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Committee Secretary
Senate Education, Employment and Workplace Relations Committee
Department of the Senate
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29 August 2008

Dear Madam/Sir

Re: Inquiry into the Effects of Climate Change on Training and Employment Needs

Thank you for the opportunity to make a submission to the Inquiry. We believe that the engagement of universities in addressing the key issue of climate change is critical to developing successful solutions and strategies.

About UWS

The University of Western Sydney is a large research-led and comprehensive metropolitan University serving a growing and diverse urban region – Greater Western Sydney.

Greater Western Sydney:

- encompasses 14 local government areas, 22 State Government electorates, and 12 Federal Government seats.
- will accommodate 60% of Sydney's growth or 600,000 in the next 25 years
- is home to one in 11 Australians with a population of 1.8 million and
- is Australia's third largest economy producing more than \$80b in economic output annually
- the region has 242,000 businesses.

UWS is recognised for our capacity to carry out successful collaborative research partnerships and for our work with partners from industry and from the government and community sectors.

Science plays a major part in the University's profile. UWS offers one of the largest range of health, science and technology offerings in any Australian university: including medicine, mathematics, engineering, nanotechnology, biology, chemistry, construction, industrial design, horticulture, agriculture, psychology, nursing and complementary medicine, as well as materials, animal, biomolecular, environmental, food, forensic, health, cognitive and sports science.

UWS has a major role working with high schools to expand the pipeline of science students for the nation. This is important because science drives productivity, health outcomes and other social benefits.

UWS has also started to address our own impact on climate change, commencing with a 'greening UWS' initiative, in which the Penrith Campus in particular is becoming a model for environmental practice..The aim is to develop a 'living laboratory' for best practice in climate change initiatives, so that local schools and communities can see in reality what can be achieved as organisations adapt to climate change.

A list of UWS current greening initiatives, main climate change research and specific climate change courses are attached to this submission.

UWS academics assisted with the provision of research for the Garnaut Report. ¹

The ability of universities and other research and training institutions to meet current and future demand for climate change professionals

It is clear that climate change is a major challenge facing Australia in the decades to come. Professor Ross Garnaut, in his speech at the National Press Club, put it in the following terms.

*"Climate change is a diabolical policy problem. It is harder than any other issue of high importance that has come before our polity in living memory. Climate change presents a new kind of challenge. It is uncertain in its form and extent rather than drawn in clear lines."*²

Understanding and addressing climate change will require universities to provide:

- research expertise
- interdisciplinary approaches which bring together researchers in a range of fields both nationally and internationally
- experts to share their knowledge on a range of committees
- specific courses focussed on issues associated with climate change
- a consideration of climate change incorporated in the breadth of university courses
- active engagement with the community and industry to build a comprehensive understanding and response to the challenges
- a critical voice contributing to the public understanding and debate
- highly skilled workers through the provision of graduates who have acquired the necessary attributes to address the climate change issue
- opportunities for people already in the workforce to return to university study addressing areas important to meet the challenge of climate change.

Climate change professionals

¹ National Centre for Epidemiology and Population Health (Australian National University), and School of Medicine, University of Western Sydney:

- [The impacts of climate change on three health outcomes: temperature-related mortality and hospitalisations, salmonellosis and other bacterial gastroenteritis, and population at risk from dengue \(549kb\)](#)
- [Climate change impacts on the burden of Ross River virus disease \(PDF, 274kb\)](#)

² transcript professor Ross Garnaut, National Press Club address, draft report launch, 4 July 2008 [http://www.garnautreview.org.au/CA25734E0016A131/WebObj/NationalPressClubAddress-Garnaut-Transcript-4July2008/\\$File/National%20Press%20Club%20Address%20-%20Garnaut%20-%20Transcript%20-%204%20July%202008.pdf](http://www.garnautreview.org.au/CA25734E0016A131/WebObj/NationalPressClubAddress-Garnaut-Transcript-4July2008/$File/National%20Press%20Club%20Address%20-%20Garnaut%20-%20Transcript%20-%204%20July%202008.pdf)

The range of climate change professionals required will clearly include a strong requirement for professionals from the full range of science, technology, engineering and mathematics (STEM) disciplines. However it will also require professionals from:

- the full range of health professionals
- international law and other law
- economics
- commerce, taxation, finance and accounting
- information technology
- education
- agriculture, horticulture and forestry
- management
- tourism
- policy, administration and a range of the humanities

In fact, the wide-ranging impact of climate change means it will affect the working life in virtually every profession and discipline. Every professional group will need to become “climate change professionals”.

Interdisciplinary nature of climate change

Climate change requires multi-disciplinary approaches as it raises system-wide problems and challenges. It is not only the development and application of new science and technologies but it also requires expertise in understanding and managing the behavioural and cultural changes required for climate change solutions to be widely put into practice.

The key areas that are needed to understand and manage in the face of climate change are cross-disciplinary: people trained in a variety of areas of science and technology who are able to couple their disciplinary knowledge with other areas of humanistic study. For example: a geoscientist or earth systems scientist with knowledge of human geography to provide relevance of his/her work to the science/policy interface. Another example is a well-trained biologist specialised in biodiversity who also understands the economics of land management. Targeted areas could include hydrology and geosciences, ecosystem and land surface process modelling, atmospheric science and climate modelling, geography and geostatistics or geographic information systems.

Importance of Education for Teachers

A vital role that universities must play in raising awareness of the issues and the skills needed related to climate change, energy efficiency and reducing carbon emissions, is to ensure that the education of future primary and secondary teachers includes:

- a comprehensive understanding of the issues and how they can be worked into the curricula at relevant points
- effective interdisciplinary teaching techniques and approaches to addressing climate change
- a commitment to the importance of addressing the pipeline issues for future STEM students, professionals and researchers

Requirements of Current Professionals

There is an even more urgent need, skilling up current professionals from these areas to enable Australia's transition into being 'climate change ready'. Traditionally these disciplines would not have had environmental issues, let alone the global phenomenon of climate change included in their training. Yet as the result of the Stern Report, the Al Gore

initiative and the Garnaut Report, climate change has become embedded in the wider community's lexicon and it is critical that a broad range of professions understand how climate change issues affect their particular roles and responsibilities. Consequently in-service training and professional programs for these disciplines must be updated.

For example, the traditional approach to economics only considers items that can be given a market value, treating the environment as an externality. The emergence of environmental economics has developed models to better account for the non quantifiable aspects of environmental health and social well being, using tools like contingency valuation, willingness-to-pay and multi criteria decision making analysis tools but these concepts have been more 'fringe' than central. Since professionals in the disciplines of management, policy and administration will be the first to face the structural reforms brought about by an emissions trading scheme, professional development and up skilling for this group should be a priority.

The University has begun undertaking some of this professional development training already. For example, the Urban Research Centre at the University has been running professional development courses for State Government and local government urban and regional planners about the impacts of climate change on the planning profession.

STEM Professionals

It is now widely accepted that Australia is facing a critical shortage of engineers and scientists, which is a critical issue in addressing the challenges of climate change.

There is a growing concern about the current and projected shortages of science graduates and the related shortage of science students and teachers/academics in both high school and universities:

1. The Department of Education, Science and Training's *Science, Engineering and Technology Skills Audit* (July 2006) estimated there will be a shortage of over 18,000 science professionals required by 2012.
www.dest.gov.au/sectors/science_innovation/publications_resources/
2. Over the past ten years, the Australian Council of Deans of Science (ACDS) has highlighted the challenges to Australia in producing the next generation of scientists with strong core enabling mathematics and science (Dobson & Calderon, 1999; Dobson, 2003 and Dobson 2007). These documents highlight the declining numbers of students at High School and university studying enabling science as well as the declining numbers of teachers in enabling sciences in both schools and university
3. The decline in enrolments is particularly significant in Earth and Environmental sciences (geology, geophysics and geochemistry especially),
4. Consultations with schools and UWS's Regional Advisory Committee ranked science and related areas as top priorities
5. Recruiters, industry groups and employers complain of increasing difficulty in filling job vacancies with suitably qualified science graduates

The approach needed to address this shortage of STEM students, teachers, graduates, and researchers must involve a comprehensive Commonwealth and State Governments commitment and funding, in strong collaboration with universities, to address the pipeline issues:

- encourage interest and study in these areas from late primary school to university

- support places for students in these fields of study
- encourage teachers with high level skills in these areas who then inspire the students
- provide scholarships in this field
- support the cost of equipment

HEEF funding

UWS has sought HEEF funding in the 2008 round, to assist with the capital works for the development of a Science Precinct in Parramatta which will bring together state of the art equipment, teaching and research facilities in new and renovated premises. It will be in the heart of the developing area of Sydney and will be innovative in bringing together science students in schools, science teachers and researchers in one area. The project is a significant commitment to addressing the pipeline issues for STEM students, graduates, teachers and researchers.

“Science in the Suburbs”

Science in the Suburbs is one example of a pathway activity by UWS which aims to improve the aspirations of students in the region by promoting science as an area they would like to pursue in school and then university.

More than 1,100 students from 44 Greater Western Sydney schools explored the wonders of science at UWS Hawkesbury campus in 2008. The program is a partnership between UWS and the Australian Museum. Thought-provoking scientific activities included 'Fun with reptiles', 'Smart Foods', 'Bees and Bugs', 'Crime Scene Investigation', 'Galactic Encounters with Galileo and Jellyfish' and 'Genes and Muscly Mice.' The workshops were designed to give students a hands-on experience of what it is like to be a scientist.

Students also saw a demonstration of the powerful new confocal microscope facility. The multimillion dollar equipment provides researchers with the resources and equipment to view inorganic materials, plants, animal cells and even track DNA in incredible detail and in real time.

The UK paper “Higher Education at Work”³ recommended significant funding and a nationally coordinated strategy to encourage more students in STEM (pp16-18 of that report). Quoting from page 18 of that report:

A particular focus on STEM graduates

5.6 We are taking action at each stage – from stimulating early interest at school through to the workplace. The Government has set targets for increased A-level STEM entries and for year on year increases in the intake of STEM undergraduates. These targets are underpinned by DCSF led work to encourage more young people to study STEM subjects at school. This

includes widening access to triple science in the maintained sector with an entitlement for any pupil achieving Level 6+ at the end of Key Stage 3 (KS3) to have the opportunity to study for triple science GCSE. The Secretary of State has asked two Vice Chancellors to provide a report to him on what role universities can play in strengthening the STEM offer in schools and colleges.

5.7 The Higher Education Funding Council for England (HEFCE) is already committed to spending £160 million over five years to increase the demand for and supply of students doing strategically important and vulnerable

³ http://www.dius.gov.uk/consultations/documents/Higher_Education_at_Work.pdf

subjects, of which the large majority will be spent on STEM subjects. DCSF has appointed a national STEM careers co-ordinator who works with employers, higher education providers, learned societies and other STEM partners and stakeholders to drive a better coordinated effort to improve the flow of information to young people, and to ensure that messages are consistent and pitched in a way that will appeal to young people. The forthcoming DIUS science and society strategy will address issues of a diverse STEM workforce. And DIUS is also leading work with the Department for Business, Enterprise and Regulatory Reform (BERR) and the Cabinet Office to understand better the labour market needs for STEM skills.

The Report recommended further consultations about how to increase STEM graduates, including what role universities can play. In January 2007 the HEFCE Board agreed to allocate £75 million in time-limited core funding to secure the provision of very high cost laboratory-based subjects. These subjects have been identified as chemistry, physics, chemical engineering and mineral, metallurgy and materials engineering.⁴

Recommendation - UWS believes the Commonwealth Government, like the UK, should make significant funding commitments to improving the number of STEM students, graduates and researchers in Australia, including:

- for universities and schools to work on increasing interest and educational attainment in the STEM area
- increased funding for research, scholarships and equipment funding at university in STEM areas
- increased core funding for universities to work on community engagement in the STEM field.

Research

Research is clearly critical in addressing the challenges of climate change.

As stated by Professor Ross Garnaut in the release of his draft report on climate change, increased funding for research will be critical:

The first, and probably the most important [market failure to address], relates to the need for a much bigger effort in research, development and commercialisation of lower emissions technologies. This is important for the whole world. ... On some arithmetic we've done and presented in the draft

*report, our share would be about \$3 billion a year at present. And that's going to be very important in Australia and in the rest of the world, in developing the capacity for low cost adjustment to a low carbon economy.*⁵

As outlined in UWS's 2008 submissions to the:

- Inquiry into research training
- Review of the National Innovation System
- Higher Education Review

if Australia is to truly be a knowledge nation, which is driven by innovation and research, to address critical issues such as climate change, there must be a significant contribution to funding for research by universities and others.

⁴ http://www.hefce.ac.uk/pubs/circlets/2007/cl13_07/

⁵ transcript professor Ross Garnaut, National Press Club address, draft report launch, 4 July 2008 , p18 [http://www.garnautreview.org.au/CA25734E0016A131/WebObj/NationalPressClubAddress-Garnaut-Transcript-4July2008/\\$File/National%20Press%20Club%20Address%20-%20Garnaut%20-%20Transcript%20-%204%20July%202008.pdf](http://www.garnautreview.org.au/CA25734E0016A131/WebObj/NationalPressClubAddress-Garnaut-Transcript-4July2008/$File/National%20Press%20Club%20Address%20-%20Garnaut%20-%20Transcript%20-%204%20July%202008.pdf)

We recommend the adoption of various measures which are applicable to addressing skills and research related to climate change:

1. Australia should be working towards a target of gross expenditure on research and development (GERD) to GDP of 2% by 2010 and 3% by 2020.
2. Research scholarship stipends must reflect the cost of living to be meaningful.

The level of remuneration for postgraduate research students is not adequate. Indeed, research has shown that the current APA is now below the Henderson poverty line for individuals.

This low level of remuneration for postgraduate research students should be compared with the high levels of remuneration for their full-time working peers and in the context of high capital city housing costs, and rising living standard expectations among young adults. Comparisons with other OECD nations, particularly in northern Europe, also indicate that the per capita number and dollar value of research stipend scholarships in Australia is falling well short of similarly developed nations.

Consideration could be made of tax obligations e.g. reduction of accumulated HECS tax liabilities by tax credits for education related expenses. Currently a non-taxed PhD stipend means the recipient has effectively no income to make claims against.

3. In some research areas research income support is not the issue, as the Commonwealth could never offer a stipend anywhere near commencing salaries in the field. The support needed is a system of working with industry so that practising professionals can research as they practise and researchers can travel easily between the academy and practice.
4. APA Stipends should not be treated as income for tax or Centrelink purposes and the APA stipend needs to be increased in both value and duration
5. Bridging funding should be available to assist researchers who have completed an APD to help establish their career

- A major deterrent in pursuing a research career is the lack of a well defined career path after graduation, particularly in the Higher Education Sector, but also in many research institutes. For example, once a researcher has finished an APD the only research career grant option is an ARF or QEII (and these are difficult to obtain). Some additional bridging-level funding opportunity would help a researcher to establish a career.
- Australia is a small nation isolated from the major research centres of the world. We need systems whereby we can encourage our brightest to work in those centres but with an incentive to return with experience and a network of contacts. However the scholarship route is very difficult for them, and more to the point there is no incentive to return to a nation which undervalues intellectual effort.
- The Future Fellowships for mid-career academics could play a strong role in this issue. However, there should be a priority in the allocation of these fellowships to attracting researchers to the sector rather than rewarding those already in it.

6. Funding of research must represent full cost recovery including salaries. The RIBG must be increased to more clearly reflect the real infrastructure costs to universities and other research institutes in conducting research. Over the years 2003-2008 the relative value of this funding has declined from 28 cents in the dollar to 23 cents in the dollar. We believe that the RIBG support for Australian competitive grants

needs to be set at an internationally benchmarked level of at least 60 cents in the dollar in order to reflect the real cost of research.

7. Universities should have access to funding aimed at building research capacity not just rewarding established research excellence – the retention of block funding for this purpose is essential.
8. All funding levels should be indexed
9. Core university funding must enable community engagement , in its broadest sense, to be an essential part of the research work of universities
10. Universities should have access to funding aimed at building research capacity not just rewarding research excellence
11. Reducing student to staff ratios would have a significant impact on the ability of academics to devote the time necessary for research
12. Universities should have funding to enable them to address the critical issue of the current and pending research staff shortage through early intervention from primary school onwards. We must build culture, aspirations and achievement to build towards university study, especially among disadvantaged students who would otherwise not attend university despite their academic abilities or potential

Proposals specific to the climate change area

Apart from addressing the broad issues affecting the supply of researchers and professionals to meet the demand as outlined above, the following specific actions targeted at the climate change issues should occur:

1. Providing additional CGS places for universities which are related to climate change in its broadest sense
2. Providing funding for school and university engagement and awareness about climate change
3. Provide specific funding for universities to use to incorporate issues related to climate change across all curricula, where appropriate
4. Provide funding to assist universities to attract and recruit leading researchers related to climate change from a competitive international field and to establish appropriate research centres related to climate change
5. Provide funding for equipment related to climate change
6. Specific scholarships for researchers in climate change

The effectiveness of current Commonwealth research training schemes:

The current Commonwealth research training scheme is effective, but is no longer broad enough to provide for the future needs of the country.

The RTS funding is rigid and does not provide for growth in the sector, and indeed the levels of provision do not adequately cover the costs of research training in the institutions. The simple High-Cost / Low-Cost model must be re-evaluated, particularly in response to the increasing importance of cross- and inter-disciplinary research areas responding to the realities of a rapidly changing global environment.

The current scheme militates against those potential students who wish to undertake a PhD after several years in industry or business. Australia's universities must work with industry to develop a research training model that will enable uptake by industry to improve its innovation potential.

We do not believe that the current Commonwealth Research Training schemes are adequate to support Australia's anticipated needs.

1. There is already a diminished labour pool for appointment to post-doctoral and junior academic positions; this situation will only deteriorate as the generational change accelerates over the next five to ten years in both the university sector and in Australia's major research organisations.
2. There is already a difficulty in maintaining a critical mass of PhD scholars for the conduct of integrated research training programs. The number of APA Scholarships should be urgently increased as well as their duration
3. The duration of the APA stipend for PhD training is too short: in addition to increasing the opportunity to complete and publish research during candidature, the breadth and depth of research training needed in preparation for a research career or a university research and teaching career would be better accomplished in 3½ to 4 years.

Tax treatment of research and development

Taxation is highly relevant to private investment in R&D. There is a direct nexus between the tax regime and industry investment. When Australia's rate dropped from 150% to 125%, private funding of R&D dropped substantially. Australia is now one of the lowest in the OECD in terms of business expenditure on R&D.

We recommend that there be a return to the standard 150% deduction rate with continuing access to a further 50% where companies increase their level of this type of R&D expenditure relative to their average over the previous three years.

We also recommend that the eligibility criteria be reviewed to assess whether it excludes too many companies on the basis of the annual turnover limit of \$5 million. We accept that any criteria would need to be clear and tight to ensure the tax relief is used for genuine purposes which boost investment in R&D.

International Solutions

International access to Australian research scholarships for major research projects e.g. those funded under ARC and NH&MRC schemes should be considered.

The difficulty of successfully recruiting trained staff from overseas is exacerbated by lengthy immigration control procedures. These procedures can delay an appointment by up to 12 months. In this time alternate job offers to the appointee often result in failure of the appointment process.

Recruitment of international students with a view to future employment in the Australian system should be anticipated. Overseas recruitment should be facilitated by a relaxing of the Australian resident eligibility rules in many circumstances and a possible expansion of overseas recruitment via Australia's aid schemes.

Investigation should be made into ways to reduce the time lag between offer and arrival in Australia. This might be by way of priority immigration processing arrangements or by granting of provisional visas.

The lack of opportunity for continuous devoted research careers in Australia, not only in basic science and medical research, but in areas more central to socio-cultural wellbeing is a major factor behind our slight decrease in international competitiveness over the last

decade, and behind both our ageing research community and our continued permanent loss of more people than desirable to other countries.

Impact of an Aging University Population

There is no doubt that the academic workforce is ageing; several demographic studies have shown this. There is also no doubt that this will have an impact if not addressed. Analysis of research success in terms of research income, publications and student supervision shows that senior staff provide by far the bulk of an institution's research output.

The question is how to mitigate the impact of losing a large number of senior staff in a short timeframe.

The implementation of effective incentives to keep productive scholars active long enough to mentor upcoming younger staff will be essential.

The Futures Fellowships scheme should be used to help fill the mid career gap. It will be imperative that this scheme is designed with the primary aim to bring new blood into the sector rather than reward those already in it. Effective support for Early Career Researchers will be vital to ensure a pipeline of research active scholars

Measures to assist understanding of climate change in the Asia-Pacific region, including provision of training and skills assistance

Australia's signing of the Kyoto Protocol has given our Asia-Pacific neighbours the expectation that our future engagement with them will be broadened to include our climate change responsibilities. If we are to truly be the global citizen, Australia's employment and training response must also involve partnering with our neighbours to find joint solutions.

For instance, the future our South Pacific state neighbours face is sobering. As observed by the South Pacific Regional Environmental Program:

*Many Pacific islands are extremely vulnerable to climate change, climate variability, and sea level rise and will be among the first to suffer the impacts of climate change and among the first to be forced to adapt or abandon or relocate from their environment....Most small island states will find it extremely difficult to adaptation to these changing conditions. The impacts will be felt for many generations because of the small island states' low adaptive capacity, high sensitivity to external shocks and high vulnerability to natural disasters.*⁶

Hence Australia's response to this dilemma should be more than just humanitarian aid and provision of AusAID programs. The Australian university sector needs an approach that builds the capacity of our Asian Pacific neighbours' current tertiary staff, as well as students, in addition to providing expertise for collaborative climate change impact research.

Recommendations

1. The Government should provide \$50-100 million to support the creation of a large interdisciplinary research centre which has a broad overview related to climate change issues. The Research Centre should be based at a lead Australian University and should involve no less than two other Australian universities, at least one Chinese University and one other university from the Asia Pacific region as active partners.

⁶ South Pacific Regional Environmental Program *Climate change, variability and sea level change* accessed 25 August 2008 <<http://www.sprep.org/topic/climate.htm#4>>

2. The Government should offer to fund and support the targeted placement of international Science Technology Engineering and Maths (STEM) and relevant humanities and social sciences discipline students into Asia Pacific countries as a form of assistance with the aim being for these future professionals to:

- facilitate climate change transition in these countries.
- deliver in-country research programs for monitoring biodiversity impacts, pest and diseases, coastal management etc. addressing other social impacts of climate change, including the increasing Pacific Diaspora due to social and cultural disruption both within the country of origin and the country of destination.⁷
- be able to evaluate Clean Development Mechanism (CDM) projects in Asia/Pacific nations in compliance with the Kyoto Protocol and emissions trading targets for Europe and Australia.

3. International science and technology exchange programs should be funded which are specifically oriented toward climate and sustainability science areas, and possibly focusing in particular geographic regions

4. Targeted international scholarships for training climate change scientists from Asia-Pacific countries in Australia should be provided

5. Cross-border virtual centres of collaboration or “collaboratories” which include the capacity for researcher colleagues and collaborators to interact, e.g. see one another over the internet and scientifically collaborate should be funded

⁷Ibid.

ATTACHMENT 1

CURRENT UWS RESEARCH RELATED DIRECTLY TO CLIMATE CHANGE

- [A Gain for Grain Farmers](#)
- [Climate and Crop Disease Management](#)
- [Crab Conditions](#)
- [Cultural Complexity](#)
- [Developing an Olive Field Guide](#)
- [EMS for SMEs](#)
- [Environmentally Aware Retailers](#)
- [Exploring Symbiotic Fungal Diversity](#)
- [Extracting More for the Environment from Olives](#)
- [Fingerprinting the Forests](#)
- [Fire Safe Seeds](#)
- [Freshwater mussels in the Hawkesbury-Nepean](#)
- [Goodbye Fruit Fly](#)
- [Grevillea seed research all fired up](#)
- [High Resolution Thermo-Analytical Facility](#)
- [Making the Turn to a Green Golf Club](#)
- [Mineral spray oil helps Asian and organic growers](#)
- [Monitoring Neonatal Medical Alerts](#)
- [Nature's Carbon Trading Scheme](#)
- [Predicting Climate Change Risks](#)
- [Protection for Honeybee Hives](#)
- [Putting the Heat on Grevilleas](#)
- [Regional Irrigation Business Partnership](#)
- [Rehabilitating Saltmarshes](#)
- [Stopping Rot in Olives](#)
- [Sustainable Irrigation in Kogarah](#)
- [The Hawkesbury Forest Experiment](#)
- [The Sustainability Challenge](#)
- [Tree Architecture and Climate Change](#)
- [Up a Gum Tree with Climate Change](#)
- [Urban Irrigation – Saving Sydney's Water](#)
- [Water Quality in the Manly Dam Catchment](#)

Hawkesbury Forest Experiment:

An example of world class research about climate change is the Hawkesbury Forest Experiment.

The Hawkesbury Forest Project has been established at the Richmond campus of the University of Western Sydney (UWS) to investigate how increased atmospheric CO₂ concentration will affect Australian forests. The experiment brings together an expert team of researchers from the University of Western Sydney, University of New South Wales, University of Technology, Sydney, NSW Department of Primary Industries and the Swedish University of Agricultural Sciences with \$1.2 million funding from the Australian Greenhouse Office.

It tests how Australia's eucalypt forests cope with climate change, and predicts what will happen to the Australian bush in 100 years' time. This experiment should give an accurate

account of how different species cope with different levels of CO₂. The project will also study how the trees deal with Australia's decreasing rainfall - half the trees will be well-watered, and the other half will be subjected to drought.

The experiment involves a dozen 10-metre-high plastic chambers, shaped like tee-pees, scattered across a paddock. Each one contains a spotted gum sapling and a different mix of carbon dioxide (CO₂) to test how each plant copes with a changing atmosphere. The sealed chambers create a mini ecosystem - half have carbon dioxide at the current level in the atmosphere, and the other half have double that amount.

The project is a carefully integrated program of experimental and modelling approaches. The centre-piece is a field facility with twelve CO₂ and temperature-controlled whole-tree chambers (WTCs), valued at over \$2 million, which have been provided by the Swedish University of Agricultural Sciences

The broad focus is on developing a predictive understanding of the growth, carbon storage potential and water use of both managed and unmanaged eucalypt forests growing in typical Australian, water-limited conditions, and their responses to the rising CO₂ that will occur during the next 50 years. Potential increases in water-use efficiency at high CO₂ are of huge potential importance to Australia, the driest inhabited continent. Consequently, the experiment will include contrasting watering treatments, which will allow researchers to test for the first time the effect of elevated CO₂ on productivity of large woody plants under water-limitation.

Long-term predictions of forest responses to climate change cannot be accomplished directly in experiments, and must rely on ecosystem models that incorporate our best understanding of plant eco-physiological responses. The Hawkesbury CO₂ enrichment experiment will guide the development of ecosystem models by testing specific, well-defined hypotheses about the response of water-limited forests to elevated CO₂.

ATTACHMENT 2 - EXAMPLE OF CURRENT U.W.S SCIENCE UNITS RELATED DIRECTLY TO CLIMATE CHANGE

Climate Change & Sustainable Resource Management Specialisation

For a Graduate Certificate or Graduate Diploma in Science (Climate Change & Sustainable Resource Management):

Climate Change Impacts

This is a flexible learning unit that provides professional environmental resource managers a range of opportunities to upgrade their leadership skills and competencies to develop policies and strategies for climate change mitigation and adaptation at local, national and international levels. The unit aims at developing critical thinking and understanding of the students about environmental issues related to climate change. Students will use contemporary interdisciplinary tools and models that have potential application in real world decision making. Each student will undertake a project in their chosen enterprise to understand and appreciate issues concerning climate change impacts on natural and built environment.

Sustainable Resource Management

This unit introduces a range of skills required to understand and assess issues for sustainable resource management. Students will have opportunities in learning the impacts of soils, climate, water and their interactions on rural, peri-urban and urban landscapes. Each student will undertake a project of their choice to carry out more in-depth study related to environmental factors for improved livelihood and effective land use. Experience gained from this unit will enhance their skills and competencies for evaluating and adapting appropriate resource management strategies and policy development.

Research Methodology and Experimental Design Science Research Project PG

This unit develops critical and analytical skills by undertaking and completing a research project in an area of relevance. The project is carried out on an individual basis. Research projects are offered in consultation with staff who possess research interests and experience in relevant areas.

Developing Professional Practice

This unit is designed to develop qualities and attributes in professionals consistent with the principles of lifelong learning, experiential learning and a variety of ways of thinking and acting. The primary aim of the unit is for students to learn by improving professional problematic issues of concern. A particular focus will be an introduction to system and holistic thinking and practice. Students will be supported in designing and managing two self directed praxis development learning projects that are connected to their own area of professional interest.

Perspectives of Sustainable Development

This unit explores the philosophy, policies and practice of sustainable development. In exploring environmental philosophy the unit provides students with an understanding of the nature and emergence of both modern and post-modern paradigms that influence the direction and nature of current development policy. The nature of environmental policy is examined by developing an understanding of how values and attitudes shape a governing ethic about environmental management. The social, political, economic and ecological elements of sustainable development are unfolded to aid students understanding of what needs to be managed. Particular attention is given to those issues confronting developing countries as they move to become industrialised nations yet have high levels of poverty.

Finally, the unit introduces the practice of environmental impact assessment as one management tool used in the management process.

Research Methodology and Experimental Design Science Research Project PG

This unit develops critical and analytical skills by undertaking and completing a research project in an area of relevance. The project is carried out on an individual basis. Research projects are offered in consultation with staff who possess research interests and experience in relevant areas.

Bachelor of Applied Science - Environmental Health

Environmental Health encompasses the health impacts of the interaction between humans and the environment. Environmental Management focuses on health in a variety of contexts including; pollution control in environmental and occupational settings, as well as assessing and managing the complex environmental and occupational risk factors of the built environment. At a global level, environmental health professionals have been actively examining the health impact of acid rain, climate change, movement of hazardous waste, ozone depletion, overpopulation and resource depletion.

Subjects

Air pollution; Community studies; Emergency management; Environmental health law; Environmental monitoring; Environmental planning; Environmental protection; Epidemiology; Food safety; Noise; Occupational environment; Risk assessment; Sustainable environmental management; Toxicology; Urban development and water pollution

ATTACHMENT 3 - U.W.S COMMUNITY ENGAGEMENT ON CLIMATE CHANGE

UWS also organises community engagement activities such as seminars which include climate change. An example some recent seminars or community events are below:

Introduction to Climate Change (a one-day course) , 22 August 2008

"Climate change poses clear, catastrophic threats. We may not agree on the extent, but we certainly can't afford the risk of inaction." Rupert Murdoch

Climate change is already upon us and every recent credible scientific review of the evidence has highlighted that its impacts are unfolding faster than previously expected

Course aims:

- To provide an overview of the basic science of climate change, sources of greenhouse gases and the possible impacts of climate change on their work
- To provide a guide about useful information sources
- To examine the implications of climate change for policy at all levels of Government
- To examine what some of the implications of climate change for the planning system

Course content:

- Basic science, expected impacts, including in Australia, scenarios, sea level changes, storm frequencies, temperature changes, rainfall changes, flood frequencies and heights, drought frequencies, wind climate, fire regimes, regional differences in impacts and overview of Intergovernmental Panel on Climate Change
- Sources of greenhouse gas emissions (examining sectors not a place based approach) - what are they, what's increasing and decreasing and why does it matter
- How are Governments at all levels responding to Climate Change?
- How could climate change affect the land use planning system?

Energy Security: The Real Story -Tuesday 13 May 2008

The critical issue of how to power the future of Australia will be discussed in a series of public forums organised by the Whitlam Institute and the College of Health and Science within the University of Western Sydney. The first topic is "Setting the Scene" which explores the connection between energy usage and climate change, Australia's current and future energy needs, energy usage in Australia, where Australia sits in the international energy context, and what the energy debate is all about. Presented by Dr Hugh Saddler, Managing Director Energy Strategies.

ATTACHMENT 4 - UWS GREENING INITIATIVES

UWS Sustainability Initiatives

UWS is developing a broad range of policies, strategies and operational initiatives across its campuses to contribute to sustainability in Western Sydney. Within an overarching Sustainability Strategy, a Greening UWS Initiative is currently developing, along with a supporting UWS Environmental Management System.

Operational strategies and initiatives include those relating to: landscape management, materials recycling, energy management, water saving measures, building and refurbishment projects, fleet management, and the conservation of natural and cultural heritage.

Greening UWS

A Greening UWS Taskforce has been established to oversee the development of this initiative. Key aspects of this initiative include: the establishment of an initial demonstration campus on South Werrington; the engagement of students and researchers; and assessment in relation to international benchmarking.

Earth Hour

UWS takes part in Earth Hour as one initiative to raise awareness about climate change and encourage the community and individuals to take simple actions that can help cut energy consumption and reduce greenhouse emissions.

UWS Environmental Management System (EMS)

In early 2008, an Environmental Management Policy, and related Environmental Management System were approved and begun implementation, providing a clear basis for due diligence in relation to environmental practice. Underpinning the EMS and Greening UWS are a UWS Environmental Management Plan and an Interim Greening UWS Action Plan which outline targets, actions and timeframes.

Landscape Management

A consistent approach to landscape management is being identified through Landscape Master Plans. As well as operational guidance consistent with the character of each campus, these will establish principles of water sensitive urban design which can be implemented at each campus. This will support tree planting and enhanced vegetation establishment across UWS.

Materials Recycling

UWS continues to expand upon a broad range of waste management and recycling initiatives. Established programs for recycling paper, printer cartridges, and mobile phones are being expanded to include fluorescent tubes, and co-mingled bottles and cans near all food outlets.

Energy Conservation

Photovoltaic arrays contributing to the local electrical grids have been established at Kingswood, with a new installation planned soon for Bankstown. Solar powered irrigation pumps and a suite of energy management options are being tested as part of the Greening UWS demonstration on South Werrington. This will include monitoring, energy efficient technologies such as LEDs, sensor controls, and the identification of further options for air-conditioning and indoor environments. Applications for funding from the NSW Climate Change Fund have been made to rehabilitate the cogeneration plant at the Parramatta Campus.

Water Saving and Recycling

Water Saving Action Plans have been developed for Penrith and Hawkesbury Campuses, with the implementation at Penrith complete and underway for Hawkesbury. This encompasses a range of water efficient taps, showers and bathroom fittings. In-ground tanks for rainwater harvesting are being established as part of the Werrington South demonstration site for garden irrigation and toilet flushing. Also, improvements and expansion of infrastructure within the Hawkesbury Water Recycling Scheme will promote the utilisation of reclaimed water and storm water. Funding from the NSW Water Savings Fund and the CSW Climate Change Fund have sought to extend this scheme, along with the establishment of hybrid cooling towers in the Parramatta Campus Multi-purpose Teaching Building and rainwater harvesting for the School of Medicine Building on the Campbelltown Campus.

Building and Refurbishment Projects

New building projects have been designed with reference to the Green Star rating system, and a range of design innovations are being incorporated including those relating to passive solar design. Sustainability design guidelines are also being developed for building refurbishments. State of the art on-site waste water systems are being used to phase out septic tanks in areas where these are established.

Fleet Management

A number of Toyota Prius hybrid cars have been purchased by Capital Works and Facilities, and issues such as life cycle costing are becoming important issues considered in the purchase of fleet vehicles. Catalytic converters are to be tested on a proportion of fleet vehicles.

Conservation of Natural Areas

Opportunities for enhancing the natural, heritage, and amenity values of natural areas on UWS campuses are being sought. An example is Werrington Creek on Kingswood Campus where a range of options and perspectives are being considered and negotiated. Opportunity for student involvement in bushcare and the development of a community park are part of the integrated solutions being sought.