ponds on the Campus (see Figure 3). The project has led to:

- Reduction of erosion;
- Minimisation of nutrient flow downstream;
- Subsequent reduction of blue-green algae outbreaks on downstream water bodies;
- Litter elimination by installing a litter trap.

The Gippsland Campus is located in Churchill. The wider community of Churchill has also benefited through the development of this project.



Figure 3: The Eel Hole Creek Ponds ecology project.

LAND FOR WILDLIFE CAMPUS ACCREDITATION

Students are actively involved in the Gippsland Campus' environmental cultural changes, eg the reestablishment of wildlife on campus under supervision. An extensive native planting programme, focusing on the installation of plants endemic to the Churchill area, encourages birds and wildlife to inhabit the Campus. This programme has resulted in the Campus being awarded *land for wildlife* accreditation.

CAMPUS GREEN PURCHASING

Students are exposed to green purchasing examples such as:

- As part of the green fleet agreement, 1,462 trees are planted *annually* on behalf of Gippsland Campus;
- Hybrid electric/petrol and diesel fuelled vehicles have been purchased as Campus pool vehicles;
- The Campus has applied for additional funding for energy savings and environmental projects in minor works submissions for 2008.

CAMPUS WASTE MANAGEMENT

Students are exposed to recycling examples, for example:

- A garden waste recycling programme has been installed that incorporates an industrial mulching machine. Garden refuse is now recycled as mulch for use on garden beds around the Campus. Mulch breaks down into compost to provide nutrients for plants and saves considerable watering;
- Recycled paper is separated at each workstation;
- Replacement of paper hand towels with energy efficient electric hand dryers in toilets has reduced 1.5 million lineal metres of Campus hand towels going into landfill.

ONGOING CAMPUS NEW SUSTAINABILITY IDEAS

Students are asked to come up with new Campus living sustainability ideas modelled on the following Gippsland Campus initiative: existing external ashtrays have been replaced with environmentally friendly smokers' poles.

DISCUSSION

Because of the Talloires Declaration and UN resolution 57/254, the environmental awareness on college and university campuses around the globe has gained momentum with environmental action on teaching, research, policy formation and efforts to make specific environmental improvements on campuses. Many *stories* have emerged since then [10]. However, the applied *going green* educational technology of the present article emphasises the following message:

When teaching going green practices, a university should practice as it preaches. In addition, going green technology on campus gives students live examples of the very systems they are learning [10].

This message has been innovatively applied in the present article through the above-mentioned unique relationship between the Campus' Facilities and Services Division, and Civil and Environmental Engineering. Students are exposed to the environmental projects undertaken on the Gippsland Campus from their concept through to completion. Students can readily evaluate and measure the environmental impact, thereby creating a sense of ownership to the significant improvements of the Campus' green identity, adding to students' experiences while studying for their degrees [11][12].

CONCLUSIONS

Monash University's *going green* practice within the Bachelor of Civil and Environmental Engineering allows unique links to be forged between the teaching of the degree programme and the actual *going green* practice of Monash University. This connection results in enormous opportunities for mutual benefits leading to the greening of the Bachelor of Civil and Environmental Engineering, the greening of Monash University's Gippsland Campus, and the greening of cultural changes. This is in line with the vision of the American Society of Civil Engineers of future civil engineering in 2025 [13].

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