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# PHOTOVOLTAICS EDUCATION OUTREACH TO THE ASIA-PACIFIC REGION

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## ABSTRACT

In an effort to reduce the barriers to Asia-Pacific students taking advantage of opportunities for studying photovoltaic engineering in Australia, funding has been sought from the Australian Government under the Asia-Pacific Partnership on Clean Development and Climate (AP6) and in-principle approval was announced in November 2006. These funds will support tuition fees at UNSW for (a) third and fourth year undergraduate study for students from particular prestigious Chinese universities with which articulation agreements have been negotiated; (b) postgraduate coursework students from China, India and South Korea; and (c) PhD students from those same three countries. In addition, the Chinese-Australian photovoltaics manufacturer, Suntech Power Co., has offered sponsorship of postgraduate coursework places for selected Chinese students.

## 1. INTRODUCTION

Tuition fees and becoming sufficiently proficient in the language of tuition can be a significant disincentive to prospective international students. This is currently of interest as the Asia-Pacific region rapidly expands its photovoltaics manufacturing capacity while relying on a small related research and education infrastructure. A short-term solution is urgently required for the dearth of trained and educated photovoltaics engineers and scientists.

Australian researchers and educators have been to the fore in photovoltaics science, engineering and teaching but Australian photovoltaics manufacturing is restricted to the Sydney factory of BP Solar and the pilot plant of Origin Solar in Adelaide. Hence, the research and education strengths in Australia are geographically separated from the photovoltaics manufacturing powerhouses, which are currently Asia and Europe. Barriers presented for Asia-Pacific students intending to study or research photovoltaics engineering in Australia include tuition fees, English

language proficiency and living expenses. In this paper we describe efforts underway to increase accessibility for international students from the Asia-Pacific region to the photovoltaics coursework and research programs at The University of New South Wales (UNSW), with assistance from the Australian Government, through the Asia-Pacific Partnership on Clean Development and Climate (AP6) and from Suntech Power Co.

## 2. OUTREACH TO ASIA

UNSW has hosted photovoltaics research activities since the 1970s, with an almost complete focus on crystalline silicon, which continues to dominate industrial photovoltaics production, as the active material. It has, consequently, built up an extensive body of experience and knowledge that has, of recent years, underlain the establishment and development of undergraduate and postgraduate teaching activities.

The former Key Centre for Photovoltaic Engineering was started in 1999, after the award of special funding from the Australian Government's Australian Research Council (ARC) to promote teaching and research in the area of photovoltaics. The main initiative of this Key Centre was the establishment of the world's first specialist undergraduate degree in Photovoltaics and Solar Energy. This demonstrated an early appreciation of the growing importance of the field of renewable energy, since it was one of only eight such Key Centres awarded Australia-wide across all disciplines. Administratively, the educational and research activities, the latter dominated by the ARC Photovoltaics Centre of Excellence, were incorporated, on 1 January 2006, into a new School, the School of Photovoltaic and Solar Energy Engineering, the tenth within the UNSW Faculty of Engineering (1).

Teaching of the Bachelor of Photovoltaics and Solar Energy program (2) began in 2000. In addition to the usual engineering preparation topics in science and mathematics,

the program did and does encompass photovoltaics science and technology development, the area of greatest experience in the Centre, manufacturing methods, applied photovoltaics systems engineering, system maintenance, reliability, lifecycle analysis and energy policy. Students also have access to modules on broader renewable energy aspects, particularly energy end-use efficiency, solar thermal, wind and biomass energy engineering and passive and active solar architecture and building design. Since 2003, a total of 70 students have graduated (Fig. 1), and, as of the first semester of 2007, a total of 101 students were enrolled in this program.



Fig. 1: Part of first graduation class with some staff, 2003.

Teaching of a new Bachelor of Engineering program, this one in Renewable Energy Engineering (3), was started in 2003. The areas of coverage are similar to those described above and there are several shared courses but the strong focus on photovoltaics is not retained in more recent program. The other obvious difference is that the Renewable Energy students do not participate in a second-year group project, which is a popular aspect of the Photovoltaics and Solar energy program. In the first semester of 2007, a total of 88 students were enrolled. 2006 saw the first graduate of this program and two more graduated in March 2007.

Some good students of either of the above programs elect to undertake combined degree programs, with Science or Arts or Commerce (4).

Until and including 2007, the Master of Engineering Science postgraduate coursework program (5) has been of two semesters duration and has had three alternative areas of focus: photovoltaic devices, photovoltaic systems, and renewable energy technologies. As a response to the rapid growth of photovoltaics manufacturing in Asia and in anticipation of the funding initiatives described below, the program will offer only the photovoltaics devices stream

from 2008. Additionally, a recent review of postgraduate programs in the Faculty of Engineering resulted in a decision to extend the program to three semesters, starting in 2008.

## 2.1 Asia-Pacific Partnership on Clean Development and Climate

The Asia-Pacific Partnership on Clean Development and Climate (6) was formed at the inaugural meeting in Sydney in January 2006, between government representatives of Australia, China, India, Japan, South Korea and United States of America. The partnership exists “to address the challenges of climate change, energy security and air pollution in a way that encourages economic development and reduces poverty.”

At that time, the Australian Government committed AUD100m over five years for the partnership, with 25% being earmarked for renewable energy aspects. The latter funds are managed within the Renewable Energy and Distributed Generation Task Force (7). The action plan of that Task Force includes a proposal (RDG-06-14) for an industry-enabling project to support Photovoltaics and Solar Energy study at UNSW (8) and it has received in-principle support for Australian Government funding (9, 10). Contract negotiations are expected to be completed mid 2007, resulting in a AUD5.2m commitment to support fees at UNSW for selected Asia-Pacific students. There are three categories of students to be supported under this scheme.

Firstly, five (5) PhD students will be sponsored to conduct photovoltaics research through the PhD program at the School of Photovoltaic and Renewable Energy Engineering. Sponsorships, covering the full university fees, will be available for students from China, India and South Korea. Awardees will be selected from the candidates following advertisement for the sponsorships and merit selection of applicants.

Secondly, eighty students, in two batches of forty students, will undertake targeted international postgraduate study through the Master of Engineering Science program at the School of Photovoltaic and Renewable Energy Engineering to prepare them to focus on and work in the photovoltaics field. Sponsorships, covering 50% of the university tuition fees, will be available to students from China, India and South Korea. The candidates will be chosen following advertisement for the sponsorships and merit selection of applicants. The two batches of students are expected to start their studies early in 2008 and early in 2009, respectively. Hence, the groups will share one semester at UNSW, since the program will be three semesters long, starting 2008.

Thirdly, sixty undergraduate students, in three batches of twenty students, from a few selected Chinese Universities, will undertake their final two years of study at the School of Photovoltaic and Renewable Energy. Students selected for sponsorships will complete their first two years of engineering or science study at a Chinese university. The final two years of study at UNSW will focus on photovoltaic energy engineering and will enable successful students to graduate from UNSW with Bachelor of Photovoltaic and Solar Energy Engineering. The groups of students are expected to start at UNSW in 2008, 2009 and 2010, respectively.

Unlike in the other two types of sponsorship discussed above, these undergraduate students will undertake their study program in two universities, in two countries. Hence, an articulation agreement is necessary between UNSW and each source university. This is the reason for the restriction of these sponsorships to particular, selected Chinese universities which have existing research programs in photovoltaics and with which UNSW has an existing relationship. Negotiations on articulation agreements are underway with Zhongshan University, in Guanzhou, Shanghai Jiao Tong University, and Nankai University, in Tianjin.

### 2.2 Suntech Power Co. Sponsorship

In a development quite separate to the AP6 support program, Suntech Power Co., a photovoltaics manufacturer based in Wuxi, Jiangsu Province, China (11), will sponsor approximately ten students per year to study the Masters of Engineering Science program in Photovoltaics and Solar Energy at UNSW. The students will be sourced from the graduates of the Optics and Optical Science program at Jiangnan University, Wuxi and from Suntech staff. The arrangement is similar to the Masters sponsorship under the AP6 scheme except that the full tuition fees are covered in this case.

### 2.3 English Language Proficiency Requirement

English language requirements for entry to UNSW are published by the UNSW Graduate Research School (12) and, in short, require confirmation of English language ability according to the International English Language Testing System (IELTS) (12) or by particular other methods. The minimum overall IELTS score is required to exceed 6.5, with a minimum score of 6.0 in each of the sub-tests in listening, reading, speaking and writing.

However, each of the sponsorship arrangements described above, apart from the AP6 sponsorship for PhD research, makes provision for admission to UNSW with sponsored English language study at UNSW for some applicants who

do not meet the above requirement but who meet relaxed conditions for a conditional offer (13). Such students would typically undertake ten weeks of intense English language study at UNSW's Institute of Languages between November and February.

## 3. CONCLUSION

These expanded photovoltaics education opportunities will build expertise in solar energy engineering in the Asia-Pacific, a region of strong growth in photovoltaics manufacturing, through education and training at the School of Photovoltaic and Renewable Engineering at UNSW. Graduates are likely to take leadership positions in the expansion of the regional industry, lead the promotion of renewable energy in their home countries and to form strong international links and networks.

## 4. NOMENCLATURE

Sponsorship: Support for education that is limited to tuition fees and distinguished from scholarship support in that no funds are paid directly to the sponsored students.

## 5. ACKNOWLEDGMENTS

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