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

Submission to the Senate Education, Employment and Workplace Relations Committee

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ENGINEERS
AUSTRALIA

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Box 1: What is engineering?

The engineering sector is a diverse and large profession that includes a range of practitioners, such as professional engineers, engineering technologists, engineering associates, and tradespeople.

Engineering is about applying science and technology to develop and implement new technologies, placing engineers in a central role in improving the security and living standards of the community, improving the standards of environmental care and generating wealth for Australia.

The traditional focus of engineering activities has been in infrastructure – the fundamental facilities and systems that allow a modern society to function effectively. These include transportation, communication systems, energy and water supply, and waste removal. However, engineering impacts on virtually every aspect of community life.

For instance, the following lists only some of the areas in which professional engineers commonly practice: Acoustics, Aeronautics, Agriculture, Automation and control, Biomedical, Bridges, Building services, Civil, Chemical, Coastal and oceans, Communications, Computing, Construction management, Dams, Electric power, Electronics, Education, Environment, Fire safety, Food technology, Fuels and energy, Geotechnics, Government, Maintenance, Manufacturing, Materials, Metallurgy, Military, Mining and tunnelling, Naval architecture, Nuclear, Petroleum and gas, Pipelines, Process control, Railways, Risk, Roads, Space, Structural, Telecommunications, Transportation and Water Resources.

There is a strong social and humanitarian dimension to engineering and virtually all engineering solutions are a response to a human need. Engineers solve problems. For example the most significant advances in medicine were not based on improved surgical or medical techniques, but almost entirely on engineering breakthroughs: from replacement joints to whole-body scanners; heart pacemakers; dialysis machines to artificial limbs - they are all designed, developed and built by engineers working closely with medical professionals and their patients.

Engineers work independently, in teams with other engineers, or as part of larger multi-disciplinary groups alongside other professionals, like scientists, researchers, architects, lawyers, human resource managers, accountants, technologists and trades people.

Engineers take practical steps towards realising positive environmental outcomes. Imagine a world where cities have become peaceful and serene because cars and buses are whisper quiet, vehicles exhaust only water vapour, and parks and greenways have replaced unneeded urban freeways. Living standards for all people have dramatically improved, particularly for the poor and those in developing countries. Home owners can pay part of their mortgage costs by the energy they produce; there are few if any active landfills; worldwide forest cover is increasing; worldwide CO_2 levels are decreasing for the first time in 200 years and the effluent water leaving factories is cleaner than the water going in.

This vision of utopia is already reality on a small scale and as long as engineering skills are valued and supported within our society, larger changes of this nature are possible. Without question, engineering has been a constant companion in our development as a civilisation and engineering continues to plays a powerful role in bringing us closer to an environmentally sustainable and economically viable future.

1. Introduction

Engineers Australia is the peak body for engineering practitioners in Australia and represents all disciplines and branches of engineering with 86 000 members Australia wide. All members of Engineers Australia are bound by a common commitment to promote engineering and facilitate its practice for the common good.

The Senate Education, Employment and Workplace Relations Committee inquiry into the *Effects of Climate Change on Training and Employment Needs* is welcomed by Engineers Australia. The discussion below considers the current engineering skills available in Australia and outlines the skills shortage currently being experienced in the sector even without the push towards a carbon neutral economy.

The current education of engineers in the vocational and university sectors is considered. Because engineers are a key skills input for climate change mitigation, the most pressing issue is for the Australian education system to produce more engineers. Without them, Australia will be unable to meet the challenges posed by climate change. The effects of climate change on training and employments needs in the engineering sector is simply that more engineers need to be grown by the Australian education system if Australia's climate change adaptation and mitigation strategies are to be supported. Engineers Australia welcomes the opportunity provided to comment on the effects of climate change on training and employment needs.

2. Meeting current labour market needs

Recent analysis of the Australian Census by Engineers Australia[1] has shown that in the five years between 2001 and 2006, the number of Australia's engineers in the profession has decreased by around 6500 individuals, with more engineers having left the engineering workforce than having joined it.

By the 2011 Census, a conservative estimate of up to 70,000 retirements may have occurred from the engineering profession. Over the same time period, only 45,000 Australian graduates will have completed study in engineering.

Engineers Australia believes that the future Australian skills base will not cover retirements, let alone increased demand for engineering expertise driven by growth in the Australian economy and our transition to a climate friendly, knowledge based economy.

Government focus on infrastructure renewal, the engineering inputs needed to support the resources boom and to tackle climate change all mean that demand for engineering expertise will only continue to increase.

Engineers Australia undertakes a regular survey of engineering companies and has included questions on engineering skill shortages in the last two surveys. Anecdotal information that engineering skills shortages were harming the Australian economy was confirmed by both surveys, with 82% of businesses reporting that there were moderate to severe consequences.

Moderate problems with some monetary consequences were experienced by about half of this group (39% in 2006 and 40% in 2008) and major problems including project delays and major cost consequences by the other half (43% in 2006 and 42% in 2008). The share of businesses which reported that projects did not proceed because of engineering skills shortages was 6 percent in 2006 and 7 percent in 2008.[2]

What is particularly concerning in terms of the long term skills need of Australian industry is that graduation and migration rates are not meeting the current skills shortage, let alone compensating for retirements from the profession.

Currently migrants account for more than half of growth of new entrants to the Australian engineering profession each year. The immigration of professional engineers into Australia through both the off-shore and on-shore permanent visas since 2000-01 and via the temporary 457 visa since 2003-04 are show in Table 1.

Table 1: Immigration of Engineers to Australia 2000-01 to 2006-07

YEAR	PERMANENT OFF-SHORE	PERMANENT ON-SHORE	TOTAL PERMANENT	TEMPORARY 457 VISA	OVERALL TOTAL
2000-01	1240	31	1271	0	na
2001-02	1140	271	1411	0	na
2002-03	1447	451	1898	0	na
2003-04	1420	952	2372	810	3182
2004-05	1732	1800	3532	540	4072
2005-06	2312	1629	3941	1380	5321
2006-07	1980	2140	4120	1970	6090

Source: To 2003-04 Birrell, Sheridan and Rapson; since 2004-05 and 457 data Department of Immigration and Citizenship

Since 2003-04, the number of engineers working in Australia on 457 temporary visas has more than doubled, increasing from 810 to 1,970. The increase between 2005-06 and 2006-07 was particularly large and may be related to the fall in permanent off-shore migration between those years.

The significance of these changes can be put into perspective by comparing migration to the output of Australian universities. In 2006, there were 5044 new four year Bachelor of Engineering graduates. The supply of new engineers to the Australian workforce is the sum of university output and immigration. Thus in 2006, the supply of new professional engineers was 11,134 (5044 new domestic graduates and 6090 new migrant engineers) with migration accounting for more than half of new supply.

Engineers Australia recognises the significant contribution made by migrant engineers to Australia's competitiveness and economic growth. Migrant engineers are a vital element in generating new ideas and approaches to engineering, and for providing skills where there are shortages.

However, there is an acute need for the Australian education system to produce more engineering graduates. Until relatively recently, only traditional immigrant countries (Australia, New Zealand, Canada and the United States) competed for immigrants. Now European nations and nations elsewhere (especially in the Middle East and Asia) are entering the competition for migrants with desired characteristics, especially skills in short supply.

Countries experiencing labour shortages and population pressures are directing the focus toward skilled migration. Australia's reliance on migrant engineers to meet skills shortages leaves industry and our innovation system vulnerable.

The engineering profession is already experiencing a significant skills shortage which is not being met by current university graduations or significantly increased migration rates. The flow on effects of low participation in science, engineering, technology and mathematics at primary and secondary school into the tertiary level has been inevitable and the domestic engineering skills base has been allowed to languish. This will have a significant impact on Australia's capacity to meet the challenges produced by climate change.

Engineering university graduates are the main domestic supply from which new demand for engineers and the replacement of older engineers, retiring from the workforce, must be met. Although there have been some increases in the number of undergraduate places in engineering, many more are needed. However, currently there is not a large enough pool of school students capable and interested in studying engineering and other science and maths subjects.

In 2004, less than 12 percent of Australian students were studying advanced mathematics[3]. In 2001, only 10 percent of Year 12 students had completed the prerequisites required to study engineering at university.[4] We need students capable and willing to fill university places. With an ageing population and booming economy it is no surprise that both graduating and experienced engineers are in high demand. For the long-term success of the Australian economy and to meet the challenges of the future including climate change, the domestic supply of "home grown" engineers must be increased.

Recommendation: Australia needs more students who choose to study high-level school science, technology and mathematics subjects and to continue into tertiary education in these fields, engineering in particular. The development of a new national curriculum for primary and secondary education must be structured to support this goal. Without "schoolroom solutions", engineering education will continue to be constrained and skill shortages will worsen.

3. Engineering shortages and climate change

There can be no doubt that there is a desperate shortage of engineers in Australia. Currently there is a tendency to over-simplify this as an outcome of the unprecedented resources boom, particularly in Western Australia and Queensland, led by China's seemingly insatiable demand for raw materials to feed its manufacturing industries.

There is no way that Australia can expect to satisfy this demand for engineers while we continue to graduate fewer than 6,000 professional engineers each year and remain at the lower end of the OECD league table of engineering graduates per head of population.

The biggest challenge ahead is climate change. This is because it impacts on so many things: water, food production, infrastructure stability, rising sea levels displacing many people, and increasingly severe weather activity that can be life-threatening. Engineers Australia is concerned that Australia is not doing enough to ensure that there are sufficient engineers to tackle the issues that are confronting us now, and well into the future.

To address these challenges, we must think in terms of the sustainable use of resources, the creation of a clean and low carbon emission environment, and measures to cope with the impacts of climate change. At the same time we must provide opportunities for all Australians to participate in society and have continuing access to the basic infrastructure and services that many of us take for granted.

Box 2: The engineering team

Engineering work is undertaken by individuals trained at both university and through the vocational educational system. As a group these engineers form the "Engineering Team". Engineers, technologists and associates come together in different combinations to undertake projects and programs. Their activities and competencies are often closely inter-related with some features of engineering being common to all three categories. All members of the "engineering team" work together and provide services to each other in order to complete engineering tasks.

Professional Engineers: The benchmark qualification for professional engineers is the four-year Bachelor of Engineering university degree. Professional engineers are required to take responsibility for engineering projects and programs in the most far reaching sense. This includes the reliable functioning of all materials and technologies used; their integration to form a complete and self-consistent system; and all interactions between the technical system and the environment in which it functions. Professional engineers have a particular responsibility for ensuring that all aspects of a project are soundly based in theory and fundamental principle, and for understanding clearly how new developments relate to established practice and experience and to other disciplines with which they may interact.

Engineering Technologists*:* The benchmark qualification for engineering technologists is the three-year Bachelor of Engineering Technology university degree. Engineering technologists normally operate within a relatively well-defined technical environment, and undertake a wide range of functions and responsibilities. They are typically specialists in a particular field of engineering technology and their expertise lies in familiarity with its current state of development and its most recent applications.

Within their specialist field, their expertise may be at a high level, and fully equivalent to that of a professional engineer; but they are not expected to carry the same wide-ranging responsibilities for stakeholder interactions, for system integration, and for synthesising overall approaches to complex situations and complex engineering problems.

The competencies of engineering technologists equip them to approve and certify many technical operations such as calibration and testing regimes, compliance with performance-based criteria for fire safety, and design of components and sub-systems and of installations such as building services in circumstances that do not call for significant new development.

Engineering Associates*:* The benchmark qualification for engineering associates is the two-year Advanced Diploma of Engineering under the Australian Qualifications Framework or the Associate Degree in Engineering. These courses are delivered by the university and vocational education system.

Engineering associates focus mainly on practical applications. They may be expert in installing, testing and monitoring equipment and systems, in the operation and maintenance of advanced plant, and in managing or supervising tradespeople in these activities. They may be expert in selecting equipment and components to meet given specifications, and in assembling these to form systems customised to particular projects.

Engineering associates are often required to be closely familiar with Standards and Codes of Practice, and to become expert in their interpretation and application to a wide variety of situations.

The roles of engineers will be to develop energy-efficient power plants, to devise and improve renewable energy options in solar, wind and geo-thermal technology, and to ensure that undesirable by-products are either made useful or disposed of safely. If Australia does this right we will have a prosperous future and be able to extend our technical expertise and prosperity outside our own borders, through the export of new technologies, new knowledge and new skills.

Engineers are involved in upgrading water infrastructure and the design, construction and maintenance of desalination plants. They are also designing water-sensitive infrastructure for residential subdivisions and commercial buildings to facilitate the safe use of reclaimed water.

Solutions to the challenges of climate change will need significant involvement by engineers. Indeed these challenges are the very ones that attract today's community-conscious and socially aware young Australians into the engineering profession. However, there are simply not enough engineers entering the profession to satisfy the combined impacts of growing demand and the demographic bulge of older engineers. The heightened activity in the resources sector, coupled with programs of infrastructure renewal and the challenges posed by climate change means that skill shortages will continue to grow.

4. Educating the "Engineering Team"

There is a broad range of skills and services that fall within the ambit of engineering and not all of these are provided by "professional" (four year university trained) engineers. Most professions, including engineering, acknowledge the broad scope of possible practice within them, and allow for differences in qualifications and for specialisation in areas of work.

For instance, engineers can be divided into three main occupational categories. These are professional engineer, engineering technologist and engineering officer/associate. The occupational categories can be differentiated by the length of education and training undertaken by the engineer. These categories and the engineering work typically undertaken by them are outlined in Box 2. In recognising the contribution that each occupational category makes to the engineering profession, Engineers Australia has designated 2008 as the "Year of the Engineering Team".[5]

Engineers, technologists and associates come together in different combinations to undertake projects and programs. Their activities and competencies are often closely inter-related and it is difficult and sometimes artificial to say where the responsibilities of one category ends and those of the next category begin. There are activities that could be undertaken, in different circumstances, by members of any of the three categories. Other activities are clearly the province of one category but not of another – for example, the province of a professional engineer but not an engineering associate, or vice versa.

Just like the university system, the vocational education system (VET/TAFE) needs to increase graduation numbers in order to meet industry needs. Skill shortages exist across the engineering team and the problems of attracting students to study engineering are equally valid for both the university and vocational education system.

4.1 Supply, demand and nationally important disciplines

The higher education sector currently has the sole responsibility for educating Professional Engineers (four year awards leading to a Bachelor of Engineering) and Engineering Technologists (three year awards leading to a Bachelor of Technology).

The higher education sector shares responsibility with the VET sector in providing award programs for Engineering Officers/Associates through two year Associate Degrees and Advanced Diplomas. Because engineering skills shortages are not confined to professional engineers, there is a need to rethink, reposition and improve the education pathways for the engineering team as a whole.

In particular, while industry needs more Engineering Technologists, the provision of these courses at universities has declined dramatically and many universities have ceased enrolling new students in three-year courses despite the shortage of graduates. Only 809 Engineering Technologists graduated from Australian universities in 2006.

Table 2: New Engineering Graduates – Universities and VET

Men

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Engineering Officer Uni	315	313	186	65	62	129	106	162	176	141	115	134	106
Engineering Officer TAFE	na	na	na	na	na	na	na	na	2810	2850	2905	2898	2525
Engineering Technologist	305	510	616	684	694	656	501	488	473	449	441	583	679
Professional Engineer	3672	5830	3737	3803	3849	3684	3753	4361	4098	4224	4398	4016	4252
Total	**4292**	**4673**	**4539**	**4552**	**4605**	**4469**	**4360**	**5011**	**7557**	**7664**	**7859**	**7631**	**7562**

Women

Engineering Officer Uni	23	17	8	10	4	16	6	5	10	15	9	7	8
Engineering Officer TAFE	na	na	na	na	na	na	na	na	405	390	420	550	530
Engineering Technologist	46	71	72	94	92	85	53	88	77	74	76	133	130
Professional Engineer	613	629	653	697	711	646	687	907	847	879	857	785	792
Total	**682**	**717**	**733**	**801**	**807**	**747**	**746**	**1000**	**1339**	**1358**	**1362**	**1475**	**1460**

All Domestic Graduates

Engineering Officer Uni	338	330	194	75	66	145	112	167	186	156	124	141	114
Engineering Officer TAFE	na	na	na	na	na	na	na	na	3205	3300	3165	3530	3055
Engineering Technologist	351	581	688	778	786	741	554	576	550	523	517	716	809
Professional Engineer	4285	4479	4390	4500	4560	4330	4440	5268	4945	5103	6255	4801	5044
Total	**4974**	**5390**	**5272**	**5353**	**5412**	**5216**	**5106**	**6011**	**8886**	**9082**	**9061**	**9188**	**9022**

Note: The protocols followed by the provider of TAFE data means that TAFE totals will not sum
Source: Data supplied by DEEWR and the National VET Provider Collection NCVER

The number of enrolments in engineering education is dependent on two factors: the number of qualified applicants and the proportion of these who are motivated towards engineering. University engineering schools have seen very low demand for three-year courses from potential students and have responded by reducing course offerings.

The majority of engineering schools are primarily focused on providing four-year Professional Engineering courses. However, a small number of universities have responded to local industry demand and have reintroduced or substantially increased offerings at the three-year level, for example the University of Ballarat, University of Southern Queensland and the Central Queensland University.

Generally, enrolments in engineering are low across all education levels. More graduates are needed and mechanisms to encourage school leavers to choose engineering education options must focus on promoting all the available education and career pathways within the Engineering Team.

In an environment where unit offerings within engineering schools have been driven by student demand there has also been ongoing concern, particularly from industry, that along with the three-year Bachelor of Technology Degree, some disciplines of engineering are in danger of disappearing because of small student numbers. The issue of maintaining specialist areas of study, critical to Australia's economy, regardless of student numbers also needs to be addressed.

Having education institutions supplying education and training on the basis of student demand, with student choice being the key determinate in what is offered, may result in the system not meeting industry needs, with skill shortages developing. Additionally, new and emerging areas of expertise needed in the Australian economy, for example related to climate change as well as other areas including nuclear science or infrastructure renewal, will have to be imported.

There is also a lag problem when pricing and labour market signals act as the key influencer of student choices. Fluctuations in the economy, combined with the length of a standard degree mean that it may take three to four years before graduate supply will begin to react to labour market signals.

This situation is at an even more critical stage for engineering skills as the number of high school students studying prerequisite subjects including maths and science continues to decline. The lag problem might in fact be more like 10-15 years.

The success of the higher education system in meeting Australia's needs for highly skilled and capable people will be determined primarily by "schoolroom solutions" that work to ensure enough students are interested and capable of studying engineering at a level that meets industries current and long-term skills needs.

Recommendation: The Federal Government must be willing to influence the education system to encourage more students into engineering careers.

5. Accreditation, articulation pathways and student support mechanisms

One of the activities undertaken by Engineers Australia is the accreditation of undergraduate engineering programs at Australian universities. Engineers Australia undertakes accreditation of engineering degrees offered by Australian higher education institutions to ensure engineering programs consistently meet national and international benchmarks, and that engineering graduates are operating at worlds best standards and meeting the needs of engineering employers.

Employers of engineers recognise that the accreditation system helps to ensure that all engineering graduates across Australia are operating at a comparable level, and that they can feel confident of an engineering graduate's skill when choosing to employ them. Over 90% of graduates from university engineering programs are employed one year out from completing their course and at one of the highest graduate salary rates of any professionals.

Engineers Australia accredits the undergraduate engineering courses offered by all university engineering schools in Australia. Recent changes to the university landscape, particularly in relation to the restructuring of the University of Melbourne has resulted in Engineers Australia broadening its accreditation function to include those Masters Degree programs where graduates would be eligible for entry into the engineering profession.

Only those courses successfully accredited by Engineers Australia provide the required level of tuition to students resulting in graduates who have the required level of education necessary to become Chartered members of Engineers Australia or to be registered on the National Professional Engineers Register (NPER) or National Engineering Technologists Register (NETR).[6]

Another type of Masters program being actively encouraged and accredited by Engineers Australia are those acting as articulation pathways into the profession for individuals who have completed a three year university qualification in engineering, or a diploma from a vocational education provider.

For example, the Master of Engineering Practice offered at the University of Southern Queensland provides an education pathway that upgrades student's vocational education qualifications to a level equivalent to a four year undergraduate engineering degree making graduates from the Masters eligible for entry into the profession as a "Professional Engineers". That is, eligible for registration on NPER and membership of Engineers Australia at the Chartered level.

Engineers Australia compiles a listing of every university course in Australia which has been given accreditation. The 2008 version can be downloaded from: www.engineersaustralia.org.au/education/program-accreditation/accredited-programs

Engineers Australia believes that all student support mechanisms including admission to a Commonwealth supported university place, Commonwealth Scholarships, HECS and Centrelink payments should be extended to all courses accredited by Engineers Australia. These courses result in graduates that increase the pool of engineering expertise in Australia and should be supported equally.

This measure will capture not only those Masters courses established by the restructure at the University of Melbourne, but also those Masters courses developed to create articulation pathways into the engineering profession. Support for articulation courses is particularly important as the engineering skills shortage continues to worsen.

Additionally, it is inequitable that some students studying Masters programs which lead to an accredited engineering degree (eg Melbourne University) are able to access government support, while other students studying articulation programs at the Masters level (eg University of Southern Queensland) are forced to pay higher fees and are unable to access equal levels of student support, despite the fact that their qualification on graduation is the equivalent to a four year undergraduate degree in engineering.

Recommendation: All students studying engineering degree programs accredited by Engineers Australia should have access to the same level of student support including admission to a Commonwealth-supported place and access to Commonwealth Scholarships, HECS and Centerlink payments.

6. Accreditation of VET engineering courses

The blurring boundary between the delivery of vocational (VET) and university education should be seen as a positive outcome. There are significant benefits to creating clear pathways between vocational and higher education where students can maintain lifelong learning by jumping in and out of education between vocational and university provided training.

Setting up pathways between VET and university education with clearly defined options and credit transfer arrangements would support the different roles of VET and university education and encourage life-long learning. Given that skill shortages are being experienced in engineering at both the trade, associate, technologist and professional level, training options need to be maintained at both the vocational and university level. A shift toward any one level could have a negative outcome on the Engineering Team as a whole.

Engineers Australia is however concerned with ensuring that a high standard of engineering training is being offered within Australia for the entire Engineering Team. Currently only those courses offered by the university sector are accredited by Engineers Australia.

In recognising the high standard of graduate attributes created through the accreditation system and the link to training outcomes which are responsive to employer needs, Engineers Australia has been working on a pilot program of VET/TAFE accreditation. This includes the accreditation of AQF advanced diplomas and associate degrees in engineering.

Accreditation is on the basis of a program implemented by a registered training authority (RTO) against a competency based training package, and dove-tails with the Australian Quality Training Framework (AQTF) audit process. Engineers Australia has recently accredited Advanced Diploma programs in Engineering Technology, at Chisholm Institute of TAFE.

Engineers Australia has developed the accreditation management system for the pilot program while maintaining links with the Australian Skills Council and various State based authorities such as TAFE NSW and the Victorian Curriculum Maintenance Managers.

In 2008, significant projects are underway with the TAFE NSW Curriculum Centre for Manufacturing Engineering (MECAT) and also with Manufacturing Skills Australia to develop umbrella guideline templates that will assist program developers implement engineering programs against the National Training Packages.

The accreditation program of Engineers Australia is a proven method of ensuring that engineering programs best meet the needs of employers and as much as possible, training outcomes for individuals and enterprises translate into appropriate employment outcomes. Engineers Australia is committed to working toward an expansion of the TAFE accreditation program to all States and Territories over the coming years.

Engineers Australia's commitment to the development of an accreditation system for education delivered across the Engineering Team means that Engineers Australia is unconcerned about who offers what within the post-compulsory education landscape. For example, there is no reason why some engineering education, for example at the Associate Degree level, cannot be offered by both the higher education and VET sector. What should be more important is whether the course has been accredited by an external body like Engineers Australia.

What will need consideration is how external accreditation and quality assurance is going to be facilitated. Engineers Australia as a not-for-profit organisation, currently accredits university engineering courses as a community service to the engineering profession. Despite the need to ensure that the education provided across the Engineering Team is internationally benchmarked and accredited, how such a program might be resourced is still uncertain.

The State and Commonwealth Governments will need to be willing to support the full-scale accreditation of Australian engineering education and be prepared to influence the post-compulsory education sector to meet this goal. Additionally, dual sector universities, for example Swinburne, RMIT, Victoria, Ballarat and Charles Darwin, have considerable positive student experiences with excellent learning outcomes and industry linkages and must be supported within the post-compulsory education system.

Recommendation: The blurring boundary between the delivery of VET and university education should be seen as a positive development. External accreditation and quality assurance will need careful and thoughtful facilitation as the post-compulsory education sector becomes more diverse and educational offerings differentiate across the sectors.

Recommendation: The Commonwealth and the States will need to be willing to support the full-scale accreditation of all post-compulsory engineering education in Australia. Without this support, program standards and articulation pathways cannot be developed and maintained across the Engineering Team.

7. Resourcing the system

Engineers Australia believes that current funding levels to public universities are insufficient to service any future increase in demand for engineering education. Since the mid 1980's (with the exception of a few years) governments have let the per capita investment by the Commonwealth in public universities slide, and have allowed it to be wholly or partially replaced with fees, grants and outside earnings. Funding per student has been decreased.

University capabilities are severely stretched, and the reduction in public funding has meant that universities must gain income from other sources. The chase for this funding depletes academic strength. This particularly affects the engineering schools' ability to engage in research. The reduction in funding is also detrimentally affecting the quality and diversity of teaching and research. The current environment limits the ability of universities to provide the high standard of undergraduate teaching and the required research infrastructure necessary to create the skilled workforce vital for Australia to remain a significant player in the world economy including in climate change mitigation strategies and technologies.

The Government's commitment to halve HECS fees for maths and science students, and halving their repayments if they take up jobs in key fields, such as teaching, must be extended to engineering graduates. Support and encouragement for more students to study engineering is particularly important as the skills shortage continues to worsen. It would be counter-productive to price engineering programs higher than science or other disciplines, for example economics and accounting, when they all draw on essentially the same school leaver pool.

Engineers Australia supports the encouragement of students into courses and universities in areas of skills need by lowering HECS fees, as long as this funding is compensated by increased levels of government funding. Government funding of higher education in Australia is currently inadequate, which has led to an over-reliance on increased HECS and full-fee paying students.

Australia is the only developed country to reduce its public investment in post compulsory education over the last decade. This is certainly not something to be proud of, nor will it benefit Australia's long term economic and climatic future. Engineers Australia is hopeful that the current Review of Higher Education will think creatively about new and innovative ways to support and fund the education system in Australia.

Recommendation: The education and training system must focus on the up skilling and retraining of existing workers. Flexible pathways must be created to meet the education and training needs of individuals at all stages of their careers.

Recommendation: Government funding to universities must be increased to at least the OECD average. Options to reduce the HECS burden on engineering students and other areas of skills-need must be explored and targeted to increase enrolments.

Recommendation: The majority of post-graduate study in Australia is full-fee paying. Options to reduce the fee burden on students in engineering and other areas of skills need must be evaluated and the best introduced. Initiatives to increase enrolments in courses that are retaining pathways for entry into the engineering profession must be launched.

7. Listing of recommendations

Engineers are a key skills input for climate change mitigation. Without them, Australia will be unable to meet the challenges posed by climate change. As outlined, the effects of climate change on training and employments needs in the engineering sector is simply that more engineers need to be grown by the Australian education system if Australia's climate change adaptation and mitigation strategies are to be supported.

Engineers Australia makes the following recommendations:

Recommendation 1: Australia needs more students who choose to study high-level school science, technology and mathematics subjects and to continue into tertiary education in these fields, engineering in particular. The development of a new national curriculum for primary and secondary education must be structured to support this goal. Without "schoolroom solutions", engineering education will continue to be constrained and skill shortages will worsen.

Recommendation 2: The Federal Government must be willing to influence the education system to encourage more students into engineering careers.

Recommendation 3: All students studying engineering degree programs accredited by Engineers Australia should have access to the same level of student support including admission to a Commonwealth-supported place and access to Commonwealth Scholarships, HECS and Centerlink payments.

Recommendation 4: The blurring boundary between the delivery of VET and university education should be seen as a positive development. External accreditation and quality assurance will need careful and thoughtful facilitation as the post-compulsory education sector becomes more diverse and educational offerings differentiate across the sectors.

Recommendation 5: The Commonwealth and the States will need to be willing to support the full-scale accreditation of all post-compulsory engineering education in Australia. Without this support, program standards and articulation pathways cannot be developed and maintained across the Engineering Team.

Recommendation 6: The education and training system must focus on the up skilling and retraining of existing workers. Flexible pathways must be created to meet the education and training needs of individuals at all stages of their careers.

Recommendation 7: Government funding to universities must be increased to at least the OECD average. Options to reduce the HECS burden on engineering students and other areas of skills-need must be explored and targeted to increase enrolments.

Recommendation 8: The majority of post-graduate study in Australia is full-fee paying. Options to reduce the fee burden on students in engineering and other areas of skills need must be evaluated and the best introduced. Initiatives to increase enrolments in courses that are retaining pathways for entry into the engineering profession must be launched.

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