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Prepared by **The Insight Centre** for **Professionals Australia**

PROFESSIONALS AUSTRALIA

Engineering a Better Future

Australia's Growing Crisis in Engineering Skills

March 2023

Executive Summary

This report presents new modelling of the supply and demand for national engineering skills and predicts a skills gap of 200,000 by 2040. This unprecedented mismatch between demand and supply will leave key roles vacant and place unsustainable pressure on the existing engineering workforce. The large-scale technological and structural transformations required to meet Australia's social, economic and climate challenges in the coming decades are at considerable risk if action is not taken to address this shortfall in critical skills. Government investment in major infrastructure projects and clean energy industries and services may also fail to deliver high quality and cost-effective outcomes without adequate engineering skills and oversight. Targeted interventions are required at the state and federal levels to bolster the Australian engineering workforce now and in the future.

KEY FINDINGS:

- Modelling of the engineering workforce forecasts that the skills gap will increase to 200,000 by 2040 if new and additional measures are not put in place to grow the workforce.
- Underutilisation of qualified engineers contributes to supply issues. Only 66% of Australian-born engineers and 49% of overseas-born engineers work in engineering roles.
- The education pipeline for engineers shows insufficient growth. Commencement and graduation numbers for domestic engineering degrees are stagnant, whereas the international student cohort is growing at a rate of 8.8% annually.
- Women are an untapped resource for meeting the growing demand for skills. Less than two in ten engineering students are women, and women make up only 15% of the university qualified engineer workforce.
- Migration intake can play a role in addressing the skills gap but must complement strategies to build domestic supply – there is limited growth across all visa categories relevant to engineering and increasing competition for engineering skills globally will limit future supply to Australia. Sustainably meeting long-term demand requires growth in permanent skilled migration, protection of working conditions and equitable pay for migrant engineers.
- The public sector engineering workforce is at even greater risk of a severe skills shortage than the private sector. Using New South Wales as a case study, the report shows that public sector wage caps are contributing significantly to this situation.
- Jurisdictions that do not require registration of engineering professionals are also at risk of deficits in skill quality and capability, and increased liability. Comparison between Queensland (which has broad-based and mandatory registration) and New South Wales (which does not) shows that mandatory registration has no negative long-term impacts on workforce growth trajectories, while offering significant benefits in terms of protecting workforce quality and reducing economic risk.

Introduction

Australia is facing a period of unprecedented levels of investment into major infrastructure projects, large-scale transformations to the energy and transport sectors, and intensified technological change in many other areas of the economy. Meeting the challenges of tackling climate change and building climate-adaptable and sustainable infrastructure requires significant investment into strengthening and growing the engineering workforce.

Currently, there is a risk of a significant shortfall in the core engineering skills required.

This report presents new modelling of the supply and demand for engineering skills nationally that predicts a skills gap of 200,000 by 2040. The skills shortage can be attributed to a growing divide between demand and supply, leaving key roles vacant and putting an unsustainable strain on the existing workforce. Specific measures need to be implemented now by both state and federal governments to protect and grow the engineering profession to meet the increasing demand for engineering skills.

While Australia has experienced skills shortages in the engineering workforce before, the scale and context of the current crisis are unprecedented. Enormous investments into infrastructure, heightened interest in minerals, the transition to clean energy and continuing technological advancements all increase the demand for engineering skills across a number of sectors and highlight the dependence on the engineering profession of a strong economy and society.[1][2]

The surge in demand for engineering skills coincides with a period of inflation, disrupted supply of materials and labour as well as declining enrolment numbers in engineering related subjects. Moreover, many other industrialised countries face similar shortages, resulting in high global demand for engineers. Multifaceted and long-term strategies are required to meet Australia's growing demand for engineering professionals.

This report establishes the need for targeted policy interventions at the state and federal levels to bolster the Australia's engineering workforce for the future. The report provides modelling that demonstrates the widening of the engineering skills gap over the next two decades and recommends interventions to strengthen the engineering workforce in terms of both numbers and quality of skills in order to comprehensively address the skills shortage. Ensuring that critical engineering services are being performed by qualified and professional engineers, alongside multi-pronged workforce growth strategies, is critical to ensure quality of service delivery and maximise the benefits of growth.

1 Engineers Australia (2022). *Strengthening the engineering workforce in Australia: Solutions to address the skills shortage in the short, medium, and long term*, p. 5. Accessed 19 Dec 2022: https://www.engineersaustralia.org.au/sites/default/files/2022-08/strengthening-engineering-workforce-australia.pdf.

2 Bradley, J. (2022). 'Addressing the engineering skills shortage in Australia'. *Create.* Accessed 3 Jan 2023: https://createdigital.org.au/addressing-the-engineering-skills-shortage/.

Forecasting Model Methods and Data Sources

The statistics for the engineering workforce used in this report are derived from Australian Bureau of Statistics (ABS) quarterly Labour Force Survey data.[3] This data has been filtered for the following 10 ANZSCO codes: 1332 Engineering Managers; 2632 ICT Support and Test Engineers; 2333 Electrical Engineers; 2334 Electronics Engineers; 2336 Mining Engineers; 2339 Other Engineering Professionals; 2331 Chemical and Materials Engineers; 2335 Industrial, Mechanical and Production Engineers; 2633 Telecommunications Engineering Professionals; 2332 Civil Engineering Professionals.

The annual rate of change of employment between 2002 and 2022 is 4% and our projections are modelled using this growth rate. We also factored in an attrition rate of 3%.[4]

Engineering graduation numbers are generally based on Field of Education codes collected and published by the Department of Education, Skills and Employment. The relevant statistics are drawn from the following code: FoE 03 Engineering and Related Technologies. However, degree completion numbers from this source do not provide insight into the number of graduates that can enter the engineering workforce, as a four-year degree has been required to become a professional engineer since 1980.[5] The number of graduates with an entry-to-practice degree is thus smaller than the number of degree completions, which include three-year bachelor's degrees. The BEng (Hons) is the 'standard' degree for entry to professional engineering practice in Australia.[6] Consequently, the graduation numbers that we used for our model are derived from Emeritus Professor Robin King's estimates,[7] which are sourced from universities directly and are the best available recent numbers of people completing entry-to-practice honours and master's degrees for domestic students. We project these numbers at the rates of growth of the official student numbers provided by the Department of Education, Skills and Employment[8] – 2% for domestic students – because King's three data points for the years 2016-2019 do not provide enough information to calculate a robust rate of change.

Our model assumes 85% of domestic graduates will enter the Australian engineering workforce each year[9] and that the numbers of students will grow annually at a rate of 1.8% (based on the growth rate between 2001 and 2020). International graduates can only enter the workforce through a subsequent visa – either a temporary graduate visa, a temporary skills visa or a permanent visa. These graduates are included via Department of Home Affairs statistics for those visas for the 10 relevant ANZSCO categories (except for the temporary graduate visas).

3 Australian Bureau of Statistics (2022). *Labour force, Australia, detailed.* Accessed 13 Jan 2023: https://www.abs.gov.au/statistics/labour/employment-and-unemployment/labour-force-australia-detailed/latest-release.

4 King, R. (2021). Working paper shortages of engineers and supply projections, p. 13.

5 Australian Council of Engineering Deans (ACED) (2020). *Australian engineering education statistics*, p. 4. Accessed 13 Jan 2023: http://www.aced.edu.au/downloads/ACED%20Engineering%20Statistics%20Mar%202020.pdf.

6 Ibid.

7 King, R. (2021). *Professional engineering graduates by branch of engineering.* Accessed 13 Jan 2023: https://www.aced.edu.au/downloads/ACED%20Graduates%20by%20Branch%20of%20Engineering%20May%202021%20-%20RKing.pdf

8 Department of Education, Skills and Employment (2022). *Higher education statistics data cube (uCube): Completion count by year by field of education 2001-2019.* Accessed 14 Dec 2022: https://highereducationstatistics.education.gov.au

9 King, R. (2021). Working paper shortages of engineers and supply projections. p. 13.

Temporary skilled visa holders receive a work permit for 2 to 4 years. This visa is generally aimed to address skill shortages in Australia. The annual growth rate over the past 16 years is -2%. Therefore, our model is based on an assumption that skilled migrant numbers will decline, although changes in policy settings could impact growth trajectories. In addition, our model is operating with the assumption that only 40% of the engineers on temporary skilled migrant visas end up working in a core engineering field.[10]

As the Department of Home Affairs has not released statistics on subsequent permanent visas granted to international students on a field of study level since 2015, we have used estimate numbers from the Australian Council for Engineering Deans.[11] These estimates consider the proportion of international engineering students of all international students in Australia (8%) and then assume that the same proportion of graduate visas will be granted to engineering students after they finish their studies.

It should be noted that projections across these extended timelines are highly sensitive to changes including inflation, policy change or global events.

10 Engineers Australia (2022). *Strengthening the engineering workforce in Australia: Solutions to address the skills shortage in the short, medium, and long term*, p. 4. Accessed 30 Dec 2022: https://www.engineersaustralia.org.au/sites/default/files/2022-08/strengthening-engineering-workforce-australia.pdf.

11 King, R. (2021). *Pipelines into Engineering Occupations*, p. 7.

The Engineering Skills Gap

Australia's needs in relation to infrastructure, energy, defence and technology are changing and growing rapidly, creating steady growth in demand for engineering skills. However, the supply of qualified engineers in Australia is lagging behind intensifying demand.

At current growth rates, our model predicts a skills shortage of **200,000 engineers by 2040**, based on estimated attrition rates and the proportion of domestic graduates and skilled migrants who end up working in the engineering workforce.

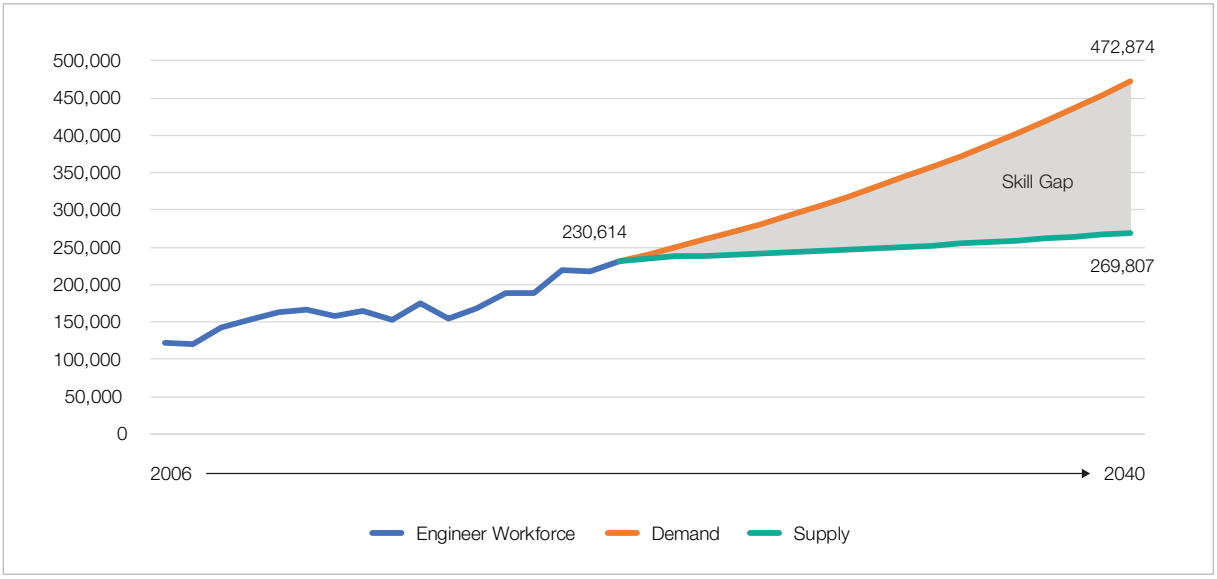

Figure 1. Projected engineering skills gap, Australia, 2022-2040

Projecting the quarterly employment numbers from the ABS[12] with an annual compound growth rate of 4% shows a *demand* in 2040 of 472,874 engineers – an increase of more than 242,257 since 2022. This prediction was contrasted with a forecasted *supply* of engineers, including those joining and leaving the workforce – i.e., domestic and international graduates, skilled migrants and retirees. The supply projection reveals a growth of only 39,193 between 2022 to 2040, which increasingly lags behind the demand, resulting in a shortage of 203,067 engineers by 2040.

12 Australian Bureau of Statistics (2022). *Table 1: EQ08 - Employed persons by Occupation unit group of main job (ANZSCO), Sex, State and Territory, August 1986 onwards.* Accessed 7 Dec 2022: https://www.abs.gov.au/statistics/labour/employment-and-unemployment/labour-force-australia-detailed/latest-release.

A closer look at the projections for the different engineering cohorts shows that levels of attrition (engineers leaving the workforce) are growing more strongly over time than levels of attraction (engineers entering the workforce). In 2022, around 3,500 more workers entered the engineering workforce than left. In 2040, we project that only 400 more workers will enter engineering than leave. This stagnant workforce growth will be insufficient to meet industry growth and demand for engineering skills. Our projections also indicate that from 2023 onwards, without interventions, the number of domestic engineering graduates will not be high enough to replace the number of engineers who leave the workforce.

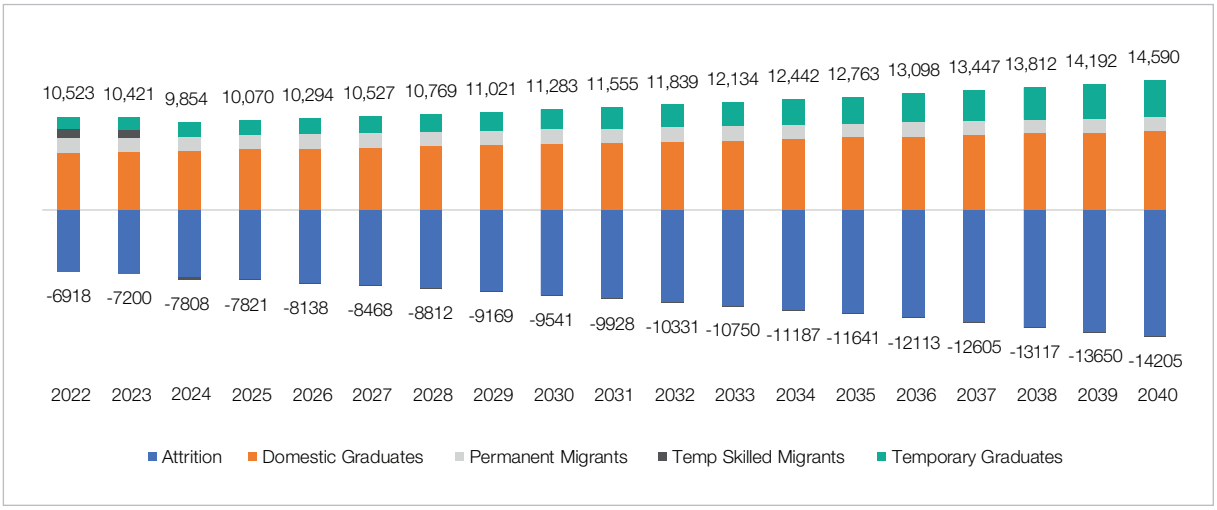

Figure 2. Projected attraction and attrition rates, Australian engineering workforce, 2022-2040

The modelling also shows the relatively small proportion of migrant engineers (temporary and permanent) in the overall engineering workforce. We have adjusted from raw migration intake numbers in our model to account for the fact that only 40% of skilled migrant engineers end up working in the engineering workforce in Australia.[13] Of those, only those who enter on permanent visas or secure permanent visas while onshore contribute to the long-term growth of the workforce.

Post-COVID-19, migration rates are set to recover over time. However, the growth in demand and increased global competition for engineering skills means that migration intake alone is unlikely to be able to address this shortage.

13 Engineers Australia (2022), p. 4.

A skills shortage of this magnitude will have severe implications for the success of major infrastructure projects and the transition to clean energy industries and services that require engineering skills. National Skills Commission projections suggest that the specific engineering occupations likely to be in highest demand in the short-term include Civil Engineering Professionals, ICT Support and Test Engineers, Telecommunications Engineering Professionals, Engineering Managers and Mining Engineers.[14]

A key issue in this looming skills crisis is that many degree-qualified engineers do not work in core-engineering jobs and engineering roles.[15] Almost four out of ten qualified engineers (37.9%) work in non-core industries such as education and training, retail or accommodation and food services – a trend that has been growing over the past few decades.[16] Engineers working in core engineering industries are much more likely to work in engineering-specific occupations.[17] Research suggests that 66% of Australian-born engineers work in engineering roles compared to only 49% of overseas-born engineers,[18] emphasising the extent of the underutilisation of many of Australia's qualified engineers. Attracting a new generation into engineering degrees thus represents part of the solution – the profession also needs to be strengthened and supported across sectors to attract and retain engineering graduates into lifelong engineering careers. This will ensure the requisite retention of experience and expertise at senior levels of the workforce.

14 Australian Government & National Skills Commission (2022). *Labour markets insights* (filtered by 10 relevant ANZSCO engineering codes). Accessed 16 Jan 2023: https://labourmarketinsights.gov.au.

15 Engineers Australia (2019, 20) defines as core industries such "industries in which the proportion of engineers in the industry who are actually employed in engineering occupations is higher than the national average".

16 Engineers Australia (2019). *Engineers and industry: A decade of change*, p. 66. Accessed 9 Jan 2023: https://www.engineersaustralia.org.au/sites/default/files/2022-06/engineers-industry-decade-change.pdf.

17 Ibid.

18 Engineers Australia (2021). *Planning Australia's skilled migration program*, p. 7. Accessed 9 January 2023: https://www.engineersaustralia.org.au/sites/default/files/resource-files/2021-12/engineers-australia-submission-planning-australias-2022-23-migration-program.pdf.

Strengthening Australian Engineering Workforce – Challenges and Solutions

The engineering workforce has grown steadily over the past four decades with two main channels of supply: Australian domestic students who complete a tertiary engineering degree and skilled migrant engineers, including a growing pool of international student graduates. Both these channels are projected to have insufficient growth to meet demand over the next two decades. While increasing the base of the domestic workforce is crucial to address the skill shortage in the long-term – for instance, through encouraging more students to take up and complete engineering degrees – other interventions are required in the short- and medium-term to increase Australia's engineering workforce and capacity.

ENGINEERING DEGREES IN HIGHER EDUCATION

Fewer young people in Australia are choosing to start and obtain an engineering degree,[19] with commencement numbers stalling since 2016 at below 40,000 and dropping further to 34,742 in 2020 during COVID-19. Graduation numbers have also been stagnant since 2018 at around 25,000 – particularly among domestic students, whereas the proportion of international students has grown continuously – indicating a shrinking pool of engineering graduates available to enter and remain in the local workforce.

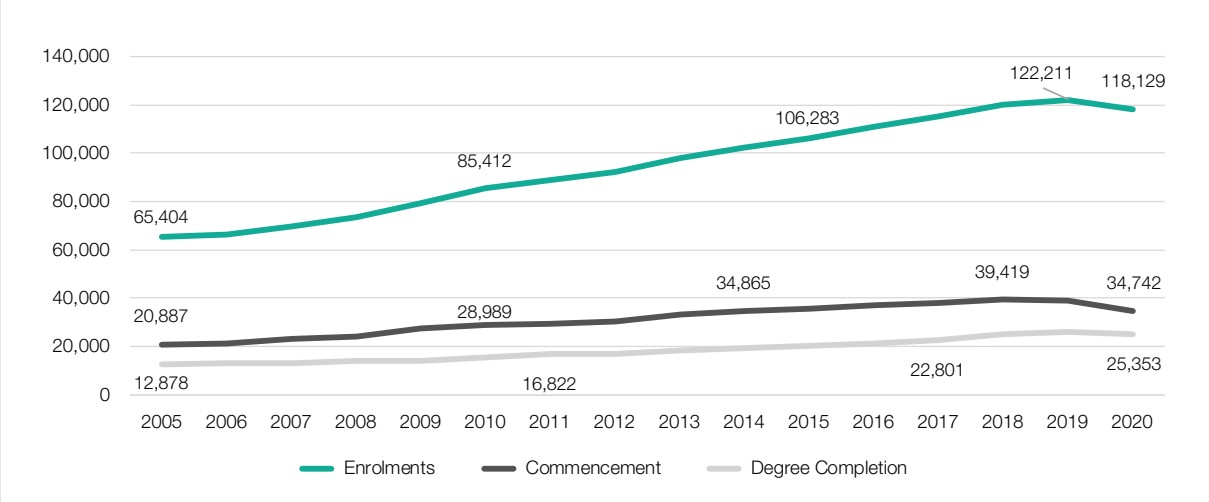

Figure 3. Engineering higher education degree enrolments, commencements and completions, 2005-202

Source: Department of Education, Skills and Employment - Higher Education Statistics Data Cube (uCube) which is based on the student and staff data collections; 2020 data from Table 14.6: Award Course Completions for All Students by Level of Course and Broad Field of Education, 2020

19 The usage of engineering degrees in this report refers to the Australian Standard Classification of Education (ASCED) Fields of Education category 'FoE03 Engineering and Related Technologies.

More people commence an engineering degree than complete it. Study times often exceed the four-year minimum, with only 25% of engineering students completing their BEng (Hons) degree within this timeframe and 75% completing their degrees within nine years. Consequently, the time between commencement and graduation can take up to a decade,[20] which needs to be factored into the planning of the future engineering workforce.

Moreover, 40% of students who commence an engineering degree do not complete their qualification, emphasising student retention strategies as another mid-term intervention to increase the pool of future engineers. Attrition rates are higher compared to other professional disciplines such as medicine or veterinary science but lower than in more open fields such as science or the arts.[21]

The percentage of young people who graduate with an engineering degree in Australia is low compared to other OECD countries. Only 8.5% of students in Australia graduate from engineering programs, with other countries having graduate percentages of almost twice (i.e., Sweden) or three times this rate (i.e., Germany). This international comparison indicates that increasing the overall proportion of engineering graduates in Australia is vital to make Australia more competitive on a global scale.

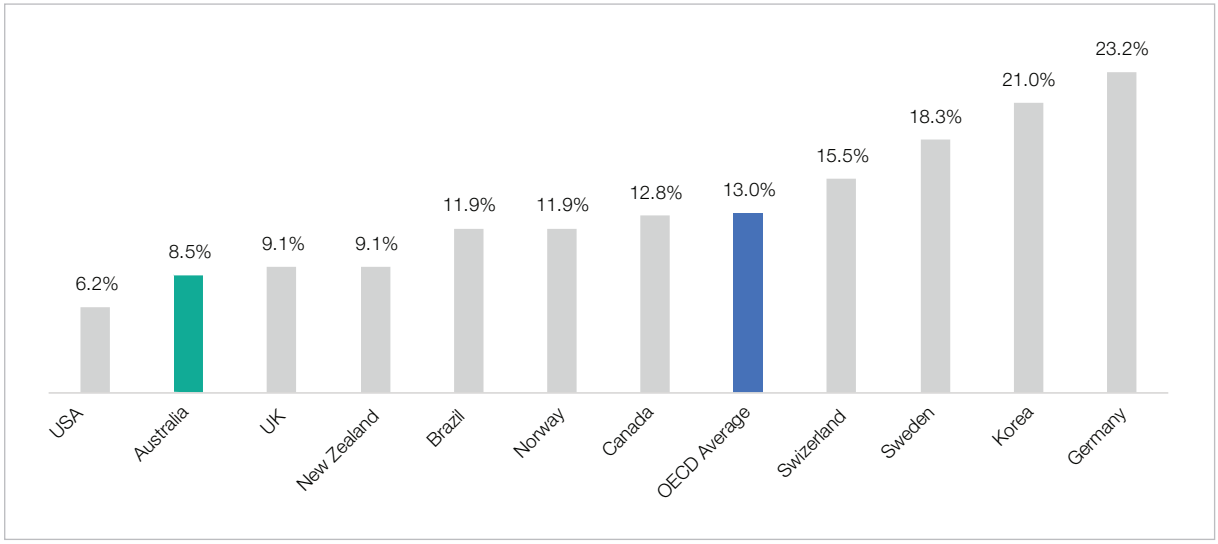

Figure 4. Engineering graduates as proportion of all graduates in selected OECD countries, 2020

Source: OECD Data (2023). Tertiary Graduates by Field.[22]

Australia's engineering sector is not only facing challenges in relation to student attraction and retention but also regarding the recruitment of graduates into the engineering workforce. A substantial percentage of engineering graduates (15%) end up working in non-engineering professions,[23] indicating a missed opportunity to channel more graduates into the engineering workforce.

20 Australian Council of Engineering Deans (2020). *Australian engineering higher education statistics 2009 – 2019*, p. 20.

21 Godfrey, E., Aubrey, T., & King, R. (2010). 'Who leaves and who stays? Retention and attrition in engineering education'. *Engineering Education*, 5:2, 26-40.

22 OECD Data (2023). *Tertiary graduates by field*. Accessed 6 Jan 2023: https://data.oecd.org/students/tertiary-graduates-by-field.htm.

23 King, R. (2021). Shortages of engineers and supply projections, p. 13.

Analysis of the higher education data shows that Australia's pipeline of locally qualified engineers is insufficient to meet rising workforce demand and is well behind in comparison to other OECD countries. There are three clear phases in the higher education pipeline that require intervention: 1) to attract more young people into engineering degrees; 2) to increase retention and completion rates among engineering students; and 3) to increase the rates of graduates who enter and remain in engineering occupations. Shoring up the education pipeline in these three areas will require collaborative intervention from government, industry and the education sector.

The attraction pipeline begins early, and initiatives should target awareness building programs around engineering concepts and careers in primary and secondary schools, including sustained exposure that is embedded into curriculum.[24] Strengthening general STEM education in terms of student participation and standards, particularly in maths and science, is also critical to boosting the numbers of students who have both eligibility and interest to go on to tertiary engineering degrees.[25]

While there is limited evidence that domestic students' university choices are driven by fee structures,[26] rising inflation and living costs may lead to some students increasingly considering the relative cost of degrees. Increasing the subsidisation of Commonwealth Supported Places in engineering degrees in line with other in-demand occupations like nursing, mathematics and agriculture could make engineering a more attractive option for both school leavers and working professionals looking to retrain or upskill into engineering careers.

Interventions to address attrition rates while students are at university encompass general improvements to student support – including financial supports such as increases to scholarships and youth allowance, and inclusion and engagement activities within university programs.[27] Targeted interventions for groups at risk of attrition are also valuable. In engineering programs, students who are above 23 years old, study part-time and are domestic students are more likely to drop-out than others, indicating a need to better understand the attrition pathways of different cohorts of students and to tailor retention support to at-risk groups including to women as an under-represented cohort.[28]

Research on effective higher education to workforce pipelines finds that industry engagement with university programs around graduate attributes enables students to be better informed and equipped for post-graduation career trajectories into engineering roles.[29] However, the attractiveness of STEM career options outside of professional engineering, and the lack of legal protection for the occupational title of engineer are also likely to contribute to engineering graduates seeking alternative career pathways.[30] As such, engineering registration (discussed in the latter sections of this report) is one mechanism to improve graduate destination outcomes for the profession.

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24 Engineers Australia (2022). *Strengthening the engineering workforce in Australia: Solutions to address the skills shortage in the short, medium, and long term*, p. 20.

25 King, R. (2008). *Addressing the supply and quality of engineering graduates for the new century*. Department of Education, Employment and Workplace Relation and University of Technology Sydney.

26 Productivity Commission (2022). I*nterim Report No. 5. 5-Year Productivity Inquiry: From Learning to Growth.* Australian Government.

27 Engineers Australia (2022). Strengthening the engineering workforce in Australia: Solutions to address the skills shortage in the short, medium, and long term, p. 24.

28 Godfrey et.al. (2010).

29 Nair, C. S., Patil, A. and Mertova, M. (2009). "Re-Engineering Graduate Skills – a Case Study." *European Journal of Engineering Education* 34, no. 2: 131–39. https://doi org/10.1080/03043790902829281.

30 Palmer, S. and Campbell, M. (2016). *Characterising the Australian engineering workforce and engineering graduate occupational outcomes using national Census data*, in PAEE/ALE 2016: Proceedings of the 8th International Symposium on Project Approaches in Engineering Education and 14th Active Learning in Engineering Education Combined Conference and Workshop, Project Approaches in Engineering Education Association, Guimarães, Portugal, pp. 69-76.

WOMEN IN ENGINEERING

Women are starkly underrepresented in the engineering field in higher education as well as in the workforce. Less than two in ten engineering students and professionals are female, making engineering one of the most male-dominated professions that require a university degree.[31]

Comparing the number of domestic female engineering graduates between 2001 (1,314) and 2019 (1,929) shows a difference of only 600 students. The proportion of female students has remained stable over this time at between 16% and 17%. In comparison, the total number of female international students has grown from 544 in 2001 to 3,107 in 2019, and the proportion of female international students in the international student engineering cohort has increased from 19% to 21%. Thus, there is a higher proportion of women among engineering students coming to Australia from overseas than in the domestic student population.

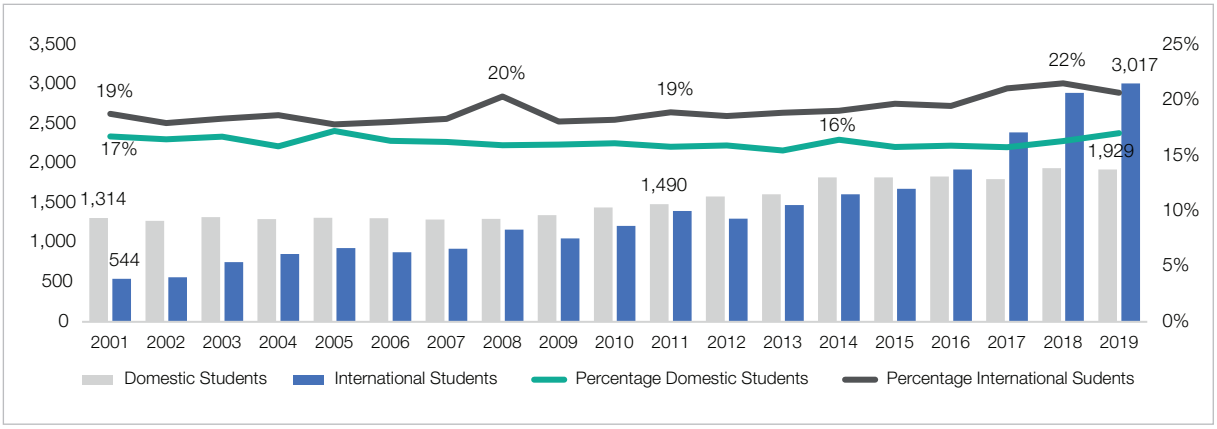

Figure 5. Total number and percentage of female domestic and international engineering graduates in Australia, 2001-2019

Source: Department of Education, Skills and Employment - Higher Education Statistics Data Cube (uCube)

A central issue regarding women's participation in engineering is the lack of awareness and consideration of engineering as a career path among girls and young women.[32] In a survey aiming to understand why women do or do not choose engineering as their area of study, 90% of participants reported that they did not consider an engineering degree at all. This lack of consideration for engineering as a field of study and career has been linked to a lack of support for female students in STEM-related subjects during primary and secondary school.[33] There is a lack of role models and a lack of positive perception of the engineering profession among young women, although women who work in the field are highly satisfied.[34] Consequently, primary efforts to increase female participation rates in engineering studies and in the workforce need to focus on the initial consideration stage and lay a foundation for an interest in engineering during primary and secondary education.

31 Silbey, S. (2016). 'Why do so many women who study engineering leave the field? *Harvard Business Review*. Accessed 9 Jan 2023: https://hbr.org/2016/08/why-do-so-many-women-who-study-engineering-leave-the-field.

32 Engineers Australia (2022). Women in engineering: Identifying avenues for increasing female participation in engineering, by understanding the motivators and barriers around entry and progression.

33 Ibid.

34 Ibid.

The number of female engineers in the workforce has grown steadily from 5,000 to 29,000 over the past 20 years, with an average annual growth rate of 9.1%. The proportion of women in the workforce has also increased from 5% in 2012 to 14% in 2020 but decreased to 12% in 2022 (probably an effect of COVID-19, which has disproportionately impacted women).[35]

As is the case in most industries, the proportion of women in part-time work is larger than the proportion in full-time work. Women make up 25% of the part-time engineering workforce, but only 13% of full-time workers.[36]

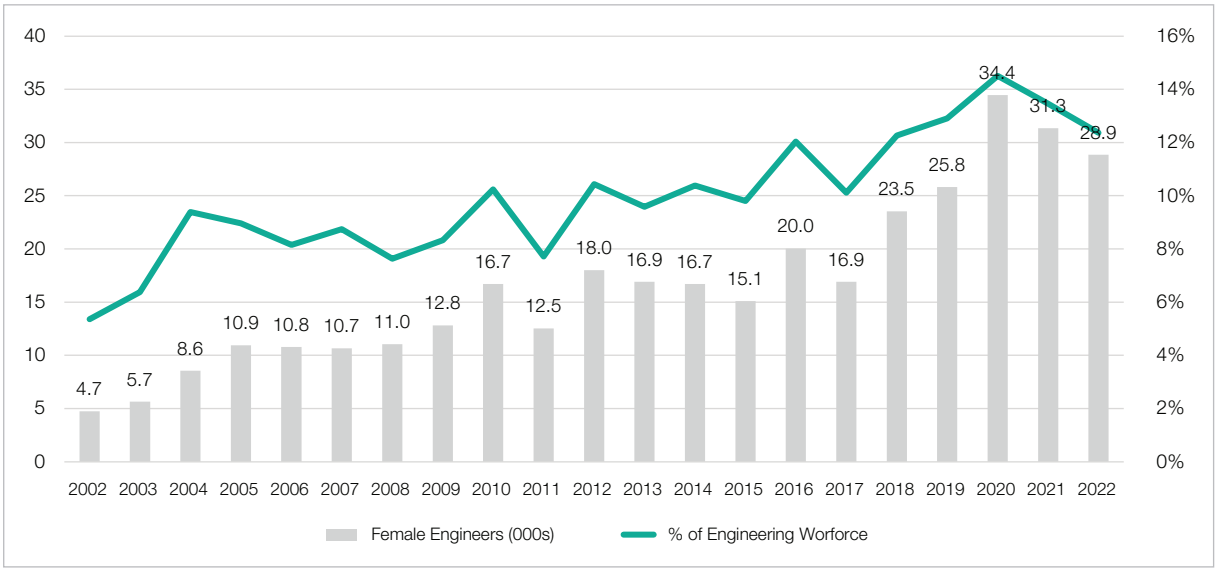

Figure 6. Total number (000s) and percentage of female engineering workforce Australia, 2002-2022

Source: ABS (2022) Table 1: EQ08 - Employed persons by Occupation unit group of main job (ANZSCO), Sex, State and Territory, August 1986 onwards[37]

Despite a positive overall growth trend of the female workforce, the engineering field compares very poorly to other STEM industries and the general workforce. While engineering is the largest STEM field nationally in terms of its workforce size, it has the lowest proportion of women. An analysis by the Office of the Chief Scientist of 2016 Census data (Figure 7) shows engineering's female participation at half of the overall STEM rate, and far behind other STEM fields.[38]

35 Davies, S. E. & di Piramo, D. (2022). 'Spotlight on the gendered impacts of COVID-19 in Australia: A gender matrix analysis'. *Australian Journal of Human Rights*, 28:1, 74-94.

36 Australian Bureau of Statistics (2022). *2021 Census: Employment, income and education. TableBuilder*.

37 Note that the ABS data used here is subject to sampling errors, such as a difference in sampling, that explains somewhat erratic annual growth rates.

38 Office of the Chief Scientist (2020). *Australia's STEM workforce; Science, technology, engineering and mathematics*. Accessed 9 Jan 2023: https://www.chiefscientist.gov.au/2016/03/report-australias-stem-workforce. The statistics in this report are based on 2016 ABS census data.

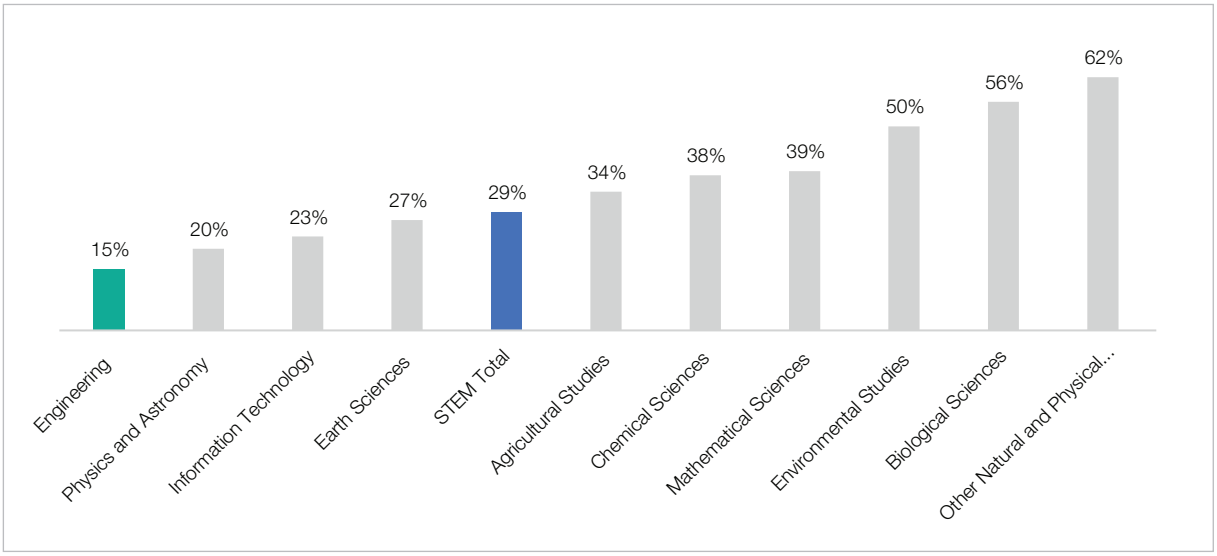

Figure 7. Percentage of university qualified women in the STEM industries, 2016, Australia

Source: Office of the Chief Scientist (2020). Australia's STEM Workforce.[39]

Of the women with engineering qualifications in Australia, only 51% work in an engineering role,[40] compared to 61.2% of men.[41] This suggests that employment practices and workplace conditions in the engineering field contain barriers for women, or, that engineering roles are less attractive to female graduates. A study conducted in the US, whose engineering sector faces similar issues, concluded that sexism and gender stereotypes were the main push factors out of the workforce among women.[42] Similarly, Australian research has found that of the women who have left the workforce, two thirds indicated that "non-inclusive workplace culture and unequal opportunities" were the main reason. Gender inequality among engineers is also reflected in their remuneration. While the gender pay gap in Australia across all industries is 14.1%[43], it is much higher in STEM industries (18%) and increases to 24% for architectural, engineering, and technical services.[44] A major cultural shift is thus required to increase the participation rate of female engineers by combating discrimination and addressing the pay gap.

The top industries that employ female engineers are: (1) architectural, engineering, and technical services, (2) computer system design and related services and (3) tertiary education – though only half work in engineering occupations here. The fourth top industry in which female engineers are employed in is 'cafes, restaurants, and takeaway food services', underlining a worrisome trend of the under-utilisation of qualified women engineers in Australia. Female engineers are more likely to be employed in state and local governments. In 2021, 17.3% of the public sector engineering workforce was female, compared to 14.4% in the private sector.[45] This preference for public sector engineering roles suggests that government workplaces could lead the industry in creating a more inclusive work environment.

39 Ibid
40 Engineers Australia (2019). Engineers and industry: A decade of change, p. 87.
41 Ibid.
42 Silbey (2016).
43 Workplace Gender Equality Agency (2022). Gender pay gap data. Accessed 9 Jan 2022: https://www.industry.gov.au/publications/stem-equity-monitor/workforce-data/gender-pay-gaps-stem-and-other-industries https://www.wgea.gov.au/pay-and-gender/gender-pay-gap-data
44 Department for Industry, Science and Resources (2021). Gender pay gaps by industry.
45 Australian Bureau of Statistics (2022). 2021 Census: Employment, come and education. TableBuilder.

The implementation of all Respect@Work recommendations including amending the Sex Discrimination Act to place a positive duty on employers to take reasonable steps to prevent sexual harassment at work and developing a WHS Code of Practice on preventing sexual harassment will contribute to creating an industry where women can thrive. In addition, the Secure Jobs and Better Pay legislation passed in late 2022 also contains much-needed reforms to make Australia's industrial relations system fairer, by establishing job security and gender equality as objects of the legislation.

While these legislative changes are important first steps, cultural and structural changes to both workplace and industry-wide practice are required to attract and retain more women in the engineering workforce. Public and private sector leaders must model and embed a culture of respect and take steps to address gender discrimination, including the significant gender pay gap that exists in engineering.

As highlighted in Professionals Australia's 2021 Women Staying in the STEM Workforce report, changes are required to organisational policies and practices to improve remuneration and conditions for women, provide career development and advancement opportunities and importantly deliver family friendly practices that support engineers and their development and career progression.[46]

International research into the retention of women in STEM consistently delivers findings showing that flexible and family-friendly workplaces can mitigate the "leaky pipeline" of women's attrition.[47]

Studies of engineering specifically further show that women who have a strong sense of professional identity as engineers and opportunities for career advancement are more likely to stay in the profession.[48]

IMMIGRATION

Almost six out of ten engineers (58%) in Australia were born overseas.[49] Overseas migrants join the engineering workforce either through temporary or permanent visa schemes. The international student base has grown significantly in the past few years – since 2018, there are more international than domestic engineering students.[50]

46 Professionals Australia. (2021). *Women staying in the STEM workforce report: An economic imperative for Australia. Report Summary and Findings*.

47 Jean, V.A., Payne, S.C and Thompson, R.J. (2015) "Women in STEM: Family-Related Challenges and Initiatives." In Gender and the Work-Family Experience: An Intersection of Two Domains, edited by Maura J. Mills, 291–311. Cham: Springer International Publishing.

48 Plett, M., & Hawkinson, C., & Van Antwerp, J. J., & Wilson, D., & Bruxvoort, C. (2011, June), Engineering Identity and the Workplace Persistence of Women with Engineering Degrees. Paper presented at 2011 ASEE Annual Conference & Exposition, Vancouver, BC. 10.18260/1-2--17872

49 EA, (2022).

50 The compound annual growth rate is 1.8% among domestic compared to 8.8% among international students.

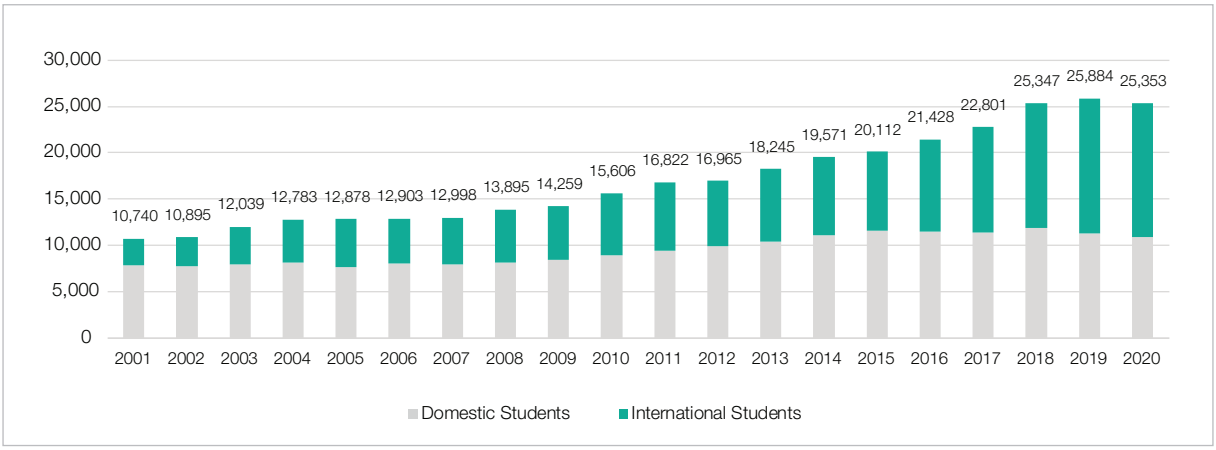

Figure 8. Engineering degree completions in Australia 2001 - 2020 by citizenship category

Source: Department of Education, Skills and Employment - Higher Education Statistics Data Cube (uCube) which is based on the student and staff data collections; 2020 data from Table 14.6: Award Course Completions for All Students by Level of Course and Broad Field of Education, 2020

There are three visa types through which qualified engineers, including international graduates, may work in Australia: (1) temporary graduate visas, (2) temporary skilled visas and (3) permanent residency. Temporary graduate visas are available to students who have completed a degree in Australia. It has been estimated that in 2020-21, 3,227 visas were granted to international students with an engineering degree.[51] Depending on the length of the degree, this visa permits graduates to work in Australia for two to four years.

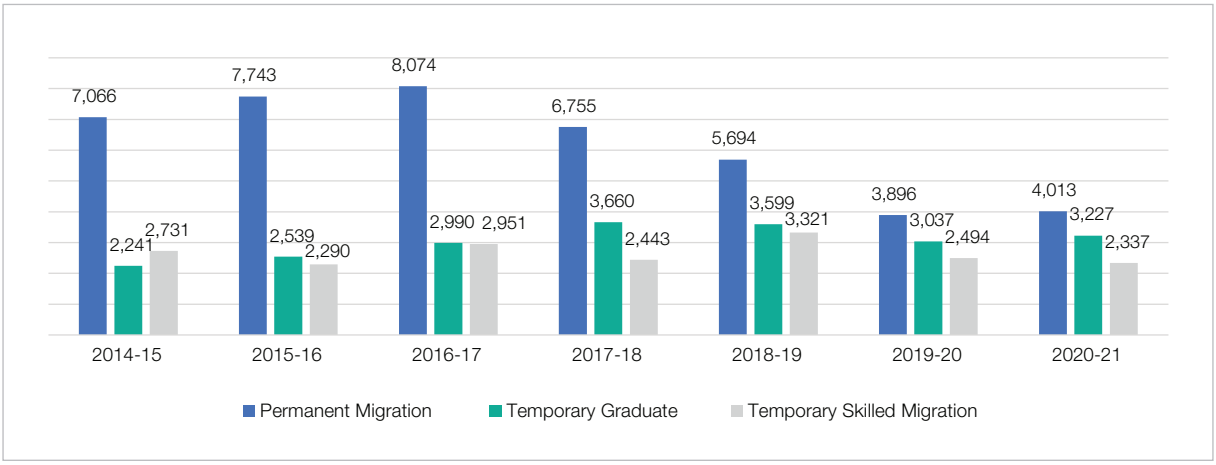

Figure 9. Numbers of migrant engineers by visa type, 2014-2021

Source: Department of Home Affairs statistics on permanent and temporary skilled migration. The temporary graduate statistics are based on estimates from the Australian Council of Engineering Deans.[52]

51 King, R. (2021). Pipelines into engineering occupations, p. 7. Accessed 13 Jan 2023: https://www.aced.edu.au/downloads/Pipelines%20to%20Engineering%20Occupations%20Dec%202021.pdf.

52 King, R. (2021). Pipelines into Engineering Occupations, p. 7.

Temporary skilled migrant visas are usually issued for 2-4 years and are aimed at balancing skill shortages within Australia. The number of these visas granted peaked in 2011 with 6,965 visas, but since 2013 have been mostly below 3,000 per year. The significant declines in the last three years in Figures 9 and 10 can be attributed to COVID-19 border closures.

However, considering pre-COVID-19 baselines, compared to the size of the engineering workforce and the projected skill gap, these skilled migration visas only account for a relatively small proportion of the workforce, particularly skilled temporary visa holders in specific in-demand occupations. For example, pre-pandemic border closures (as of September 2019), there were 997 civil engineer professionals on Temporary Skills Shortage (TSS) visas in Australia, making up only about 1% of the total number of employed civil engineers. For industrial, mechanical and production engineers, there were 745 TSS visa holders, making up only about 2% of the total number of workers employed in this occupation category.[53]

Migrant engineers will be more difficult to attract in the future due to engineering skill shortages in other English-speaking countries (i.e., the UK and the US), putting the international pool of skilled engineers in high demand.

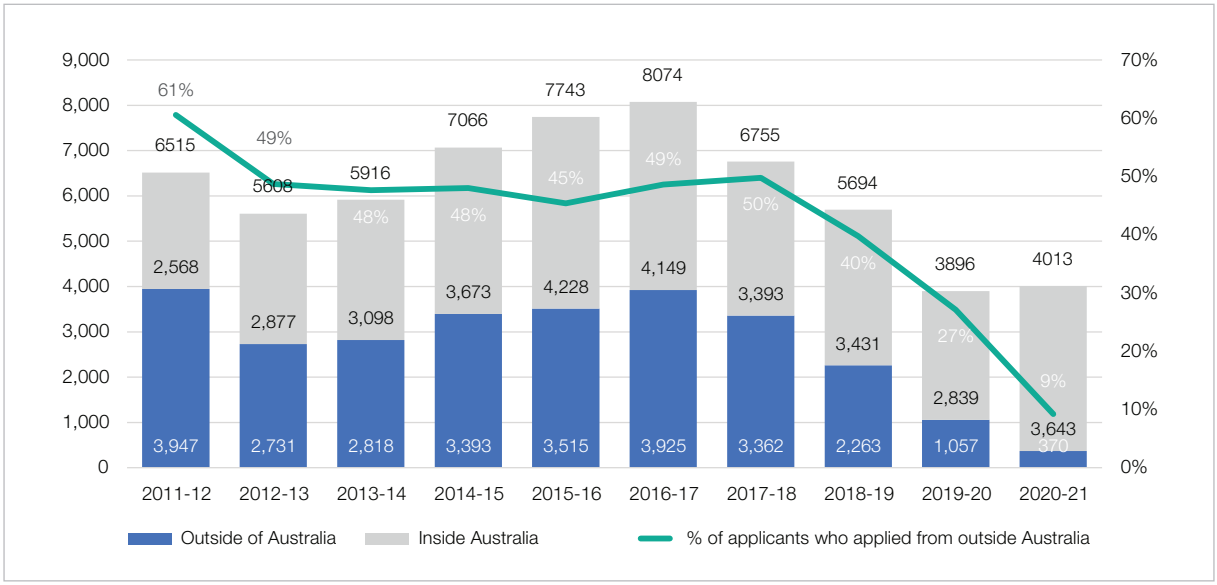

Figure 10. Permanent visa engineering applicants by location, 2011-2021

Source: The Department of Home Office (2022). Migration Program, Expert Panel (Family) and Child Outcomes since 2011-12 pivot table, 10 relevant ANZSCO categories.

53 Mackey, W., Coates, B. & Sherrell, H. (2022) *Migrants in the Australian workforce*. Grattan Institute.

Increasing the intake of migrants does not automatically translate to a commensurate boost of labour into the workforce. Of the skilled migrants who arrive in Australia, only 40% end up working in engineering roles.[54] Slightly more (43.5%) overseas-born engineers work in non-core industries, indicating a general loss of engineering skills to other sectors such as real estate, health care and financial and insurance services.[55]

For the engineering sector, this represents 'skills wastage' in the migration intake. Programs that allow for formal and timely recognition of qualifications, provide migrant engineers with information on the labour market and recruitment processes and support employers to break down recruitment barriers for migrant engineers are commonly seen as ways to minimise skills wastage.[56] A more effective utilisation of existing skilled arrivals would increase the workforce significantly and take the pressure off the current under-resourced workforce to manage the growing demand.

Further, ensuring fair working conditions and equitable pay arrangements for migrant engineers across the industry is critical to protecting the workforce and increasing retention. Migration reforms that complement domestic skills development, ensure fair treatment of the migrant workforce, and support permanent migration pathways can create sustainable and ethical growth of the engineering workforce. Industry sponsored, rather than employer sponsored visas, may also enable a more responsive and targeted approach to skills gaps.

Exploring the barriers migrant engineers face when entering the job market in Australia, a survey identified the following key issues: lack of local work experience (60%); lack of recognition of international work experience (47%); lack of local networks (44%); no references (36%); no eligibility due to residency status (25%); visa-related job restrictions (20%).[57]

International student graduates face additional barriers to employment when they are on temporary graduate (subclass 485) visas. Despite the formal work rights provided by this visa research has found that many Australian employers, including in engineering, prefer to hire applicants with permanent residency.[58]

To increase the integration of migrant engineers into the workforce it is thus necessary to provide more assistance both to employers and employees. Approaches to strengthen the benefits to the profession of the migration program include: 1) providing stronger pathways into industry and secure employment for international graduates; 2) supporting new migrant arrivals with labour market integration to ensure a greater proportion are employed in engineering occupation; 3) ensuring secure employment, fair working conditions and pay equity with the local workforce.

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54 Engineers Australia (2022). *Strengthening the engineering workforce in Australia: Solutions to address the skills shortage in the short, medium, and long term*, p. 4. Accessed 30 Dec 2022: https://www.engineersaustralia.org.au/sites/default/files/2022-08/strengthening-engineering-workforce-australia.pdf.

55 Engineers Australia (2019). *Engineers and industry: A decade of change*, p. 87. Accessed 9 Jan 2023: https://www.engineersaustralia.org.au/sites/default/files/2022-06/engineers-industry-decade-change.pdf.

56 Cameron, R., Joyce, D., Wallace, M., & Kell, P. (2013). 'Onshore skilled migrant engineers: Skills wastage and atrophy'. *Australian Bulletin of Labour* 39(1), 88–111.

57 Engineers Australia (2021). *Barriers to employment for migrant engineers*, p, 15. Accessed 9 January 2023: https://www.engineersaustralia.org.au/sites/default/files/resource-files/2021-10/barriers-employment-migrant-engineers.pdf.

58 Tran, L.T., Tan, G., Bui, H. & Rahimi, M. (2023) 'International Graduates on Temporary Post-Graduation Visas in Australia: Employment Experiences and Outcomes.' *Population, Space and Place* 29(1): e2602.

Case Study: The New South Wales Engineering Workforce

State governments in Australia are responsible for issues that affect the engineering workforce in their respective state or territory[59] – including funding and resourcing of major infrastructure projects and workforce regulations. As such, state government policies can have a significant impact on growing and protecting engineering skills. This report looks at the case study of Australia's most populous state, New South Wales, with the aim of highlighting two further issues that need addressing to strengthen the engineering workforce: the declining engineering capacity of the public sector and the benefits of engineer registration.

Protecting the engineering profession through registration and ensuring that the public engineering workforce is well-resourced are of significant benefit to the broader New South Wales community, given the immense infrastructure commitments that New South Wales has made over the next two decades. Federal and state and territory governments have allocated $248 billion government funding for infrastructure in 2020-2021 budgets over the coming four years, a 10% increase from the previous year.[60] Victoria and New South Wales lead the rankings of infrastructure expenditure with $90.2 and $85.6 billion respectively and together account for 71% of the total national infrastructure funding.[61]

Currently, the three biggest infrastructure projects in New South Wales funded by public and private investments are: West Connex ($16 billion); Sydney Metro ($12 billion); and Western Sydney Airport ($5.3 billion).[62] These key 'city-shaping' projects will provide major economic stimulus for the state and enhance liveability and transport services. Ensuring that these projects are managed by a highly skilled and well-resourced engineering workforce will minimise both risks and costs of these major projects that will shape the lives of New South Wales residents for decades to come.

THE CRISIS OF THE NEW SOUTH WALES PUBLIC ENGINEERING SECTOR

The past decades have seen slow growth of the public sector engineering workforce in New South Wales and a decline in the overall proportion of the engineering workforce who choose public sector careers. In 2006, 18.6% of engineers were employed in the public sector in New South Wales, dropping down to 13.2% by 2021.

Significantly, there was no growth in numbers in public sector engineering after the last major engineering skills shortage in 2011, whereas the private sector continued to grow, albeit at a smaller rate than before. Consequently, it can be expected that the current shortage will be felt most acutely in the New South Wales public sector if no targeted interventions are introduced to attract and retain skills. The public sector's declining engineering capacity has immense financial implications, as the necessity to outsource critical engineering tasks to private contractors has increased public costs significantly across a wide range of projects.[63]

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59 Parliamentary Education Office (n.d.). *The roles and responsibilities of the three levels of government.* Accessed 10 Jan 2023: https://peo.gov.au/understand-our-parliament/how-parliament-works/three-levels-of-government/the-roles-and-responsibilities-of-the-three-levels-of-government/

60 Infrastructure Partnerships Australia (2022). 2021-22 *Australian infrastructure budget monitor*. Accessed 29 Dec 2022: https://infrastructure.org.au/budget-monitor-2021-22/.

61 Ibid.

62 Nugent, A. (n.d.). A complete list of Australian infrastructure. Accessed 29 Dec 2022: https://blog.iseekplant.com.au/australian-infrastructure-guide.

63 Institute of Public Works Engineering Australasia (2018). A scarcity of in-house engineering ability is one of the leading workplace concerns among engineers in the public sector, an industry report reveals. Accessed 11 Jan 2023: https://www.ipwea.org/blogs/intouch/2018/10/17/lack-of-in-house-engineering-skills-public-sector.

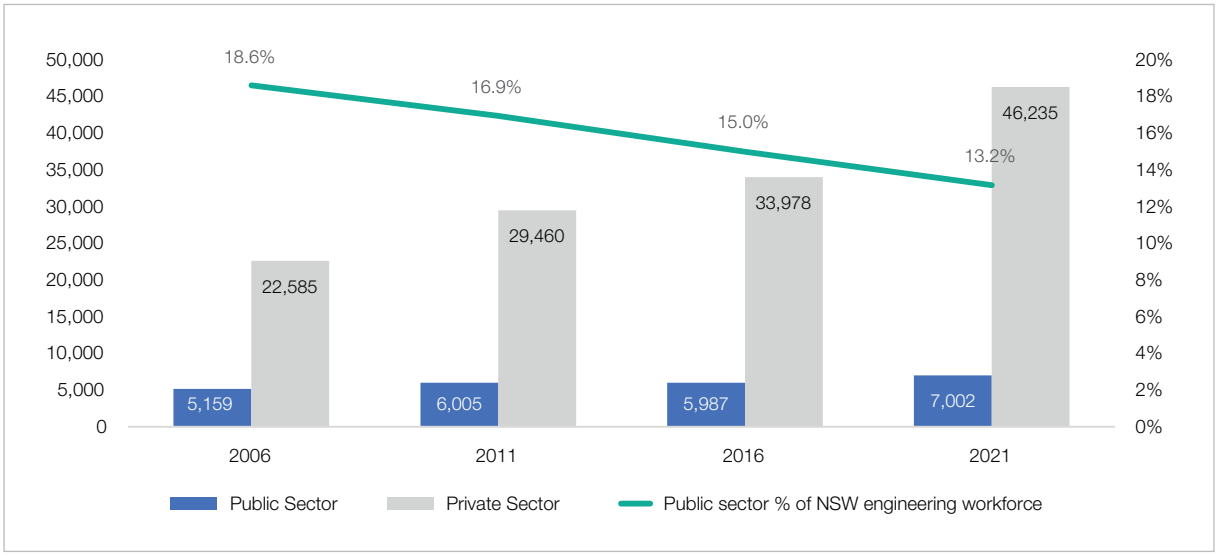

Figure 11. New South Wales public and private sector engineering workforce, 2006-2021

Source: ABS census data 2006-2021, TableBuilder.

Along with limited growth, an ageing workforce is a further challenge in the New South Wales public sector. Over half (52.4%) of the engineers employed in the public sector are over 40, compared to 45.4% in the private sector. This indicates that the public sector is less attractive for younger engineers such as graduates. Moreover, with nearly 30% of the public sector engineering workforce aged 50 and above, a loss of skill due to retirement will be felt severely in the public sector over the next few decades.

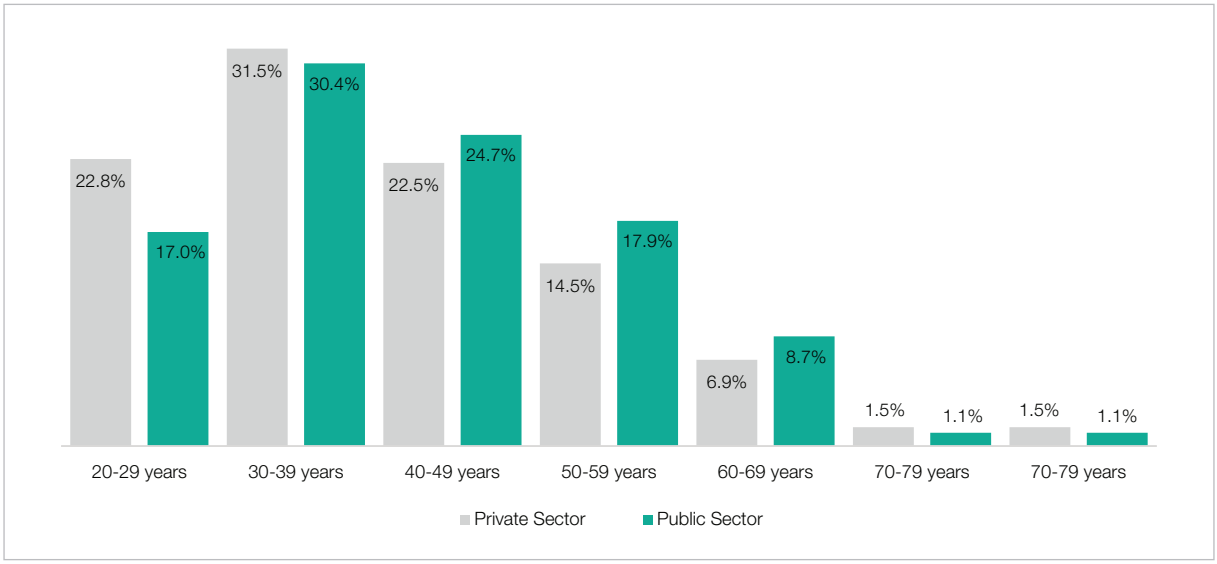

Figure 12. Age breakdown of the New South Wales engineering workforce by public/private sector, 2021

Source: ABS Census data 2021, TableBuilder.

Overall, more engineers opt to work in the private than the public sector in New South Wales (as well as Australia-wide), indicating an inability of the public sector to provide an attractive workplace in the increasingly tight competition for skills. This is confirmed by a survey conducted in 2021 with engineers in Australia (n=1,566) that found over half (53.4%) of public sector respondents perceived an increasing lack of in-house engineering capacity as a major issue in their workplace over the last 12 months, compared to 32% of private sector respondents.[64] Furthermore, 24.7% of public sector respondents reported their organisation did not actively regard engineering capability as a source of innovation compared with only 10.3% of engineers in the private sector.[65] Those results indicate significantly lower levels of workplace satisfaction among public sector engineers.

A further reason for the lack of competitiveness of the public sector in New South Wales is the state's cap on public sector wages, which prevents the sector from paying competitively to attract and retain staff. The pay cap was initially introduced at 2% in 2011 and was increased to 3% in 2022/23 and 3.5% in 2023/24 due to increasing pressure from unions.[66] However, sharp accelerations in inflation and rising costs of living mean public sector workers in New South Wales have faced a substantial fall in real wages because of the caps.[67]

Surveys of the Professionals Australia membership show some trends in public and private sector pay which may be impacting the hollowing out of the public sector engineering workforce in NSW as well as in other states.[68] While both sectors offer similar base salaries for engineers at Level 1, engineers in the Level 2 band earn a mean income that is $17,000 higher in the public than in the private sector. At Level 3 both sectors pay at similar rates – $113,000-$114,500. However, the public sector falls behind when it comes to remuneration of senior engineers at skill Level 4 and above. Level 4 and Level 5 engineers in the private sector earn median base salaries $18,000 and $14,000 higher respectively than public sector engineers. These remuneration rates show that the public sector is less attractive to senior engineers as it does not offer competitive pay rates and adequate wage growth across the span of a career. Plateauing salaries at mid-career are likely to disincentivise engineers from pursuing careers in the public sector, as well as encourage attrition of experienced staff to the private sector.

Wage caps in New South Wales contribute to pay disparities which limit the public sector's capacity to attract and retain engineers. But they also have a negative impact on overall industry conditions for the engineering workforce. This is due to the capacity for public sector wage outcomes to set the tone for wage outcomes in the private sector, including by sending a message around the norms of 'fair and reasonable' pay.[69]

64 Professionals Australia (2021): *Professional engineers' employment and remuneration report 2021/22*, p. 7. Accessed 10 January 2023: https://members.professionalsaustralia.org.au/documents/Engineers/RemunerationReport/2021_22_Professional_Engineers_Employment_Remuneration_Report.pdf.

65 Ibid.

66 Skats son, J. (2022). 'New South Wales to raise public sector wage cap to 3 per cent'. *Government News*. Accessed 11 Jan 2023: https://www.governmentnews.com.au/New South Wales-to-raise-public-sector-wage-cap-to-3-per-cent/.

67 Peetz, D. (2022). *Wage norms and the link to public sector salary caps*. Unions NSW. New South Wales. https://apo.org.au/node/318126.

68 Professionals Australia (2021). *Professional engineers' employment and remuneration report 2021/22*, p. 27.

69 Peetz (2002).

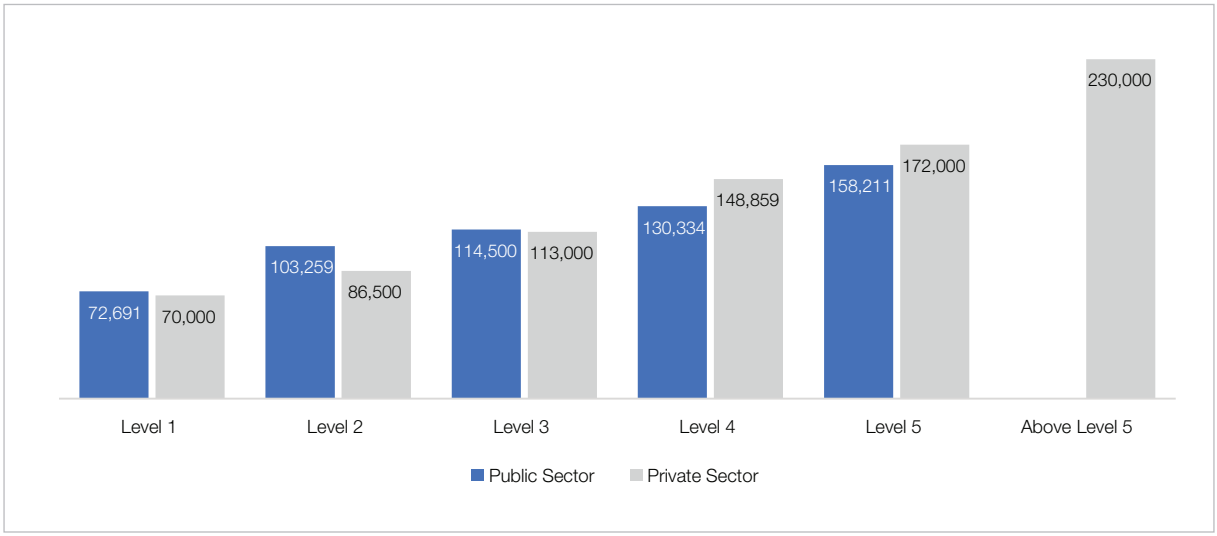

Figure 13. Median base salary per skill level and sector in the engineering workforce, Australia, 2021/22

Source: Professionals Australia (2021): Professional Engineers Employment and Remuneration report 2021/22, p. 27.

Additional public sector benefits, like Defined Benefit Superannuation Schemes, are no longer available to new workers entering the sector, so are unable to offset salary gaps for workers as they have in the past.

In addition to offering competitive wages and benefits packages, increasing the numbers of women in the workforce, who are more likely to work in the public sector, could be a strategy to increase the public sector engineering workforce. In 2021, the proportion of female engineers in the public sector in New South Wales was 16.1% compared to 14.9% in the private sector. Targeted efforts could be made to increase this and for the public sector to lead the industry in developing women-friendly workplaces within the engineering field.

However, the higher proportion of women in public sector engineering is also a key reason for ensuring public sector wages keep up with the private sector. If the public sector employs a larger proportion of women, stagnant growth in public sector remuneration can contribute to the overall widening of the gender pay gap in the industry.

PROTECTING THE PROFESSION THROUGH REGISTRATION

State and territory governments are responsible for the registration of engineers in their jurisdictions. Registration requires engineers to be registered with a licensing authority to provide professional engineering services in prescribed areas of engineering. Requirements of registration schemes include possessing recognised engineering qualifications; specific durations of experience in the chosen field; maintenance of skills and knowledge via required hours of Continuing Professional Development (CDP); assessment processes; and audit requirements. Registration is not required if working under the direct supervision of a registered practising professional engineer. Registration also provides legislative protections for consumers around standards of practice.

The objectives of engineering registration encompass protecting the public by ensuring professional engineering services are provided by a registered professional engineer in a professional and competent way; maintaining public confidence in the standard of services provided by registered professional engineers; and upholding the standards of practice of registered professional engineers.[70]

Registration provides the most practical and effective system to maintain the level of competence of those responsible for the delivery of professional engineering services and to ensure high standards of service delivery, allowing for: responsibility to be carried by a fully qualified engineer; monitoring of continued professional development for the workforce; and a formal system to deal with complaints.[71]

New South Wales is currently the only state on the eastern seaboard that does not have comprehensive and mandatory registration requirements for engineers. Queensland has long-standing registration legislation, while mandatory registration legislation in Victoria took effect from 1 July 2021. The ACT has recently introduced a bill for engineering registration which is expected to take effect later in 2023. Currently, in New South Wales only engineering professionals working on class two buildings or buildings with a class two part, are required to be registered under the Government's Design and Building Practitioners Bill 2019. Under this Act, only engineers who work on the construction of residential buildings need to be registered and those who work on other critical infrastructure such as commercial buildings, bridges, tunnels, transport infrastructure or schools and hospitals do not.[72]

Formal registration is a key policy lever to strengthen the engineering workforce in New South Wales and is also firmly in the public interest. Registration ensures the integrity of the profession, improves capability, and reduces risk and liability. Unlike most other related skilled professions with a significant impact on community safety (electricians, plumbers, architects) anyone in New South Wales can currently call themselves an engineer and carry out work on major infrastructure projects. Given that engineering skills are critical to our everyday lives – the buildings we live and work in, the technical devices we use, for our travel and leisure – public trust that these are built by qualified and competent engineers is important. Registration ensures that "engineering professionals meet benchmarked education, training, professional conduct and competency standards,"[73] and thus increases public confidence in their products and services.

Engineers need to be regulated by law and have their competence verified in order to safeguard the public, the industry, and the engineering profession. This will also give a legal remedy for subpar work. Registering engineers will increase their accountability, improve professional standards, and enhance safety for workers and the community.

Mandatory registration also delivers tangible economic benefits and reduced economic risk. Poor scoping, design and implementation of engineering projects have enormous financial impacts, particularly on major infrastructure projects, where they can cause significant cost over-runs and delays. A 2020 report from the Grattan Institute on transport megaprojects found that Australian governments have spent $34 billion over their original stated commitments on transport infrastructure projects over the last two decades. Actual costs exceeded promised costs by 21% for all projects valued at $20 million or more.[74]

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70 Queensland Government (2022). *Professional Engineers Act 2002*. Accessed 12 Jan 2023: https://www.legislation.qld.gov.au/view/pdf/inforce/current/act-2002-054.

71 IPWEA (n.d.). Queensland submission to the productivity commission on public infrastructure specifically addressing section 13: Workforce skills registration/accreditation of engineers. Accessed 3 Feb 2023: https://www.pc.gov.au/inquiries/completed/infrastructure/submissions/submissions-test2/submission-counter/subdr141-infrastructure.pdf

72 Professionals Australia (2019). Engineer registration bill moved in parliament. Accessed 13 Jan 2022: https://www.lgea.org.au/lge/news_and_views/newscontent/professional%20engineers%20registration%20bill%202019%20moved%20in%20parliament.aspx.

73 Engineers Australia (2022). *Registration*. Accessed 11 Jan 2023: https://www.engineersaustralia.org.au/credentials/registration.

74 Terrill, M., Emslie, O., and Moran, G. (2020). *The rise of megaprojects: counting the costs.* Grattan Institute.

Registration helps ensure those leading major projects are suitably qualified to scope and design projects to budget and timeframe. ACIL Tasman calculated the benefit-cost ratio of an engineer registration scheme to be 3.14 in 2012.[75] Registration schemes are self-funding with the assessment component generally managed by engineering representative organisations so with minimal cost to government and taxpayers.

The costs to the community when professional engineering services are not provided by fully accredited and competent professionals can be significant, including failure or poor quality of infrastructure; inefficiencies in process and practice; and in extreme circumstances, catastrophic asset failure and risk to human lives. The community widely supports the idea of registering engineers. A survey conducted in New South Wales by Omnipoll in June 2018 showed that 92% of respondents believed that engineers should be registered or licensed to practice.[76] Additionally, over 80% of engineers surveyed by Professionals Australia have expressed support for the implementation of a statutory scheme.[77]

Mandatory registration across the profession is a necessary step to protect and strengthen the New South Wales workforce in the long-term, and to ensure that standards of engineering in New South Wales do not fall behind other states.

Comparing workforce growth data between Queensland and New South Wales clearly demonstrates that registration requirements have no negative impacts on state workforce growth in the long-term. While a registration act has been in place in Queensland since 1929, the Professional Engineers Act of 2002 codified the current modern registration process for the state and led to the number of engineers registered with the Board of Professional Engineers Queensland (BPEQ) doubling over the following decade.[78] While workforce numbers went down slightly in the two years after the 2002 Act was introduced, they rapidly recovered and continued growing at a similar rate to New South Wales.

Figure 14. Comparison of the engineering workforce in NSW and QLD between 2000-2010 (000s)

Source: ABS 6291.0.55.001 - EQ08 - Employed persons by Occupation unit group of main job (ANZSCO), Sex, State and Territory, August 1986 onwards, Table 1 (used August data for each year)

75 The National Engineering Registration Board. (2012). *Submission to Senate Education, Employment and Workplace Relations Committees on the shortage of engineering and related employment skills.* NERB.

76 Omnipoll (2018) *Attitudes to Registration of Engineers in NSW.* Polling Report for The Shape Agency, June.

77 Professionals Australia (2022). *Engineering a Better NSW: Survey Report.* Accessed 8 Feb 2023: https://www.professionalsaustralia.org.au/Engineers/News/EABF_Survey_Report.aspx

78 Board of Professional Engineers of Queensland (2020). *Annual Report 2019-20*. Accessed 3 Feb 2023: https://bpeq.qld.gov.au/wp-content/uploads/2020/10/200911-BPEQ-Annual-Report-2019-20.pdf.

The relative change – the average annual change rate – of the workforce is a more accurate depiction of the short-/medium-term impact of registration in Queensland. It demonstrates in more detail that the drop after 2002 in Queensland is insignificant and occurs at similar rates as in New South Wales and Australia.[79]

Figure 15. Relative change (%) of engineering workforce 2000-2010 in Australia, NSW and QLD

Source: ABS 6291.0.55.001 - EQ08 - Employed persons by Occupation unit group of main job (ANZSCO), Sex, State and Territory, August 1986 onwards, Table 1 (used August data for each year)

This data shows that registration did not negatively impact the growth of the engineering workforce in Queensland in the long-term. The significant benefits of registration in mitigating risks to public safety and public confidence in the profession clearly outweigh any risk of dips in workforce numbers – which are minor and temporary – as registration processes are implemented.

79 Note that the ABS data used here is subject to sampling errors that explains somewhat erratic annual growth rates.

Conclusion

The engineering workforce is critical to Australia's future growth. Large-scale transformations to key industries like transport, minerals, and energy as well as rapid technological transformation across all sectors of the economy depend on a robust, fully qualified and growing engineering workforce.

A projected skills shortage of 200,000 engineers nationally by 2040 puts Australia's capacity to meet the challenges of the next two decades at significant risk. Local infrastructure investments will fail to deliver on economic and social benefits and Australia's global competitiveness as a knowledge economy will flounder. Immediate interventions are needed to address this looming skills shortage at both state and national scales.

Efforts to bridge this skills gap need to be multi-faceted. Focus is required not only on growing the number of qualified engineers in Australia, but also on maximising utilisation, quality, and competency in the workforce. Growth strategies need to focus on all stages of the skills pipeline and require collaborations between government, industry, and the education sector to increase degree enrolments, degree completions, graduate outcomes, and workforce retention across the career span.

Making engineering careers more attractive to women – both by encouraging young women into engineering degrees and by ensuring women-friendly workplaces and pay equity – will benefit growth. Engineering is currently seeing less success than other STEM fields in this regard.

The underutilisation of engineering skills also needs be addressed. Skills wastage is apparent in the significant proportion of migrant and locally born engineers in Australia working in non-engineering industries. Further research into job-readiness of migrants and graduates, recruitment issues and attraction factors (such as workplace cultures and pay structures) is required to understand and address the drivers of underutilisation.

State government policies can also have a significant impact on their local engineering workforces. New South Wales provides a case study of a high-demand context in terms of infrastructure commitments, but with supply and quality barriers, particularly when it comes to the public sector. In New South Wales, wage caps are likely to accelerate existing declines in public sector engineering skills, particularly given increasing inflationary pressures and an ageing workforce. Further, New South Wales needs to protect workforce quality and minimise potential liability by pursuing mandatory registration policies. National alignments in registration, following Queensland, Victoria and the ACT would be a critical step in the protection of skills quality across the profession. Registration also has indirect positive outcomes for the profession and for the capacity of the field to attract more workers by raising the profile of the profession, increasing public confidence in the profession, and increasing connection in the workforce to a strong professional community.

Professionals Australia is a union representing the industrial and professional interests of over 20,000 professional employees across Australia, including engineers, scientists, IT workers, pharmacists, architects and language service practitioners.

Learn more about Professionals Australia ***www.professionalsaustralia.org.au****.*

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