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Submission to the Senate Inquiry into the Effects of Climate Change on Training and Employment Needs

Climate Change is a dangerously broad term for a Senate Enquiry to attempt to consider. Training professionals in “climate change” can encompass everything from mathematics, physics, computer science, through biology, ecology and geology, into demography, economics, law, engineering and political science. “Climate Change” can mean “climate changes over a few million or billion years” or can be used as short-hand for “human-induced future climate change”, as in “global warming”. I am going to assume this Senate Inquiry is mainly concerned with training as it relates to industry, government etc – and that means training relating to global warming science, impacts and adaptation.

The *science* of climate change requires significant mathematics, statistics, physics and quantitative biology. The science of climate change is about meteorology, climatology and how the change in the amount of carbon, a biologically-driven element, affects these things. Training in this requires a founding in quantitative disciplines followed by broad but advanced training in how the atmosphere, oceans, terrestrial systems and cryosphere work in a coupled system. With the right undergraduate quantitative background, a strong understanding of the science can be achieved in a 1-year program but a deep understanding of the subtleties of this system takes several years and is best achieved via graduate level PhD-type study.

The *impacts* of climate change require a different training, although an undergraduate degree in quantitative science linked with a reasonable exposure to climate science is usually helpful. Some of the major advances in impacts research require impressive statistics – specifically Bayesian methods that permit changes in climate to be discussed as *risks and probabilities*. Impacts of climate change are highly specific and a general training program is difficult to conceive. For example, impacts of climate change on biological systems needs training in biological sciences; impacts on infrastructure needs training in engineering, impacts on financial markets needs training in economics and impacts on society needs training in the humanities and law. Any attempt to develop a basic program will lead to generality.

A classic example of generality is Geography’s capacity to provide strong training in this area (see Pitman, A.J., 2005, On the role of Geography in Earth System Science, *Geoforum*, 36, 137-148). Geography teaches all areas of climate change – there are Geographical programs at many Australian Universities that teach about climate impacts and adaptation across the whole spectrum of the problem. However, industry, government etc tends not to source advice from Geographers. When economic advice is needed, an Economic Geographer is not engaged. When advice on water allocations is needed a Physical Geographer is not engaged. Instead, a formally trained

economist or a formally trained engineering hydrologist is used because what is required is *detailed specialist knowledge* and this is only achieved by specialization (with one eye on breadth) rather than generalization (with one eye on specifics).

In terms of Climate Impacts, what is needed are specialists with knowledge of the big picture *not* generalists with a little specific knowledge. A program that achieves specialization in all areas of Climate Impacts is therefore not achievable at any single institution and attempts to develop one will lead to the same sorts of generality that has limited the impact of Geography in this field.

Issues and recommendations

Almost every University in Australia now lists “climate change” among its areas of speciality and most claim leadership in this area. It is likely true that most Universities have one or two *individuals* with expertise – but to offer a coherent and sustained program in this area requires critical mass.

The Climate Change Research Centre at the University of New South Wales (www.climate.unsw.edu.au/) has three Professors, and a further eight full-time academic staff. All staff are focussed on climate *science*. We have a Federation Fellow, we convene the Australian Research Council’s (ARC) Network in this area (www.arcness.mq.edu.au) and have several ARC Research Fellows. In 2007 we co-launched the University Climate Consortium (www.monash.edu.au/climate-consortium) – which includes UNSW, Monash University, the Australian National University and Melbourne University. This was recognition that the scale of the Climate Change Research Centre at the University of New South Wales, while very large relative to many other groups, remains too small to cover the whole of the Climate Science field. We saw strategic need to partner with outstanding capacity elsewhere in the University Climate Consortium. Early discussions on a joint climate change program across these Universities in graduate level training have begun and may offer a nationally strategic approach to excellence in training. I emphasise the point here in my view a group of a dozen world-class researchers co-located at UNSW remains too small to thoroughly train the next generation of climate *scientists*. The Senate Committee might reflect on Universities with 1-2 Staff who claim to offer full programs.

Recommendations

Undergraduate-level

- The University of New South Wales’ Climate Change Research Centre offers degrees that train students in Climate Science. We are expanding this now to encompass a fully integrated set of courses. At least Monash University offers a program of similar scope. These are well-developed programs taught by experts and offer a very strong grounding for undergraduates. A national curriculum identifying the minimum education for a given degree, informed by government, employer groups etc should be established. In particular, the Academy of Science, the Bureau of Meteorology, Bureau of Rural Science and CSIRO might be consulted in the design of this national curriculum.
- An analogous program in Climate Impacts is difficult to imagine but training in aspects of impacts, within existing programs in Engineering, Biological Sciences, Physical Geography, Law etc exist and can be nurtured.

Postgraduate Research

- At present, a PhD student can undertake a program at any Australian University in this area. When “Climate Change” was purely an academic pursuit this was acceptable. There is now a lack of quality students relative to demand undertaking PhDs in this area,
- hence ensuring these students gain the very best training is vital. A form of accreditation of programs in this area is needed such that PhD-training encompasses a

- breadth of high-quality teaching. This is a US-style PhD where a year or so of formal coursework, at advanced level, accredits a student to continue to complete a PhD.
- It is not possible in the Australian system to provide a formal year of training followed by a formal PhD all within the 4 years funded. The establishment of a system to allow formal training as part of a qualifier for a PhD, coupled with innovative solutions to the students' financial burden is urgent.
- A mechanism to facilitate graduate students spending time engaged with expertise within the Bureau of Meteorology and/or CSIRO is required. This involves support for the student, but also recognition of the supervisory role within Bureau of Meteorology and/or CSIRO.
- The ARC Research Network for Earth System Science has been running graduate schools annually to bring experts from overseas to encourage engagement of Australian students in this field. Identifying ways to maintain this beyond the life of the Network is important (the Network currently ceases to be funded in early 2010).
- Climate Change is an area of national priority. Universities lose a significant number of excellent students at the end of undergraduate study – before the deep-learning that establishes expertise in this area can be accomplished. The major drivers for this loss is HECS debt combined with good starting salaries for graduates. Salaries for nonPhDs in meteorology and climatology can exceed those in research institutes – thus the Market acts as a disincentive to students to reach a level of knowledge that contributes to research-led solutions. Given the demands for research-level trained graduates in this area – the graduates who need to identify urgent solutions – the Federal Government might consider cancellation of the full HECS debt for PhD graduates completing degrees in less than 4 years. This would provide incentive to undertake further training in a timely manner and would cost little – it would be a reward for excellence.
- A series of industry-targeted graduate level short-courses and professional training opportunities are under development at several Universities including the University of New South Wales. These can be efficiently taught through user-defined packaging of undergraduate and postgraduate courses. These are best driven by market demand.

I can be contacted should you wish to discuss these matters further via a.pitman@unsw.edu.au



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