

Budget submission

Engineering a better future for Australia

January 2023



ENGINEERS  
AUSTRALIA

## Budget submission: Engineering a better future for Australia

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# Introduction

The work of engineers is an intrinsic part of life. From technology to infrastructure and beyond, engineers have an impact on it all. Engineers Australia's budget submission puts across five areas where funding should be allocated to improve Australia's future prospects:

- skills for the future
- professional mobility
- engineering-led climate action
- a reliable energy transition
- innovation and industry.

As seen in all five areas, Australia is in a very significant transition period: engineering skills, professional mobility, carbon abatement technologies, energy transition, and technology and innovation are all transforming. This is a moment in which the engineering profession is more vital than ever. Engineering underpins every aspect of economic and social life. The criticality of labour/skills and professional mobility has the potential to drive progress on climate action, the energy transition and industry innovation.

Engineers Australia would welcome the opportunity to continue to engage Treasury on the areas covered in this submission. If you wish to discuss anything raised further, please contact Michael Bell, Senior Policy Advisor, at [mbell@engineersaustralia.org.au](mailto:mbell@engineersaustralia.org.au).

## About Engineers Australia

Engineers Australia is the peak body of the engineering profession in Australia with over 115,000 individual members. Established in 1919, Engineers Australia is a not-for-profit organisation, constituted by Royal Charter to advance the science and practice of engineering for the benefit of the community.

Engineers Australia maintains national professional standards, benchmarked against international norms. As Australia's signatory to the International Engineering Alliance, this includes accreditation of undergraduate university engineering programs. Furthermore, Engineers Australia manages Australia's largest voluntary register for engineers, the National Engineering Register (NER). Under the Migration Regulations 1994, Engineers Australia is the designated assessing authority to perform the assessment of the potential migrant engineering professionals' skills, qualifications, and/or work experience to ensure they meet the occupational standards needed for employment in Australia.

## Summary of recommendations

Section	Recommendations
Skills for the future	<ul style="list-style-type: none"><li>– Prioritise funding for programs to train and upskill mid-career STEM professionals to become maths, science or engineering studies teachers.</li><li>– Fund resources to support out-of-field mathematics and science teachers.</li><li>– Increase the financial support offered to students undertaking tertiary education to a livable allowance. This will help lift study completion rates and reduce time-to-completion.</li><li>– Provide Commonwealth Supported Places (CPS) for accredited engineering master's qualifications to help articulate other STEM bachelors' qualifications to the level of professional engineers and to help retain engineers in the workforce by upskilling them in new and emerging fields.</li><li>– Incentivise contractors to provide graduate programs and internships for engineers through procurement processes.</li><li>– Offer engineering internships and graduate programs in agencies and departments which have an engineering capability.</li></ul>

Section	Recommendations
	<ul style="list-style-type: none"> <li>– Provide funding to support programs that assist engineers returning to the workforce after a career break.</li> <li>– Fund new programs to help and incentivise engineers working out of field to return to engineering.</li> <li>– The Government should support upscaling the Global Engineering Talent program, which can then be used as the basis for other professions that are facing similar issues.</li> </ul>
<b>Professional mobility</b>	<ul style="list-style-type: none"> <li>– Engineers Australia calls on the Commonwealth Government to work with the state and territories to coordinate a nationally consistent scheme for the registration of professional engineers.</li> <li>– To assist with this, funding should be allocated to the development of model Professional Engineers legislation, which can be implemented in each jurisdiction.</li> <li>– In addition, the Commonwealth Government should work to ensure all States and Territories implement the amendments to the Mutual Recognition Act 1992.</li> </ul>
<b>Engineering-led climate action</b>	<p>Engineers Australia calls on governments, investors, the private sector and the wider community to work with the engineering profession to accelerate engineering innovation for a swift transition to a sustainable economy. Initiatives must include:</p> <ul style="list-style-type: none"> <li>– the principles of near zero emissions, climate resilience, and a circular economy in all policy, regulations, standards and technical specifications applicable to engineering</li> <li>– a standardised means of calculating the emissions footprint of engineering works, products and services across the entire project and product lifecycle</li> <li>– a mechanism to factor external costs including GHG emissions into product design, use, maintenance and project feasibility assessments</li> <li>– a means of assessing the exposure of new and existing engineered systems to climate disruptions to inform and motivate mitigation and adaptation responses</li> <li>– a means of monitoring and measuring progress to inform learning and improvement actions needed for climate change mitigation and adaptation</li> <li>– improved education and training of members of the engineering team and the wider community on climate change, resilience and sustainability.</li> <li>– These initiatives will support engineers in their ethical responsibility to tackle climate change, and to proudly deliver the trusted products, assets and services that are the foundation for our future well-being.</li> </ul>
<b>A reliable energy transition</b>	<p>Engineers Australia recommends that the Government creates and supports a national energy governance structure that:</p> <ul style="list-style-type: none"> <li>– Drives multi-stakeholder and whole-system approaches to both the envisioned final energy system, and to the various stages along the way.</li> <li>– Calls upon independent technical advice.</li> </ul>

**Section****Recommendations**

Government should conduct modelling and planning to ensure we have the engineering workforce we need to successfully complete the energy transition.

Government should support re-training/up-skilling for those working in fossil fuel based industries as part of a just transition and to fill skills gaps.

**Innovation and industry**

- Develop a centralised online repository of grants and programs for ease of access.
- Reduce the bureaucratic burden on the application process for small, and medium businesses applying for grants to alleviate resource requirements.
- Improve processes to reduce the time between a successful grant application and funds being received by the applicant.
- Reducing the business licensing and compliance requirements for engineering and STEM companies more broadly, particularly where there is no safety concern associated with the regulation.
- Provide further investment to create additional innovation hubs including in regional Australia centred around start-ups and the commercialisation of Australian innovation.
- Governments must allocate funding for training and upskilling of the labour force in digital skills.
  - Part of this funding should support subsidised programs, to promote collaboration between industry and academia, fostering greater integration of current and emerging technologies.
- The government should invest in reforms to the tendering process. Reforms should include:
  - Providing visibility of cost to tender bidders.
  - Early engagement with bidders before the request for tender stage.
  - Acceleration of shortlisting and award processes.
  - Consider stage based tendering processes and in-house design teams to allow equitable participation from a broader bidder market.
- Develop and implement a consistent procurement framework across all levels and between all departments associated with interrelated infrastructure, applying the ISO 55000
- Governments should avoid using non-standard contracts and provide visibility of contracts before tender, allowing sufficient time for review. Any required amendments to standard contracts must be subject to collaborative negotiation with industry stakeholders.

# About engineering in Australia

There are  
**545,000**



engineers in Australia with about  
**80%** in the labour force.

**243,000**

of these engineers work in  
engineering occupations (56%).



An increase of

**115,000**

engineers since the 2016.



2016

2023



Overseas Born  
Australian Born

Australia has qualified engineers  
from every nation on earth.

There are over  
**87,000**



women engineers in Australia, of these  
around **75%** were born overseas.

## STEM

Mathematics

2003

Science

2012

2023

The OECD reports Australia's students' performance in mathematics has been declining since 2003 and our performance in science **has been declining** since 2012.

2014

2023

Higher education commencements in engineering study in Australia, for domestic students, **has been declining** since 2014.

STEM occupations

12%

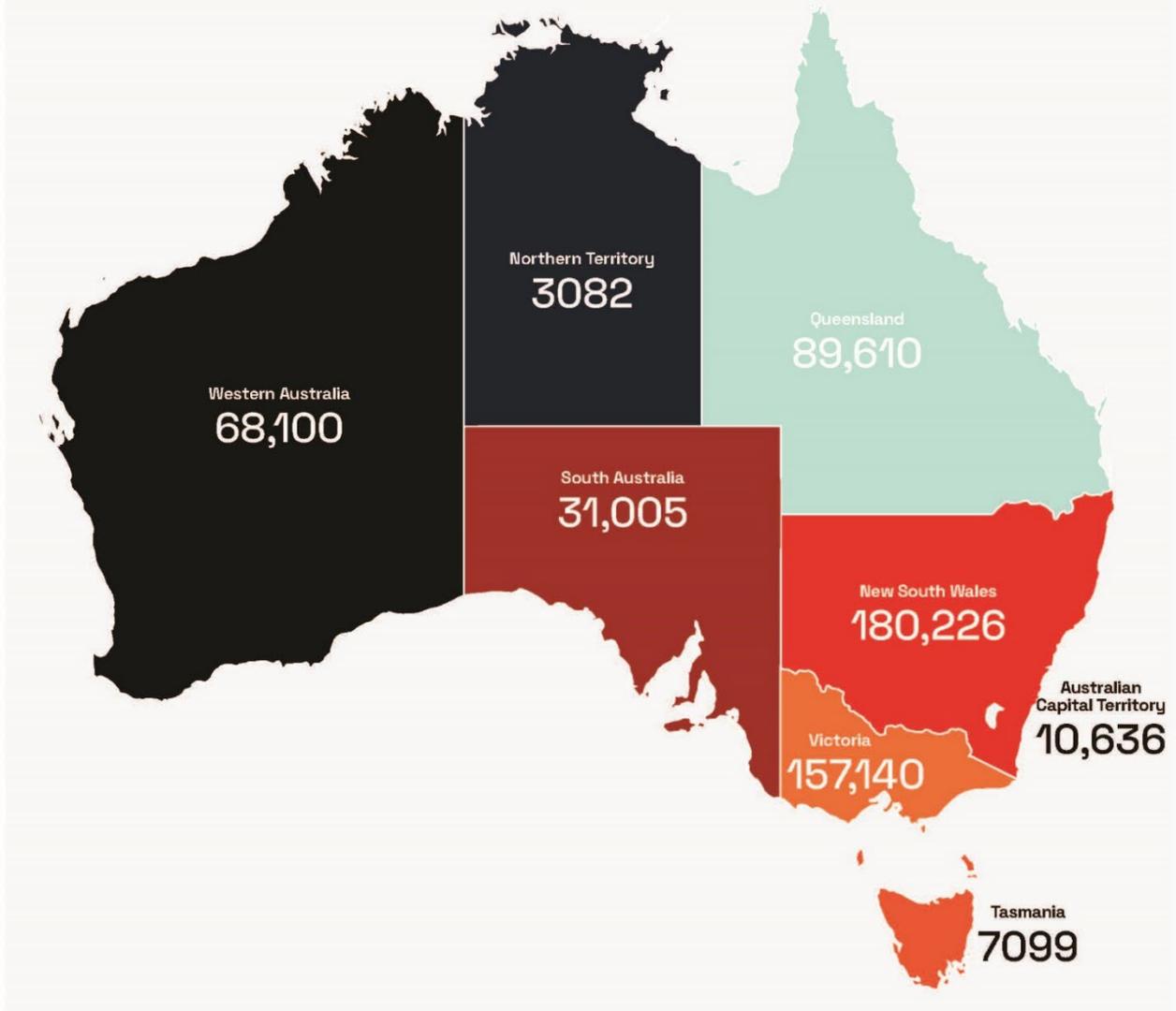
Science, technology, engineering and mathematics occupations are **predicted to increase** by more than **12%** over the coming years.



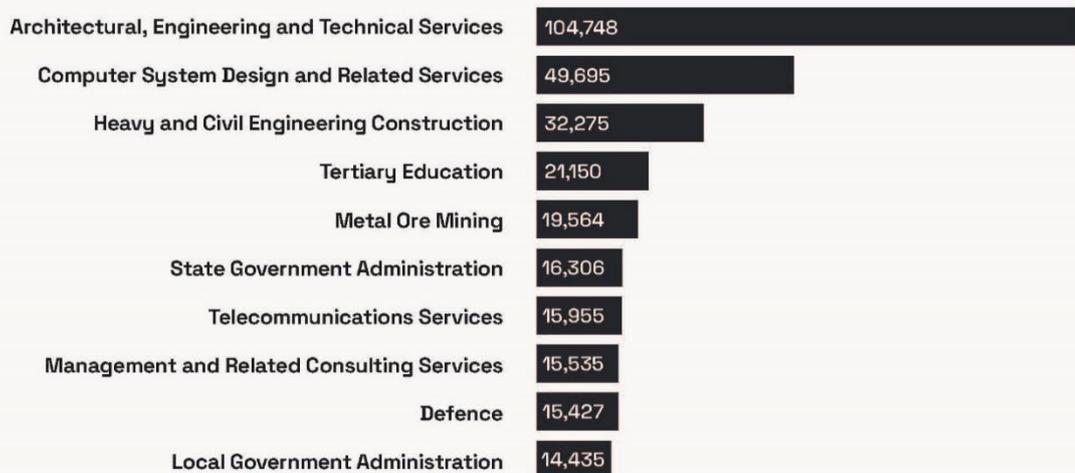
Increasing take-up of **STEM** subjects and building awareness of engineering **is critical** to boosting domestic supply.

## ENGINEERING

## Number of engineers per state



## Top ten sub industries for engineers

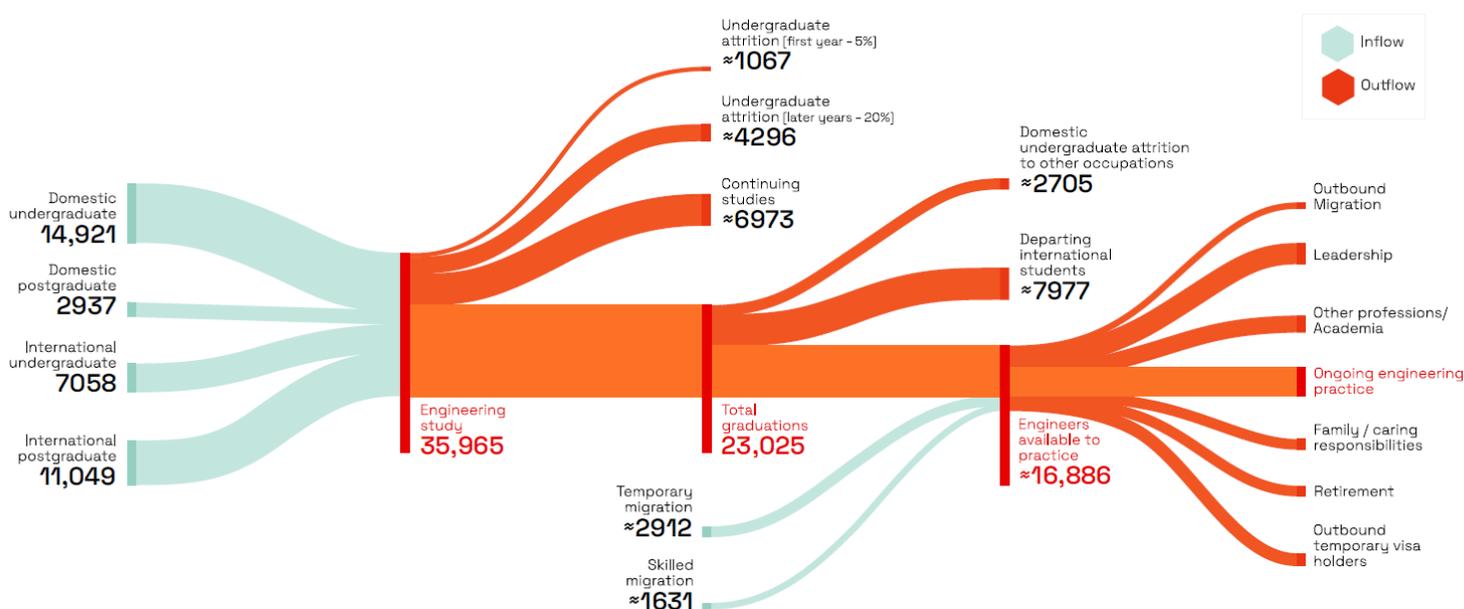




# 1. Skills for the future

Engineers and the skills they possess will be vital to Australia's future economic and societal prosperity. Demand for engineering skills continues to increase with engineering vacancies rising by over 40 per cent during the 2022 financial year. The National Skills Commission predicts cognitive ability to be one of the most highly sought-after skills in the future, a skill which engineers possess.<sup>1</sup> A high value is placed on the cognitive abilities of engineers due to their ability to think and solve complex problems. This means engineers are often pulled away from engineering work, meaning Australia needs to ensure it has a strong pipeline of engineering skills available in the future.

Australia has been experiencing an engineering skills supply challenge since the late 1980s. Pandemic induced border closures (limiting migration) and an increase in projects has meant many sectors are currently experiencing a cyclical shortage of experienced engineers. However, the solution to overcoming this is not as simple as increasing migration or higher education opportunities. The current shortages are being experienced at the same time as there is an economy-wide oversupply of qualified -but underutilised- migrant engineers. This is coupled with persistent challenges in the source of domestic engineers partly due to the declining education system. Even once an engineer has commenced engineering study or migrated to Australia, there are various outflows which affects supply, as illustrated in Figure 1 below.



This diagram is indicative only, providing provisional figures and best estimates from the data and research available. It is provided to illustrate the magnitude of inflows and outflows each year and is not an exact representation of the number of people entering and exiting the profession.

Australian Engineering Higher Education Statistics 2009-2019, Australian Council of Engineering Deans, December 2020 & King, R, Working Paper: Pipelines into Professional Engineering Occupations, Australian Council of Engineering Deans, December 2021

**Figure 1: Inflows and outflows of Professional Engineers 2019**

Engineers Australia's research shows Australia needs to address five areas to build an engineering workforce that can meet our current and future needs. The five categories of factors that influence the engineering workforce include:

1. **School education (primary and secondary)** – the factors that influence how many young Australians choose to study engineering for their higher education
2. **Engineering study (vocational and higher education)** – the factors that influence engineering graduation rates and skillsets

<sup>1</sup> Skills and jobs of the future – the Four Cs' Australian Government National Skills Commission (accessed 3 February 2021) <https://www.nationalskillscommission.gov.au/sites/default/files/2021-12/Skills%20and%20jobs%20of%20the%20future%20%E2%80%93%20the%20Four%20Cs.pdf>

3. **Retention in the engineering workforce** – the factors that influence how many qualified engineers stay in the engineering workforce (work in an engineering role)
4. **Skilled migrant engineering workforce participation** – the factors that influence how many skilled migrant engineers work in an engineering role
5. **Demand forecasting** – how data on current and future demand of engineering skills can enable better workforce planning and inform career choices for Australians.

Engineers Australia supports the work being undertaken by the Government to address labour shortages around the country, including the development of Jobs and Skills Australia and the review of Australia's migration program. This budget should consider and fund other measures which can provide tangible benefits to the supply of skills in Australia.

## 1.1. Education

To increase the pipeline of engineers in Australia more needs to be done at the early stages of a person's education. More needs to be done to increase awareness of science, technology, engineering and mathematics (STEM) careers to enable students to undertake the prerequisites required to complete tertiary engineering education. Currently, Australia's capacity to develop engineers domestically, is reduced due to a low participation rate in Year 12 science and mathematics subjects with the number of school students studying intermediate and advanced levels of maths at an all-time low.<sup>2&3</sup> Contributing to this is a decline in Australia's early and secondary education system. The latest OECD Programme for International Student Assessment (PISA) results show Australian students' performance in mathematics has declined since 2003 and its performance in science has declined since 2012. To overcome this, Australia's teaching workforce (particularly in subjects such as maths and science) needs more support. This is highlighted in the State of Our Schools 2020 national survey, which reported 38 per cent of secondary education teachers had taught outside their field of expertise, including mathematics, science, and technology.<sup>4</sup>

If reforms are not made to increase the availability of domestic students who have an interest in and prerequisites to undertake tertiary study in engineering, commencements will continue to decline, deepening current skills challenges and hindering Australia's future prosperity. Encouraging young Australians to choose prerequisite subjects for engineering study (science and maths) and inspiring more young Australians to choose to study engineering for their tertiary education should be priorities.

For those that meet the requirements and undertake tertiary education in engineering, around 40 per cent of students don't complete their engineering qualification.<sup>5</sup> Reasons for this vary, however more needs to be done to support engineering students to complete their qualifications, including an increase to Au study to allow tertiary students to focus on their study. Internships, graduate programs, and early career employment opportunities are also important to keep students in the profession.

The time is now:

- Prioritise funding for programs to train and upskill mid-career STEM professionals to become maths, science or engineering studies teachers.
- Fund resources to support out-of-field mathematics and science teachers.
- Increase the financial support offered to students undertaking tertiary education to a livable allowance. This will help lift study completion rates and reduce time-to-completion.

<sup>2</sup> Bell, M & Briggs, P. 'Engineering skills – supply and demand discussion paper' *Engineers Australia* (March 2022) <https://engineersaustralia.org.au/sites/default/files/2022-03/Engineers-Australia-Skills-Discussion-Paper-20220310.pdf>

<sup>3</sup> Australian Mathematical Sciences Institute, Year 12 Mathematics Participation Report Card, 27 April 2022 <https://amsi.org.au/?publications=year-12-participation-in-calculus-based-mathematics-subjects-takes-a-dive>

<sup>4</sup> O'Flaherty, Antonia. (2021) "Worrying' STEM teacher shortage with pressure felt in rural and remote schools' ABC News (accessed 9 February 2022) <https://www.abc.net.au/news/2021-06-15/school-principals-dont-have-enough-maths-science-teachers/100214738>

<sup>5</sup> 'Student Data' Australian Government Department of Education (accessed 2 August 2022) <<https://www.dese.gov.au/higher-education-statistics/student-data>>

- Provide Commonwealth Supported Places (CPS) for accredited engineering master’s qualifications to help articulate other STEM bachelors’ qualifications to the level of professional engineers and to help retain engineers in the workforce by upskilling them in new and emerging fields.

## 1.2. Retention in the profession

In addition to supporting engineers entering the profession, more needs to be done to increase the number of graduates entering the profession and retain engineers at all stages of their career. Analysis shows more people in Australia hold an engineering qualification than there are engineers working in the profession. Engineers are highly employable which is a good thing, however some don’t enter the profession or leave the profession for reasons out of their control. The exact reasons for why so many engineers don’t work in the profession is unknown, however graduates unable to find employment or internship opportunities, poor internship or graduate program experiences, and some sectors having a better reputation for salaries and career prospects are all cited anecdotally by our members as some of the reasons. For more experienced engineers, lack of career progression and inflexible and demanding working environments in some sectors (particularly a barrier for those with caring responsibilities) and organisational cultures are cited as reasons for leaving the profession, particularly for women.<sup>6</sup>

Investing in engineering graduate employment outcomes, supporting engineers return from career breaks and increasing career opportunities for mid-senior level engineers will lessen future skills shortages.

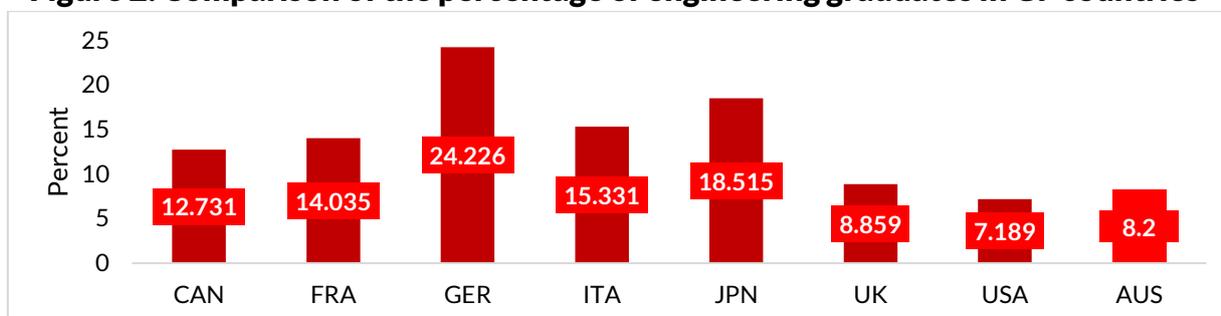
The time is now:

- Incentivise contractors to provide graduate programs and internships for engineers through procurement processes.
- Offer engineering internships and graduate programs in agencies and departments which have an engineering capability.
- Provide funding to support programs that assist engineers returning to the workforce after a career break.
- Fund new programs to help and incentivise engineers working out of field to return to engineering.

## 1.3. Supporting migrant engineers

Australia’s engineering capability is highly reliant on migrant engineers. Over 60 per cent of engineers in the labour force were born overseas. However, they experience unfavourable employment outcomes with research showing migrant engineers are more likely than their Australian born counterparts to work in non-engineering roles. When compared to G7 countries, Australia produces the second lowest percentage of engineering graduates. With global competition for engineering skills increasing, Australia needs to improve our migration program and the employment outcomes of migrant engineers to compete for migrant skills.

**Figure 2: Comparison of the percentage of engineering graduates in G7 countries<sup>7</sup>**



<sup>6</sup> Romanis, J. ‘Women in engineering report’ *Engineers Australia* (June 2022)

<https://www.engineersaustralia.org.au/publications/women-engineering>

<sup>7</sup> Source: ‘Tertiary Graduates by Field’ *OECD Data* (accessed 3 February 2022) <https://www.oecd.org/statistics/compare-your-country.htm>

Engineers Australia research has identified seven main barriers to engineering workforce participation for migrant engineers. Government need to prioritise funding to help overcome these barriers. This will make available a pool of engineers, currently in Australia with full work rights, who can help alleviate current and future skills shortages. The full [Barriers to Employment for Migrant Engineers](#) report which identifies the barriers and ways to overcome them can be found on Engineers Australia's website.

Engineers Australia has developed a *Global engineering talent* program based on the findings of this research. A pilot of the program will be running mid-2023 with a small cohort of skilled migrants and industry partners participating. This pilot will deliver the necessary business case and measured employment outcomes required as we seek funding to increase the scale of the program to meet market needs.

The time is now:

- The Government should support upscaling the Global Engineering Talent program, which can then be used as the basis for other professions that are facing similar issues.

## 2. Professional mobility

Society trusts engineers without even realising it. They trust what engineers design is safe and will work as intended. While most engineering services provided in Australia is done so competently, ethically and with diligence, the title engineer is unrestricted, meaning anyone can refer to themselves as an engineer. As such, Engineers Australia continues to advocate for the registration of engineers across all areas of engineering. By registering engineers, society is provided a safeguard by ensuring engineers meet benchmark education, training, professional conduct and competency standards.

In Australia, the responsibility for registering engineers lies with the states and territories. The design and implementation of statutory registration of engineers' schemes therefore differ throughout Australia with some governments not requiring engineers to be registered, others only requiring registration of engineers in certain circumstances and some schemes being more comprehensive, applying to all engineers. Differing schemes has created a problem for businesses and sole practitioners who now find themselves needing to be registered in multiple jurisdictions, creating financial and regulatory impediments to the movement of labour between states and territories.

### 2.1. National consistency

Multiple registration schemes around Australia are creating barriers for engineers and engineering businesses to undertake work. Consistency between the state and territories would allow an engineer or business to only register once to demonstrate competence and then be permitted to deliver professional engineering services anywhere in Australia.

The amendments made to the *Mutual Recognition Act 1992* to implement Part 3A which sets out the automatic deemed registration process. Automatic mutual recognition allows an individual who is registered in one state in an eligible occupation, can be considered registered to perform the same activities in another jurisdiction.<sup>8</sup> The benefits of automatic mutual recognition include increased flexibility and movement of people, increased competition, cost and time savings. The reforms also help to increase productivity, lessen the time lost from natural disasters (by allowing those in other states to undertake work in an affected state) and improve the performance of regulators.<sup>9</sup> Economic modelling in 2021 showed labour productivity and administrative savings would lead to an estimated increase of \$1.14 billion over a 10-year period.<sup>10</sup>

Developing a nationally consistent, comprehensive registration of engineers scheme will have many benefits to society and the economy. Examples of where national consistency has been achieved successfully include:

1. A single national registration scheme such as that for the health sector administered by the Australian Health Practitioner Agency.
2. Model Work Health and Safety legislation, which has now been adopted in all jurisdictions except Victoria.
3. Standards and process alignment and cooperation between individual state and territory regulators, such as the way Architects Boards have established the Architects Accreditation Council of Australia.

Outside of the benefits stated above, a consistent scheme covered by automatic mutual recognition will also assist in addressing skills shortages by facilitating mobility of engineers within Australia and in attracting engineers with internationally recognised qualifications. A national scheme should consist of:

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<sup>8</sup> 'Mutual Recognition' *Australian Government Department of Employment and Workplace Relations* (accessed 13 January 2023) <https://www.dewr.gov.au/skills-support-individuals/mutual-recognition#toc-automatic-mutual-recognition>

<sup>9</sup> 'Improving occupational mobility' *Australian Government Department of Prime Minister and Cabinet* (accessed 13 January 2022) <https://www.regulatoryreform.gov.au/sites/default/files/improving-occupational-mobility.pdf>

<sup>10</sup> *ibid*

1. A stand-alone act for the registration of professional engineers for implementation in each state and territory.
2. Coverage for all areas of engineering.
3. An agreed set of registration standards and assessment processes.
4. Automatic mutual recognition in each jurisdiction for a professional engineer registered in one jurisdiction.
5. Consistent guidelines for and approval of professional associations as assessment entities.

The time is now:

- Engineers Australia calls on the Commonwealth Government to work with the state and territories to coordinate a nationally consistent scheme for the registration of professional engineers.
- To assist with this funding should be allocated to the development of model Professional Engineers legislation which can be implemented in each jurisdiction.
- In addition, the Commonwealth Government should work to ensure all States and Territories implement the amendments to the Mutual Recognition Act 1992.

# 3. Engineering-led climate action

Engineers Australia recognises the extent of the challenges presented by climate change, the disruptions it causes, and the pivotal role of engineering in enabling a socially just transition to a sustainable society. Australia's recently legislated emissions reduction targets and the continued impacts associated with extreme and more frequent climate events requires policy makers at all levels of government to consider the climate and energy policies and regulations.

The energy, transport, telecommunication, water, buildings, agricultural and health systems that are integral to our modern society are all threatened by climate change. The natural ecosystems and biodiversity upon which we all depend are at risk, requiring active protection and rehabilitation. Engineering leadership and multi-disciplinary problem solving is crucial to achieving the necessary step change toward a sustainable society. Practical solutions and innovative engineering are essential to transform systems, technologies and infrastructure. Engineers must be at the forefront in policy formulation and decision-making affecting the scoping, planning, design, delivery and operation of systems for climate change mitigation, adaptation and resilience.

Climate change is a complex and multifaceted issue that requires a carefully managed transition to net zero emissions and beyond. With any major industrial and societal transition, the government will need to provide dedicated support, especially for a range of vulnerable industries, communities, and workforces.

The transition necessitates a coordinated approach that allows research of engineering innovations to nimbly develop into market ready industry solutions across a range of sectors. Of particular note are emissions reductions in hard-to-abate industries, particularly for facilities that emit over 100Mt CO<sub>2</sub>e annually; renewable energy production, storage and transmission opportunities in the context of an upgraded electricity grid; and reimagining modern transport systems in a net zero world.

Engineer's Australia believes the legislated emissions reduction targets are possible within the required timeframes, however...

The time is now:

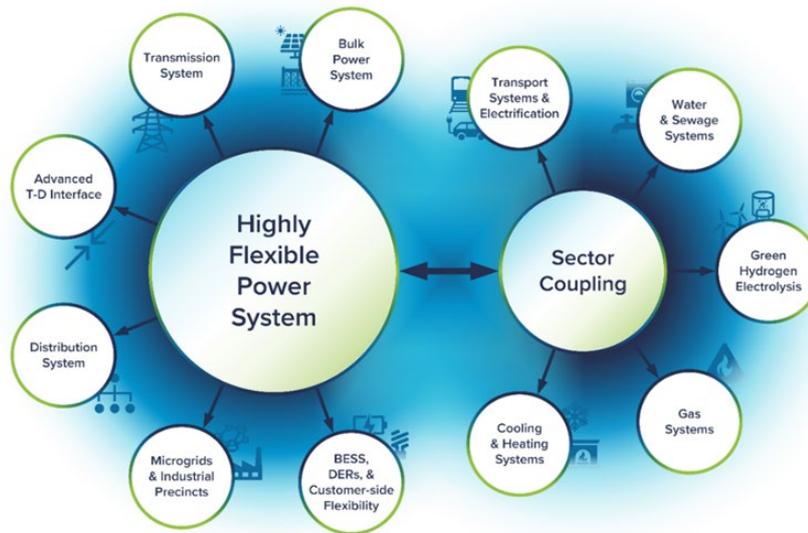
- Engineers Australia calls on governments, investors, the private sector and the wider community to work with the engineering profession to accelerate engineering innovation for a swift transition to a sustainable economy. Initiatives must include:
  - the principles of near zero emissions, climate resilience, and a circular economy in all policy, regulations, standards and technical specifications applicable to engineering
  - a standardised means of calculating the emissions footprint of engineering works, products and services across the entire project and product lifecycle
  - a mechanism to factor external costs including GHG emissions into product design, use, maintenance and project feasibility assessments
  - a means of assessing the exposure of new and existing engineered systems to climate disruptions to inform and motivate mitigation and adaptation responses
  - a means of monitoring and measuring progress to inform learning and improvement actions needed for climate change mitigation and adaptation
  - improved education and training of members of the engineering team and the wider community on climate change, resilience and sustainability.
  - These initiatives will support engineers in their ethical responsibility to tackle climate change, and to proudly deliver the trusted products, assets and services that are the foundation for our future well-being.

## 4. A reliable energy transition

Australia is undergoing a once-in-a-century energy transformation. The energy systems created in the 20th century were already some of the most complex systems ever created. Deep decarbonisation, with its dependence on an expanding range of highly variable renewable energy resources, is driving the most profound expansion of energy system complexity ever seen.

As this critical societal system experiences deep decarbonisation through the withdrawal of dispatchable coal-fired generation, entirely new sources of system flexibility will be required to maintain an instantaneous balance of supply and demand every microsecond of the year. This will require a new level of sector coupling with other parts of Australia's energy system. Collaboratively navigating this complexity requires appropriate 'system of systems' level governance structures.

**Figure 3 Decarbonised power systems requires new sources of flexibility and deep sector-coupling<sup>11</sup>**



To maintain support, the energy system must primarily exist for the well-being of Australians and to support our lifestyles and businesses. Access to affordable, reliable, sustainable and modern energy is a human right. In the last century, energy consumers were largely treated as passive recipients of a limited range of utility offerings. This century, consumers in every sector are empowered with an expanding range of traditional and disruptive options and the energy sector is increasingly impacted by these very same disruptive trends. In the context of the current energy crisis, driven by geopolitical events and high coal and gas prices, it is increasingly difficult for many residential and business customers to see the system as working for their benefit. If Australia's energy systems are to rapidly decarbonise while remaining economically viable and enhancing equity, it is critical that the needs and aspirations of diverse customers are placed at the very centre of decision-making processes.

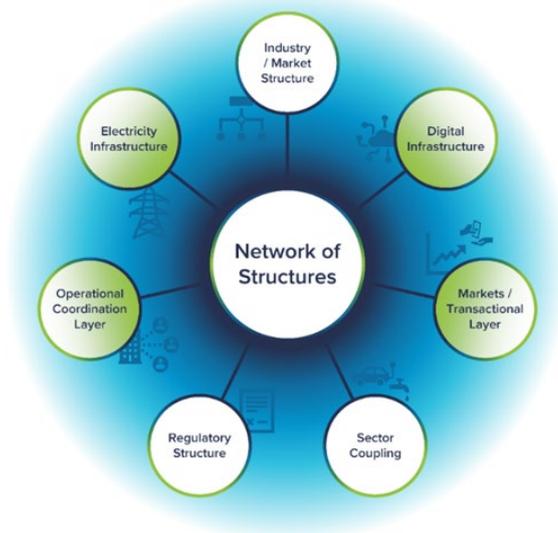
Critical national infrastructures such as our energy system may typically be thought of as a 'system of systems'. For example, not only do electricity systems require increasing couplings with other sectors (as above), internally, they are also a network of seven major structures, each of which impacts the operation of the others. As highlighted in Figure 4 below, the power system is a network of physical and digital infrastructures, regulatory structures, markets and operations – changing any one of these will positively or negatively influence the function of the others.

**Figure 4: Modern power systems are an ultra-complex 'Network of Structures'<sup>12</sup>**

<sup>11</sup> Image: International Renewable Energy Agency (IRENA) and Strategen Consulting

<sup>12</sup> Image: Pacific Northwest National Laboratory (PNNL) and Strategen Consulting





The role of market economics is currently very apparent in the governance structures of Australia's energy systems. By contrast, however, a focus on holistic, independent technical advice is lacking in decision-making and forward planning. These systems are irreducibly 'physics-based' and highly competent engineering is critical for system and market design, safe operation and technological innovation. Governance models must therefore ensure that a balanced range of discipline perspectives are heard in the transformation of these systems. While market and economic perspectives are critical, it is imperative that these are balanced with the voice of the engineering profession, which deeply understands the cyber-physical realities of these highly complex systems.

The current governance arrangements are a separation of functionally differentiated roles that risks accentuating compartmentalised problem solving when far more holistic and multi-disciplinary solutions informed by independent engineering advice free from political or ideological bias are required. Australia needs an energy governance structure that will manage diverse, competing needs and drive the energy transition in a timely manner.

Australia is currently experiencing a shortage of engineering skills, with an expectation these shortages will become acute and persistent. The dynamics of Australia's supply of engineers are complex and require changes to both the local supply of engineers and the skilled migration program. As presented in *The Australian Electricity Workforce for the 2022 Integrated System Plan: Projections to 2050*, the required increases in the workforce are steep for the Step Change scenario and even more so for the Hydrogen Superpower scenario. The widespread skill shortages, including civil, electrical and mechanical engineers, combined with a widening training gap, could undermine the ISP's delivery and the Engineering Framework's ability to solve the technical challenges on the pathway to 100% renewables. Maintaining an adequate supply of engineers will require modelling, planning and a long-term commitment by industry, the tertiary sector and government.

The time is now:

- Engineers Australia recommends that the Government creates and supports a national energy governance structure that:
  - Drives multi-stakeholder and whole-system approaches to both the envisioned final energy system, and to the various stages along the way.
  - Calls upon independent technical advice.
- Government should conduct modelling and planning to ensure we have the engineering workforce we need to successfully complete the energy transition.
- Government should support re-training/up-skilling for those working in fossil fuel based industries as part of a just transition and to fill skills gaps.

# 5. Innovation and industry

## 5.1. Supporting STEM Innovation

The Australian Government currently provides various grants to support businesses and innovation, however, interviews by Engineers Australia with start-ups and other industry participants indicate systemic inefficiencies continue to inhibit their impact.

Founders of STEM start-ups have repeatedly experienced challenges around finding appropriate grants and relevant programs, the administrative burden and bureaucratic process of applying for grants, and the long wait time between applying, being accepted and receiving the funds. There is also a significant disparity between large and small players, because larger firms can dedicate significant time and money to apply for grants, while smaller start-ups, which are arguably in more need of funding, are unable to invest sufficient human capital to apply.

Grants programs should be easy to use for applicants, have minimal administrative processes, and take a risk-based approach to probity checks. This should be part of a larger, integrated framework to create systems that promote innovation and ensure compliance is not a burden on start-ups. Given start-ups are time-sensitive in nature due to their limited capital and liquidity limitations, funds should be transferred quickly to have a meaningful impact. Waiting six months for funding after a successful application can mean the difference between survival or dissolution.

The time is now:

- Develop a centralised online repository of grants and programs for ease of access.
- Reduce the bureaucratic burden on the application process for small, medium businesses applying for grants to alleviate resource requirements.
- Improve processes to reduce the time between a successful grant application and funds being received by applicant.

## 5.2. Innovation ecosystems

The regulatory and compliance burden for engineering start-ups is frequently higher than for start-ups in other sectors due to the regulated nature of the industry. In contrast, pure technology firms often have little regulation, which enables them to scale rapidly and reduces the capital investment required.

STEM start-ups that are at the nexus of innovative technology and traditional engineering practice are frequently mired in regulatory or legal uncertainty. Where clear laws and regulations do exist, they tend to increase costs, dissuade investors, and threaten the survival of the start-up.

The time is now:

- Reducing the business licensing and compliance requirements for engineering and STEM companies more broadly, particularly where there is no safety concern associated with the regulation.
- Provide further investment to create additional innovation hubs including in regional Australia centred around start-ups and the commercialisation of Australian innovation.

## 5.3. Increasing the use of digital tools

Greater support needs to be provided to support industry in investing and utilising digital technologies. In infrastructure for example, the use of digital tools at all phases of asset lifecycles enhances productivity in delivery, operation, maintenance and decommissioning. The use of digital twins, smart sensors, building information modelling systems, digital engineering and digital asset management tools will ensure Australia is future ready and that our infrastructure can be managed efficiently, sustainably, and effectively.

For many sectors, the benefits of digital technologies include enabling more collaboration and coordination between teams and stakeholders and increasing innovation through improved data capture. The difficulty facing industry is the exponential rate of technological change. Government and industry must look to training and upskilling the labour force both in using the technology and rolling out new digital tools. Training in these skills should complement and expand core competencies and drive the standardisation of methods.

The time is now:

- Governments must allocate funding for training and upskilling of the labour force in digital skills.
  - Part of this funding should support subsidised programs, to promote collaboration between industry and academia, fostering greater integration of current and emerging technologies.

## 5.4. Best practice procurement in infrastructure investment

Government investment should be directed to support greater innovation in Australian infrastructure. Investment in infrastructure has two main outcomes, firstly, it supports society and the economy by providing roads and healthcare. Secondly, it stimulates the economy. Greater involvement by small and medium enterprises (SME) in infrastructure projects is good for the economy. These businesses create jobs and are often innovative in their thinking and way of working. Infrastructure projects are mostly medium-to-long-term endeavours, making procurement processes difficult, with tendering and contracting issues regularly preventing small-to-medium-sized enterprises (SMEs) from equitable participation.

A way to encourage more diverse participation is to develop baseline infrastructure first, with a structured return on investment, before proceeding to the next level of value-adding infrastructure. Ensuring that project bidders are shortlisted promptly can also assist by limiting the time and money spent by companies that are unsuccessful. Government should also consider stage-based tender processes and in-house design teams to allow equitable participation of a broader bidder market.

The time is now:

- The government should invest in reforms to the tendering process. Reforms should include:
  - Providing visibility of cost to tender bidders.
  - Early engagement with bidders before the request for tender stage.
  - Acceleration of shortlisting and award processes.
  - Consider stage based tendering processes and in-house design teams to allow equitable participation from a broader bidder market.
- Develop and implement a consistent procurement framework across all levels and between all departments associated with interrelated infrastructure, applying the ISO 55000
- Governments should avoid using non-standard contracts and provide visibility of contracts before tender, allowing sufficient time for review. Any required amendments to standard contracts must be subject to collaborative negotiation with industry stakeholders.



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