ENGINEERS
AUSTRALIA

Engineering Tomorrow

Strengthening the engineering workforce for Australia's future prosperity

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Engineering Tomorrow:
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Foreword

At Engineers Australia, we back today's problem-solvers so they can shape a better tomorrow. Engineering is critical to Australia's ability to maintain a high quality of life and to advance society. Engineers in Australia are delivering more resilient infrastructure, developing smart systems, clean energy and critical mineral technologies, implementing building reforms and advancing domestic manufacturing. In short, Australia's engineering capability is a national asset.

Across Australia and throughout the world, Engineers Australia members are tackling some of the most significant industrial and social challenges of our time: the large-scale transformation of how we generate and use energy; a massive build-out of housing; revitalising our manufacturing industry and strengthening supply chains; pursuing innovative medical devices and diagnostic tools for healthier communities; and helping deliver on unprecedented investment in infrastructure. Engineers are crucial to all these initiatives.

A skilled workforce fuelling a strong engineering capability is critical for Australia's prosperity.

We are calling on our nation's leaders to jumpstart Australia's engineering capability by taking critical and urgent steps to secure our national engineering workforce pipeline:

1. **Secure Australia's future through a boost to our national engineering capability.** A national engineering surge could be informed by engaging Engineers Australia to deliver a rapid-response report with five key actions to dismantle existing obstacles and strengthen the engineering pipeline from school through to skilled migration.
2. **Set a target for 60,000 additional engineering graduates over the next decade.** This would catalyse universities, industry and governments to collaborate on strengthening this essential professional pipeline.
3. **Establish additional senior engineering roles in the Australian Public Service, including a National Chief Engineer.** This would ensure access for public decision-makers to critical technical and systems advice to inform procurement, programs and policy. This would help minimise risks, including cost and time overruns, and increase resilience, achieving optimal project outcomes for all Australians.
4. **Respond in full to the 2024 Pathways to Diversity in STEM report,** implementing its recommendations for stable and sustainable action to increase diversity and inclusion in STEM.

The Australian engineering profession is skilled, talented, and capable and it continues a tradition of engineering that dates back tens of thousands of years to indigenous innovation in hunting and fishing. Aboriginal and Torres Strait Islander peoples designed fish traps, used thermoplastic resins to set spear tips, and carved aerodynamics into boomerangs to make them return. Engineers Australia and all levels of government must continue working together to create better outcomes for engineers and the engineering profession, for the benefit of all Australians.

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Executive Summary

The engineering profession is essential to the nation's economic performance, both as a core contributor to GDP and critical industries, and as the largest STEM employer.

Engineers help to drive technological advancement and foster productivity.

Engineering is at the heart of the innovation process which translates new scientific knowledge into practical solutions, products and technologies.

Engineering is a socio-technical profession that impacts on an ever-increasing complex of interrelated systems and challenges. Key areas of impact include advanced manufacturing, building and construction, climate change, critical minerals, defence and space, energy, health and medicine, infrastructure, IoT, R&D, cyber systems, transport and mobility, water and waste management.

The changes that will impact our economy in the next decade and beyond will rely extensively on engineering expertise to lead us to a sustainable, innovative and productive future for Australia, including to:

- Deliver the energy transition
- Apply circular economy principles and practice
- Transform transport and infrastructure
- Build workforce capability for Australia's growing decommissioning industry
- Improve climate-related disaster resilience
- Engineer water security
- Revitalise manfuacturing
- Grow sovereign capability and new industries, and
- Develop and apply nascent technology and AI.

Many national challenges require engineered solutions, which means that bolstering Australia's engineering skills capability is critical. A skilled future for Australia will:

- Meet engineering skills needs in the economy, matching labour supply and demand
- Ensure skilled engineers, including migrant engineers, do not face barriers to employment in engineering roles
- Utilise all talent available to enter the engineering profession, ensuring that the workforce reflects the diverse communities it serves
- Remove impediments to workforce mobility across jurisdictions, including through nationally consistent registration for professional engineers

Australia must address critical challenges with its engineering workforce, including that a significant portion of Australian engineers are set to retire in the coming years, amidst increasing global competition for STEM talent.

Despite being a sought-after and valued profession, engineering faces significant challenges in retaining talent at every stage of the pipeline, from education through to professional practice.

The declining representation of engineering in government is undermining public sector project delivery. Decisions made for the community must be informed by robust technical analysis. Chief Engineers strengthen technical leadership in governments to address critical priorities.

Engineering is the essential link between thinking and doing, between ideas and implementation. At Engineers Australia, we back today's problem-solvers so they can shape a better tomorrow.

The engineering profession has come together to back the solutions in this report, building on Engineers Australia's latest research and analysis along with our established,

evidence-based positions to strengthen Australia's engineering capability.

Engineers Australia is indebted to the new and experienced engineers right across the country who shared their thoughtful insights and lived experience in service of this report. Typical of the engineering team, our consultations elicited both enthusiasm and practical, pragmatic solutions designed to deliver the best outcomes to the community.

A skilled workforce fuelling a strong engineering capability is critical for Australia's prosperity. Engineers Australia calls on the Australian Government to adopt four solutions to strengthen the national engineering workforce.

1. National engineering surge

2. Engineering graduate target

3. Strengthening engineering advice in government

4. Diversity in STEM

1.0 Introduction

As Australia's national body for the engineering profession, we are the voice and champion of 130,000 plus individual members. As a mission-based, not-for-profit professional association, Engineers Australia is constituted by a Royal Charter to advance the science and practice of engineering for the benefit of the community.

Adept with complex systems and grounded in ethical decision-making, the engineering profession is synonymous with collaborative problem solving and renowned for providing trusted and reliable advice to governments, industry and the broader community

Engineers Australia draws on the collective experience of our members. Our professional engineers, engineering technologists and engineering associates represent every discipline of engineering and work across every sector of the economy. Established in 1919, our membership spans five generations of Australians, and we are the internationally recognised custodian of the engineering profession in Australia.

Our members:

- share technical insights with other professionals and the broader community
- guide practical design and delivery – from the largest buildings to the smallest sensors, and
- provide pragmatic, workable policy advice to the highest levels of government.

Engineers Australia and its members work closely with our industry partners and allied professions.

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This report provides the context and rationale for our recommendations to government, including:

- engineering workforce insights and challenges
- the profession's contribution to the economy
- the importance of engineering skills and representation in government
- the need for engineering skills in addressing societal challenges and opportunities
- research and policy recommendations for a more sustainable, skilled and innovative Australia

The report provides an update and builds on policy advice in Engineers Australia's 2022 report, 'Strengthening the Engineering Workforce'. Much of the analysis and recommendations in that report remain highly relevant, including the actions for government, industry, and the tertiary sector to address Australia's engineering skills challenges. The foundational insights into the factors influencing the engineering workforce—such as education pathways, skilled migration, workforce retention, and industry demand—continue to shape policy discussions.

This report provides a comprehensive view of Australia's engineering workforce needs and the ongoing strategies required to support a resilient and sustainable profession.

2.0 Engineering and the economy

The engineering profession is essential to the nation's economic performance, both as a core contributor to GDP and critical industries, and as the largest STEM employer.

2.1 Contributing to national GDP

The engineering profession has long been a core contributor to Australia's gross domestic product (GDP) and key industries, adapting over time to meet evolving needs. Engineers play a crucial role in technological development - a key driver of productivity and economic growth. Over half of industry value added in the economy is generated through just six engineering-heavy segments of the private sector.[1] The largest value adding sector in Australia, mining,[2] accounted for 13.6 per cent of GDP in 2023,[3] and has been particularly dependent on engineering innovation to deliver economic benefits.

Infrastructure is also reliant on engineering expertise and a key performer in Australia's economy. Estimates suggest that for every $1 million invested in infrastructure, $3 million is returned to the economy.[4] According to the 2024 Infrastructure Market Capacity Report, Australia's five-year major public infrastructure pipeline stands at $213 billion, signalling a potentially substantive return for the broader economy.[5]

Historically, nations that were early creators, developers, and adopters of technology generally were those that gained the more significant economic and strategic advantages. The global impact of engineering on economic development was analysed by the Royal Academy of Engineering (UK), who found strong correlations between engineering capacity and economic success.[6] Similarly, a study co-authored by the World Bank's Chief Economist for Latin America and the Caribbean showed a "robust correlation" between a country's number of engineers during the Second Industrial Revolution, and that country's present-day income levels.[7] It found that countries with similar income levels in 1900 experienced markedly different economic trajectories in the following century, largely based on their varying engineering capacities.

When reflecting on historical divergences, the parallels with today's context—shaped by the dual revolutions of energy transition and smart technology—are striking. For example, commentators have argued that China's significant increase in engineers since 2000 "heralds a fresh growth model" that opens opportunities to lead the world in AI applications and biotech.[8] The risk of Australia not investing in engineering capacity, in an era defined by rapid technological change, threatens our ability to meet national goals and maximise societal benefits, both in the short and longer term.

1 Organisation for Economic Co-operation and Development (OECD), Gross Domestic Product (GDP), OECD, https://data.oecd.org/gdp/gross-domestic-product-gdp.htm.

2 Organisation for Economic Co-operation and Development (OECD), Gross Domestic Product (GDP), OECD, https://data.oecd.org/gdp/gross-domestic-product-gdp.htm.

3 U.S. Department of Commerce, International Trade Administration. "Australia - Mining." Trade.gov, https://www.trade.gov/country-commercial-guides/australia-mining.

4 National Builders Guide. "Engineering Construction Keeps the Economy Moving." National Builders Guide, www.nationalbuildersguide.au/industry/engineering-construction-keeps-the-economy-moving/.

5 Infrastructure Australia. 2024 Infrastructure Market Capacity Report. 23 Dec. 2024. www.infrastructureaustralia.gov.au/reports/2024-infrastructure-market-capacity-report.

6 Centre for Economics and Business Research (Cebr). "Engineering and Economic Growth: A Global View." Royal Academy of Engineering, September 2016. https://raeng.org.uk/publications/reports/engineering-and-economic-growth-a-global-view.

7 Maloney, William F., and Felipe Valencia Caicedo. "Engineering Growth: Innovative Capacity and Development in the Americas." CESIFO Working Paper No. 6339, Category 5: Economics of Education, February 2017. Accessed February 23, 2025. https://www.ssrn.com/sol3/papers.cfm?abstract_id=2932756.

8 Henderson, Greg. "China's Engineer Dividend Is Paying off Big Time." The Australian Financial Review, 25 Mar. 2025, http://www.afr.com/world/asia/china-s-engineer-dividend-is-paying-off-big-time-20250325-p5lme4

2.2 Improving productivity

Productivity growth is a crucial driver of economic expansion and improved living standards.[9] However, following a strong period in the 1990s and 2000s, it has declined globally among advanced economies. Between 2010 and 2020, productivity growth was the slowest in 60 years. [10]

This decline is attributed in part to stagnating technological advancements and innovation, global economic impact on global trade and ageing populations. The Global Financial Crisis and the COVID-19 pandemic have also played a part in persistent declines in productivity, mainly due to a reduction in investment[11]. If productivity growth had remained consistent with the average over the past 60 years (1.7 per cent instead of 1.1 per cent), gross national income would have been about 6 per cent higher in 2020[11]. Australia must seek to invest in an enhanced productive capacity to ensure we can attain our economic goals and maintain or increase our standard of living.

The engineering profession helps to drive technological advancement and foster productivity. Their expertise is directly involved in the creation of productivity enhancing systems, products and services that provide benefit to workers across almost all occupations[13]. Engineers drive productivity growth in two key ways:

- **Productivity-enhancing product development:** Engineers are adept at translating scientific knowledge into practical applications. By creating new and more efficient tools or methods, engineers help increase efficiency across multiple sectors, boosting overall productivity. Examples may include modern methods of construction, the development of digital twins, or innovation of manufacturing process design.
- **Development of productivity-enhancing infrastructure:** Engineers have long been instrumental in designing infrastructure that drives productivity and development, including rail, roads and air travel systems. They also design and maintain digital infrastructure that ensures connectivity and access to productivity-enhancing services, such as generative AI. By developing such infrastructure, the engineering profession acts as an enabler of broader productivity.

2.3 Engineering and innovation

Innovation is central to driving economic complexity, which is vital for increasing national income and fostering long-term prosperity[14]. At the heart of this process is engineering, which translates new scientific knowledge into practical solutions, products, and technologies. The expertise of engineering professionals directly contributes to advancing innovation, enabling economies to develop new capabilities and enhance their global competitiveness.

Australia has a strong foundation for innovation, with world-class engineering research and development (R&D) output. For

[9] Parliament of Australia. Productivity Commission Inquiry Report: Chapter 2. House of Representatives, 2022, www.aph.gov.au/parliamentary_business/committees/house_of_representatives_committees?url=economics/productivity/report/chapter%202.pdf.

[10] Australian Government Treasury. Intergenerational Report 2023: Australia's Demographic and Economic Outlook. Australian Government, 2023, https://treasury.gov.au/sites/default/files/2023-09/p2023-447996-06-ch4.pdf.

[11] 5-year Productivity Inquiry: The key to prosperity The Australian Government Productivity Commission, July 2022. https://www.pc.gov.au/inquiries/completed/productivity/interim1-key-to-prosperity/productivity-interim1-key-to-prosperity.pdf

[12] Recent trends in Australian Productivity Reserve Bank of Australia, September 2023. https://www.rba.gov.au/publications/bulletin/2023/sep/recent-trends-in-australian-productivity.html

[13] Engineers Australia. Submission to the Productivity Inquiry. Engineers Australia, 7 Oct. 2022. www.engineersaustralia.org.au/sites/default/files/2022-10/Engineers-Australia-Submission-Productivity-Inquiry-20221007-Final.pdf.

[14] Hausmann, Ricardo, et al. The Atlas of Economic Complexity: Mapping Paths to Prosperity. MIT Press, 2011. https://direct.mit.edu/books/oa-monograph/3014/The-Atlas-of-Economic-ComplexityMapping-Paths-to.

all R&D, Australia has the 6th highest share of world citations and publications (3.5 per cent), and is cited 42.2 per cent higher than the world average[15]. Our universities rank highly in global engineering education, and the quality of Australia's R&D output across sectors is reflected in various national and international assessments: 18 Australian institutions in the top 200 for citations per staff in QS's R&D rankings, and 15 institutions in the top 200 overall.[16]

In the 2024 Global Innovation Index, Australia ranks 23rd.[17] However, despite having one of the world's most educated and wealthy populations, and a notably productive tertiary research sector, Australia underperforms in commercialising local engineering innovation, ranking 61st out of 67 countries in the 2024 IMD World Competitiveness Yearbook rankings for 'entrepreneurship'.

One of the key issues is Australia's capacity to translate R&D into viable products and services; we continue to face commercialisation challenges that impede our innovation capacity. The 2024 Global Innovation Australia report highlights a 14.3 per cent decline in international patent filings from 2022 to 2023,[18] signalling weaknesses in turning innovation into economic output. Further;

- Australia ranks 84th globally when it comes to the percentage of graduates in science and engineering[19], and
- Australia ranks 91st globally in terms of production and export complexity.

To reverse this trend, and to maintain our ability to innovate and commercialise new solutions and products, Australia must retain and build its engineering workforce. A critical lack of engineers coupled with increased inefficiencies in innovation, may see low degrees of economic complexity persist, and impair economic growth into the future. Australia must invest further in its innovative capacity to ensure future economic wellbeing.

Product development is a key driver of economic complexity, through enhancing productive capabilities, and the range of goods and services that can be produced and exported. Innovation, particularly in engineering and technology, plays a substantive role in product development by transforming new ideas and research into tangible products.

[15] Independent Expert Panel. Strategic Examination of R&D Discussion Paper.12 February, 2025. Commonwealth of Australia. Retrieved from https://storage.googleapis.com/converlens-au-industry/industry/p/prj31a02fa37c9ece8370e29/page/SERD_Discussion_Paper.pdf.

[16] QS Quacquarelli Symonds. 2025 QS World University Rankings. 2024. www.topuniversities.com/university-rankings/world-university-rankings/2025.

[17] World Intellectual Property Organization (WIPO). Global Innovation Index 2024. https://www.wipo.int/gii-ranking/en/australia

[18] Ibid.

[19] Ibid.

Global case study: Republic of Korea (South Korea)

The Republic of Korea (South Korea) is cited as one of the most high performing innovation countries and most capable of translating research inputs to outputs. It invests heavily in research and development, has a strong focus on high quality education emphasising STEM, and it has an innovation-friendly ecosystem that has fostered the growth of tech giants such as Samsung and LG.

South Korea ranked 18th in the proportion of graduates in science and engineering (in contrast to Australia which ranked 84th). This correlation is observed across a number of the highest performing countries on the index, and demonstrates the importance of engineers in facilitating innovation and economic growth.

2.4 Employment and jobs

Engineering stands as the largest employer within the STEM field in Australia. According to the 2020 Australia's STEM Workforce Report[20], individuals with engineering qualifications represented 80 per cent of the VET STEM-qualified labour force and 38 per cent of the university STEM-qualified labour force. The report highlighted the strong earning potential enjoyed by engineering graduates, including that 40 per cent of employed engineering bachelor graduates were earning in the highest income brackets, and engineering graduates had the highest employment rate among all STEM qualifications for university and doctoral graduates.As such, the engineering profession not only plays a vital role in addressing key societal challenges but also contributes to economic resilience by providing a stable and well-compensated career pathway for many.

The engineering profession also offers extrinsic benefits and has the potential to create a multiplier effect in employment. As engineering projects often require support from other industries, the increased employment of engineers can lead to both direct and indirect job opportunities within the field, and in engineering-adjacent professions across various industries.

Case study: Engineering's contribution to the US economy

The engineering and architectural sector plays a significant role in job creation. For example, aside from accounting for 2.8 per cent of jobs in the United States, each new job in the sector leads to two more being created in supporting industries.[21] This pattern of job creation is similarly observed across various engineering-related fields, including technical consulting and the manufacturing of electrical equipment, medical devices, semiconductors, and other essential components. [22]

Conversely, the loss of engineering jobs can have a significant negative impact on employment across sectors. For example, the American durable manufacturing sector—an industry closely tied to engineering expertise—has the second-highest employment multiplier of any of the major industry groups analysed in the survey. For every 100 direct jobs lost in this sector, 744 indirect jobs are also lost. [23]

[20] Leigh, Katherine, et al. Australia's STEM Workforce: Science, Technology, Engineering, and Mathematics. Office of the Chief Scientist, July 2020, www.chiefscientist.gov.au/sites/default/files/2020-07/australias_stem_workforce_-_final.pdf.

[21] American Council of Engineering Companies. "Engineering Industry Impact Report." American Council of Engineering Companies, 2020, www.programs.acec.org/impact-report/.

[22] Bivens, Josh. Updated Employment Multipliers for the U.S. Economy. Economic Policy Institute, 2023, www.epi.org/publication/updated-employment-multipliers-for-the-u-s-economy.

[23] Ibid.

Key areas of impact

Engineering is a socio-technical profession that impacts on an ever-increasing complex of interrelated systems and challenges. The engineering profession is able to analyse and consider these interconnected and interdependent systems, meaning that engineering skills and engineering solutions are applied and valued across broad and diverse sectors, industries and societal challenges.

Advanced manufacturing

Advanced manufacturing plays a pivotal role in modern production, with engineering essential to every stage – from product development to system design. The potential of Industry 4.0 and automation have unlocked opportunities for highly sophisticated and cost-effective manufacturing processes that can significantly benefit Australia's economy. A range of industrial, mechanical and production engineers, including automation, process and systems engineering specialists, are at the forefront of driving this evolution.

Building and construction

Engineers in civil, structural, mechanical, fire safety and electrical fields are crucial to boosting housing supply and affordability. The steady flow of these engineering projects has a strong influence on economic growth and urban development.

Climate change

Environmental and sustainability engineering professionals assess and mitigate the impact of human activities on the environment, managing natural resources and addressing issues like contamination from past activities. Heritage engineers support sustainability initiatives and conserve natural resources through maintenance, repurposing and adaptive reuse. Engineers from a wide range of disciplines will also be pivotal in achieving more sustainable and resilient project outcomes through engineering design, innovative construction methods, development and use of recycled materials and decommissioning.

Critical minerals

Australia possesses large mineral reserves, many of which are central to global supply and value chains. Critical minerals serve as enablers of many crucial technologies, such as batteries, computer chips, and renewable energy technologies. Mining and chemical engineers are essential to this sector, playing a key role in ensuring extraction and refinement processes are safe, efficient, and sustainable.

Cyber systems security

Cyber security and resilience engineering are vital to national security and the protection of sensitive data and information. Engineers design, implement and improve information security measures to protect the confidentiality, integrity, availability and safety of systems.

Defence and space

Engineers in Australia's Defence Force and defence industry including in disciplines such as mechanical, electrical, aeronautical and cybersecurity, support national security and defence operations in Australia and overseas. Australia's growing space industry relies on engineering expertise from all disciplines, including aerospace and systems engineers, to deliver activities such as ground operations, satellite communication, robotics, astronomy and Earth observation.

Energy

The engineering profession plays a critical role in the development of economic business cases, planning design, construction, roll out, maintenance and decommissioning of projects across many sectors. A key aspect of their work will be to ensure the efficient adaptation of our energy systems to greener technologies, as well as protecting energy delivery during the transition. As well as civil and electrical engineers, specialists such as power systems engineers and grid engineers are essential to a smooth transition to net zero.

Health and medicine

With an ageing, growing population and a trend towards precision medicine, biomedical engineering is an important area of practice that is applying and improving medical technologies to optimise healthcare diagnostics and delivery. Rehabilitation engineering is providing technological solutions to overcome challenges of people with disabilities.

Infrastructure

Australia is currently delivering on a record level of infrastructure investment, including more mega projects than ever before. Planning, designing and constructing major infrastructure such as roads, bridges, pipelines, harbours, airports and railways is only possible with the engineering team.

Internet of Things (IoT)

Engineers, including software and systems engineers, design applications, creating a network of internet-connected devices that communicate and share data with each other over the internet. These technologies can collect and exchange data, enabling them to monitor and control various aspects of the physical world. These technologies have immense potential in analytics, predictive maintenance and the operation of 'smart cities'.

Research and development

Engineering scholars in our universities and research-focussed engineers in the broader research sector are essential to developing new technologies, materials, processes and engineering solutions. Commercially, engineers possess a unique product development mindset that enables the creation of technologies in high demand by both businesses and households.

Transport and mobility

Transport and mobility infrastructure are vital for livable cities and facilitating the flow of commerce. This infrastructure is also central to individual wellbeing, by ensuring accessibility, safety and community access. Inclusive and efficient transport systems rely on engineers with specialist skills in transport, rail, maritime, aviation and logistics to design and deliver systems that operate safely and effectively and remain fit for purpose amidst a changing urban environment and across regional and international transport routes.

Water and waste

Chemical engineers are vital in processing water, food, fuel, metals, pharmaceuticals and waste. They are an integral part of developing and implementing renewable, sustainable technologies and embedding the circular economy.

3.0 Today's engineering workforce

Australia must address critical challenges with its engineering workforce, including over-reliance on international migration and a significant portion of engineers set to retire in the coming years.

Engineers Australia periodically gathers data about the engineering workforce to help understand whether there are enough engineers coming into the profession to maintain our present and future engineering capabilities. We source data from various trusted sources, including census data which is available every five years.

3.1 Snapshot of Australia's engineers

Below are some key highlights from 'The Engineering Profession: A statistical overview, 15th edition' [24] and 'The Engineering Labour Market Overview'. [25]

- At the time of the last census in 2021, there were 546,905 qualified engineers in Australia, with 433,353 participating in the labour force, and 243,157 working in engineering occupations.
- In 2021, nearly 44 per cent of the engineering workforce were Millennials, representing the largest proportion of working engineers.
- Over 60 per cent of Australia's qualified engineers were born overseas.
- Only 16 per cent of engineers working in engineering occupations are women (around 87,000), and only 4.1 per cent of the engineering qualified labour force are women born in Australia.
- Up to almost 70,000 engineers are predicted to retire over the next 15 years, and at current rates more than 60 per cent of domestic engineering graduations would need to enter the workforce to replace these departing engineers.
- Aboriginal and Torres Strait Islander people working in engineering occupations have increased by 51.9 per cent compared with the 2016 census. Although Indigenous people make up 3.8 per cent of the overall Australian population, they represent just 0.3 per cent of the engineering workforce—about 12 times smaller than their proportion of the population.
- Like most of the Australian population, a vast majority of engineers live in urban, metropolitan areas, in and around capital cities.
- The average Australian engineer's salary during the 2021 census was $118,232.
- 60.3 per cent of engineers work full-time, 12.7 per cent work part-time, 20.6 per cent are not in the labour force, and 2.9 per cent are unemployed and looking for work.

[24] Briggs, P. 'The Engineering Profession: A Statistical Overview Fifteenth Edition' Engineers Australia. 2023, https://www.engineersaustralia.org.au/publications/engineering-profession-statistical-overview-15th-edition

[25] The Engineering Labour Market Overview – August 2024. Engineers Australia, 2024, https://www.engineersaustralia.org.au/sites/default/files/2024-09/The-Engineering-Labour-Market-Overview-August-24.pdf.

Labour force statistics

	Qualified Engineers		Working in Engineering Occupations	
Component of Labour Force	Number	% of LF	Number	% of EO
Male, Aboriginal and Torres Strait Islander	1,086	0.3%	638	0.3%
Male, born in Australia	146,779	33.9%	95,775	39.4%
Male, born overseas	217,375	50.2%	112,730	46.4%
Male total	364,154	84.0%	209,143	86.0%
Female, Aboriginal and Torres Strait Islander	82	0.0%	63	0.0%
Female, born in Australia	17,979	4.1%	10,985	4.5%
Female, born overseas	51,220	11.8%	23,029	9.5%
Female, total	69,199	16.0%	34,014	14.0%
Aboriginal and Torres Strait Islander total	1,168	0.3%	701	0.3%
Australian total	164,758	38.0%	106,760	43.9%
Overseas born total	268,595	62.0%	135,759	55.8%
Total	433,353	100.0%	243,157	100.0%

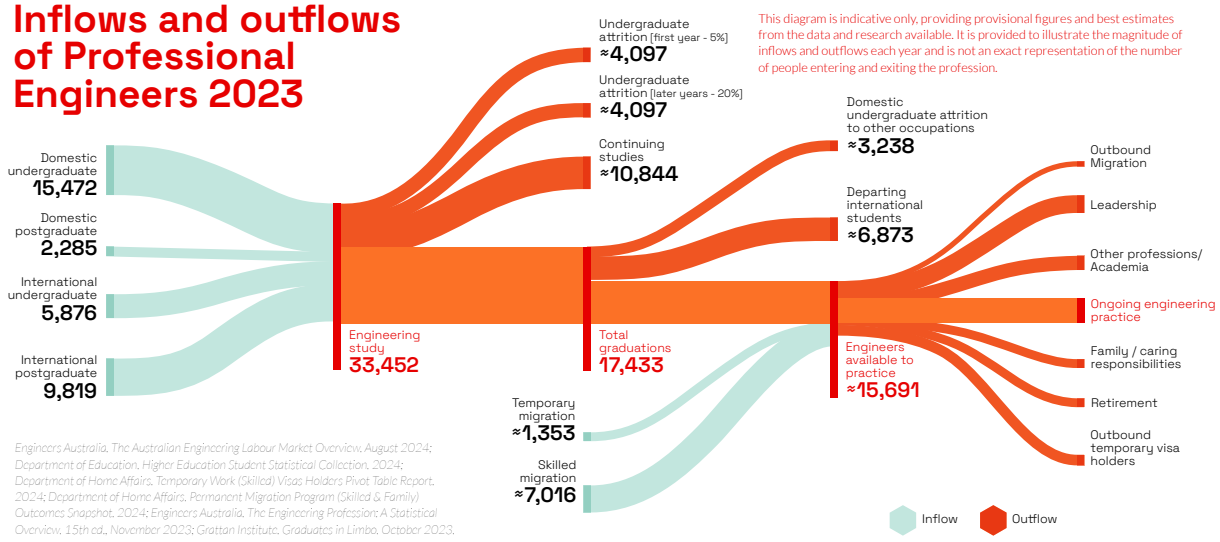
Top 20 occupations

Occupation	Number
Civil Engineering Professionals	38,347
Industrial, Mechanical and Production Engineers	24,342
Software and Applications Programmers	19,993
Electrical Engineers	14,782
Engineering Managers	12,377
Construction Managers	11,440
Contract, Program and Project Administrators	8,974
ICT Managers	7,882
Mining Engineers	6,586
Production Managers	6,560
Other Engineering Professionals	6,349
Other Specialist Managers	5,021
Air Transport Professionals	4,934
Chief Executives and Managing Directors	4,867
Management and Organisation Analysts	4,750
Architectural, Building and Surveying Technicians	4,194
ICT Business and Systems Analysts	3,861
Electronics Engineers	3,776
Telecommunications Engineering Professionals	3,677
General Managers	3,639
University Lecturers and Tutors	3,588
Total	199,939

3.2 Attraction and retention

Despite being a sought-after and valued profession, engineering faces significant challenges in retaining talent at every stage of the pipeline, from education through to professional practice.

Only 70 per cent of students who commence an engineering degree in Australia complete their studies, based on 9-year outcomes.[26] Some are lost to attrition, with others either continuing their education, moving overseas, or transitioning to other fields. At the four-year point, only 22.3 per cent of engineers have graduated with their bachelors qualification; this number has fallen 15 per cent since 2011.[27] There is a need to better understand this as we know many factors influence this outcome. For example, a strength of Australian engineering programs is that they are often completed as double degrees. Earn while you learn program models also need to be considered.



Engineering is a key part of Australia's STEM talent pipeline and holds strong appeal among students due to positive perceptions of engineering as a career.[28] Factors such as personal interest, job security, creativity, and societal impact drive students' interest in engineering. However, a student's level of interest is also strongly influenced by their family's career perceptions.

Despite favourable perceptions of the profession, Engineers Australia research found both traditional and technology-driven engineering fields face challenges with limited teacher encouragement,[29] potentially deterring students from pursuing engineering careers. This issue could stem from educators' limited exposure to engineering concepts, career pathways, and real-world applications.

These findings support earlier research into the motivators and barriers for entry into engineering specifically for women and girls. The research found that greater familiarity with engineering among several groups – from teachers and career advisors to parents and guardians – will lead to greater external encouragement of girls to study engineering. In some cases girls are actively **dis**couraged from pursuing engineering – they may be pushed to instead study science or health degrees.[30]

[26] Engineers Australia. Australian Higher Education Statistics 2012-22. Engineers Australia, 2024, www.engineersaustralia.org.au/sites/default/files/2024-11/Australian-Higher-Education-Statistics-2012-22-Nov24.pdf

[27] Ibid

[28] Engineers Australia & Student Edge. Decoding the Career Path of Today's Young People. June 2024.

[29] Ibid

[30] Romanis, J. Women in Engineering. Engineers Australia. June 2022, https://www.engineersaustralia.org.au/publications/women-engineering

Even when students choose to study engineering, retaining them in the profession remains a challenge. The attrition rate of engineering students is noted to be five per cent in the first year, with a further 20 per cent attrition over later years.[31] Research by Engineers Australia has shown that engineering students often feel unsupported throughout their studies, a potential factor in this trend.[32] In addition, many graduating engineers from international backgrounds may return to their home countries, where they can contribute to their local communities or practice in familiar environments. However, failing to retain these international graduates in Australia represents a missed opportunity to tap into a talent pool with professionally accredited qualifications and valuable knowledge of engineering practice in the Australian context.

Attrition continues to occur in the professional stage due to retirements, family and caring responsibilities, leadership opportunities, transitions into other non-engineering roles and outbound migration. This loss is particularly impactful on long-term supply, as engineering professionals who have been away from the field for extended periods face challenges re-entering the workforce. This issue is especially pronounced for young graduates who have never had the opportunity to work in a professional engineering role.

3.3 Vacancies and demand

Many engineers and engineering employers are reporting skills challenges of varying degrees in their organisations. A survey of audience members at Engineers Australia's Climate Smart Engineering Conference in 2023 found 36 per cent of the audience were experiencing acute skills shortages in their work, and 60 per cent had faced skills shortages at certain times or for more particular skills. [33]

Consult Australia's 2024 survey of its members found this trend had changed, but 57 per cent of businesses needed to redeploy staff to alternative projects, and 51 per cent of businesses identified staff recruitment as their biggest challenge. [34] Evidently, there are still ongoing challenges related to skills and their efficient allocation to where they are most needed.

According to a labour market analysis in August 2024, vacancies remain elevated (16.8 per cent above the indexed level recorded in January 2006). [35] The largest share of vacancies is for Civil Engineering Professionals, with Chemical and Materials Engineers showing the lowest proportion of vacancies. Vacancies are highest in ACT, Tasmania and WA.

In the face of current skills challenges, Australia has the additional task of preparing itself for anticipated rises in demand for engineering professionals. Ongoing increased investment in public infrastructure is driving demand for engineers, as is a re-emergence of demand for minerals, a global transition to clean energy and climate change adaptation. Employment across all STEM disciplines is projected to grow by 14.2 per cent by 2026, nearly double the growth rate for non-STEM jobs. [36]

[31] Engineers Australia. The Engineering Profession: Statistical Overview, 15th Edition. Engineers Australia, 2023, https://www.engineersaustralia.org.au/sites/default/files/2023-11/engineering-profession-statistical-overview-fifteenth-edition.pdf. & King, R., 'Australian Engineering Higher Education Statistics 2010–20', Australian Council of Engineering Deans, (April 2022) https:// www.aced.edu.au/downloads/ACED%20Engineering%20Statistics%20April%202022.pdf

[32] Engineers Australia. The Engineering Profession: Statistical Overview, 15th Edition. Engineers Australia, 2023, https://www.engineersaustralia.org.au/sites/default/files/2023-11/engineering-profession-statistical-overview-fifteenth-edition.pdf.

[33] Engineers Australia. The Engineering Labour Market Overview: August 2024. Engineers Australia, August 2024, www.engineersaustralia.org.au/sites/default/files/2024-09/The-Engineering-Labour-Market-Overview-August-24.pdf.

[34] Consult Australia. 2024 Confidence & Continuity Report. Consult Australia, 2024, www.consultaustralia.com.au/docs/default-source/advocacy/2024-confidence-continuity-report.pdf?sfvrsn=2dfca33_3.

[35] Engineers Australia. The Engineering Labour Market Overview: August 2024. Engineers Australia, August 2024, www.engineersaustralia.org.au/sites/default/files/2024-09/The-Engineering-Labour-Market-Overview-August-24.pdf.

[36] Jobs and Skills Australia. NSC22-0041 Employability Projections. 2022, jobsandskills.gov.au.

Preliminary modelling by Jobs and Skills Australia indicates Australia will need nearly two million workers in engineering and building trades in the clean energy sector by 2050.[37] An Australian Council of Education Deans (ACED) working paper shared projections that Australia will need one hundred thousand more engineers alone by 2030, representing a 50 per cent increase to deliver on government initiatives.[38]

The Australian Government's Jobs and Skills Councils (JSCs) have also highlighted the skills challenges in engineering across the diverse portfolio of workforce plans. The JSCs bring together employers, unions and governments in a tripartite arrangement to find solutions to skills and workforce challenges. For example, the Manufacturing Industry Skills Alliance highlight the demand growth for skills in core manufacturing occupations electrical engineering, systems engineering and mechanical engineering[38] . Likewise, the Industry Skills Australia Maritime[39], Rail and Aviation[40] industries' workforce plans all include engineering among the occupations required to deliver on major projects and cite shortages across many engineering disciplines required for these workforces.

Notwithstanding, Infrastructure Australia has found businesses continue to report pipeline uncertainty as one of the biggest risks to project delivery. Despite workforce shortages at the national aggregate level, Infrastructure Australia suggest delays or uncertainty at the project level may disincentivise businesses from investing in workforce capacity building.[41] This trend is seen in Consult Australia's 2024 survey of design, advisory and engineering businesses which found that in the last 12 months, almost half (46 per cent) of respondents have made resource cuts and more (57 per cent) have redeployed staff to alternative projects due to changes to the government infrastructure pipeline. [42]

However, the scale of activity required to undertake the clean energy transition and decarbonise the economy by 2050, as well as the infrastructure and construction demand from an increasing population, and the new investment from the Australian Government's Future Made in Australia agenda is likely to see strong demand for engineers in the longer-term.

[35] Jobs and Skills Australia. The Clean Energy Generation: Workforce Needs for a Net Zero Economy, 2023, https://www.jobsandskills.gov.au/publications/the-clean-energy-generation.

[36] King, Robin. Engineer Shortages and Projections. Australian Centre for Engineering Education, Dec. 2021, www.aced.edu.au/downloads/Engineer%20Shortages%20and%20Projections%20Dec%202021.pdf.

[37] 2023 Initial Workforce Plan' Manufacturing Industry Skills Alliance (Accessed 8 May 2024) https://manufacturingalliance.org.au/wp-content/uploads/2024/02/Initial_Workforce_Plan_2023_excerpt.pdf

[38] Manufacturing Industry Skills Alliance '2023 Initial Workforce Plan' Manufacturing Industry Skills Alliance (Accessed 8 May 2024) https://manufacturingalliance.org.au/wp-content/uploads/2024/02/Initial_Workforce_Plan_2023_excerpt.pdf

[39] Industry Skills Australia Limited, Maritime Industry 'Maritime Industry 2023 Initial Workforce Plan' Industry Skills Australia (Accessed 8 May 2024) https://www.industryskillsaustralia.org.au/initial-workforce-plans

[40] Industry Skills Australia Limited, Aviation Industry 'Aviation Industry 2023 Initial Workforce Plan' Industry Skills Australia (Accessed 8 May 2024) https://www.industryskillsaustralia.org.au/initial-workforce-plans

[41] Infrastructure Australia. 2024 Infrastructure Market Capacity Report. Infrastructure Australia, 2024, www.infrastructureaustralia.gov.au/2024-infrastructure-market-capacity-report.

[42] Consult Australia. (2024). 2024 Confidence and Continuity Report. Retrieved from https://www.consultaustralia.com.au/docs/default-source/advocacy/2024-confidence-continuity-report.pdf

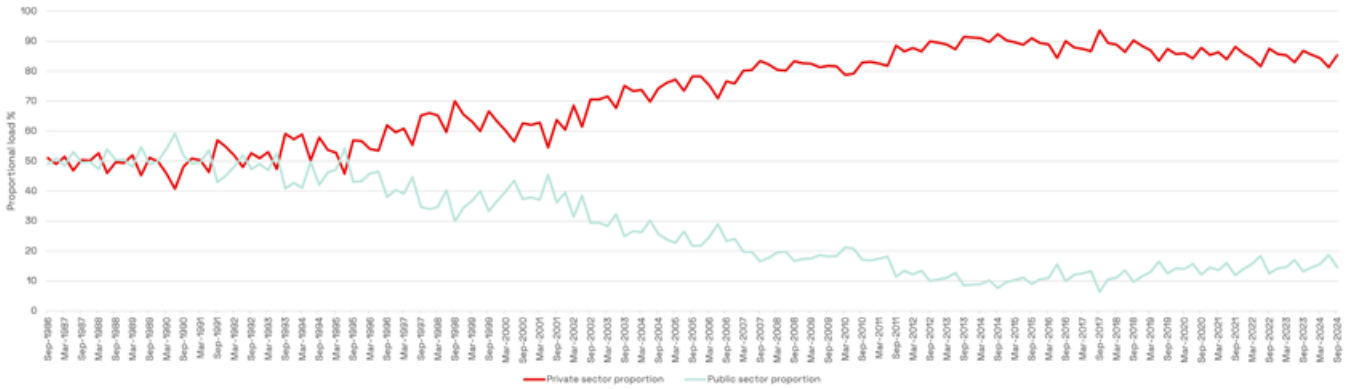
4.0 The declining representation of engineering in government

Senior engineering roles in government ensure decisions made for the community are informed by robust analysis and innovative thinking to enhance outcomes. Chief Engineers strengthen technical leadership in governments to address critical priorities.

The demand for public sector work is rapidly growing, driven by the federal government's goals and Australia's expanding population. The nation's major public infrastructure pipeline, valued at $213 billion through to 2027-28,[43] underscores the increasing need for government-funded projects across urban infrastructure, public transport, and energy systems. As the country faces the imperatives of the energy transition and a future built on sustainable development, the government will continue to bear substantial responsibility for critical engineering projects. This growing demand for public infrastructure stands in stark contrast to the decreasing proportion of engineers employed within the public sector.

Currently, around 45 per cent of all engineering work is completed for the public sector, yet only 15 per cent of engineering work is executed by the public sector itself.[44] This shift reflects an alarming reality—despite the increasing pressure on the government to deliver projects with greater scale and frequency, the share of engineers directly employed by the public sector continues to proportionally decline. As of 2021, 85.7 per cent of qualified engineers work in the private sector,[45] highlighting the shift toward private procurement and consultancy. In 2021, there were 59,292 engineers employed across the three levels of Government,[46] a 40 per cent reduction to the estimated size of the engineering workforce in the public sector in the 1980s.[47] At the same time, the inflation adjusted value of engineering construction work conducted for the public sector has increased by an astounding 211.8 per cent from 1986 to 2024. [48]

Chart 1: **Proportion of Australian Engineering work completed by Public v Private Sector**



Data extracted from: Australian Bureau of Statistics. Engineering Construction Activity, Australia, latest release, Australian Bureau of Statistics, www.abs.gov.au/statistics/industry/building-and-construction/engineering-construction-activity-australia/latest-release. Accessed 5 Mar. 2025

[43] Infrastructure Australia. 2024 Infrastructure Market Capacity Report. Infrastructure Australia, 2024, www.infrastructureaustralia.gov.au/2024-infrastructure-market-capacity-report.

[44] Foley, B. & Briggs, P. 'The engineering workforce in Australia – supply and demand dynamics'. Engineers Australia, July 2024. (internal briefing)

[45] Engineers Australia. About Engineering: Statistics. Engineers Australia. https://www.engineersaustralia.org.au/about-engineering/statistics

[46] Engineers Australia. Engineering Profession: A Statistical Overview, Fifteenth Edition. Engineers Australia, 2023, https://www.engineersaustralia.org.au/sites/default/files/2023-11/engineering-profession-statistical-overview-fifteenth-edition.pdf.

[47] Engineers Australia. "Why Government Needs More Engineering Expertise." Engineers Australia, 2018, https://www.engineersaustralia.org.au/news-and-media/2018/07/why-government-needs-more-engineering-expertise.

[48] Australian Bureau of Statistics. Engineering Construction Activity, Australia, Latest Release. Australian Bureau of Statistics, https://www.abs.gov.au/statistics/industry/building-and-construction/engineering-construction-activity-australia/latest-release. Statistics were retrieved from this source, with the 1986 figure CPI adjusted. The percentage increase represents the proportional percentage difference.

The impacts of increased reliance on procurement and contracting

While private sector delivery of public projects can provide significant benefits, the shift towards private procurement does not remove the need for technical skills and advice – rather it necessitates deploying these skills in different ways. Market-based approaches can drive efficiency, but government leadership is necessary at a system-level.

Engineering expertise is needed in procurement for project scoping, ideation of solutions, knowledge about technical limitations and compliance issues, and an understanding of systems integration. This ensures tender documentation is prepared in a way that efficiently supports the best and most competitive responses from the private sector (including those that support innovation and sustainability), and funding agreements support governments as informed buyers – with expert technical assessment of feasibility, cost, risk and safety. In-house, ongoing engineering expertise can further support private sector innovation, by advising governments on where they can have a higher risk appetite to 'do things differently' and adopt innovative private sector solutions, rather than undertake procurement for an already-determined – and potentially less ideal – outcome.

Engineering expertise is crucial in many central public sectors like defence, energy, transport, infrastructure, and climate, where decisions, investments and projects have particularly long-lasting impacts. While outsourcing engineering advice or hiring fixed-term contactors may fill short-term gaps, it cannot replace institutional knowledge and the long-term commitment needed for nation-building projects, which limits the capacity to drive continuity and a broader, systems-level view of infrastructure development.

However, it is apparent that where the use of procurement mechanisms has led to the assumption that external firms can deliver the needed expertise, then in-house technical expertise has been reduced. This reliance on private sector procurement reduces the incentives for government departments to identify and scope senior engineering roles, which, over time, diminishes the government's internal technical capability.

As fewer engineers remain in the public sector, its capacity to design and evaluate projects effectively, scrutinise costs and risks, and ensure the most efficient utilisation of taxpayer funds is eroded. This raises the risks of project failures, delays and cost overruns. The 2024 Strategic Review of the Infrastructure Investment Program identified $32.8 billion in cost pressures, including $14.2 billion arising from projects still in the planning phase. [49] The review noted many projects received government funding before sufficient planning, robust design, or accurate costing had been completed. This premature funding could potentially stem from a knowledge or expertise gap, as well as a reduction of in-house oversight. The lack of adequate internal technical expertise may contribute to inefficiencies, delays, and increased risks of failure, highlighting the importance of strengthening public sector engineering capacity to ensure more effective project management. In acknowledging the value of procurement services, the public sector must match their engagement with proportional hiring of engineers, to ensure such services can be leveraged in the most effective manner.

Impacts on technically sound policy and regulation

Much of contemporary policy-making is increasingly shaped by engineering-related issues, yet the reduced proportion of engineering professionals in government limits the development of informed policies and regulations. In a global context marked by complex technological implementation and interrelated systems challenges, governments need to have access to adequate technical expertise.

[49] Department of Infrastructure, Transport, Regional Development, Communications and the Arts. Independent Strategic Review of the Infrastructure Investment Program – Executive Summary. Australian Government, 2024, www.infrastructure.gov.au/sites/default/files/documents/independent-strategic-review-iip%E2%80%93executive-summary.pdf.

The expertise gap can undermine governance and planning at the systems level, particularly when addressing critical challenges such as the energy transition, supply chains, and national risk and resilience. With less in-house technical expertise, governments have diminished access to the necessary knowledge to inform policy, planning and regulation.

Benefits of Engineering Advice in Government

- By training, engineers apply a systems approach
- Engineers assess risks and safety, and have a practical eye for implementation
- Engineering expertise directly aligns with government responsibilities such as planning and project management
- Engineers work to improve quality and reliability
- Engineers are integral to testing, inspecting and detecting defects
- Technical understanding and subject matter expertise supports innovative policy solutions

The role of Chief Engineers

Governments worldwide recognise the importance of professional expertise by appointing Chief Officers in various fields, such as Chief Medical Officers, Chief Economists and Chief Scientists. Chief Engineer roles follow this model, ensuring engineering expertise informs government decisions.

Chief Engineers in governments can be responsible for providing system-level, strategic and technical advice to support sustainable, practical and informed policy, projects and decision making. An example includes the New South Wales Chief Scientist and Engineer, who provides independent advice on research support and industry development, to drive research commercialisation, and science and engineering outreach. [50]

[50] Office of the Chief Scientist and Engineer, New South Wales. Chief Scientist and Engineer, NSW. https://www.chiefscientist.nsw.gov.au/

"Governments own and operate a wide range of assets for the community, including schools, hospitals, roads, parks and urban spaces and rail to name a few. The Chief Engineer role, and the engineers delivering the projects, ensure that decisions made for the community are informed by sound engineering principles, delivering robust and fit for purpose infrastructure.

Engineers are a key profession when it comes to strategic planning for our cities. I think it is important, and valuable for governments, to have senior leaders in their executive team who have a technical/engineering background, who can influence and support good government decision making.

I would also say that engineers are trained problem solvers (irrespective of the issue) so they can be valuable contributors to any process. Engineers, with their STEM background, also provide diversity of thought and experience that complements other decision makers such as public policy experts."

ACT's former Chief Engineer Adrian Piani FIEAust CPEng EngExec NER on why it is important to have Chief Engineers working in the states and territories. [51]

[51] Engineers Australia. "The Role of Engineering in Government." Engineers Australia, 2023, www.engineersaustralia.org.au/news-and-media/2023/09/role-engineering-government.

5.0 Strengthening the engineering workforce

Many national challenges require engineered solutions, which means that bolstering Australia's engineering skills capability is critical. At Engineers Australia, we back today's problem-solvers so they can shape a better tomorrow.

By leveraging our member expertise and convening power, we partner with governments and industry to solve critical societal challenges for the benefit of the community. Engineers Australia advocates on important matters for engineers, the engineering profession and for all Australians.

The changes that will impact our economy in the next decade and beyond will rely extensively on engineering expertise to lead us to a **sustainable, innovative** and **skilled** future for Australia.

A sustainable future

with a decarbonised economy that has adopted the principles of a circular economy to reduce waste and maximise reuse of resources, mitigating the impacts of climate change and delivering sustainability and resilience across sectors including energy, transport and infrastructure.

An innovative future

centred on:

- advanced manufacturing that is critical for industry growth and sovereign capability as well as enhancing national productivity;
- effective development and deployment of emerging technologies including the rapid adoption of AI, other digital innovation and biomedical technologies; and
- a thriving research and development ecosystem that supports the translation and commercialisation of new knowledge and discovery into innovative products and processes.

A skilled future

where a robust, highly skilled and competent, ethical, diverse and highly mobile engineering workforce pipeline fuels the strong engineering capability critical for national prosperity. Quality education, training and skills development is at the centre of improved productivity and increased innovation in industry and the public sector.

A Sustainable Future

Achieving a sustainable future will rely extensively on engineering expertise. A sustainable future envisions a decarbonised nation, where Australia's complex and interconnected energy systems and industries align with global efforts towards achieving net-zero emissions by 2050. To achieve ambitious net-zero targets, and to fully decarbonise our economy, significant changes are required across several key sectors, such as energy, transport and infrastructure. The growing challenges of climate change, alongside the increasing intensity of extreme weather events, will necessitate the strengthening of disaster resilience as well as considered resource use and sustainable management of water, biodiversity and other natural resources.

Delivering the energy transition

Engineers are essential to the development and deployment of clean energy technology and the optimisation of energy grids. However, persistent skills challenges and structural barriers to entry pose significant obstacles to our capacity to transition to clean energy, in addition to decarbonising our emissions-intensive sectors. Wage disparities and limited awareness of career opportunities may prevent the seamless transfer of skills to new industries and hinder a timely decarbonisation process.

Australia must also ensure that its energy market and regulatory bodies have effective engineering capabilities for technical power system design, operation and regulation to complement the existing capabilities in economic design. Engineering insights must be integrated into government decision-making frameworks to support sound analysis on the future of Australia's energy mix.

Energy is more than a component of the economy; it is fundamental to the prosperity and well-being of all Australians. The future of energy generation must be safe, reliable, affordable and clean. The energy market must be able to draw on a mix of proven available generation and distribution technologies, noting Australia's abundance of resources and strategic and geographical advantages.

The decarbonisation of our emissions-intensive energy sector stands as one of the most significant and complex engineering challenges of our time. According to the Australian Energy Market Operator's (AEMO) 2024 Integrated System Plan (ISP), addressing this challenge will require tripling grid-scale variable renewable energy by 2030 and increasing it six-fold by 2050, almost quadrupling firming capacity from non-coal sources, and supporting a four-fold increase in rooftop solar to 72 GW by 2050. [52]

At present, the Australian Government is attempting to deliver the energy transition in line with its 82 per cent renewable electricity by 2030 target.[53] Delivering this exponential increase in renewable energy generation—and fundamentally transforming the energy system within times set out—will require a significant expansion of the engineering workforce skilled in renewable technologies.

Preliminary modelling by Jobs and Skills Australia (JSA) suggests the clean energy workforce will need to grow by 58.49 per cent by 2050. [54]

Beyond scaling up renewable energy supply, managing a smarter, net-zero energy grid requires new skills to manage, maintain, and continuously develop infrastructure. Alongside technical expertise, engineers will need to develop specific capabilities in teamwork, digital literacy, and interpersonal skills to meet the demands of this evolving sector. [55]

[52] Australian Energy Market Operator, 2024 Integrated System Plan, June 2024, https://aemo.com.au/en/energy-systems/major-publications/integrated-system-plan-isp

[53] Department of Climate Change, Energy, the Environment and Water. Capacity Investment Scheme. Australian Government, last updated 25 February 2025, www.dcceew.gov.au/energy/renewable/capacity-investment-scheme

[54] Department of Employment, Skills, Small and Family Business, The Clean Energy Generation, 2023, https://www.jobsandskills.gov.au/publications/the-clean-energy-generation

[55] Engineers Australia, Discussion Paper: Integrating DER into the Grid, March 2022, https://www.engineersaustralia.org.au/publications/discussion-paper-integrating-der-grid

Transferability of Engineering Skills for the Clean Energy Transition

Engineers are well-positioned to transition into the renewable energy sector due to their adaptability and transferable skill sets. Research by Engineers Australia, in partnership with Mott McDonald, examined the skills required for the energy transition and the barriers preventing engineers in the thermal sector (as the fossil fuel industry is phased out) from moving into clean energy opportunities. Through extensive interviews, workforce data, and consultations with employers, the study identified several key challenges: [56]

- → A wage gap between clean energy roles and fossil fuel industries, with the latter offering higher wages due to remote locations of work and industry premiums.
- → A lack of awareness regarding renewable energy careers as viable and impactful options, creating a significant barrier to entry.
- → A growing skills shortage in the clean energy sector threatens to delay rollouts across the sustainable energy economy.
- → Training pathways and coordination of policy drivers are needed.

Failing to address these challenges could create significant workforce issues in the energy transition. Retaining engineers in the sector and encouraging new talent to enter the clean energy workforce is crucial to achieving broader national objectives. The phase out of fossil fuels poses an imperative to ensure engineers and other such professions from the sector are supported to remain in work, and to ensure the existing skills base is not lost or underutilised.

Applying circular economy principles in engineering practice

A circular economy is an innovative process model that prioritises sustainable and efficient use of resources, making it highly relevant to the engineering profession. Unlike the traditional linear model of "take, make, dispose", the circular economy seeks to maintain the value of resources within the system for as long as possible.

According to modelling by the CSIRO, doubling Australia's circularity in line with Australia's Circular Economy Framework could add $26 billion in GDP each year by 2035.[57] The Framework outlines three ambitious targets to help achieve this goal:

1. Reducing the material footprint (i.e. the use of raw materials) by 10 per cent
2. Lifting materials productivity (i.e. how efficiently materials are used) by 30 per cent
3. Safely recovering 80 per cent of our resources from landfill

The engineering profession plays a critical role in designing out waste and pollution, preserving and enhancing material value and conserving natural resources and regenerating nature – the three guiding principles of a circular economy. Rethinking product design and optimising materials usage will

[56] Engineers Australia, Transferability of Engineering Skills for the Clean Energy Transition, September 2024, https://www.engineersaustralia.org.au/publications/transferability-engineering-skills-clean-energy-transition.

[57] Department of Climate Change, Energy, the Environment and Water. Australia's Circular Economy Framework. Australian Government, 2022, www.dcceew.gov.au/sites/default/files/documents/australias-circular-economy-framework.pdf. report.pdf

require upskilling and the development of updated training methods for engineers, to ensure the broader adoption of circular principles.

The established circular economy sector in Europe has proven to be a significant source of employment, with the number of people employed in the sector increasing by around 28.1 per cent from 2005 to 2021.[58] A survey conducted by the Australian Industry Group revealed that only 39 per cent of businesses felt their workforce possessed circular economy skills. Among the businesses that anticipated an increase in skills requirements, 48 per cent believed this would be in areas related to the circular economy.[59]

To meet the growing demand for these specialised skills, the Circular Economy Ministerial Advisory Group recommended in their final report that the government address skills gaps within the circular economy and invest in the development of a workforce with skills relevant to a circular economy.[60] The report stresses the need for comprehensive workforce planning, with a particular focus on upskilling and reskilling existing workers. Micro-credentials are cited as a flexible, scalable solution to help meet the sector's needs.

As the transition to a more circular economy accelerates, the demand for engineering professionals—particularly those equipped with relevant circular economy skills—will increase significantly.

Transforming transport and infrastructure

Australia's net-zero transition extends beyond transforming national energy infrastructure—it requires fundamental changes across industries, all of which will demand new skills and an expanded workforce to meet rising demands.

Transport is Australia's third-largest source of emissions (after electricity and stationary energy production), accounting for 20 per cent of national emissions, with over two-thirds coming from light vehicles.[61] This highlights the need for inclusive, efficient, and low-emissions transport solutions.

Decarbonising transport infrastructure presents unique challenges, given Australia's vast geography and reliance on emissions-intensive systems.

Challenges exist in broader infrastructure development, where expertise in carbon cost accounting, lifecycle assessment, material provenance, and material composition will be essential. Training professionals—such as project directors, engineers, development managers, and cost controllers—in these areas will be critical to ensuring infrastructure projects align with net-zero goals.[62]

[58] European Environment Agency. Employment in the Circular Economy. European Environment Agency, June 2024, https://www.eea.europa.eu/en/circularity/thematic-metrics/business/employment-in-the-circular-economy.

[59] Australian Industry Group. Skills for a Cleaner Future: Report January 2024. Australian Industry Group, Jan. 2024, https://www.aigroup.com.au/globalassets/news/reports/2024/skills_for_a_cleaner_future_report_jan_2024.pdf.

[60] Department of Climate Change, Energy, the Environment and Water. Circular Advantage: Final Report. 2024, https://www.dcceew.gov.au/sites/default/files/documents/circular-advantage-final-report-cemag.pdf.

[61] Engineers Australia, Submission to the Transport and Infrastructure Net-Zero Consultation Roadmap, July 2024, https://www.engineersaustralia.org.au/sites/default/files/2024-08/EA_Submission_Transport-and-Infrastructure-Net-Zero-Consultation-Roadmap.pdf.

[62] Engineers Australia, Reducing Infrastructure Embodied Emissions, November 2023, https://www.engineersaustralia.org.au/publications/reducing-infrastructure-embodied-emissions.

Building workforce capability for Australia's growing decommissioning industry

Decommissioning is a growing industry in Australia. Much of the offshore oil and gas infrastructure is approaching the end of its productive life and decommissioning is expected to take decades. Engineering expertise is essential in the decommissioning of emissions-intensive infrastructure, a $60 billion industry over the next 30-50 years.[63] The Centre of Decommissioning Australia (CODA) estimates there is around 5,695 kilotons of offshore infrastructure that will need to be removed, mainly steel and concrete but also other materials that have more complicated disposal and recycling pathways.[64] As much as possible, Australia should look to conduct these activities locally.

The task of decommissioning is another demand on workforce capability, particularly given the limited local experience to date. CODA and the Department of Industry, Science and Resources are working to identify the skills required and analysing the gaps in capability. CSIRO estimates show the decommissioning value chain could create more than 3,500 jobs.[65] Many of these workers could transition from the oil and gas industry and be needed by the offshore wind industry in the decades ahead. The scale of this opportunity not only underscores the financial potential of decarbonisation and decommissioning but also highlights the pressing need for workforce readiness. Currently, only two universities in Australia offer undergraduate petroleum engineering programs, and only one course specifically covers decommissioning.[66]

Improving climate-related disaster resilience

As the frequency and intensity of climate-related disasters escalate, it is vital Australia's engineering workforce is equipped to strengthen community resilience. Engineering expertise is integral to planning, preparedness, disaster management, and long-term recovery.[67] Engineering skills and workforce supply must extend to working collaboratively on endeavours to insulate communities from risk and to recover from disaster and extreme-weather events. This requires investment in specialist skills such as flood modelling, resilient infrastructure design, emergency response planning, and climate risk assessment to ensure engineers can effectively address these challenges.

For example, Engineers Australia members have played a key role in strengthening disaster resilience through its leadership in updating the Australian Rainfall and Runoff (ARR) guidelines.[68] First published in 1958, these guidelines are critical for flood estimation and infrastructure design across the country. Recognising the growing challenges posed by climate change, Engineers Australia, in partnership with the Australian Government Department of Climate Change, Energy, the Environment and Water, led a comprehensive update of the ARR guidelines. This revision incorporates the latest climate science, equipping engineers and decision-makers with improved tools to design infrastructure that is more resilient to increasing flood risks.

By integrating contemporary data and predictive models, the updated guidelines enable more accurate assessments of flood behaviour, enhancing communities' ability to prepare for and respond to extreme weather events.[69] However, the effective application of these guidelines relies on ensuring that engineers across sectors, particularly in local government, consulting, and construction, have access to the necessary training and expertise.

[63] Yielded from Engineers Australia's Decommissioning consultations, statistic comes from Dr Francis Norman (CODA)

[64] Department of Industry, Science and Resources. Understanding Australia's Decommissioning Value Chain. Australian Government, 2024, www.industry.gov.au/publications/australias-offshore-resources-decommissioning-roadmap/understanding-australias-decommissioning-value-chain

[65] Australia's Offshore Resources Decommissioning Roadmap. Department of Industry, Science and Resources, Dec. 2024, www.industry.gov.au/sites/default/files/2024-12/australias-offshore-resources-decommissioning-roadmap.pdf.

[66] Engineers Australia. Decommissioning Roadmap Submission, Oct. 2023, www.engineersaustralia.org.au/sites/default/files/2023-10/EA_Decom%20Roadmap_Submission_Oct2023.pdf. In time since the Submission, UNSW has started offering a decommissioning course.

[67] Engineers Australia, Submission to the Inquiry into Australia's Disaster Resilience, December 2023, https://www.engineersaustralia.org.au/publications/submission-inquiry-australias-disaster-resilience.

[68] Ball, J., et al. "Climate Change Chapter Update (2022), Chapter 6, Book 1." Australian Rainfall and Runoff: A Guide to Flood Estimation, edited by J. Ball, M. Babister, R. Nathan, W. Weeks, E. Weinmann, M. Retallick, and I. Testoni, Version 4.2, Geoscience Australia, 2019.

[69] Foster, L. "New Rainfall Guidelines Go Step Further in Tackling a Changing Climate." Create Digital, 8 Aug. 2023, www.createdigital.org.au/rainfall-guidelines-tackling-changing-climate/.

Engineering water security

Engineering expertise plays a pivotal role in advancing sustainable water outcomes across Australia through the implementation of integrated water management strategies. By adopting a holistic 'OneWater' approach, engineering professionals consider all water sources—surface water, groundwater, stormwater, and recycled water—as a unified resource. This methodology ensures the sustainable use of water resources to meet diverse needs, including potable supply, agriculture, industry, environmental preservation, recreation, tourism, and cultural practices.[70] Such comprehensive management enhances water security, supports public health, and bolsters environmental and urban amenities. To achieve these outcomes, Australia must secure and develop engineering expertise in water-sensitive urban design, large-scale water infrastructure planning, hydrological modelling, and climate adaptation strategies.

Furthermore, the engineering profession is instrumental in developing water infrastructure that is resilient to climate change, thereby safeguarding communities against future challenges.[71] However, the increasing frequency of extreme weather events, coupled with population growth and rising demand for water resources, underscores the need to strengthen engineering capability in areas such as desalination, wastewater treatment, and circular water management.

In the context of Australia's transition to green hydrogen, engineers are addressing the significant water demands of hydrogen production. By integrating water source considerations into hydrogen strategies, they ensure that the burgeoning hydrogen industry develops sustainably without compromising water resources.[72] This requires expertise in water allocation planning, technological innovation in water efficiency, and collaboration between engineers, policymakers, and industry to balance competing water needs.

Through these multifaceted efforts, the engineering profession is essential in steering Australia toward a future where water resources are managed sustainably, supporting both societal needs and environmental integrity.

[70] Engineers Australia, submission to the National Water Agreement: Principles Consultation, September 2024, https://www.engineersaustralia.org.au/sites/default/files/2024-09/national-water-agreement-submission-principles-consultation-sep-2024.pdf

[71] Engineers Australia, submission to the National Water Reform Inquiry, February 2024, https://www.engineersaustralia.org.au/sites/default/files/2024-02/National-Water-Reform-EA-20240202.pdf.

[72] Costello S. & Simpson, M. Exploring the Water-Energy Nexus through Hydrogen: An Early Careers Perspective, October 2024 https://www.engineersaustralia.org.au/sites/default/files/2025-01/Water-Energy-Nexus-through-Hydrogen.pdf.

An Innovative Future

The engineering team are the architects of progress, driving innovation and shaping the systems, products, and services that propel industries forward. Through fostering efficiency, embracing new technologies, and solving complex challenges, the engineering profession is central to advancing sectors and enhancing national productivity. As Australia looks to develop sovereign capabilities—particularly through initiatives like the Future Made in Australia agenda—the nation finds itself at a pivotal moment.

Manufacturing

Globally, nations are recalibrating their manufacturing strategies in response to supply chain disruptions from the COVID-19 pandemic and ongoing geopolitical shifts. For Australia, adopting advanced manufacturing technologies presents a significant opportunity to rebuild a competitive sector while focusing on high-value and niche products.

Transitioning to advanced manufacturing processes will require overcoming substantial structural challenges, including the aftermath of decades of offshoring and the stagnation of multifactor productivity in the manufacturing industry up to 2023.[73] Moreover, existing infrastructure is often ill-equipped to accommodate the technologies required to meet the ambitions of the Future Made in Australia agenda.

The revitalisation of domestic manufacturing will need significant investment in technology, infrastructure, and workforce development. A critical component of this transition is the reskilling of the existing workforce to bridge the gap between current capabilities and the requirements of Industry 4.0 technologies. The 2024–25 Federal Budget's allocation of $22.7 billion over the next decade to stimulate private sector manufacturing investment marks a crucial step in this process.[74]

However, these investments must be paired with comprehensive efforts to reskill workers and address shortages in essential professions, particularly engineering. At present, the Future Made in Australia agenda lacks detailed initiatives and dedicated funding to establish a strong skills foundation in advanced manufacturing, which is vital to its long-term success.

Manufacturing workforce

Projections for manufacturing employment suggest only a modest recovery, from 909,100 workers in 2024 to 959,300 by 2034, with the industry's share of total employment declining from 6.3 per cent to 5.9 per cent.[75] These figures highlight a growing disconnect between Australia's ambitions to revitalise manufacturing and the current trajectory of the sector. Recruitment challenges are further exacerbating this concern, with 92 to 95 per cent of manufacturing employers reporting difficulties in finding workers with the necessary skills to support current activity levels, let alone the growth required to meet government targets.[76]

[73] Engineers Australia, The Engineering Labour Market Overview, June 2024, (https://www.engineersaustralia.org.au/sites/default/files/2024-09/The-Engineering-Labour-Market-Overview-August-24.pdf.

[74] Department of Employment, Skills, Small and Family Business, Towards a National Jobs and Skills Roadmap, October 2024, https://www.jobsandskills.gov.au/publications/towards-national-jobs-and-skills-roadmap.

[75] Department of Employment, Skills, Small and Family Business, Employment Projections (https://www.jobsandskills.gov.au/data/employment-projections), accessed January 11, 2025.

[76] Engineers Australia, Engineering Profession Statistical Overview, 15th Edition, November 2023, https://www.engineersaustralia.org.au/publications/engineering-profession-statistical-overview-15th-edition.

Growing sovereign capability

The Future Made in Australia legislation presents significant opportunities to advance Australia's national interests, particularly through its 'Economic Security and Resilience Stream.' This stream focuses on strengthening supply chain resilience, which is vital for Australia as a middle power in the Asia-Pacific, where resilience is shaped by regional shifts and global dynamics.

Improving responsiveness to these shifts and dynamics requires an economy capable of producing crucial resources independently of exogenous shocks and global disruptions. Engineers play a key role in ensuring this sovereign capability by designing and developing the infrastructure, technologies, and systems that enable Australia to operate independently in critical sectors. By fostering sovereign industries and developing the necessary skills, Australia can better progress national economic and strategic priorities, ensuring preparedness for both foreseeable and unforeseen challenges in an increasingly contested world. Any investment into economic security and resilience will require parallel consideration of the skills required to develop and maintain these sectors, which in some cases will need to be built from the ground up.

Growing industries

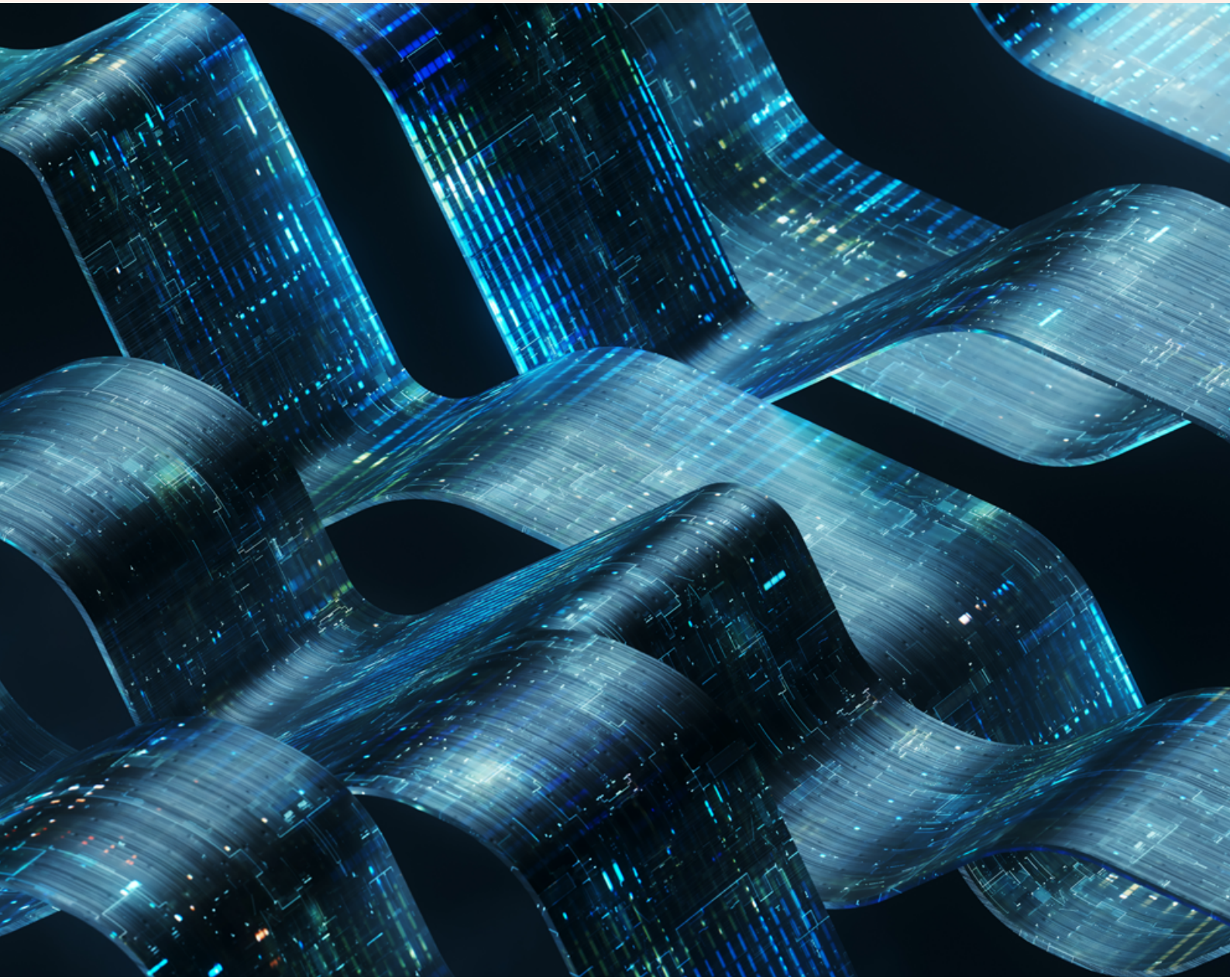
The engineering profession is central to the development of sovereign capability in several defence-adjacent sectors, where engineering expertise is pivotal to advancing national interests. Engineering expertise assists in the creation and maintenance of essential technologies and infrastructure required to support Australia's strategic interests and deliver on critical Defence strategies such as the National Defence Strategy, Defence Industry Development Strategy, and Digital Engineering Strategy.

The nascent domestic space industry is heavily reliant on engineering skills. Engineers Australia's National Committee for Space Engineering has highlighted the growing uptake of space-related activities in Australia, signalling the urgent need for investment in skills development and local industry growth.[78] However, Australia must address the absence of a robust "pyramid of supply" that exists in more established space sectors such as the US and the UK. These countries benefit from well-established supply chains that underpin the space sector, providing critical infrastructure and human capital that Australia needs to build from the ground up. Investment in both local industry growth and workforce development is therefore essential to establish a competitive and sustainable space sector in Australia.

Commitments under the AUKUS agreement requires Australia to develop a highly skilled workforce for constructing, operating, and maintaining conventionally-armed, nuclear-powered submarines. This is a monumental task and, with Australia's limited experience in this highly specialised field, it is clear an influx of skilled engineers will be essential.

[78] Engineers Australia. Space Policy Advice Paper. Engineers Australia, Feb. 2024, http://www.engineersaustralia.org.au/sites/default/files/2024-02/Space-Policy-Advice-Paper.pdf

Digital and data sovereignty are crucial to Australia's prosperity. Positioned strategically in the Asia-Pacific region, Australia is an attractive destination for foreign investment, boasting world-class digital infrastructure that ranks highly on the global stage.[79] As digital technology evolves, the demand for physical infrastructure—particularly data centres—will increase to support the growing digital economy and technologies such as e-commerce, AI (Industry 4.0), and cloud computing. Australians also require reliable access to internet and mobile services for personal use. Government initiatives like the Universal Service Obligation will further drive the need for expanded infrastructure. As demand for advanced digital technologies rises, developing and maintaining this infrastructure will require specialised engineering skills. In addition to traditional engineering expertise, professionals will need to stay ahead of emerging technologies and develop innovative solutions to meet the growing infrastructure demands.



[79] Australian Trade and Investment Commission (Austrade). Why Australia – Digital Technology. Commonwealth of Australia, 2023, www.international.austrade.gov.au/content/dam/austrade-assets/international/documents/reports/why_australia_digital_technology_2023.pdf.

Nascent technology and AI

An integral part of progressing Australia's vision for an innovative future is being adequately prepared for the effective deployment of emerging technologies. The rapid adoption of AI, generative AI (GenAI), and other digital innovation technologies is transforming industries and workplaces, demanding a workforce capable of leveraging these tools while managing their risk. Engineers Australia affirms that, as key developers and deployers of such technologies, engineers must be equipped with the skills and knowledge to be able to navigate this evolving landscape. [80]

The Impact of AI and Generative Technologies on the Engineering Profession [81]

The potential of AI to drive productivity is undeniable. In 2024 Engineers Australia commissioned Ergo Strategy to engage in research investigating the impact of Generative AI on the Engineering Profession. The proliferation of accessible GenAI programs presents a significant opportunity to enhance productivity, much like in other sectors. Through this research, Engineers Australia aimed to understand how engineers' work has already been altered by GenAI, their trust in the technology, their ability to fully utilise it, demographic factors influencing comfort with the tools, and access to training.

The findings revealed that 72 per cent of members agreed that GenAI would significantly boost productivity in the engineering sector, with 77 per cent viewing it as a professional tool, similar to the calculator. However, 90 per cent of engineers acknowledged the inherent risks of GenAI, and 82 per cent believed it would always require oversight. Alarmingly, 78 per cent of engineers reported that their learning was mostly self-driven, rather than formal education, and 66 per cent indicated they had received no workplace training on GenAI.

The research highlighted the critical role of businesses and employers in fostering a culture of openness and in ensuring engineers are empowered to use productivity-enhancing technologies effectively and appropriately.

Ethics training should be integrated into engineering education and professional development. Engineers need to possess technical expertise and have the ability to anticipate and address potential societal harms associated with emerging technologies. The global conversation about AI ethics, as seen in the European Union's AI Act and OECD AI principles,[82] highlights the need for Australia to align with international standards and contribute to global AI governance.

The lack of structured upskilling as identified through the Engineers Australia report exposes engineers to risks such as cybersecurity threats, inaccurate outputs, and data leaks—risks already demonstrated in real-world cases like biased AI in hiring and cybersecurity breaches. Without proper training, engineers may struggle to fully leverage AI's potential while mitigating these risks.

[80] Bell, M. (2025). The impact of AI and generative technologies on the engineering profession. Engineers Australia. Retrieved from https://www.engineersaustralia.org.au/sites/default/files/2025-01/impact-ai-generative-technologies-engineering-profession_0.pdf

[81] Ibid

[82] OECD. OECD Principles on Artificial Intelligence, Organisation for Economic Co-operation and Development, 2019, oecd.ai/en/ai-principles. & European Commission. Regulatory Framework for AI, Digital Strategy, European Commission, 2024, digital-strategy.ec.europa.eu/en/policies/regulatory-framework-ai#

Australia must urgently invest in upskilling and reskilling initiatives that go beyond basic AI literacy. Engineers need the skills to safely deploy AI and GenAI technologies, as well as the ethical foundation to make responsible decisions. Engineers Australia's call for mandatory AI guardrails highlights the importance of developing strong regulatory frameworks to ensure AI is used safely, prioritising public safety and societal benefit.

This investment in skills extends to other emerging technologies like IoT, blockchain, and quantum computing. Engineers must be prepared to design secure systems, with education addressing these areas. As digital technologies advance, the risks grow, requiring proactive workforce preparation and regulatory agility. Quantum computing, for example, will revolutionise industries but will also present new cybersecurity challenges.

A Skilled Future

The shape and face of the engineering profession are constantly evolving. Key drivers involve access to novel and big data, automation, the race to decarbonise the global economy, circular economy uptake, the Internet of Things, and increasing globalisation.

To remain globally competitive, Australia must address the existing skills challenges and build a sustainable pipeline of engineering skills. Our engineering workforce needs to be inclusive, accessible, and future-ready. An engineering workforce fit for the future requires an increase in the number of students choosing to study and practice engineering in Australia as well as equipping existing engineers to be able to meet rapidly evolving workforce and community needs.

The Engineering Labour Market Overview by Engineers Australia highlights the increased demand for engineering skills to solve these challenges:

"The scale of activity required to undertake the clean energy transition and decarbonise the economy by 2050, as well as the infrastructure and construction demand from an increasing population, and the new investment under the Australian Government's Future Made in Australia agenda, is likely to see strong demand for engineers in the longer term." [82]

Long-term demand for engineering expertise is unlikely to be met in a system already struggling to meet existing skills needs. Several demand-side and supply-side factors that currently impact Australia's engineering workforce must be addressed if we are to meet our future workforce needs.

Labour demand factors

Several demand-side trends are impacting the engineering workforce – some of which impact the labour market as a whole, and others that are unique to the engineering profession.

The COVID-19 pandemic retains a residual impact on current engineering skills challenges, due to the surge in infrastructure demand in its aftermath, and the decline in employment faced throughout it. Border closures during the pandemic further limited skilled migration exacerbating these challenges.[83]

The rising cost of living has similarly impacted the engineering workforce. Engineering students, pressured by high living costs and the demands of their qualification, often cannot commit to full-time study, resulting in lower graduate completion rates.[84]

The challenge of regional development and access to engineering expertise is another trend affecting the sector. With the majority of engineering roles in metropolitan areas, particularly Sydney and Melbourne, there is reduced opportunity for infrastructure development essential to productivity growth to be developed across regional communities.[85] Engineers are essential to regional Australia for building and maintaining roads, rail, and energy networks, driving renewable energy projects, and supporting industries transitioning from traditional sectors to advanced manufacturing and clean energy. They play a key role in designing resilient infrastructure to withstand extreme weather events, improving water security for agriculture,

[82] Engineers Australia, The Engineering Labour Market Overview, June 2024, https://www.engineersaustralia.org.au/sites/default/files/2024-09/The-Engineering-Labour-Market-Overview-August-24.pdf

[83] Engineers Australia. Submission to the Australian Universities Accord. Engineers Australia, 2023, www.engineersaustralia.org.au/publications/submission-australian-universities-accord.

[84] Ibid.

[85] Engineers Australia. Enhancing Australia's Migration Program. Engineers Australia, Dec. 2022, www.engineersaustralia.org.au/sites/default/files/2022-12/enhancing-australias-migration-program.pdf. & Engineers Australia. Regional Development: Global Sydney Submission June 2017. Engineers Australia, June 2017, www.engineersaustralia.org.au/sites/default/files/2022-06/regional-development-global-sydney-submission-june-2017.pdf.

and ensuring sustainable regional development. Without sufficient engineering capacity, regional areas risk falling behind in infrastructure investment, economic diversification, and sustainability efforts, limiting their ability to attract businesses, workers, and long-term residents.

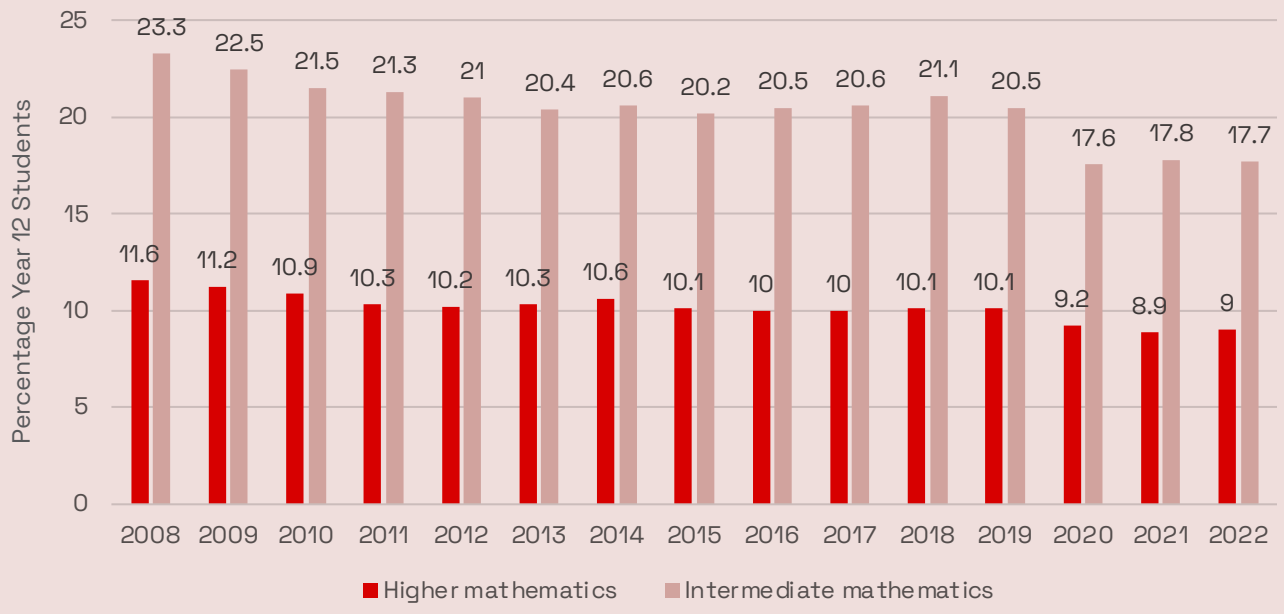
Labour supply challenges

Insufficient supply of new engineers: the domestic engineering talent pipeline is at risk

Challenges arise early in the STEM talent pipeline, as students often develop narrow perceptions of engineering, viewing it as overly focused on mathematics or less interesting compared to other career paths. Research suggests improving understanding of engineering as a viable career option is essential to better support students' entry into the pipeline.[86]

Research from the Australian Mathematical Sciences Institute (AMSI) reveals nearly 40 per cent of Australian maths teachers lack formal maths qualifications, undermining student confidence and leading to poorer outcomes.[87] The Program for International Student Assessment (PISA) shows a decline in mathematical literacy since 2003, with performance dropping further between 2012 and 2022.[88] This decline results in a growing number of students leaving primary school without foundational maths skills, limiting their ability to pursue secondary-level maths and eventually engineering careers. AMSI data also highlights Year 12 participation in higher-level maths is at an all-time low.

Chart 2: Proportion of high school students studying mathematics in Australia (Source: AMSI, 2022) [89]



[86] Engineers Australia & Student Edge. Decoding the Career Path of Young People – Key Outcomes. July 2024

[87] Marchant, Tim, and Sophie Kennedy. The State of Mathematical Sciences 2024: 8th Discipline Profile of Mathematics and Statistics in Australia. Australian Mathematical Sciences Institute, 2024, amsi.org.au/?publications=the-state-of-mathematical-sciences-2024-8th-discipline-profile-of-mathematics-and-statistics-in-australia.

[88] OECD, PISA 2022 Results (Volume I and II): Country Notes – Australia, Dec. 2023, https://www.oecd.org/en/publications/pisa-2022-results-volume-i-and-ii-country-notes_ed6fbcc5-en/australia_e9346d47-en.html.

[89] AMSI. Year 12 Mathematics Participation Report Card: Mathematics Enrolments Remain at All-Time Lows April 2024. https://amsi.org.au/?publications=year-12-mathematics-participation-report-card-mathematics-enrolments-remain-at-all-time-lows#:~:text=Since%202020%20the%20numbers%20and,in%20intermediate%20mathematics%2C17.7%25.

This trend in maths education is linked to the reduced supply of domestic engineering graduates. Domestic engineering commencements have declined since 2014, increasing reliance on imported skills. In 2018, the total number of graduations of international students overtook those of domestic students.[90] Retention and completions also have room for improvement. Only 25 per cent of engineering students complete their degree in the minimum four-year time frame and just 50-65 per cent of students who start engineering degrees graduate.[91]

The decline is similar in graduate and post-graduate studies, with ACED statistics showing a 22 per cent drop in domestic students completing doctorates and a 35 per cent decrease in those completing research or master's degrees.[92] The COVID-19 pandemic exacerbated this trend, with commencements for both degree types remaining 40 per cent below the 2015 peak.

Inefficient allocation of existing engineers: migrant engineers are not employed in engineering roles

A report by Settlement Services International Limited claimed Australia can unlock $9 billion annually, economy wide, by fully utilising the skills potential of already settled permanent migrants.[93] Research by Engineers Australia found some 47 per cent of migrant engineers actively seeking a job in the sector were currently unemployed.[94] Many engineers born overseas continue to be employed in industries where their skills are not being utilised, and the over indexation of qualified engineers in non-engineering professions suggests sub-optimal employment outcomes for this cohort.[95]

Consultations as part of the research found this cohort was susceptible to structural barriers that prevented them from obtaining gainful employment in the engineering sector, with many respondents indicating their lack of local experience was a significant barrier to obtaining any experience, and a large amount feeling their international experience was not valued. On the employer side, Engineers Australia found a lack of awareness regarding the availability of migrant engineers as a talent pool capable of resolving immediate skills supply issues, due to misperceptions of employer accessibility.[96]

The underutilisation of migrant engineers is noted across the sector, with the 2024 Infrastructure Market Capacity Report acknowledging the challenge, and some attempted resolutions to address this problem through government funded programs.[97] This includes a revised approach that prioritises the skills and experience needed in Australia, rather than relying solely on the Occupation Standard Classification for Australia (OSCA, formerly ANZSCO) occupation list. Furthermore, it is noted Australia should maintain a migration program that is adaptable to the evolving needs of the Australian context. Currently, the skills listed on the migration assessment are too rigidly tied to the OSCA occupations list, limiting the ability to respond to emerging skill demands.[98]

[90] ACED, Engineering Statistics April 2022,http://www.aced.edu.au/downloads/ACED%20Engineering%20Statistics%20April%202022.pdf

[91] Engineers Australia, Engineering Profession Statistical Overview, 15th Edition, November 2023, https://www.engineersaustralia.org.au/publications/engineering-profession-statistical-overview-15th-edition.

[92] ACED, Engineering Statistics April 2022, http://www.aced.edu.au/downloads/ACED%20Engineering%20Statistics%20April%202022.pdf.

[93] Settlement Services International Limited, Skills Mismatch Report, June 19, 2024, https://www.ssi.org.au/wp-content/uploads/2024/06/DAE_SSI_Skills_Mismatch_Report_19062024_WEB.pdf.

[94] Barriers to Migrant Employment. Engineers Australia, 2021, https://www.engineersaustralia.org.au/Barriers-to-Migrant-Employment.

[95] Engineers Australia, Engineering Profession Statistical Overview, 15th Edition, November 2023, https://www.engineersaustralia.org.au/publications/engineering-profession-statistical-overview-15th-edition.

[96] Barriers to Migrant Employment. Engineers Australia, October 2021, https://www.engineersaustralia.org.au/Barriers-to-Migrant-Employment.

[97] Infrastructure Australia 2024 Infrastructure Market Capacity Report, December 2024, https://www.infrastructureaustralia.gov.au/reports/2024-infrastructure-market-capacity-report.

[98] Engineers Australia. Review of the Points Test Submission, May 2024, https://www.engineersaustralia.org.au/sites/default/files/2024-05/Engineers-Australia-submission-Migration-Review-of-the-points-test-%28Cth-May-2024%29.pdf.

Underutilised talent: The current workforce does not reflect the diverse communities it serves

As of 2021, women accounted for just 16 per cent of Australia's engineering workforce, with Australian-born women making up only 4.1 per cent. Engineering has the lowest female representation across all STEM professions, with structural barriers preventing greater participation.

Research by Engineers Australia highlights key factors constraining female participation, spanning the entire engineering pipeline. According to AMSI, in 2020 37.8 per cent of students undertaking higher mathematics were female, the gender balance is more even at the intermediate level.[99] Many women and young girls avoid engineering due to a lack of awareness and familiarity with the profession, coupled with negative perceptions, such as its male-dominated image and the belief that it is not fulfilling or impactful.[100] These issues are compounded by poor STEM engagement in schools, with many young women reporting insufficient support during their STEM education. Although university experiences are generally positive, many female engineering students feel less supported compared to peers in other disciplines.

The challenges continue into the workplace, where only 55 per cent of women in engineering report equal opportunities to men, and nearly one in five women report gender-related bullying or exclusion. These factors contribute significantly to the high attrition rates of women in the engineering workforce.

Similarly, Aboriginal and Torres Strait Islander peoples are underrepresented in Australia's STEM workforce. While they make up 3.8 per cent of the population, they represent only 0.3 per cent of the engineering workforce.[101] This disparity underscores the need to promote greater First Nations participation in engineering to ensure the profession reflects the diversity of the communities it serves.

Impediments to workforce mobility across jurisdictions: a lack of nationally consistent registration for professional engineers

Comprehensive statutory registration for engineers in all Australian states and territories has long been touted as a method of raising professional standards amongst engineers. In the absence of regulation for engineering, anyone could purport to be an engineer and provide engineering services without appropriate qualifications, experience, or competencies and with disregard to professional standards and ethical conduct. Until recently, Queensland was the only state with such laws.

Australia is a federation where the states and territories have responsibility for certain areas of government, including the registration of professions. This means that the registration of engineers in Australia is unlikely to ever be governed by a single piece of legislation, enacted by the Commonwealth Government. However, a "federal" system, whereby registration is managed on a state-by-state basis, but with close alignment of standards and application of the Mutual Recognition Act 1992, is achievable.

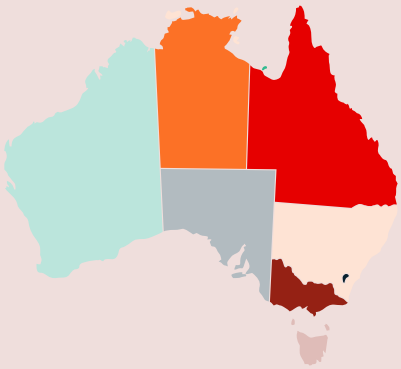
[98] Engineers Australia, Engineering Profession Statistical Overview, 15th Edition, November 2023, https://www.engineersaustralia.org.au/publications/engineering-profession-statistical-overview-15th-edition.

[99] Australian Mathematical Sciences Institute, Year 12 Participation in Higher-Level Mathematics: 2022 Report, April 2022, https://amsi.org.au/wp-content/uploads/2022/04/year-12-participation-2022.pdf.

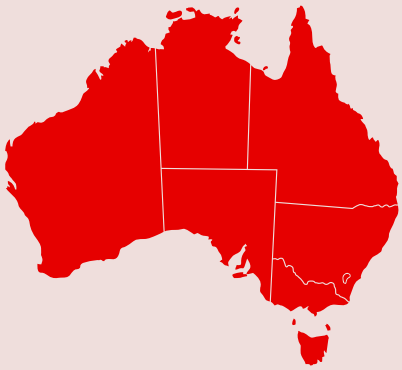
[100] Romanis, J. Women in Engineering. Engineers Australia. June 2022, https://www.engineersaustralia.org.au/publications/women-engineering

[101] Engineers Australia, Engineering Profession Statistical Overview, 15th Edition, November 2023, https://www.engineersaustralia.org.au/publications/engineering-profession-statistical-overview-15th-edition.

National Registration



State registration



Nationally consistent registration

Nationally consistent registration enables effective mutual recognition and reduces regulatory burden for engineers and industry that work across state (and international) borders.

Engineers Australia advocates for nationally consistent engineering registration schemes, meaning that each jurisdiction's engineers registration scheme is consistent with the other schemes across the country. Having nationally consistent schemes should allow for a model (facilitated by Mutual Recognition) of 'register once, practice anywhere', similar to the operation of driver licences. Having consistent schemes stands to deliver over $54 million in savings for businesses with registered professional engineers that work across state borders[102]. By comparison, without nationally consistent registration schemes:

- Individual engineers, particularly those that provide services in more than one jurisdiction, need to maintain records and keep track of their registration in the various jurisdictions. These can vary in cost, area of engineering they will be registered under, period of registration, CPD requirements and legal obligations. This increases administrative burden and hampers productivity.
- Engineering firms and other businesses delivering or receiving engineering services, see increases in administrative costs. Many companies cover the cost of registering their employees to do their work. For companies which work across jurisdictions, this would mean paying fees for their employees in each jurisdiction. Variations in legal obligations also increase administrative burdens on businesses possibly forcing them to pull out of jurisdictions.
- Regulators, would struggle to trust the assessment of engineers from other jurisdictions, this hampers mobility and force engineers to get registered in every state they wish to practice in.

[102] Consult Australia, Federal Pre-Budget Submission 2025-26, January 2025, https://www.consultaustralia.com.au/docs/default-source/submissions/consult-australia's-federal-pre-budget-submission-2025-26.pdf?sfvrsn=ecd06ecd_0

6.0 Solutions

Engineering is the essential link between thinking and doing, between ideas and implementation. Engineers Australia calls on the Australian Government to adopt the following four solutions to strengthen the national engineering workforce. A skilled workforce fuelling a strong engineering capability is critical for Australia's prosperity.

Solution 1 Engineering Surge

The Australian Government should secure Australia's future through a boost to our national engineering capability. A national engineering surge could be informed by engaging Engineers Australia to deliver a rapid-response report with five key actions to dismantle existing obstacles and strengthen the engineering pipeline from school through to skilled migration.

An urgent, concentrated effort to grow, strengthen and secure our national engineering capability is essential for Australia's future. Engineering is crucial for driving economic growth, infrastructure development, and advancing sectors like renewable energy and advanced manufacturing.

The Australian Government should commission Engineers Australia to develop a rapid-response report to zero in on critical, targeted action to dismantle barriers and strengthen the engineering pipeline from schooling through to skilled migration. Rapid-response reports are effective because they provide timely, evidence-based insights that allow for swift decision-making and immediate action. Engineers Australia, with its extensive expertise, national reach and industry convening power, is uniquely positioned to provide this advice, having a deep understanding of sector needs and challenges.

The report would focus on the top five practical actions for efficient, low-cost and high-impact change – avoiding a long 'to-do' list. Based on existing research and validated by industry and other engineering advocates, the actions would focus on disrupting enduring engineering workforce challenges such as skill shortages, underutilisation of skills, impediments to mobility across jurisdictions, and declining STEM access and capability in the future pipeline that risk hindering progress.

Engineers Australia's ability to collaborate with industry partners ensures the recommendations are practical, aligned with real-world needs, and can be swiftly implemented. By engaging stakeholders across the sector, including businesses, educational institutions, and government agencies, we can work together to address immediate workforce gaps and ensure the long-term sustainability of Australia's engineering talent pool.

This initiative will enhance the engineering workforce, tap into talent, support emerging industries, and secure the skilled professionals needed to drive Australia's long-term prosperity.

Solution 2 Graduate Target

The Australian Government should set a target for 60,000 additional engineering graduates over the next decade. Setting a target would catalyse universities, industry and governments to collaborate on strengthening this essential professional pipeline.

The demands of a sustainable and innovative future necessitate the development of new skills within the engineering workforce, along with new approaches to tackling contemporary challenges. To facilitate this shift and ensure the future supply of talent, Engineers Australia urges the Australian Government to set a national target of 60,000 additional engineering graduates by 2035 - over and above the number we can reasonably anticipate graduating based on current trends.

In the same way that the current government has set targets for tertiary attainment[103], and for the tech sector workforce[104], setting an engineering graduate target will signal the national priority to strengthen Australia's engineering skills pipeline and ensure we have the domestic workforce necessary to achieve our long-term objectives. This communicates and promotes to students, their parents, careers advisors, career-changers, industry and education providers the value of engineers and engineering, encouraging pathways into engineering careers.

The engineering talent pipeline in Australia is affected by attrition at key stages and heavily relies on international students to maintain tertiary participation, and skilled migration to meet industry workforce demand. Migrant engineers make a strong, positive contribution to Australia's engineering workforce and bring with them global expertise and experience. However, Australia faces growing competition from other advanced economies for engineering talent, as global demand for engineering skills rises with the approaching peak population and all countries seek to retain their own homegrown STEM talent. Growing the future pipeline of domestic graduates is therefore essential to build longer-term self-sufficiency and to reduce dependence on external sources in an increasingly competitive contest for global talent.

While increasing commencements of undergraduate engineering students to meet this target will be important, so too will be increasing the retention and completion rates of students already in the pipeline – as well as supporting more timely completions to facilitate ready graduates into industry and professional practice. Enabling more supportive pathways to completion of Masters-level engineering qualifications, and innovative VET/higher education pathways, will also support additional graduates into the pipeline.

Thus, the target is not about finding an additional 60,000 school leavers to take up engineering; it aims to address critical barriers in the STEM talent pipeline, which can only be achieved through fostering collaboration between universities, industry, and governments to drive efforts to enhance engineering education and align it with workforce needs. For example, extending financial support like the Commonwealth Practical Payments to engineering students to help them to undertake industry work placements during their studies will help to retain students who suffer from financial hardship while attempting to complete their degree.

Why 60,000 over the next decade? On average, Australia sees just over 11,000 domestic higher education completions in engineering and related technologies each year.[105] Engineers Australia has analysed and triangulated relevant data to estimate the additional needed capacity, taking into account expected population and economic growth, and trends in qualified engineers who do not work in engineering. For example, we know that with an ageing workforce, up to 70,000 engineers are predicted

[103] Australian Government, Department of Education. Australian Universities Accord 2024-25 Budget Summary. 2024, http://www.education.gov.au/download/18195/australian-universities-accord-2024-25-budget-summary/37352/document/pdf#:~:text=The%20Government%20is%20setting%20the,working%20aged%20people%20by%202050.

[104] Husic, Ed. "Mapping Out Australia's Path to Tech Jobs of the Future." Minister for Industry and Science, 26 Mar. 2025, http://www.minister.industry.gov.au/ministers/husic/media-releases/mapping-out-australias-path-tech-jobs-future

[105] ACED Engineering Statistics April 2022. Australian Council of Engineering Deans, Apr. 2022, http://www.aced.edu.au/downloads/ACED%20Engineering%20Statistics%20April%202022.pdf

to retire over the next 15 years; at current rates more than 60 per cent of domestic graduations would need to enter the workforce just to replace these departing engineers. However, as cited earlier in this report, various predictions anticipate growth in demand for engineers and other STEM professionals right across the economy, including in clean energy and infrastructure. Research by the Australian Council of Engineering Deans in 2021 showed that a 10 per cent per annum (compounding) increase of domestic graduates was needed at a minimum.[106]

This solution also aligns with reform underway through the Universities Accord. Targeted pathways into engineering education, fostering university-industry collaborations, and increasing access to engineering education in regional areas through flexible learning options would all mutually support an engineering capability uplift as well as Australia's vision for a revitalised higher education sector.

[106] Engineer Shortages and Projections December 2021. Australian Council of Engineering Deans, Dec. 2021, http://www.aced.edu.au/downloads/Engineer%20Shortages%20and%20Projections%20Dec%202021.pdf

Solution 3 Strengthening the Voice of Engineering in Government

The Australian Government should establish additional senior engineering roles in the Australian Public Service, including a National Chief Engineer. This would ensure access for public decision-makers to critical technical and systems advice to inform procurement, programs and policy – addressing cost overruns, risk and resilience, and ensuring the best, integrated, sustainable outcomes for Australians.

Strengthening access to in-house engineering advice in government is essential to ensuring national challenges are met with informed, technical responses that consider the range of risks and solutions to provide the best outcomes for the community. The creation of additional senior engineering roles within the federal public service, including the appointment of a National Chief Engineer, would provide access for decision-makers to essential technical oversight, guidance, and advisory resources for national systems and key technical projects, ensuring engineering expertise informs policy, procurements, implementation and regulation.

Additional engineering capability would be of benefit to a range of departments and agencies which maintain stewardship of important national systems or are overseeing critical national reform, for example:

- With respect to the energy transition and energy system governance, the Department of Climate Change, Energy, Environment and Water (DCCEEW), the Australian Energy Market Operator, Australian Energy Market Commission, Australian Renewable Energy Agency, Clean Energy Regulator, Clean Energy Finance Corporation, Climate Change Authority, Australian Radiation Protection and Nuclear Safety Agency, and the Net Zero Economy Authority
- With respect to national risk, resilience and emergency response, the Department of Home Affairs, the National Emergency Management Agency, and the Bureau of Meteorology
- With respect to critical infrastructure, the Department of Infrastructure, Transport, Regional Development, Communications and the Arts (DITRDCA), Infrastructure Australia, and other infrastructure and transport safety authorities
- With respect to emerging and future technologies and digital capability, the Department of Industry, Science and Resources (DISR), the Digital Transformation Agency, Geoscience Australia, and the Australian Space Agency

The 2019 Thodey Review of the Australian Public Service (APS) recommended establishing an APS 'professions model' to deepen capability and expertise in various disciplines and to build service-wide capability in procurement, contracting and commissioning. The model aims to define generalist and specialist careers paths, valuing technical expertise and leadership and management capability.[107] An engineering profession stream would align with this approach, ensuring technical expertise is recognised and embedded within government decision-making processes.

Australia also needs a National Chief Engineer to provide the highest level, strategic advice on the investment, implementation and operation of major government-backed projects and interdependent national systems. Complementing the role of Australia's Chief Scientist, the National Chief Engineer would consider whole-of-government implementation, procurement and regulatory challenges for technical projects and systems, facilitate cross-sector collaboration, and provide authoritative engineering expertise.

While Australia's Chief Scientist focuses on advancing research, innovation, and technology policy, a National Chief Engineer would apply engineering principles to infrastructure, technology investment, urban planning, transport, and energy systems. A National Chief Engineer would ensure:

- Engineering rigor in decision-making, focusing on constructability, lifecycle performance, cost efficiency, and risk mitigation.
- Technical scrutiny in major government investments, reducing investment or project risks and inefficiencies.
- Practical implementation of new technologies, ensuring feasibility, safety, and economic viability.

A relatively low-cost investment, the National Chief Engineer would improve efficiency across the public service and reduce reliance on external expertise. The Chief Engineer would draw on engineering expertise across the APS to address cost blowouts, infrastructure quality, and shape innovative procurement and solutions, leading to strengthened public confidence and industry engagement. Even a 10 per cent reduction in project overruns could save billions annually – funds that could be reinvested in essential services and infrastructure.

The National Chief Engineer would be ministerially appointed and hosted within a key department such as the Treasury, Home Affairs, or Infrastructure. All Ministers would have access to technical insights, policy guidance, and coordination to deploy Australia's engineering capability to meet national needs.

[107] Department of the Prime Minister and Cabinet. Independent Review of the Australian Public Service (2019), 2019, www.pmc.gov.au/resources/independent-review-australian-public-service.

Solution 4 Diversity in STEM

The Australian Government should respond in full to the 2024 Pathways to Diversity in STEM report, implementing its recommendations for stable and sustainable action to increase diversity and inclusion in STEM.

Systemic, sustainable and evidence-backed change to enhance diversity and inclusion in STEM education and workplaces is needed to meet the growing skills demands of Australia's future. To fully harness the potential engineering talent available, it is essential to tap into underrepresented groups.

In 2023, the Independent Diversity in STEM Review Panel, chaired by Sally-Ann Williams, undertook considerable public consultation and research, including hearing from around 385 individuals and 94 organisations through conversations, interviews and workshops, and receiving 300 written submissions, and a new commissioned research report, STEM Career Pathways.[108] The Review Panel's final report, Pathways to Diversity in STEM, was released by the Australian Government in February 2024 and made 11 recommendations, including for:

- Government coordination and leadership
- Creating safe and inclusive workplaces
- Lifelong learning
- Changing perceptions and valuing diverse knowledge.[109]

In delivering its final report, the Panel said:

> "The recommendations in this report reflect the urgency of supporting and retaining diverse people in our existing STEM workforce. We cannot afford to lose anyone. We must harness the potential of all people with a curious mind, a spark for problem-solving and a keenness to build up and change our world." [110]

Twelve months on, the Australian Government had not responded to the Panel's report, nor implemented its recommendations. Then, on 5 March 2025, media reported comments made at an Adelaide conference by the Hon Ed Husic MP, Minister for Industry, Science and Resources, that the Government would accept all 11 of the recommendations and "make them a reality"[111]. However, this commitment did not translate to investment through the 2025-26 Federal Budget announced on 25 March 2025.

The engineering workforce must reflect the community it serves. Having more perspectives in the profession will lead to more productivity, innovation and better outcomes for everyone in our communities. We must ensure that all engineers, regardless of their background, are valued and supported to contribute meaningfully. Implementing the recommendations from the Pathways to Diversity in STEM report is imperative and should not be delayed any longer. These evidence-based, actionable measures can help increase the future-readiness of Australia's engineering sector by ensuring a more inclusive and diverse workforce.

[108] Husic, Ed. Pathway to Diversity in STEM: Report Released. Minister for Industry and Science, Feb. 2024, www.minister.industry.gov.au/ministers/husic/media-releases/pathway-diversity-stem-report-released. Pathway to Diversity in STEM Review Final Recommendations Report. Department of Industry, Science and Resources, 13 Feb. 2024, www.industry.gov.au/publications/pathway-diversity-stem-review-final-recommendations-report.

[109] Ibid.

[110] Hendry, Justin. "Govt Accepts All Diversity in STEM Review Recommendations." InnovationAus, 13 Feb. 2024, www.innovationaus.com/govt-accepts-all-diversity-in-stem-review-recommendations/ .

7.0 Next Steps

This report demonstrates a skilled workforce fuelling a strong engineering capability is critical for the nation's prosperity.

Australia needs to jumpstart its engineering capability by taking critical and urgent steps to secure our national engineering workforce pipeline.

We must attract and retain enough talent, with the right skills, to meet our current and future needs – this includes upskilling and reskilling within the workforce.

Advancing the science and practice of engineering for the benefit of society is Engineers Australia's purpose. It's what Engineers Australia was set up over 100 years ago to do.

We have ideas. We have solutions. Our advocacy focuses on realising them.

Now, we need your help to amplify these messages. We encourage you to share this report with your colleagues, industry partners, and professional associations, and engage MPs on the urgent need to strengthen Australia's engineering workforce. Together, we can drive action and deliver solutions that secure Australia's future.

To discuss the ideas outlined in this paper, please contact policy@engineersaustralia.org.au.

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