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Mr Tim Watling
Committee Secretary
Senate Education, Employment and Workplace Relations Committees
PO Box 6100
Parliament House
Canberra ACT 2600

7 February 2012

Dear Mr Watling

The shortage of engineering and related employment skills

The Australian Academy of Technological Science and Engineering (ATSE)[1] welcomes this opportunity to provide some comments on the supply of engineering and related skills.

The Academy notes that there have been concerns regarding the adequacy of Australia's output of engineering graduates going back at least two decades (for example, it was the subject of a Prime Minister's Science Engineering and Innovation Council report in 1991).

Australia trains substantially more scientists than engineers, and both disciplines draw from the limited pool of secondary students leaving school with adequate competencies in mathematics and science. By contrast, nations with a strong engineering capacity and an adequate supply of engineers (e.g. Japan and Korea) train many more engineers than scientists.

Too few school leavers are opting to study mathematics and science at school to a level necessary for university entrance. The problem of attracting secondary school students to study these subjects is closely related to the supply of engineering graduates. ATSE has developed the STELR (Science Technology Education Leveraging Relevance) program[2] as its main education program for Secondary Schools. The primary aim of STELR is to address the problem of low participation rates in science and mathematics subjects at the upper secondary school level in Australia by relating these subjects to highly relevant issues such as climate change and renewable energy. In 2012, 285 schools across Australia will use the STELR equipment, comprehensive curriculum package (including both physical and chemical sciences) and Teacher Professional Development program to effectively implement STELR at years nine and ten.

Students making career choices may perceive engineering as a "hard" course that leads to jobs, albeit well paid, but often in remote areas. HECS fees for four-year engineering courses are believed to be a significant deterrent. A recent Universities Australia report provides more information about student attitudes to science and engineering.[3]

In the past, possible solutions to increasing the number of engineers quickly included retraining scientists through a two-year intensive program, or the filling of some engineering positions with three-year BSc (Tech) engineering graduates.

[1] The Australian Academy of Technological Sciences and Engineering (ATSE) is an independent body of 800 eminent Australian engineers and scientists driving technological solutions for a better Australia. ATSE was established in 1976 with the mission to promote the application of scientific and engineering knowledge to the future benefit of Australia. ATSE is one of four learned national Academies, which have complementary roles and work together both nationally and internationally. www.atse.org.au
[2] The STELR (Science Technology Education Leveraging Relevance) program http://www.stelr.org.au
[3] Universities Australia 2012, STEM and non-STEM First Year Students, Canberra January 2012, accessed on 7 February 2012 at http://www.universitiesaustralia.edu.au/page/submissions---reports/reviews-and-inquiries/stem-and-non-stem-first-year-students-/

Other measures that have helped to raise the status of engineering include funding Centers of Engineering Excellence and encouraging universities to offer articulation of TAFE qualifications into engineering undergraduate programs.

During the 1990s some universities (notably the University of NSW, Queensland, Monash University, RMIT University and Swinburne) offered special scholarship programs for undergraduates (co-op scholarships) whereby undergraduate engineering degrees were extended to include specially programmed stays in industry. Bright country students were attracted to these scholarships and they were attractive to industry because these graduates were geographically mobile. Such programs persist to this day, continuing to attract strong industry support.

In other instances where there have been specific needs for engineering graduates industry groups have got together, and worked with selected universities to establish undergraduate and postgraduate programs. A good example is the Petroleum Engineering course at the University of NSW, which was established following significant capital funding by the industry and now trains fifty petroleum engineering graduates per year.

Australia shares the problem of training engineers with some other OECD countries. The problem was highlighted in a recently released study of the US National Science Board (NSB).[4] Whilst the NSB study focuses primarily on spending on research, it expresses particular concern that 56% of the world's new engineering degrees are in Asia and only 4% are in the USA. In the USA 57% of new engineering doctoral degrees are awarded to foreigners, mostly from East Asia or India. These highly trained people are increasingly being attracted back to their home countries as the Asian demand for engineers is high and the financial rewards provided have significantly improved. In this climate it is highly unlikely in the 21st century that Australia's needs for skilled engineers will be met by migration.

Recent trends by some universities to introduce the "Melbourne Model" may exacerbate the situation. In the "Melbourne Model, the student first completes a generalist three-year undergraduate degree and then completes a further two years of specialization in a specific discipline such as engineering. Apart from extending the length of training by one year, the added HECS and fee burden will in all likelihood disincline rural and regional students (often those with the greatest geographical flexibility) from studying engineering.

Because of pressures from Government activities such as Excellence in Research Australia (ERA), Australia's engineering departments have increasingly focused on publications in highly rated journals as a measure of excellence. The publications tend to encompass engineering science rather than heavy engineering practice. Notably, in the most recent ERA round no Australian engineering faculty was ranked in category "5", the highest of the ERA rankings. Yet Australia is committing itself to massive resource projects (mineral resources, LNG, coal seam methane, alternative energies and water reclamation) where there is a massive need for quality R&D that extends through to the applications level. Engineering graduates frequently leave Australian universities with little appreciation of the complexity of mega projects and require substantial on-the-job training before they are fit for purpose.

There is little collaboration between industry and universities to offer high-level post graduation training programs to ensure that Australia's engineers are kept at the cutting edge of their disciplines.

But there are some promising developments. The Australian minerals industry has been quite active in coming together to define what training is desirable and in supporting initiatives and R&D. Likewise, the Australian Power Institute, recognizing an imminent shortage in power engineers, has developed scholarships and training programs to encourage more students to choose this option.

[4] National Science Board 2012, *Science and Engineering Indicators 2012*, Washington accessed on 7 February 2012 at http://www.nsf.gov/statistics/seind12/

I trust that these comments are helpful.

Yours faithfully

Robin Batterham
President