Comment – Engineers Australia

Comment

As Australia's national peak body for engineering, Engineers Australia is the voice and champion of our 130,000-plus members, with over 28,000 residing in Queensland. We are a mission-based, not-for-profit professional association, 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 (IEA), this includes accreditation of Australia's undergraduate university engineering programs.

Engineers Australia stands ready to actively participate in the QPC consultation and provides the following brief comments on your Terms of Reference and additional support material in the form of recent submissions to assist the QPC in its work.

As Engineers Australia outlines in its April 2025 Engineering Tomorrow report, Australia need to secure its future through a boost to our national engineering capability.

To this end, we make three key recommendations to the QPC, that the Queensland Government actively consider:
(1) appointing a Queensland Chief Engineer in the public service, similar to Queensland's Chief Scientist role
(2) developing with us the pipeline of engineering talent needed now and, in the decades ahead, and
(3) working with other states to deliver a nationally consistent engineering registration scheme that facilitates Automatic Mutual Recognition across
jurisdictions.

Engineers Australia has also made another submission to the QPC in conjunction with Consult Australia, RICS and the Strata Community Association, outlining support for decennial liability insurance and warning against the risks of mandating Professional Standards Schemes (PSSs)

Australia needs more senior engineering roles in the public service, including a Chief Engineer at both state and federal levels. 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.

NSW has a Chief Scientist & Engineer. Given Queensland's massive public sector infrastructure pipeline, including the Olympics, it is our firm belief public policy advice and decision making would be strengthened through immediate appointment of a Chief Engineer in Queensland.

In addition to the QPC's work on productivity and costs we stress the need for a continued focus on maintaining high quality standards and enabling improved labour flexibility and mobility.

In particular, for all states to work together to achieve a nationally consistent registration scheme for engineers. Queensland pioneered the registration of engineers in 1930. Queensland can and should continue to lead to deliver nationally consistency, to enable professional workforce mobility (through signing on to Automatic Mutual Recognition) given engineers (and engineering firms) work across the country on a range of projects. Queensland through its history and expertise with the RPEQ can play a key role to help champion and deliver national consistency and improve national engineering standards.

As source materials for future discussion with the QPC, Engineers Australia has also provided attachments. reports and submissions.
Yours sincerely, Jenny Mitchell.

ENGINEERS AUSTRALIA

The case for nationally consistent registration of professional engineers

Professional engineers plan, design, construct, test, commission, maintain, operate, and decommission safety critical systems whose performance can have significant consequences for public health and safety and economic implications for businesses and the community. Most engineers provide their services competently, ethically and with diligence. However, 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.

Engineering services are vital to national economic prosperity and social well-being, yet there is no uniform regulatory regime covering engineering practitioners in Australia.

Registration of engineers enhances public confidence the engineering services have been delivered by qualified, experienced, and competent professionals who practice ethically, develop safe and sustainable solutions, apply local engineering knowledge, and manage risks effectively.

The benefits of registration

Compulsory registration for anyone providing professional engineering services enables significant enhancement of public safety and consumer protection. More broadly, there are six key benefits of a registration system for engineers:

1. Reducing risks to public health, safety, and welfare through strengthening confidence in the competency of the people who deliver professional engineering services.
2. Economic benefits from reduced cost of re-work and improved system performance.
3. Improved industry and consumer information about who is competent to deliver professional engineering services.
4. Professional recognition for registered engineers.
5. Enhanced national and international mobility and trade in engineering services.
6. Legislative efficiency enabling regulators to more effectively develop, implement and improve consistent regulatory frameworks for the delivery of engineering services consistently in a timely manner.

Essential elements of statutory registration scheme

All registration systems should have the same characteristics in that standards must be set, qualification requirements specified, applicants assessed against specified competencies, and a register maintained. Performance must be monitored, and failures investigated and disciplined where appropriate. A register has greater effect if supported by legislated regulatory powers of government.

Engineers Australia supports the co-regulatory model of registration implemented in Queensland and Victoria through Professional Engineer Registration acts, which enables statutory bodies and professional associations to undertake roles that align with their expertise. The co-regulatory model provides greater assurance of the competency of registered engineering practitioners and reduces the risk of physical and financial harm to consumers. This approach allows industry and assessment entities, like Engineers Australia, to assess the qualifications and competency of individuals to the agreed national standards required. This then allows government to implement and maintain a formal register, including prosecution for unregistered work.

Statutory registration of professional engineers should apply to anyone who provides professional engineering services, and in any area of engineering in any industry. The exceptions are those performing professional engineering services under the supervision of an appropriately registered engineer, and those that only apply prescriptive standards/processes.

Some jurisdictions limit registration schemes to the building sector. The benefits of registration extend beyond the building sector as engineers provide critical services and products across all sectors including public infrastructure, power generation, manufacturing, health, and mining. Engineers Australia supports the expansion and alignment of schemes beyond the building sector to realise the benefits of nationally consistent registration of professional engineers.

How to regulate engineering

Engineers Australia supports the co-regulatory model of registration, initially introduced in the *Queensland Professional Engineers Act 2002*, which includes a statutory regulatory body and professional associations each undertaking the various roles they are best suited to perform.

Under a co-regulatory approach, Engineers Australia believes that legislation governing the delivery of engineering services in states and territories should:

- Include restrictions on who may deliver engineering services
- Restrict the 'registered' title to those who are on an engineering register
- Register engineers in the broadest possible areas of engineering practice aligned with the areas of practice and not limited to a specific industry sector, with the onus on each registered engineering practitioner to only undertake work that they are competent to undertake. Statutory registration should apply to professional engineers who provide engineering services in any industry
- Base registration on a set of minimum requirements which are benchmarked against recognised national and international standards. Refer to Engineers Australia's Minimum Requirements for Registration.

Mutual recognition

Australian governments have agreed to a nationally uniform approach to mutual recognition based on the *Commonwealth Mutual Recognition Act 1992*. In 2020 this Act was amended to provide for automatic mutual recognition (AMR).

Engineers Australia supports AMR as a key component of nationally consistent registration, with the effect that an individual professional engineer need only be registered in the engineer's home state to do professional engineering work while present in, or for a project located in, any other Australian jurisdiction without further application, assessment, or fees. Engineers Australia recognises that the provision of engineering services is not bounded by jurisdictional boundaries and there are productivity and administrative efficiencies through effective mutual recognition.

Support for comprehensive registration of engineers

Broad-based registration of engineers has very high levels of public support across all demographics. In a 2019 Engineers Australia commissioned poll[1], 88 per cent of respondents answered 'Yes, engineers should have to be registered'.

About Engineers Australia

Engineers Australia was established in 1919 and is Australia's peak body for the engineering profession.

We are a not-for-profit organisation, constituted by Royal Charter, to advance the science and practice of engineering for the benefit of the community.

Our 115,000 individual members represent all disciplines and branches of engineering and all three of the profession's occupational categories (Professional Engineer, Engineering Technologist, Engineering Associate).

[1] The poll was conducted for Engineers Australia by OmniPoll. The poll was conducted nationally among 1222 people aged 18 years and over. Respondents were drawn from the online consumer panel managed by Lightspeed Research, OmniPoll's online partner. Sample quotas were set for each state, city and regional area, along with sex and age. To help reflect the overall population distribution, results were post-weighted to Australian Bureau of Statistics data on age, sex, area and highest schooling.

ENGINEERS
AUSTRALIA

Games Independent Infrastructure and Coordination Authority

100DayReview@gvlda.au

Via online submission portal

10 January 2025

Re: 100 Day Review of the Brisbane 2032 Olympic and Paralympic Games infrastructure and planning

Dear Chair,

As Australia's national body for engineering, Engineers Australia is the voice and champion of our 127,000-plus members. We provide them with the resources, connections, and growth they need to do ethical, competent and high-value work in our communities. A mission-based, not-for-profit professional association, Engineers Australia is constituted by Royal Charter to advance the science and practice of engineering for the benefit of the community.

Engineers play a critical role in planning, designing, building, commissioning, testing, operating and maintaining infrastructure assets throughout Queensland. They bring important insights to deliver the right projects in the right places with the right governance. Engineers will play a critical role in ensuring that the infrastructure and planning that supports a successful Brisbane 2023 Olympic and Paralympic Games also generates lasting economic, social and environmental benefits across the State, and Australia as a whole.

Our submission is enclosed below. Engineers Australia is available to participate in future opportunities to discuss the issues raised in this submission. Please contact Darren Beattie – General Manager, Queensland Division [redacted] to continue the discussion.

Sincerely,

[redacted]

Jenny Mitchell

General Manager, Policy and Advocacy

Submission

Engineers Australia welcomes the opportunity to provide advice to the Games Independent Infrastructure and Coordination Authority (the Authority) in response to the 100 Day Review of the Brisbane 2032 Olympic and Paralympic Games infrastructure and planning (the Review). Engineers Australia **broadly supports the principles and objectives** outlined in the Review's terms of reference and suggests that engineering expertise will be essential to their delivery. We present nine recommendations to the Authority for consideration.

Recommendations

1. **Consider developing new or upgrading existing venues outside of Brisbane and/or Queensland.**

The Brisbane 2032 Olympic and Paralympic Games (the Games) present an opportunity to showcase a vision that extends beyond Brisbane and Queensland, encompassing all of Australia. The Paris 2024 Games introduced a flexible model with 35 venues spread across Paris, regional French cities, and the French territory of Tahiti. Notably, the opening ceremony was held along the Seine River—the first time such an event occurred outside a stadium—highlighting the creative potential for Olympic venues. Similarly, incorporating regional venues and existing infrastructure across Queensland or Australia could significantly reduce costs, as upgrading current facilities is often more economical than building new ones. At a minimum, this approach would distribute costs between State and Federal Governments while fostering the enhancement or creation of national assets, ensuring the Games deliver benefits across the country.

2. **Develop funding pathways for the continued utilisation and maintenance of Olympic venues post-2032.**

To avoid or reverse the financial losses often incurred by Olympics host nations, long-term funding pathways should be mapped to ensure that Olympic venues can continue to be maintained and utilised, or converted for alternative uses, following the conclusions of the Games.

3. **Prioritise local businesses for procurement related to the Games.**

Local engineering and construction businesses should have the opportunity to contribute to and benefit from the Games, reversing the trend of awarding major contracts to international firms. This shift is essential for fostering local growth, supporting First Nations workers, and retaining expertise and funding within the community. This could also contribute to compensating for the often uncosted losses to small businesses resulting from the disruption caused by megaproject construction.

4. **Establish environmental sustainability guidelines for all Games-related and supporting infrastructure.**

The Games provide an opportunity to showcase sustainable building practices, advancing environmental goals for both Queensland and Australia. Key sustainability measures could include using a minimum amount of low-carbon building materials to reduce embodied carbon emissions, enhancing public transport connectivity to lower operational carbon emissions, and prioritising modular designs to allow for venue deconstruction or reuse. Venues could also be designed to withstand future climate impacts, such as extreme weather events. Additionally, supporting infrastructure will need a sustainability focus, with upgrades to existing waste and water systems essential to manage the increased demands from the temporary population surge during the Games.

5. **Alleviate infrastructure skills shortages through funding education and training and staging Olympic project deployment.**

There are significant skills shortages in areas critical to the construction of Olympic infrastructure. These could be alleviated by targeted funding to educate new workers, upskill existing workers, reattracting qualified engineers to the profession who are employed in other sectors and staging projects so that there is minimal overlap between projects that require similar workers.

6. **Enhance cross-sectoral collaboration by establishing a coordination body within the Authority.**

The success of megaprojects requires the successful coordination of sectors that (at best) exist in silos or (at worst) actively compete with one another. A coordination team should be created to broker knowledge and enhance collaboration between sectors in the lead up to and during the Games. In addition to avoiding duplication (and thus producing cost savings), cross sector collaboration could also enhance the safety and accessibility of the Games through swift information sharing should security threats arise.

7. **Use stadium cost benchmarks to assess the cost-benefit of new or upgraded infrastructure.**

To ensure cost-effective investments in new or upgraded stadium infrastructure, projected construction costs should be compared with benchmarks from previous Games. This approach can help ensure costs remain reasonable and avoid unintended consequences, such as triggering major transport infrastructure upgrades outside of those that have already been outlined to meet long-term planning objectives.

8. **Harmonise existing State and Federal legislation to support efficient and safe construction outcomes.**

The recently amended *Brisbane Olympic and Paralympic Games Arrangements and Other Legislation Amendment Act 2024* has impacted other legislation that supports construction project processes and approvals, and construction workplace safety. The impacted legislation should undergo a holistic review to avoid duplication (thus streamlining processes) and close prospective loopholes that could put projects and people at risk.

9. **Reestablish a Chief Engineer role within the Queensland Government.**

This role could provide strategic and technical advice to the Queensland Government on infrastructure and planning challenges reliant on Australia's engineering capability, including the 2032 Brisbane Olympic and Paralympic Games. At a minimum, the appointment of technical experts like engineers on existing Olympic advisory boards should be considered in order to benefit from the systems- and risk-based approach to decision making that is inherent to the engineering profession.

This role could provide strategic and technical advice to the Queensland Government on infrastructure and planning challenges reliant on Australia's engineering capability, including the 2032 Brisbane Olympic and Paralympic Games. At a minimum, the appointment of technical experts like engineers on existing Olympic advisory boards should be considered in order to benefit from the systems- and risk-based approach to decision making that is inherent to the engineering profession.

Engineers Australia Submission

Mandating Decennial Liability Insurance

28 July 2023

ENGINEERS
AUSTRALIA

Contents

Mandating Decennial Liability Insurance

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Executive Summary

Engineers Australia welcomes the proposal by the NSW Government to introduce a form of Decennial Liability Insurance (DLI) for class 2 buildings in New South Wales and supports the establishment of a mandatory DLI requirement after an acceptable transition period.

Engineers Australia is a strong supporter of building regulatory reform and our response to the 2018 Building Confidence Report, Building Confidence: How to use engineers to improve building and construction, proposes a new paradigm for building engineers that can support the introduction of DLI. However, Engineers Australia remains concerned at the piecemeal introduction of reforms across Australia and the effectiveness of some reforms built on over-simplified assumptions and over-complicated processes. Engineers Australia's support for DLI is contingent upon:

1. **Nationally consistent reforms including a national DLI market.**

The building industry in Australia is not localised to any one state or territory. There are many national and international businesses involved, especially in the high-end commercial sector. Engineering design and documentation for buildings in NSW can be done in any state or territory, or even overseas, and building components and modules can be sourced from anywhere. A national industry is best supported by nationally consistent regulations, insurance schemes and underwriting. Engineers Australia strongly advocates for nationally consistent registration of professional engineers in Australia and the mobility of engineers and engineering services through automatic mutual recognition. DLI will work best if it is available in all states and territories. A larger insurance pool will stabilise the market and encourage competition. Engineers Australia urges the NSW Government to work with other states and territories on nationally consistent reforms.

2. **The establishment of an Engineer of Record for each engineering system in the building.**

Traditional commercial building procurement saw owners commission a team of engineers and other specialists to design, inspect and document the building and its major engineering systems. This was done to ensure the building was constructed properly and defects were promptly corrected. There are now much more complex procurement methods available, and developers do not have a similar long-term interest in the quality of construction. There is often no consistent oversight of critical engineering systems. Engineers Australia strongly recommends that the project owner appoints an Engineer of Record for each engineering system in the building who can endorse the drawings, reports and documents for the project and the final construction and installation. An Engineer of Record is an efficient risk-mitigation measure that will give insurers greater confidence to underwrite DLI. Legislation change may be needed to ensure the contract with the Engineer of Record is passed on to the new owners after strata titles are issued.

3. **Rationalisation of liability and insurance requirements for engineers.**

Engineers Australia welcomes DLI as an overriding, one-stop-shop for unit owners to deal with building defects. However, the current overly complex liability regime focusses on individual employees rather than the contracting businesses. This will complicate the task of insurers acting in subrogation to owners and cause the cost of DLI policies to be higher than they need be. Owners' and industry's money are better spent on quality control and quality work rather than lawyers' fees. DLI will work best as part of a simpler, better integrated, national scheme of liability, dispute resolution and insurance that properly distinguishes between businesses and their employees and that allocates risk to the party best able to manage it.

4. **A straightforward claims and redress processes.**

DLI must have an easy-to-understand claims and redress process to ensure the ongoing sustainability and reputation of the scheme and the trust placed in it by consumers.

Introduction

Engineers Australia is the peak body of the engineering profession with representation from a vast array of engineering disciplines. We are constituted by Royal Charter and our mission is to advance the science and practice of engineering for the benefit of the communities in which we live. Engineers Australia is the collective voice of over 115,000 members across Australia with approximately 25,000 in NSW alone.

Engineers Australia supports the establishment of mandatory DLI for class 2 buildings in NSW and believes engineers will play a critical role in the implementation of the policy. However, Engineers Australia remains concerned at the piecemeal introduction of reforms across Australia and the effectiveness of some reforms built on over-simplified assumptions and over-complicated processes. Engineers Australia's support for DLI is contingent upon:

1. Nationally consistent reforms including a national DLI market.
2. The establishment of an Engineer of Record for each engineering system in the building.
3. Rationalisation of liability and insurance requirements for engineers.
4. A straightforward claims and redress process.

Engineers Australia thanks the Department for the opportunity to provide comments on the Discussion Paper – Decennial Liability Insurance, which was distributed in June 2023.

National Consistency

The building industry in Australia is not localised to any one state or territory. There are many national or international businesses involved, especially at the high-end commercial sector which includes class 2 buildings. Architectural and engineering design and documentation for buildings in NSW can be done in any state or territory, or even overseas, and building components and modules can be sourced from anywhere.

Inconsistency and fragmentation in regulation causes a number of problems, including unjustified compliance burden and cost, impediments to information sharing and national initiatives, and confusion about who to approach. National consistency, therefore, should be one of the goals of building regulation.

Engineering services are vital to national economic prosperity and social well-being, yet there is no uniform regulatory regime covering engineering practitioners in Australia. Engineers Australia strongly advocates for nationally consistent registration of professional engineers in Australia and mobility of engineers and engineering services through automatic mutual recognition.

Engineers Australia strongly supports the consistent legislation to register professional engineers in Queensland, Victoria and the ACT and the adoption of similar legislation by other states and territories to deliver a nationally consistent registration framework. Whilst the established Professional Engineers Acts have slight variations, the move towards legislative consistency is advancing. Placing engineer registration in the *Design and Building Practitioners Act* in NSW is inconsistent with all other major economies in Australia and proposals to transfer these provisions to a Building Bill will further isolate NSW.

DLI will work best if it is available in all states and territories. For this to happen, the building industry needs nationally consistent regulations, insurance schemes and underwriting. This will mean insurers only need to deal with a single set of regulations and trade barriers instead of multiple ones at the state level.

A larger insurance pool will:

1. Stabilise the market: A national insurance market encompasses a larger population base, allowing for a larger risk pool. This can help spread the risk more effectively and reduce the impact of adverse events on insurance premiums.

2. Encourage competition: A national market can foster greater competition among insurance providers, leading to a wider range of options for consumers. Increased competition may drive down prices and improve the quality of insurance products and services.
3. Improve efficiency and cost savings: A national insurance market can benefit from economies of scale and streamline administrative processes. This can potentially result in cost savings for insurers, which can be passed on to developers and consumers in the form of lower premiums.

Engineers Australia urges the NSW Government to work with other states and territories on nationally consistent regulations, insurance schemes and underwriting.

The role of an Engineer of Record

An Engineer of Record, for each engineering system within a building, oversees the design, construction, and commissioning of the system. This provides a sign-off to the owner that the system is free of defects and will work effectively. This replicates the traditional consultant role used by long-term building owners to control quality in the more complex building industry of today. This role provides the continuity lost when developers sell apartments on practical completion. A certificate from an Engineer of Record can be relied on by subsequent owners, insurers and building regulators to give assurance that each system is properly designed, constructed and commissioned.

A fundamental problem with the way strata-titled apartments are procured and sold is that the contractual arrangements entered into by the original developer do not carry over to the strata company or the purchasers of individual apartments. An Engineer of Record contracted initially by the developer, and whose contract passes over to the strata company, can continue to monitor each engineering system during the defects liability period, which follows completion of the building, and sign off on the system when it is fully commissioned, and any defects have been rectified. Some provision must be made in strata titles; residential apartment buildings design; and building or approval legislation for the initial owner of the project to appoint and pay for the necessary Engineers of Record.

Sign-off by an Engineer of Record is not currently covered by the declaration provisions in Part 2 of the *Design and Building Practitioners Act*. This Part requires each registered design practitioner who prepares a regulated design to provide a design compliance declaration to any person to whom they provide the design. It does not provide a for a person such as an Engineer of Record who oversights design, construction or commissioning work done by others to provide a certificate of compliance. While Engineer of Record appointment and responsibilities can be set out and managed through contracts, it is highly desirable to have some statutory provision for systemic certification and to regulate the form of contract that provides for them.

A certificate of compliance by an Engineer Record is consistent with the recommendations in the Building Confidence Report that the design documentation presented for building approval has a certificate from the registered practitioner responsible for the overall work. The *Design and Building Practitioners Act* currently does not distinguish between individual employees or members of a design team and the employer or team leader responsible for the overall work. It requires declarations from each individual for their individual component of the design work but not from the employer or team leader who ensures the individual components work effectively together. This focus on the individual, which ignores the pivotal role of the businesses that actually undertake, contract and take financial responsibility for work, is an over-simplified assumption that leads to overcomplicated processes for certification, rectification and redress. Amending the *Design and Building Practitioners Act* to provide for an Engineer of Record and similar roles in other disciplines is an opportunity to fix these defective provisions.

One of the difficulties Engineers Australia sees with the NSW proposals for DLI is that it is marketed as covering latent defects. These are usually defined as defects that could not have reasonably been identified and dealt with at the time of practical completion or during the defects liability period. So the proposal may not effectively tackle the current situation where construction work is not properly inspected and defects are not identified and dealt with by the developer before selling the units on. Currently, the developer sells units off the plan and settles the sale on practical completion, leaving

obvious and apparent defects to be dealt with by the new owners and the strata company. It is not clear that DLI will cover these. Having in place Engineers of Record for each engineering system of the building can help strata companies, new owners and DLI insurers acting on their behalf apply the defects liability provisions under the original contract with the developer and ensure the obvious and apparent defects are dealt with during the defects liability period and are not claimed against DLI.

For more information on the role of an Engineer of Record, please see Engineers Australia's document: Building Confidence: How to use engineers to improve building and construction.

Insurance requirements for engineers

Under DLI, an apartment owner or the strata company notifies the insurer of a defect and the insurer is obliged to fix it. Engineers Australia supports this as a useful protection for apartment owners that avoids them having to fund rectification and take legal action to recover economic loss. However, the insurer is entitled to pursue rectification costs from any person liable for the defect.

Currently the *Design and Building Practitioners Act* and Regulations have liability and insurance requirements that put unreasonable burdens on individual engineers. These duties and statutory requirements add to the cost of recovery and will increase DLI premiums making entering the market less attractive to insurers. It also makes it less attractive for individual engineers to work in the building sector in NSW.

The *Design and Building Practitioners Act* has introduced a strict, non-delegable duty on each person who carries out construction work to avoid economic loss to each owner and subsequent owner of the land. This bottom-up approach targets individual employees and workers rather than their employing businesses. This has significantly increased the number of people whose individual contribution must be assessed, quantified, and who must be joined in legal action.

Similar problems arise with insurance requirements in the *Design and Building Practitioners Act* and the proposed Building Bill that require each individual registered engineer to assess and record the risks of their work and the adequacy of any professional indemnity insurance (PII) policy that covers the work. If the individual engineer cannot form an opinion that work to be done is covered by adequate PII, the engineer must not do the work.

This has created many issues for NSW engineers including:

1. Engineers are not trained in insurance risk assessment and interpretation of insurance policies and may struggle to make the assessments of adequacy of insurance required under Section 33 of the *Design and Building Practitioners Act* or the proposals in Section 35(2) of the Building Bill. Engineers need to be able to rely on the advice provided by their employer, insurance and commercial professionals.
2. It is inefficient and prone to conflicting interpretations to require each individual employee engineer to carry out and record the assessment of a single PII policy taken out by the employing business, which in turn may be a standard policy offered by a single insurer to multiple businesses. More centralised assessment of PII adequacy by people trained in insurance risk assessment is more efficient and reliable.
3. The Design and Building Practitioners Regulations were used to prohibit the Secretary from registering bodies corporate, with the practical effect that only individuals have been registered as professional engineers. This applies the insurance provisions to each individual registered professional engineer rather than to businesses such as partnerships or corporations. PII cover is usually taken out by businesses and not individual employees. Competent and ethical engineers still have an obligation to ensure that the work they do is covered by insurance, but the liability should fall on the contracted party rather than an individual engineer.

4. The PII market for professionals in the building sector is volatile, with underwriters adding exclusions to policies to reduce exposure, raising premiums to maintain margins, refusing cover or leaving the market completely. The *Design Building Practitioners Act* and associated regulations and standards introduce new statutory obligations on engineers which are not covered by current insurance providers. New insurance products may be needed to cover engineer's liabilities.

For further details please see Engineers Australia's submission, The issue with insurance requirements for engineers.

Introduction of DLI provides an opportunity to amend the *Design and Building Practitioner's Act* to ensure that:

1. The complex liability arrangements for engineers do not complicate the task of insurers acting in subrogation to owners and cause the cost of DLI policies to be higher than they need be.
2. Competent and ethical engineers are not driven away from the building sector due to excessive, unreasonable, and burdensome insurance obligations.

Proposed DLI Scheme

Other Concerns

While supporting the overall thrust of introducing DLI for apartment buildings in NSW, Engineers Australia has some concerns with the details of the proposal and is happy to work with the NSW Government to address them. These include:

- It is unclear what happens if an individual DLI insurer, or the DLI market, collapses. Relying on a commercial product without some safety valve to prevent the process or industry stopping dead if the market fails, is misguided. How the mechanism would react in such a situation is critical to the ongoing sustainability and reputation of the scheme and the trust placed in it by consumers.
- It is not clear how an interim Occupancy Certificate (OC) may affect the commencement of a DLI policy, as the final OC may be issued much later after the first interim OC.
- It is suggested that compensation payment timeframes, especially for carrying out emergency maintenance works, be prescribed.
- DLI should only be mandatory if the market is mature otherwise in order to maintain profits developers may be inclined to squeeze contractors (engineers) to perform for lower fees.

Questions

1. **Do you consider there should be an extension of time to enable an insurer to initiate proceedings to protect their right of subrogation against the at-fault party where a claim is made under a DLI policy towards the end of the limitation period? Why?**
   No comment

2. **Do you consider 24 months from the time the claim is made under the policy is reasonable? Why?**
   No comment.

3. **What impacts do you consider the extension of time to initiate proceedings will have upon practitioners in the industry?**
   The extension of time to initiate proceedings can have significant impacts on practitioners in the industry. By effectively extending the period to 12 years, practitioners may face prolonged exposure to potential claims and litigation. This can result in increased costs and uncertainties for practitioners, as they may need to maintain insurance coverage and documentation for an extended period. It may also impact their ability to plan and allocate resources effectively, considering the potential liabilities that may arise even years after completing a project. Therefore, practitioners in the industry may need to adapt their practices, insurance coverage, and risk management strategies to account for the

extended timeframe. NSW must ensure that PII coverage for this is available for practitioners before making DLI mandatory.

4. **What other means should be considered to balance the rights of the insurer to recover their loss against those of practitioners operating in the industry?**
   DLI will work best as part of a simpler, better integrated, national scheme of liability, dispute resolution and insurance that properly distinguishes between businesses and their employees and that allocates risk to the party best able to manage it. See 'Insurance requirements for engineers' above for more details.

   The duty of care provisions in Part 4 of the *Design and Building Practitioners Act* and its focus on individuals and not businesses seriously complicate the process of obtaining redress for economic loss, whether by an owner or an insurer acting on the owner's behalf. Reforming these provisions to reduce the number of people who must be drawn into legal proceedings will increase the ability of insurers to recover the principal part of their loss from the relevant business and shield individual employees from ruinous personal claims.

5. **Do you agree that the indicators outlined in the proposed evaluation matrix (at Appendix D) will appropriately indicate market maturity? Why?**
   No comment

6. **Do you consider any other indicators are necessary for the assessment of market maturity? If so, please specify what these are.**
   No comment

7. **Do you agree that if performance against the evaluation matrix indicates the market is not ready to transition to a mandatory model, then mandatory DLI be deferred for an extended transitional period?**
   In terms of deferring the mandatory DLI if the market is not ready, Engineers Australia agrees that extending the transitional period would be appropriate. It is crucial to allow sufficient time for market participants to adapt and prepare for the mandatory model. If the evaluation matrix indicates that the market is not adequately mature or prepared for the transition, a deferred implementation would provide the opportunity for further development and readiness. This would help prevent potential disruptions and ensure a smoother and more successful implementation of the DLI in the future.

   DLI should only be mandatory if the market is mature otherwise in order to maintain profits developers may be inclined to squeeze contractors (engineers) to perform for lower fees. The average cost of premiums and deductible amount payable will be key indicators that must be considered before switching to mandatory DLI.

   Expanding to a national DLI market will accelerate the maturing of the market. A national market would allow for a larger risk pool which would stabilise the market, encourage competition which lowers prices and improve market efficiency. For this to happen, the building industry needs nationally consistent regulations, insurance schemes and underwriting. See 'National Consistency' above for more details.

8. **Do you agree the building types outlined above should be exempted from the DLI scheme? Why?**
   Engineers Australia considers DLI should be available to the widest range of buildings possible. This will encourage a robust and financially stable market and will reduce complication from having different requirements for different types of buildings.

9. **Should other building types be exempted from the DLI scheme? If so, which other building types should be exempted and for what reason?**
   No

10. **Should smaller Class 2 buildings be captured by the SBBIS instead of being exempt, during the transitional period?**
    No comment


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Queensland's 2025-26 State Nominated Skilled Migration Program

Engineers Australia Submission

March 2025

Queensland's 2025-26 State Nominated Skilled Migration Program

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About Engineers Australia

As Australia's national peak body for engineering, we are the voice and champion of our 130,000-plus members, with over 28,000 residing in Queensland. We provide them with the resources, connections, and growth they need to do ethical, competent and high-value work in our communities. A mission-based, not-for-profit professional association, Engineers Australia is 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 (IEA), this includes accreditation of undergraduate university engineering programs.

Under the Migration Regulations 1994, Engineers Australia is the designated assessing authority to perform the assessment of potential migrant engineering professionals' skills, qualifications, and/or work experience to ensure they meet the occupational standards needed for employment in Australia.

Due to this and to avoid any actual or perceived conflict of interest, Engineers Australia does not provide advice to government on the composition or number of engineers which should be targeted through Australia's migration program. However, this submission highlights key data which should be considered for the occupations targeted for consultation.

Contact

Engineers Australia welcomes the opportunity to provide feedback to Migration Queensland regarding the 2025-26 State Nominated Skilled Migration Program. We look forward to continued engagement on this important initiative. Please feel free to contact Caitlin Buttress, Head of Advocacy, at cbuttress@engineersaustralia.org.au for further information.

Introduction

Engineers Australia welcomes the opportunity to provide feedback to Migration Queensland on the 2025–26 State Nominated Skilled Migration Program.

Australia faces persistent and structural shortages of engineers, with migration playing a critical role in addressing workforce gaps. Our submission highlights the growing demand for engineers, the importance of aligning skilled migration with workforce needs, and the value of experienced engineers and international graduates in sustaining Australia's engineering capability. We look forward to continued collaboration with Migration Queensland to support a strong and resilient engineering workforce.

The engineering profession in Queensland

Based on the most recent census data from 2021, Queensland had 42,071 engineers working in engineering occupations, 17 per cent of the national total. That represents a 40 per cent increase over a decade in the number of engineers working in engineering occupations from the 2011 census.

Table 1: Statistics for the engineering population in Queensland

Census Year	2011		2016		2021	
Employed	45,497	80.5%	52,568	74.8%	68,743	76.7%
Not in the labour force	9,578	16.9%	14,277	20.3%	18,360	20.5%
Looking for work	1,400	2.4%	3,427	4.9%	2,359	2.6%
Total Labour force	46,897		55,995		71,102	
Working in engineering occupations	28,525	60.8%	31,095	55.5%	42,071	59.2%

The strong growth of Queensland's engineering workforce reflects the state's expanding infrastructure, energy, and manufacturing sectors, as well as its role in major national priorities such as the clean energy transition and critical infrastructure development. A larger engineering workforce is essential for delivering complex projects, driving innovation, and ensuring Queensland remains competitive in a rapidly evolving global economy. This growth also highlights the increasing demand for engineering expertise across industries, reinforcing the need for a sustainable pipeline of skilled professionals through both education and migration pathways.

Figure 1: Distribution of qualified engineers in the top 5 sub industries for each state/territory (represents 26.2% of the qualified engineering labour force)

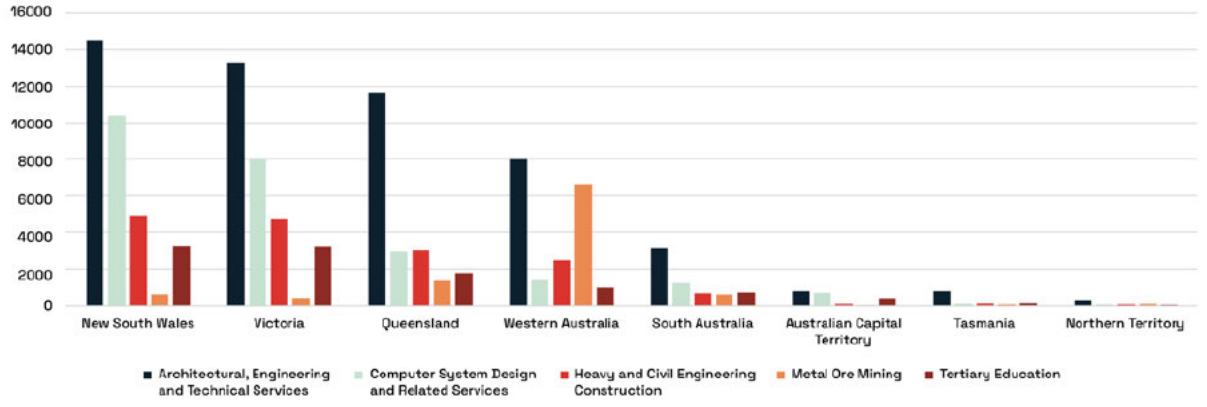
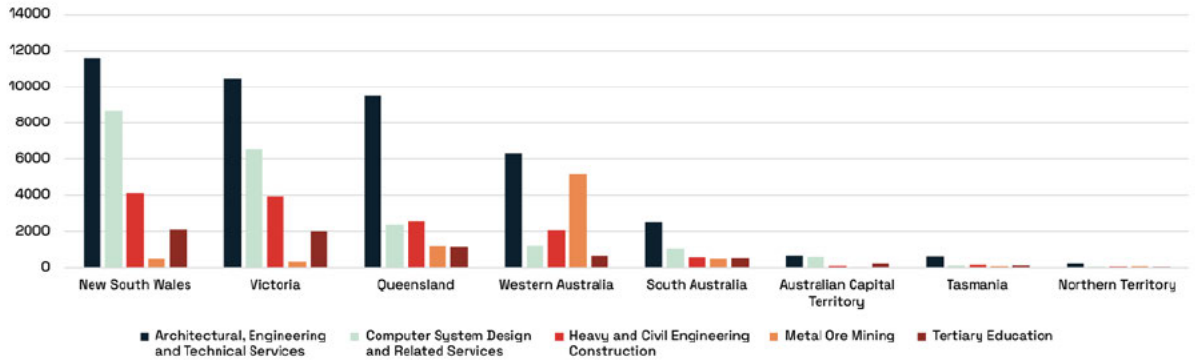


Figure 2: Distribution of engineering occupations in the top five sub-industries for each state/territory (represents 36.6% of the population of engineering occupations)



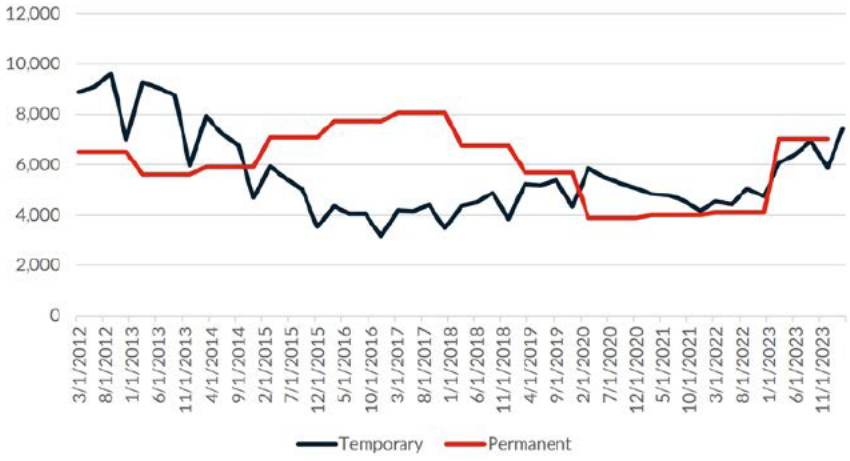
Supply of engineers via migration

Engineers born overseas who migrate to Australia, via the skilled, temporary or humanitarian migration programs, are essential to the supply of engineering capability in Australia. The total number of permanent settlements in Australia through the skilled migration program[1] is shown in the table and figure below, filtered to professional engineering unit groups within ANZSCO[2]. We note the recovery in levels of permanent skilled migration since the COVID-19 pandemic occurred, with a 70.8 per cent increase in 2023.

Table 2: Permanent settlements - skilled migration scheme – engineers

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Total	5,916	7,066	7,743	8,074	6,755	5,694	3,896	4,013	4,107	7,016
% change year on year	-	19.4%	9.6%	4.3%	-16.3%	-15.7%	-31.6%	3.0%	2.3%	70.8%

Figure 1: Numbers of permanent and temporary engineer migrants in Australia



[1] Department of Home Affairs. Permanent Migration Program (Skilled & Family) Outcomes Snapshot – Annual Statistics, BP0068L Permanent Migration Program (Skilled & Family) Outcomes Snapshot – Annual Statistics 2013-14 to 2022-23 v100, 22 (March 2024)
https://data.gov.au/data/dataset/096fd157-807c-4ba0-8c63-0754cae4ba35/resource/f0d43822-512e-4687-8bc3-fa59926306a7/download/bp0068-migration-and-child-outcome-since-2013-14-to-2023-06-30-masked-v100.xlsx

[2] Briggs, P. 'The Australian Engineering Labour Market Overview *Engineers Australia* (August 2024)
https://www.engineersaustralia.org.au/sites/default/files/2024-09/The-Engineering-Labour-Market-Overview-August-24.pdf

Some engineers born overseas and working in Australia are here under different visa types not examined, including temporary graduate visas, partner visas and others. The figures presented here provide an indication of the overall dynamics of the supply of skilled migrant engineers to Australia.

Engineering skills challenge

Engineers Australia would like to emphasise the challenges facing the engineering profession. Australia has experienced a structural shortage of engineers exacerbated by cyclical shortages of engineering skills every decade since the 1980s. This topic has been the focus of both a parliamentary inquiry and other government supported papers.

Analysis of the 2021 census data shows an increase of over 93,000 engineers in Australia's labour force between 2016 and 2021, with overseas-born engineers making up over 70 per cent of this total[3]. Australia continues to face a challenge in its engineering workforce supply, making migration an essential part of the pipeline to meet the demands of current and future projects over the short and medium term.

The engineering skills challenge in Australia has been highlighted by numerous reports by organisations competing for engineering skills across various sectors.

- Infrastructure Australia notes that labour remains the top capacity constraint for infrastructure delivery, with engineers and scientists continuing to experience the largest shortfalls[4].
- Similarly, Jobs and Skills Australia includes Engineering Managers, Chemical and Materials Engineers, Civil Engineering Professionals, Electrical Engineers, Industrial, Mechanical and Production Engineers, Mining Engineers and other Engineering Professionals in the list of those which will be critical to at least one segment of the workforce required to achieve the Australian government's net-zero emissions target by 2050[5].
- 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[6].
    - Likewise, the Industry Skills Australia Maritime[7], Rail[8] and Aviation[9] 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.

Furthermore, these industries also compete with the likes of major projects in Defence, such as the AUKUS agreement, which will require a significant engineering workforce to deliver over the coming decades. The impacts of engineering disciplines not being included in Queensland's State Nominated

[3] Briggs, P. 'The Engineering Profession: A Statistical Overview Fifteenth Edition' *Engineers Australia* (November 2023) https://www.engineersaustralia.org.au/publications/engineering-profession-statistical-overview-15th-edition
[4] Infrastructure Australia 'Infrastructure Market Capacity 2023 Report' *Infrastructure Australia* (November 2023) https://www.infrastructureaustralia.gov.au/publications/2023-infrastructure-market-capacity-report Jobs
[5] Jobs and Skills Australia 'The Clean Energy Generation: Workforce needs for a net zero economy' *Jobs and Skills Australia* (October 2023) https://www.jobsandskills.gov.au/publications/the-clean-energy-generation
[6] 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
[7] 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
[8] Industry Skills Australia Limited, Rail Industry 'Rail Industry 2023 Initial Workforce Plan' *Industry Skills Australia* (Accessed 8 May 2024) https://www.industryskillsaustralia.org.au/initial-workforce-plans
[9] 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

Skilled Migration program for 2025-26 could range from affecting delivery of major infrastructure, to achieving a clean energy transition.

Underemployment of migrant engineers

Ensuring the correct skills are targeted through Australia's migration program is essential to not exacerbate the current issue of underemployed migrant engineers already in Australia. Engineers Australia's 'Barriers to Employment for Migrant Engineers' research report[10] identified seven barriers to employment, leading to recommendations such as positioning migrant engineers as a collective talent pool and providing credible information on employment pathways, aimed at ensuring a sufficient supply of skilled engineers for future projects.

To address this issue, governments bear dual responsibilities: targeting the correct skills through the migration program, and supporting migrants to transition into employment in critical industries. Such efforts, as referenced in the Pathway to Diversity in STEM Review[11], highlight a concerted push to create sustainable pathways to meaningful employment for migrant engineers. Continued collaboration between Engineers Australia, employers, and government partners is vital for the success of these endeavours.

Benefits of retaining international students

International students who graduate locally are a cohort of engineers who could also be supported to facilitate an easier transition to a permanent migration visa. This cohort of engineers in Australia do not face as many barriers as migrant engineers, as they will already have some Australian experience (through work integrated learning) and would have started building local networks through their university course. Despite this, there are unconscious biases which will still go against them. However, programs such as *Professional Year* can support them in entering the Australian workforce.

The multidisciplinary nature of engineering

Engineering is a multidisciplinary profession, so a prescriptive focus on individual disciplines or sectors may not resolve workforce issues; a more holistic approach should be taken to address these challenges.

Today's engineering challenges require a blend of knowledge that cuts across traditional disciplinary boundaries. For instance, implementing renewable energy solutions requires electrical engineers, environmental engineers, geotechnical engineers, control systems engineers and others to create effective, sustainable systems.

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[10] Romanis, J. 'Barriers to Employment for Migrant Engineers; Research Report' *Engineers Australia* (October 2021) https://www.engineersaustralia.org.au/publications/barriers-employment-migrant-engineers

[11] Department of Industry, Science and Resources, Australian Government 'Pathway to Diversity in STEM Review final recommendations report' *Department of Industry, Science and Resources, Australian Government* (13 February 2024) https://www.industry.gov.au/publications/pathway-diversity-stem-review-final-recommendations-report

An engineer's qualification discipline does not always align with the area of practice in which they gain competence, and the discipline does not restrict them to any one particular sector. Some engineers may progress their careers in the same industry they started in after graduating, but many move to other industries or sectors and can develop competencies in one or more areas of practice. For example, an engineer working in the biomedical field may have a background in mechanical engineering but apply those skills towards developing medical devices.

There are also many engineers leading multidisciplinary teams. They will not have the technical expertise of all disciplines represented on the project and so will rely on their broad knowledge across the sector and the discipline experts in the team to achieve the project objectives. Engineering occupations span various ANZSCO/OSCA categories due to the varied nature of engineering disciplines. The whole engineering team is required to achieve the best results:

- Engineering Associate requires an advanced diploma (2-year degree).
- Engineering Technologist requires a bachelor's in science engineering (3-year degree).
- Professional Engineer requires a bachelor's in engineering (4-year degree).

The need for experienced engineers

Ensuring that the correct skills are targeted to enable experienced engineers to migrate to Australia can alleviate workforce challenges. Supplementing domestic talent pools with seasoned professionals who possess honed expertise and can mentor younger engineers can help address skills challenges and foster innovation within the industry. Experienced engineers can also contribute to the timely delivery of critical infrastructure projects, bolstering economic growth and sustainability.

In engineering, gaining experience through practice is critical to an engineer's ability to practice competently. An engineer's value is not only in the deep understanding of theoretical principles but also in their ability to draw on practical insights and tacit knowledge gained through years of hands-on work on diverse projects and with different teams. Seasoned professionals bring a nuanced perspective to problem-solving, risk assessment, and innovation that would not be present in inexperienced engineers.

To mitigate the risk of adverse outcomes in engineering projects, it is standard practice that experienced engineering professionals have oversight of projects undertaken by more junior engineers. This is because engineering often involves making decisions with long-term implications under conditions of uncertainty and in the absence of complete information. Attempts to substitute experienced capability with headcount will likely lead to inefficiencies and potentially increase the risk of not meeting project objectives, including timeframes, health and safety outcomes and costs.

Engineers Australia values the opportunity to contribute to the consultation on Queensland's 2025-26 State Nominated Skilled Migration program. Our commitment to addressing the complex challenges facing the engineering profession, particularly regarding workforce shortages and skills development, remains steadfast.

ENGINEERS
AUSTRALIA

Registration of Engineers in NSW

Engineers Australia NSW Reforming Building Laws Submission

November 2022

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Table of Contents

1 Introduction

1.1 Purpose of this document

Engineers Australia supports the efforts of the NSW Government to reform the building industry in NSW and to implement the recommendations of the *Building Confidence Report*.

Engineers Australia has prepared three submissions in response to the proposed building reform laws and associated Regulatory Impact Statements. These submissions are:

1. *NSW Reforming Building Laws* submission
2. *Registration of engineers in NSW* submission (this document)
3. *The issue with insurance requirements for engineers* submission

This document provides Engineers Australia's feedback to the proposed Building Bill 2022, specifically in relation to the registration of professional engineers. This should be read in conjunction with Engineers Australia's *NSW Reforming Building Laws* submission and *The issue with insurance requirements for engineers* submission.

1.2 Engineers Australia

Engineers Australia (EA) is the peak member- based professional association for engineers. Our work is supported by around 100,000 members, including about 25,000 in NSW. Established in 1919, Engineers Australia is constituted by Royal Charter to advance the science and practice of engineering for the benefit of the community.

The term 'community' is used in its widest sense, and the issues raised in this submission seek to improve outcomes for everyone. Engineers Australia's contribution is designed to help create a legislative framework to deliver a better-performing engineering sector with clearer accountability of those involved.

The majority of engineers provide their services competently, ethically and with diligence. However, in the absence of regulation for engineering, anyone could purport to be an engineer and provide engineering services without appropriate competencies and with disregard to standards and ethical practice.

Engineering services are vital to national economic prosperity and social well-being, yet there is no uniform regulatory regime for engineering practitioners in Australia.

Engineers Australia maintains national professional standards, aligned with the International Engineering Alliance standards. As Australia's signatory to the International Engineering Alliance, we have authority to accredit higher education engineering programs and credential experienced engineers against international independent practice standards. Engineers Australia also manages Australia's largest voluntary register for engineers, the National Engineering Register (NER).

2 Key Recommendations

The existing engineer registration legislation (*Design and Building Practitioners Act 2020*) provides for general professional engineer registration that is broadly consistent with the national model based on the Queensland and Victorian legislation despite some process inconsistencies. These inconsistencies include scope (restricts to certain classes of building), unspecified standard of competence and variation in what constitutes eligible pathways. Harmonisation of registration schemes across Australia, allowing for Automatic Mutual Recognition (AMR) and/or Automatic Deemed Registration (ADR) is a high priority for industry so that the unnecessary administrative burden associated with navigating different systems does not impact productivity. The current NSW Reforming Building Laws proposals would move engineering registration in NSW further away from a nationally consistent model. To be more aligned with a nationally consistent model, it is recommended that the NSW Government:

1. **Establish a NSW Professional Engineers Registration Act**

   The best way for NSW to align with other jurisdictions is to develop a NSW Professional Engineer Registration Act based on the Queensland/Victoria model.

   Until a Professional Engineer Registration act can be implemented in NSW, **Engineers Australia does not support modification of the three pathways to registration for engineers should the Building Bill proceed**.

2. **Ensure registration covers all areas of engineering**

   Potentially significant health, safety and economic risks exist beyond the building sector if engineering work is conducted by unqualified or incompetent persons. Engineers Australia recommends that statutory registration of professional engineers should apply to professional engineers who provide professional engineering services in any area of engineering in any industry. Not doing so could encourage those unsuitable to do engineering work to transfer into sectors in which engineering work is not subject to registration, thereby increasing risk in those sectors. It will also disadvantage NSW engineers compared to those in jurisdictions with comprehensive registration with respect to mutual recognition.

3. **Accept an agreed set of registration standards and assessment processes.**

   The Queensland and Victorian acts require practice standards and assessment processes to be consistent with national and international standards and these should be clearly linked to the International Engineering Alliance (IEA) *Graduate Attributes and Professional Competencies*. Engineers Australia is a member of the IEA and is recognised as the custodian of Australian competency standards by all other IEA members. NSW should accept an agreed set of registration standards and assessment processes consistent with these national and international standards.

4. **Facilitate Automatic Mutual Recognition for a professional engineer registered in NSW.**
   The *Mutual Recognition Act 1992* enables an individual who is registered in an occupation in one state to be registered in the equivalent occupation in another. Mutual recognition relies on equivalence. A professional engineer registered in a tightly confined area of engineering in NSW may not be recognised as equivalent in other jurisdictions with general registration of professional engineers, while broadly registered professional engineers in other jurisdictions are eligible to be registered and do work in NSW. NSW should move as quickly as possible to general registration of professional engineers in NSW to facilitate the advantages of automatic mutual recognition.

5. **Approve consistent guidelines for professional associations that operate as assessment entities and validate the operational model and performance of entities.**

   For a nationally consistent co-regulatory approach to work, the NSW Government must approve appropriate professional associations as assessment entities. Importantly, it is necessary to validate their scheme's operation and its alignment to national and international standards. Pathway 2 for the existing NSW *Design and Building Practitioners Act* allows for this mechanism. A requirement for national consistency and mutual recognition is confidence that the regulators in other jurisdictions make sound judgements about which assessment entities operate sound assessment schemes in accordance with national and international standards.

3 The Benefits of Registration

Registration is the first recommendation of the Building Ministers Forum's (BMF) Shergold Weir report because it is the logical first step; it creates a system to recognise people likely to perform competently, and a mechanism to exclude those found to be unsuitable to work as an engineer.

All registration systems have the same basic characteristics in that practice standards must be set, qualifications accredited, candidates examined or assessed for competency, and a register of competent professionals maintained. Performance must be monitored, and failures investigated and disciplined. A register has greater effect if supported by the regulatory sections of government (refer Section 5 - A Co-Regulatory Approach).

Compulsory registration for anyone providing professional engineering services will enable significant enhancement of public safety and consumer protection. More broadly, there are six key benefits of a registration system for engineers[1]:

1. Reducing risks to public health, safety and welfare through strengthening confidence in the competency of the people who deliver professional engineering services;
2. Economic benefits from reduced cost of re-work and improved system performance;
3. Improved industry and consumer information about who is competent to deliver professional engineering services;
4. Professional recognition for registered engineers;
5. Enhanced national and international mobility and trade in engineering services; and
6. Legislative efficiency enabling regulators to more effectively develop, implement and improve consistent regulatory frameworks for the delivery of engineering services consistently in a timely manner.

Statutory registration of professional engineers should apply to anyone who provides professional engineering services, and in any area of engineering in any industry. The only exceptions would include those performing professional engineering services under the supervision of an appropriately registered engineer or if only applying prescriptive standards or designs. Consideration of registration for other members of the engineering team including associates and technologists is not addressed in this submission.

The current provisions for registration of professional engineers in Part 3 of the *Design and Building Practitioners Act 2020* largely meet these aims. Engineers Australia understands the reasons why these provisions were initially limited to engineers doing work on Class 2 buildings, but notes that the provisions as enacted allow for expansion so that registration of professional engineers is required in all areas of engineering.

Engineering services are often discussed in the context of the building sector—and often apartment buildings as a sub-set of that industry. However, engineers provide critical services and products as solutions to many complex challenges across many industries, like public infrastructure, power generation, manufacturing and mining.

It would be a missed opportunity if the registration scheme for professional engineers in NSW was not applied more broadly, and not doing so would transfer risk to sectors in which engineering work is not subject to registration. Registration of professional engineers has a significantly broader scope in Queensland, Victoria and soon to be the Australian Capital Territory.

[1] https://www.engineersaustralia.org.au/sites/default/files/resource-files/2022-05/registration-engineers-case-for-statutory-registration.pdf

4 Nationally Consistent Engineer Registration

Engineers have an important role to play in developing a more robust Australian economy and improving quality of life for Australians. A consistent national registration scheme model for professional engineers will address skills shortages by facilitating mobility of engineers within Australia and in attracting engineers with internationally recognised qualifications. The cornerstones of such as scheme are already in place.

Whilst Engineers Australia recognises that regulation of occupations is a matter for the states and territories, there are successful models for national consistency including:

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.

The Intergovernmental Agreement on the Automatic Recognition of Occupational Registration[2] defines the objective of the AMR as being to promote the freedom of movement of service providers across jurisdictions by reducing unnecessary burden, while maintaining high standards of consumer protection, and the health and safety of the workers and the public. It also emphasises that improving occupational mobility through AMR of registrations will help employers access registered skilled workers more quickly, and at lower cost, by more seamlessly moving employees to where they are most needed and matching job seekers with employment opportunities, boosting competition, productivity, and economic growth.

It is the strongly and clearly expressed wish of individual engineers and engineering businesses in Australia to have a single, nationally consistent scheme of registration where an individual or business need only register once to demonstrate competence and be permitted to deliver professional engineering services anywhere in Australia. The current *ad hoc* expansion of registration schemes is not delivering this.

There is now a solid base for consistent statutory registration of professional engineers in Queensland, Victoria, NSW and shortly in the Australian Capital Territory and Western Australia. This comes from applying the key provisions of the Queensland *Professional Engineers Registration Act 2002*, either as a stand-alone act (Victoria, ACT) or as a self-contained module within a broader act (NSW, Western Australia). Engineers Australia is communicating with the Commonwealth, and State and Territory governments to advocate a national commitment to consistent registration of professional engineers based on the Queensland model. The model has demonstrated, over many years, to function effectively with current best practice being a stand-alone Professional Engineers Act in each jurisdiction. A federal model act could support this ambition but will take time to progress.

The Regulatory Impact Statement (page 52) states that "the original design of the DBP legislation did not intend for the registration/licensing framework for professional engineers to be held in the DBP legislation." The current proposal in NSW to remove the professional engineer registration module from the *Design and Building Practitioners Act 2020* and merge it into a general registration scheme for building occupations in a new Building Bill further distances professional engineer registration from the consistent national model. Engineers Australia does not support this move, and strongly recommends that the existing module remains as initially implemented until it can be moved to a Professional Engineers Act to align with the national model. Should the module be moved to a new Building Bill, Engineers Australia would seek to provide additional feedback.

As there is legislation for professional engineer registration in Queensland, Victoria and NSW and likely soon to be in the Australian Capital Territory and Western Australian, it is critical that the alignment of standards and requirements are monitored to enable mutual recognition. Engineers Australia is currently engaging with the relevant regulator in each state and territory and are planning a regulatory forum to agree on actions to make the co-regulatory model work more effectively. It is suggested that this forum could progress the alignment of legislation and processes towards a truly national scheme.

[2] https://federation.gov.au/sites/default/files/about/agreements/amr-iga-signed-11-december-2020.pdf

A national scheme would consist of:

1. **A stand-alone Professional Engineers Registration Act in each state and territory.**

This is already the case in Queensland and Victoria and is the intended model in the Australian Capital Territory. The Queensland and Victorian Acts provide a template for a model Act that NSW could enact and that other states and territories could (and should) adopt so that consistency across Australian jurisdictions is achieved.

2. **Registration to cover all areas of engineering.**

This is an important public safety and quality requirement that Queensland has applied successfully since 1929. While introduction of new regulation may need to be phased, and there are sound grounds to start with high-risk areas, comprehensive coverage will uphold standards for all engineering work and ensure that all engineers can be held accountable for their work. Not doing so could encourage those unsuitable to do engineering work to transfer into sectors in which engineering work is not subject to registration, thereby increasing risk in those sectors.

3. **An agreed set of registration standards and assessment processes.**

The Queensland and Victorian acts require practice standards and assessment processes to be consistent with national and international standards and these should be clearly linked to the International Engineering Alliance (IEA) Graduate Attributes and Professional Competencies. Engineers Australia is a member of the IEA and is recognised as the custodian of Australian competency standards by all other IEA members. NSW should accept an agreed set of registration standards and assessment processes consistent with these national and international standards.

4. **Automatic mutual recognition in each jurisdiction for a professional engineer registered in one jurisdiction**.

The *Mutual Recognition Act 1992* of the Commonwealth includes the mechanism for automatic mutual recognition and is dependent on registration in a "home state". Professional engineers whose home state does not have a registration scheme, or one which does not cover the relevant area of engineering, are not eligible for automatic mutual recognition and so expansion of registration to all areas of engineering to all states and territories is a priority. Ineffective mutual recognition places unnecessary burden on engineers and businesses that operate in more than one jurisdiction and can impact productivity.

5. **Consistent guidelines for and approval of professional associations as assessment entities.**

An issue for national consistency and mutual recognition is that the regulator in each jurisdiction must have confidence that the regulators in other jurisdictions make sound judgements about which professional associations are approved to assess competency, and the standards and processes they apply.

5 A Co-Regulatory Approach

Engineers Australia supports a co-regulatory model of registration, initially introduced in the Queensland *Professional Engineers Act 2002*, which includes statutory regulatory bodies and professional associations each undertaking the various roles they are best suited to perform. The co-regulatory model provides greater assurance of the competency of registered engineering practitioners and reduces the risk of physical and financial harm to consumers. This approach allows industry and assessment entities like Engineers Australia to assess the qualifications and competency of practitioners and empowers government to maintain registers and prosecute unregistered work. It also draws on the technical expertise of association members to assess conduct and complaints while empowering governments to investigate and take disciplinary action.

Table 1 Responsibilities within a co-regulated engineering profession

Professional Associations	Regulators
Consistent national standards of competency	
Verify applicant identity	Nationally consistent legislation
Develop and implement assessment schemes	Approve and monitor assessment schemes
Assess qualifications, relevant experience and competency to practice	Verify applicant identity, including fitness tests
Implement complaints and disciplinary processes	Register engineers, and maintain a register
Benchmark and audit assessment scheme performance	Investigate and prosecute offenders
Maintain assessment capability and capacity	Powers to compel and take disciplinary action
Provide and audit continuing professional development requirements	Specify continuing registration requirements (including continuing professional development)

5.1 The Role of Regulators

Under a co-regulatory approach, legislation governing the delivery of engineering services in states and territories should:

- Be nationally consistent to deliver consistent registration outcomes, lower costs for the industry, improve mobility of professional engineers, and reduce risks.
- Restrict who delivers professional engineering services to competent individuals.
- Restrict the 'registered' title to those who are on an engineering register.
- Register engineers in the broadest possible areas of engineering practice aligned with the areas of practice and not by industry sector, with the onus on each registered engineering practitioner to only undertake work that he or she is competent to undertake.
- Base registration on a competency assessment, against agreed standards, by approved assessment entities.
- Include a mandatory continuing professional development regime for ongoing registration.
- Investigate complaints, take disciplinary action and apply penalties where appropriate against registered professional engineers.

5.2 The Role of professional associations

The role of professional associations in a co-regulatory approach is to provide expertise and services in the assessment of applicants to regulators in the registration process. Professional associations are uniquely positioned to offer the assessment service based on their knowledge and experience with national and international engineering practice standards acquired over a period of time.

Professional association members' qualifications, experience and competency are often already assessed as part of their membership and/or credentials. The maturity of these assessments will vary depending on the purpose of their professional association and their knowledge of, and engagement with, national and international recognised professional engineering standards. Assessment by approved professional bodies with validated standards can form a strong foundation for state-based registration schemes and can be available to both members and non-members.

The following requirements are considered the minimum requirements for registration for independent practice as a professional engineer in Australia. The Engineers Australia voluntary National Engineering Register (NER) for all disciplines is consistent with these requirements.

1. An IEA Washington Accord recognised qualification (or assessed equivalent).
2. At least five years of relevant experience in the Area of Engineering being sought for registration.
3. Demonstration of at least the following five of the sixteen Engineers Australia independent practice (Stage 2) competencies.
    i. Deal with ethical issues
    ii. Practise competently
    iii. Develop safe and sustainable solutions
    iv. Identify, and assess and manage risks
    v. Local engineering knowledge
4. A commitment to ethical practice (e.g. Engineers Australia's Code of Ethics) and (if applicable, a jurisdiction's Code of Conduct).
5. A demonstrated commitment to undertaking Continuing Professional Development (CPD) while registered of at least 150 hours every three years.
6. Any other requirements for a given jurisdiction (for example: for practice in the building sector, knowledge of the National Construction Code and relevant standards; some jurisdictions stipulate a minimum number of years of experience in Australia).

Where other requirements are considered necessary, these should be kept to a minimum.

Competent and ethical engineers also demonstrate that they have access to an appropriate level of Professional Indemnity Insurance (PII) for their engineering services whilst registered.

6 Current Issues and Proposals that Undermine National Consistency

Even where registration and disciplinary processes are consistent with the national model they must work efficiently and be flexible to deal emerging or unexpected issues. Engineers Australia has previously identified process design flaws in the *Design and Building Practitioners Act* and in conjunction with Consult Australia and the Insurance Council of Australia has raised some of these with the Minister for Fair Trading. Some of these design flaws place unreasonable burdens on individual engineers and may act as a disincentive for engineering businesses to provide services in NSW. The Reforming Building Laws in NSW proposals will perpetuate and extend these design flaws, with the likely outcome that the reforms will not provide the intended protections. Engineers Australia recommends that these process design flaws be corrected in any new legislation.

6.1 Registration of Individuals

The existing Queensland and Victorian Professional Engineers Acts register individuals with the required professional engineering skills and competencies. In NSW the *Design and Building Practitioners Act* , including Part 3, provides for the registration of "persons", defined in the *Interpretation Act* to include an individual, a corporation and a body corporate or politic. Regulation 31 of the Design and Building Practitioners Regulation provides that the Secretary must refuse to register a body corporate as a registered professional engineer. This may leave it open to the Secretary to register a corporation as opposed to a body corporate or politic, but in practice the Secretary is only registering individuals at the moment.

In the current NSW proposal to move registration of professional engineers into a general registration scheme in a Building Bill, the registration scheme provides for the registration of "persons". There is no indication that this will be limited by regulation to individuals.

There are sound grounds to differentiate between individuals registered on the basis of individual training, skills and competency and businesses registered on the basis of organisational and financial capacity to trade. Nevertheless, a nationally consistent scheme for registration of professional engineers is limited to individuals. Engineers Australia believes this is best protected through a stand-alone Professional Engineers Act rather than relying on regulations to limit a more general power in a multi-occupation registration scheme.

The majority of professional engineers work as officers or employees of a separate business. Very few operate as sole traders. The existing provisions for professional engineers in the *Design and Building Practitioners Act*, the Design and Building Practitioners Regulations and in draft subsidiary legislation such as the proposed Engineering Practice Standard blur the distinction between individual and business.

The Queensland and Victorian Professional Engineers Acts use the expression "professional engineering services" to describe what professional engineers do, and what may only lawfully be done by a registered professional engineer. The *Design and Building Practitioners Act* and the proposed Building Bill use the expression "professional engineering work" to describe the same. An interim step to national consistency would be for NSW to adopt a stand-alone Professional Engineers Act on the Queensland and Victorian models that clearly limits registration to individuals and adopts the standard terminology of "services".

Engineers Australia recommends that NSW restrict registration of professional engineers and registration offences to individuals in the principal legislation, to be as consistent as possible with the Queensland and Victorian Acts.

6.2 Mutual Recognition

Australian governments have agreed to a nationally uniform approach to mutual recognition based on the *Mutual Recognition Act 1992* of the Commonwealth. In 2001 this Act was amended to provide for automatic mutual recognition (AMR). Although there are transitional processes affecting the application of AMR, it is expected that this should apply to professional engineer registration.

Engineers Australia supports AMR as a key component of nationally consistent registration, with the effect that an individual professional engineer need only be registered in the engineer's home state in order to do professional engineering work while present in, or for a project located in, any other Australian jurisdiction. Engineers Australia also supports the use of the International Register to provide international mutual recognition in appropriate circumstances.

The mutual recognition principle applies to "equivalent occupations". Professional engineering is carried out in a consistent way in each Australian jurisdiction, and it is commonly understood to be an equivalent occupation. However, this status can be undermined by legislation with inconsistent descriptions of engineering work or services, inconsistent definitions of areas of engineering and inconsistent assessment schemes.

The Queensland *Professional Engineers Act 2002* clearly covers all areas of engineering, although registration can be in separately prescribed areas of engineering. By contrast the Victorian *Professional Engineers Registration Act 2019* defines areas of engineering as structural, civil, mechanical, electrical and fire safety engineering, plus any other prescribed area of engineering. The *Design and Building Practitioners Act* adopts a similar approach.

Engineers Australia supports registration in all areas of engineering and cautions against the prescription of many precisely defined areas for the purpose of registration and registration offences. The important boundary for regulators to administer is between individuals with professional engineering skills and competencies and who are registered as such, and those who do not have these skills and competencies and who are not registered. The boundaries between areas of engineering are blurred and have considerable overlap which make investigation and prosecution of registered professional engineers for area-related registration offences both resource intensive and problematic.

Where there are traditional and broadly defined areas of engineering, such as civil, mechanical and electrical engineering, equivalence can be undermined if registration is limited to sub-sets or particular types of application. NSW has commenced its registration of professional engineers with a severely restricted definition of professional engineering work applied just to Class 2 Buildings. The proposal to place professional engineer registration within a Building Bill suggests an intent never to register professional engineers in any other industry sector.

It is plausible that the regulator in Queensland or Victoria, or in any other jurisdiction that registers professional engineers, might consider, say, civil engineer registration in NSW to do only civil engineering on a Class 2 building is not equivalent to civil engineer registration in Queensland or Victoria to do civil engineering in any industry sector. This means an engineer based in and registered in NSW cannot use the mutual recognition principle to be registered in other jurisdictions and must go through the full assessment process in order to do work outside of NSW. Conversely, a civil engineer broadly registered in Queensland or Victoria can use the mutual recognition principle to be registered in NSW without further assessment.

This asymmetry also disadvantages professional engineers based in NSW when wishing to apply the automatic mutual recognition principle which is also based on equivalence of occupations. Under AMR a broadly registered civil engineer in Queensland or Victoria is permitted to do all civil engineering work in NSW while a narrowly registered civil engineer in NSW is only permitted to do civil engineering on Class 2 buildings in Queensland or Victoria.

This narrow approach to registration of professional engineers places both individual engineers and engineering businesses based in NSW at a commercial disadvantage to those based in other jurisdictions such as Queensland and Victoria. It is far more viable to operate a national or international engineering business out of a jurisdiction with comprehensive, broad-based professional engineer registration than it is to operate from a jurisdiction with limited or no registration of professional engineers. This is another reason why Engineers Australia does not support the narrow registration of professional engineers implied by transferring registration to a new Building Bill and recommends retaining registration as currently enacted in the *Design and Building Practitioners Act* until a stand-alone Professional Engineers Act can be developed.

6.3 Co-Regulation and Assessment Entities

The *Queensland Professional Engineers Act 2002* introduced co-regulation by providing for the approval of assessment entities and assessment schemes. The requirements for approval are set out in the Act. This introduces a pathway for individuals to satisfy the regulator that they are eligible to be registered rather than the pathway in some legislation where the regulator assesses the skills and experience of each applicant. The *Victorian Professional Engineers Registration Act 2019* adopts the assessment scheme approach.

The primary mechanism for registration in NSW provides three pathways for an applicant to demonstrate the required skills and knowledge:

Pathway 1 - Apply to the Secretary and provide the Secretary with all the evidence and details of qualifications and experience for the Secretary to assess them.

Pathway 2 - Apply to the Secretary and provide evidence of recognition or registration by an engineering body recognised by the Secretary;

Pathway 3 - Apply to the Secretary and provide evidence of recognition or registration by a professional body of engineers that has a Professional Standards Scheme (PSS).

Pathway 2 is broadly consistent with the co-regulatory regime adopted in Queensland and Victoria (and, proposed for the Australian Capital Territory).

Engineers Australia has previously expressed concerns regarding the implementation of pathway 1. These concerns relate to the pathway not including an assessment of competency against agreed standards, and assessments being completed by a compliance team that do not have the same expertise (or systems) as professional associations.

The *Design and Building Practitioners Act* and the Design and Building Practitioners Regulations set out the requirements for recognition of professional bodies of engineers for pathway 2 for registration. The requirements for recognised professional bodies are also broadly comparable with the requirements in the Queensland and Victorian Acts but are structured and worded differently. Engineers Australia recommends aligning the wording and requirements in the Regulations to the nationally consistent wording in the Queensland and Victorian Acts as an interim step before moving registration of professional engineers into a stand-alone Professional Engineers Act.

The proposed Building Bill provides a head of power for approval of professional bodies but requires the detailed provisions to be prescribed in regulations. For national consistency Engineers Australia strongly recommends that the requirements for assessment of professional bodies of engineers be prescribed in the principal act using the nationally consistent wording including the required competency standard.

The third pathway, Professional Standards Scheme (PSS), is unique to NSW. The requirements for a professional body to establish a PSS under the Professional Standards Acts are very similar to the requirements in the Queensland and Victorian Acts to be recognised as an assessment entity. However, membership of a professional body of engineers that has a PSS is not necessarily equivalent, unless the relevant scheme applies the same standards, eligibility requirements and ongoing commitments as required through Pathway 1 and 2. For this reason Engineers Australia does not support it in its current form.

The draft Building Bill appears to further narrow the pathways available to the Secretary and to applicants by combining the second and third pathways so that the Secretary may only approve a professional body that has adopted a PSS. This is a process design flaw in the Bill. The Secretary has no control over which professional bodies may set up or maintain a PSS. If none do, then there is no co-regulatory mechanism for registration and the Secretary must assess each applicant's skills, knowledge or experience with the necessary time, cost and resourcing implications. The Professional Standards Acts and regulations do not allow businesses with fee income exceeding $20 million to be members of a PSS, thus excluding employees of such businesses from this pathway. If only niche or specialist professional bodies set up a PSS it is unlikely that mainstream engineers will join such bodies just to engage a second path to registration. In these cases, it may be more expedient to apply for registration through an assessment entity in another jurisdiction and then rely on Automatic Mutual Recognition to work in NSW. This process design flaw will make it less attractive for engineering businesses to operate from NSW.

Engineers Australia understands the theoretical benefits to engineers of operating under a PSS, but also understands the difficulties faced by large, multi-faceted organisations to set up schemes under the current limitations in the Professional Standards Acts. The PSS set up by Engineers Australia from 2008-2016 was allowed to expire because of very limited take up. It is likely that most of the approved assessment entities in Queensland and Victoria will not set up a PSS simply to enable this pathway in NSW. This will further undermine national consistency because NSW will not be able to rely on assessments by these entities.

Engineers Australia strongly recommends that the existing second pathway continues to be available to professional engineers and is modified to align it more closely with the nationally consistent use of assessment entities by Queensland and Victoria. This is best achieved in the short term by leaving the process for registration of professional engineers in the *Design and Building Practitioners Act* until it can be moved to a stand-alone Professional Engineers Act on a nationally consistent basis.

6.4 Continuing Professional Development

Engineers Australia supports Continuing Professional Development (CPD) and its standardisation across jurisdictions. Currently Engineers Australia's CPD requirements include 150 hours over three years with at least 50 hours towards an individual's area of engineering, 10 hours towards risk, and 15 hours towards business and management. Engineers Australia is reviewing CPD requirements and considering including ethics, and sustainability. Ethics is a CPD requirement of the Board of Professional Engineers Queensland (BPEQ).

Queensland and Victoria have taken the approach of requiring 150 hours over three years with each jurisdiction specifying their own breakdown.

The Australian Building Codes Board (ABCB) Continuing Professional Development on the NCC and Ethics 2021 provide guidance on CPD on the NCC and ethics. In doing so, they also emphasise the need for consistency across jurisdictions to facilitate mutual recognition.

Engineers Australia notes that the CPD requirements outlined in NSW's proposed reforms do not match the nationally consistent requirements. CPD requirements for engineers are fundamentally different compared to building practitioners and provide another reason on why registration of engineers should be contained in a stand-alone Professional Engineers Registration Act. Engineers Australia also suggests that NSW, rather than adopting an annual approach to CPD, consider adopting a requirement of 150 hours over three years specifying their own breakdown that applies and may include CPD on ethics and the NCC. This will be a positive step towards consistency of CPD requirements across jurisdictions.

7 Conclusion

Statutory registration of professional engineers should be nationally consistent and apply to anyone who provides professional engineering services, and in any area of engineering in any industry.

Engineers Australia recommends the proposed changes to the *Design and Building Practitioners Act* and proposed NSW Building Bill 2022 be reviewed and brought into line with a nationally consistent registration system for professional engineers that can be implemented across Australia.

The changes should include:

1. Creation of a stand-alone NSW Professional Engineers Act.
2. A registration scheme which covers all areas of engineering.
3. An agreed set of registration standards and assessment processes, aligned to national and international standards
4. Facilitation of Automatic Mutual Recognition for engineers registered in NSW.
5. Approve consistent guidelines for professional associations as assessment entities and validation of these assessment entities' scheme operations and performance to provide confidence to other regulators for AMR and to consumers of engineering work. Ensure Pathway 2 is included for professional bodies should the Building Bill proceed, as is provided for in the *Design and Building Practitioners Act*.

Engineers Australia appreciates the continued opportunity to support the NSW Government in reforming building laws. For further discussion about this submission, please contact the Engineers Australia's team at policy@engineersaustralia.org.au.

Yours sincerely,

Jane MacMaster FIEAust CPEng NER

Chief Engineer, Engineers Australia

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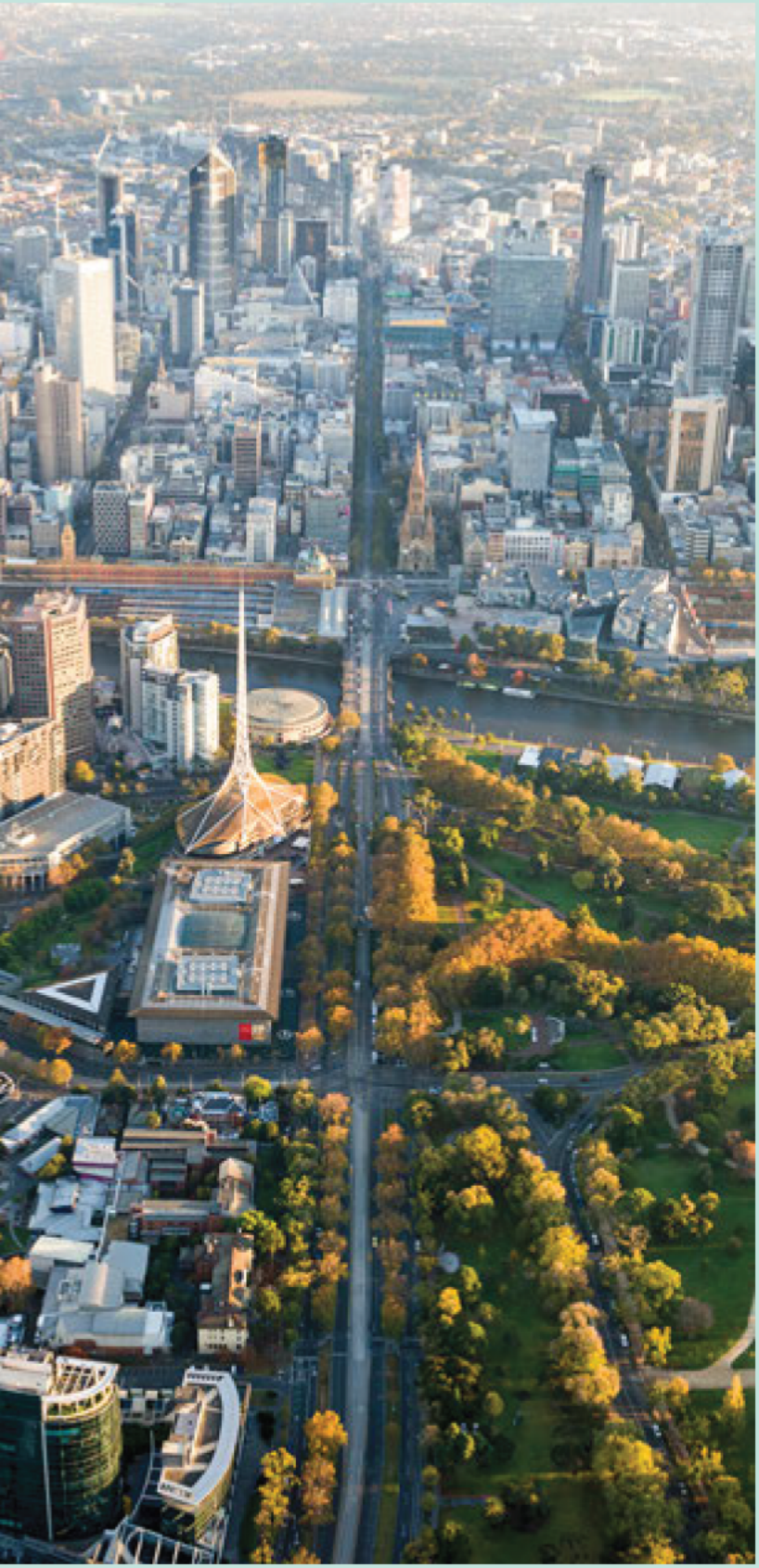

Enhancing productivity in infrastructure delivery

Policy directions paper

March 2022

Enhancing productivity in infrastructure delivery: Policy directions paper

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Executive Summary

Adequate infrastructure is essential to support a sustainable, liveable, and productive Australia. As part of the economic recovery response to COVID-19, governments have committed to a significant number of infrastructure projects at various stages of development, and to fast-tracking shovel-ready projects. Despite this, longstanding flaws in project planning, procurement and capability, and barriers to the uptake of innovative design and new technologies, will impede productivity and delivery.

This infrastructure policy directions paper provides recommendations from Engineers Australia on the measures required to enhance economic productivity in Australian infrastructure delivery. These recommendations will assist to increase productivity in the infrastructure sector, and determine how engineers can best contribute to meaningful, evidence-based development of policy in support of these aspirations.

Efficient and effective infrastructure is vital to our country's economic prosperity. Federal, state and territory governments must commit to a coordinated project pipeline through collaboration, thorough application of risk-management practices, a mature approach to project governance and procurement, and funding for infrastructure investments.

Industry also has a crucial role to play in building a healthy and progressive infrastructure sector in Australia. There is an opportunity for government and industry to consider how we collaborate and compete while working towards a prosperous and secure future for our communities and businesses in a post-COVID-19 world. Governments at all levels must work collaboratively to implement the recommendations contained in Infrastructure Australia's *Australian Infrastructure Plan 2021*.

Pipelines need to reflect priorities, based on risk and value, but flexibility is essential as priorities change. All political parties should commit to risk- and value-based prioritisation, derived from a risk assessment process, to provide a more objective list of project requirements and outcomes.

Infrastructure projects are mostly medium-to-long-term endeavours, taking many years to reach completion. Procurement processes are often unreasonably complex, with tendering and contracting issues regularly preventing small-to-medium-sized enterprises (SMEs) from equitable participation. Improving management and project procurement practices is essential as we move toward a more sustainable, productive, and resilient future.

Access to lessons learned is also necessary to drive desired behaviours in infrastructure project management, delivery, and operations. Greater collaboration is needed on this issue between government, contractors, and industry, but ensuring in-house technical capability is also vital.

Engineers Australia believes new models for infrastructure planning, funding and delivery are critical. A firm pipeline provides continuity, which is imperative to long-term planning. The infrastructure schedule of works should have committed project funding for at least the first five years of work, with additional prioritised projects for the following five years.

There also needs to be clarity on the applicability of the 'common design' approach and more scope for customised solutions. Engineers Australia recommends balancing a focus on national design standards, guidelines, and specifications, which would drive efficiency and control cost, with innovation.

Broad uptake and use of digital technologies at all phases of asset lifecycles will enhance productivity in infrastructure delivery and operation. Governments must allocate funding for training and upskilling the labour force and subsidise programs to promote collaboration between industry and academia to encourage greater integration of current and emerging technologies. In addition, people from a range of socioeconomic and sociocultural backgrounds, with different genders, abilities, and experiences, must be included in the planning and design of infrastructure assets. Homogeneity in teams limits innovation and leaves blind spots in planning and riskmanagement practices.

Infrastructure is the basis of civilisation, and longstanding challenges can be addressed through the recommendations contained in this paper. There are significant opportunities for reform to enhance productivity at all stages of infrastructure project lifecycles.

1. Introduction

Infrastructure is the cornerstone of civilisation. Adequate infrastructure is essential to support a sustainable, liveable, and productive Australia.

As part of the response to economic recovery in the wake of COVID-19 and associated restrictions, governments have committed to streamlining the infrastructure development process, and to fast-tracking shovel-ready projects. Despite this, longstanding flaws in project planning, procurement and capability, and barriers to the uptake of innovative design and new technologies, will impede productivity. There are significant opportunities for reform to enhance productivity at all stages of infrastructure project lifecycles.

This infrastructure policy directions paper provides recommendations from Engineers Australia on the measures required to enhance economic productivity in Australian infrastructure delivery.

In this document, the term *infrastructure refers to the classes of economic infrastructure for which the Australian Bureau of Statistics provides data. These include: roads; highways and subdivisions; bridges; railways; harbours; water storage and supply; sewerage and drainage; electricity generation, transmission and distribution; pipelines; telecommunications; recreation assets; and assets related to oil, gas, coal, and other minerals.*

Engineers Australia is the peak body for the engineering profession in Australia. With more than 105,000 members, we represent individuals from a wide range of engineering disciplines and branches. Engineers Australia is constituted by Royal Charter to advance the science and practice of engineering for the benefit of the community. This policy directions paper is guided by our Royal Charter and Code of Ethics, which state that engineers act in the interests of the community, ahead of sectional or personal interests, working towards a sustainable future.

1.1 Consultation process

This policy directions paper is based on a series of roundtable discussions with Engineers Australia members, and broad consultation with internal and external members of the engineering profession, members of peer peak bodies, engineering industry professionals and representatives, specialists from academia and government, and other relevant stakeholders. These discussions constituted the initial consultation phase.

In late 2020, three roundtable briefings were held with Engineers Australia members. These were facilitated by the Infrastructure, Industry and Productivity chapter lead for Infrastructure Australia's *Australian Infrastructure Plan 2021 and chaired by Engineers Australia members. The Engineers Australia infrastructure series discussion paper Enhancing productivity in infrastructure delivery (the discussion paper) was developed based on feedback from these consultations.*[1]

The discussion paper was reviewed by Engineers Australia members and formed the basis of a roundtable discussion with executive-level representatives from across infrastructure-interested sectors. Feedback on the discussion paper, roundtables, and subsequent consultations have informed the recommendations contained in this policy directions paper.

1 Engineers Australia, *Enhancing productivity in infrastructure delivery: Infrastructure series discussion paper*, March 2021, accessed February 2022 https://www.engineersaustralia.org.au/government-and-policy/external-voice-project

1.2 Overview

The extensive consultation process outlined in section 1.1 identified 20 recommendations for reform to support greater productivity and industry in the nine areas:

1. Project governance and planning
2. Collaboration
3. Risk management
4. Procurement
5. Lessons learned
6. Whole-of-life investment
7. Capability and diversity
8. Common design and industrialised construction
9. Digital infrastructure and innovation

This document provides recommendations for implementation by Australian governments, in collaboration with industry and academia, to increase productivity in the infrastructure sector and to determine how engineers can best contribute to these aspirations.

1.3 Next steps

This policy directions paper will provide the basis for further consultation to inform the initiatives and advocacy campaigns Engineers Australia will undertake, including in collaboration with others in the infrastructure sector, to contribute to a more productive, innovative, and resilient Australian infrastructure industry.

Engineers Australia's infrastructure workstream includes work on important future topics that will complement this paper. These topics include sustainability and resilience in infrastructure, cities, regions and remote communities, water, the future of transport, social infrastructure, telecommunications and digital and waste and the circular economy.

Engineers Australia welcomes the opportunity to discuss the content of this paper with interested parties. If you would like to engage with the work being undertaken, please contact policy@engineersaustralia.org.au

2. Recommendations

2.1 Project governance and planning

Recommendation 1: Governments must commit to long-term collaborative planning to mitigate the negative effects of short-term electoral cycles on infrastructure planning and delivery.

Recommendation 2: The House of Representatives Standing Committee on Infrastructure, Transport and Cities should consider establishing an advisory group, comprised of representatives from across infrastructure industry, associations, and academia, to advise on best practice in planning, delivery, and maintenance of Australian infrastructure.

Recommendation 3: The Standing Committee, working with the advisory group, should engage a broad range of stakeholders to develop an infrastructure industry playbook. This would be a best-practice guide mandating key policies to optimise benefits and minimise risk in infrastructure project management, delivery, and operations.

Recommendation 4: The sector must better communicate the desired outcomes of projects and embed sustainability, resilience and circular economy principles at all stages of the asset lifecycle.

2.2 Collaboration

Recommendation 5: Governments at all levels must work collaboratively to implement the recommendations contained in Infrastructure Australia's *Australian Infrastructure Plan 2021 particularly the sustainability and resilience recommendations outlined in Section 2.*

2.3 Risk management

Recommendation 6: Best-practice risk management processes must be embedded into business-case planning and project lifecycle processes. They should include all stakeholders to identify, control, mitigate and report on risks at each critical project stage.

Recommendation 7: Risk-informed management practices require frameworks to manage risk across the value chain and to ensure appropriate allocation, reporting and discipline, and proactive management of risk and return at all stages of the project lifecycle.

2.4 Best-practice procurement

Recommendation 8: Essential reform of tendering processes should be considered. This would include: providing visibility of cost to tender bidders; early engagement of potential bidders before the request for tender stage; acceleration of the shortlisting and awarding processes, and of common projects that have been successfully delivered previously; and consideration of stage-based tender processes and in-house design teams to allow equitable participation of a broader bidder market.

Recommendation 9: Engineers Australia recommends governments implement a consistent procurement framework across all levels and between all departments associated with interrelated infrastructure, applying the ISO 55000 series of standards for asset management for consistency across states and territories.

Recommendation 10: 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.

Recommendation 11: In addition to independent statutory infrastructure bodies (iBodies) providing training to decision-makers, relevant technical experts must be incorporated into all project planning, procurement, and decision-making processes at all stages of the project lifecycle.

2.5 Lessons learned

Recommendation 12: Engineers Australia recommends the Australian Government consider use of funding and payment withholding mechanisms to incentivise knowledge capture and sharing at project kick-off and completion.

Recommendation 13: Engineers Australia recommends that the Australian Government develop and implement a widely accessible, centralised database for lessons learned, with limited intellectual property controls.

2.6 Depoliticised whole-of-life investment

Recommendation 14: State and territory treasuries should develop a whole-of-life infrastructure benchmarking tool and mandate its use on projects of national significance.

2.7 Capability and diversity

Recommendation 15: Engineers Australia supports a halt on tenders between 18 December and 4 January to allow for holiday leave, recognising that the wellbeing of project teams is essential to innovation, quality, and good project outcomes.

Recommendation 16: State and territory governments should provide specialist programs to support skilled migrants to transition into occupations that align with their skills and qualifications, and should provide greater opportunities for them to engage in leadership roles across the sector. Where such programs exist, they should be subject to regular review to determine efficacy and allow for continuous improvement.

Recommendation 17: People from various socioeconomic and sociocultural backgrounds, with different genders, abilities, and experiences, must be included in the planning and design of infrastructure assets to maximise accessibility for all users.

2.8 Common design and industrialised construction

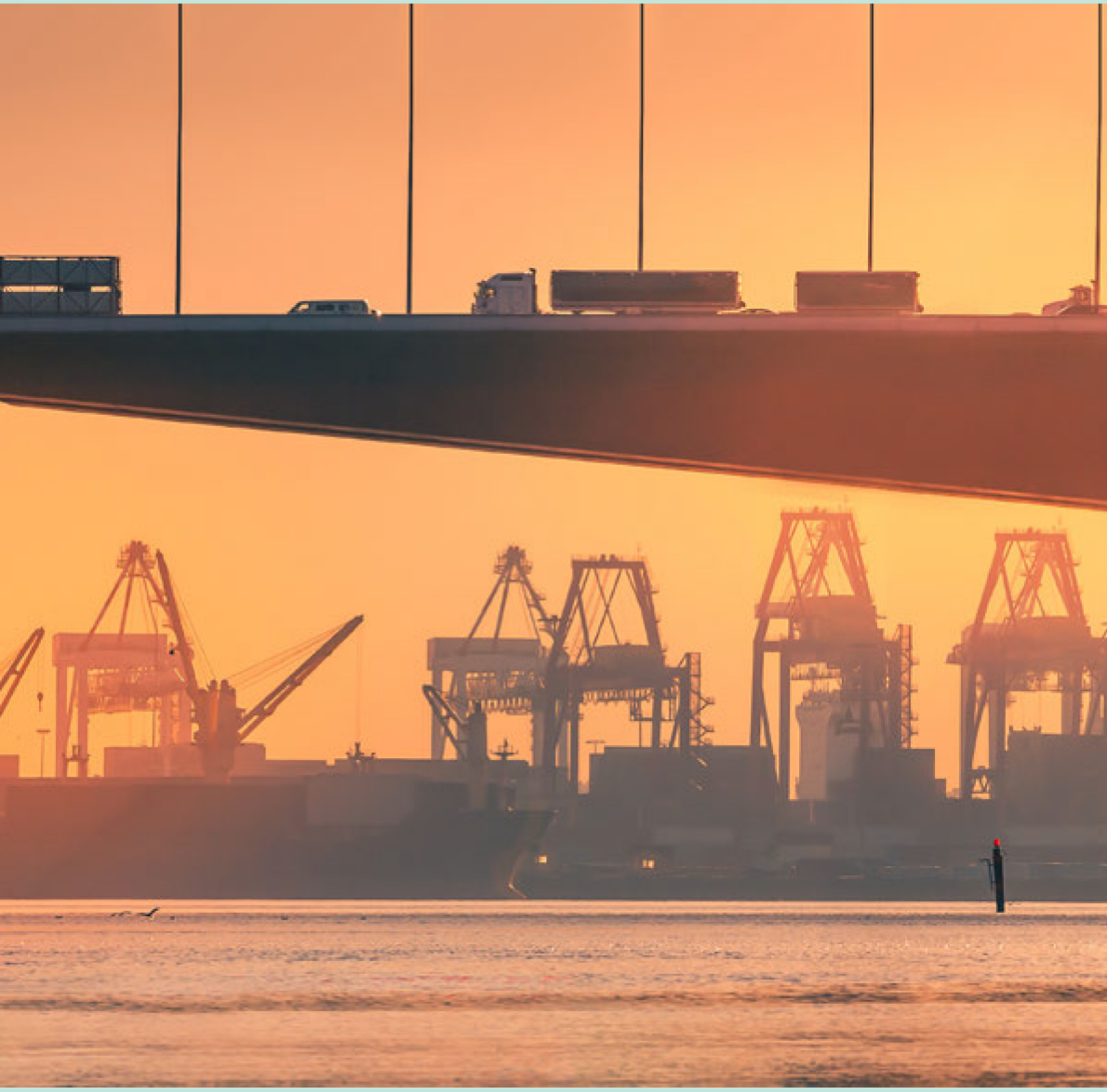
Recommendation 18: Engineers Australia recommends government and industry collaborate to nominate specific processes or products to be purchased across the project pipeline, while providing mechanisms for implementing customised solutions as required.

Recommendation 19: Engineers Australia recommends government and industry collaborate to ensure consistent national design standards, guidelines, and specifications, which would drive efficiency and control cost.

2.9 Digital infrastructure and innovation

Recommendation 20: Governments must allocate funding for training and upskilling of the labour force, and subsidise programs to promote collaboration between industry and academia to encourage greater integration of current and emerging technologies. This will be essential to designing a better future for Australian infrastructure.

Recommendation 21: Governments must provide a streamlined grants process and additional funding for start-ups and scale-ups to support innovation (for more information, refer to Engineers Australia's *Commercialisation of engineering innovation discussion paper*).



3. Project governance and planning

Australia is relying on governments to improve the management of project pipelines to boost our economy in the wake of the COVID-19 pandemic and to ensure we are future-ready. Collaborative, cross-sectoral, long-term planning of infrastructure is critical to sustainable economic prosperity.

The Australian Government must work with governments at all levels to commit to continuous improvement through best-practice project governance, planning, procurement, and delivery. Federal, state and territory governments must also commit to a coordinated project pipeline through collaboration, thorough application of risk-management practices, a mature approach to project governance and procurement, and funding for infrastructure investments.

Best practice requires that governments at all levels, and across all parties, work together to ensure a reliable and productive pipeline. Intergovernmental forums have been subject to several reviews, which have highlighted limited success in improving productivity. With the dissolution of the Council of Australian Governments (COAG) and the formation of the National Cabinet in March 2020, there is an opportunity for bipartisan, intergovernmental commitment to long-term planning. However, it is not enough for governments to simply talk to each other about the issues impacting the stability and productivity of our infrastructure project future. Engineers Australia recommends the establishment of an advisory group of relevant and diverse stakeholders to provide expert guidance to the House of Representatives Standing Committee on Infrastructure, Transport and Cities on specific issues in infrastructure industry.

An opportunity identified by Engineers Australia members and other key stakeholders is for the Australian Government to develop a blueprint for best practice in infrastructure construction.

The United Kingdom released the Construction Playbook to set out key policies and guidance for how public works projects and programs are assessed, procured, and delivered.[2] Whether a playbook or a blueprint, Australian infrastructure industry requires clear guidance on how to implement the existing Infrastructure Investment Program and the recommendations contained in the *Australian Infrastructure Plan 2021 to enable successful delivery.*

While not covered in detail in this paper, sustainability and resilience of infrastructure is an important overarching topic that requires consideration at every stage of an assets lifecycle. More severe and frequent extreme weather events – in the form of bushfires, flood and drought – disruptions due to the COVID-19 pandemic and geopolitical conflicts have exposed Australian infrastructure to heightened and more complex risks in recent years. These ongoing, and in many cases escalating issues, should inform every facet of the infrastructure conversation. The importance of this topic is highlighted in Infrastructure Australia's *Australian Infrastructure Plan 2021* with reforms concerning sustainability and resilience being considered in every chapter of the plan.[3]

An interdependent relationship exists between productivity and resilience as it relates to infrastructure. Investment, both monetary and time, in rebuilding and repairing damaged or offline infrastructure prevents the development of new capabilities and hinders growing demand by delaying other projects.

2 Cabinet Office, *The Construction Playbook: Government guidance on sourcing and contracting public works projects and programmes*, Version 1.0, Cabinet Office, HM Government, December 2020, accessed February 2022 https://www.gov.uk/government/publications/the-construction-playbook

3 Infrastructure Australia, *Reforms to meet Australia's future infrastructure needs: 2021 Australian Infrastructure Plan*, 2021 accessed 15 March 2022 https://www.infrastructureaustralia.gov.au/2021-australian-infrastructure-plan

Productivity within the sector is likely to decrease without a concerted effort to improve the resilience of current and future infrastructure.
Resilience goes further than just extreme weather events, and also includes supply chains, skills and cyber threats. To assist in responding to this issue the *Australian Infrastructure Plan 2021* proposes taking a systems approach to resilience, starting with developing a nationwide understanding of the risks being faced, and sharing accountability across all partaking organisations.[4]

Likewise, reforms are needed to enhance sustainability within the sector. Infrastructure Australia's *Delivering Outcomes: A roadmap to improve infrastructure industry productivity and innovation*[5] calls for the sector to improve conveying desired sustainability outcomes to better facilitate the development of solutions, by focusing on the needs of people and place. Change is required to focus on longer-term decision making processes which are clear and comprehensive and recognise the future value derived by focusing on sustainability and resilience.

Due to the magnitude and complexity of this topic, Engineers Australia proposes to explore infrastructure sustainability and resilience in dedicated discussion papers and directions papers.

Recommendation 1: Governments must commit to long-term collaborative planning to mitigate the negative effects of short-term electoral cycles on infrastructure planning and delivery.

Recommendation 2: The House of Representatives Standing Committee on Infrastructure, Transport and Cities should consider establishing an advisory group, comprised of representatives from across infrastructure industry, associations, and academia, to advise on best practice in planning, delivery, and maintenance of Australian infrastructure.

Recommendation 3: The Standing Committee, working with the advisory group, should engage a broad range of stakeholders to develop an infrastructure industry playbook. This would be a best-practice guide mandating key policies to optimise benefits and minimise risk in infrastructure project management, delivery, and operations.

Recommendation 4: The sector must better communicate the desired outcomes of projects and embed sustainability, resilience and circular economy principles at all stages of the asset lifecycle.

4 Infrastructure Australia, *Reforms to meet Australia's future infrastructure needs: 2021 Australian Infrastructure Plan*, 2021 accessed 15 March 2022 https://www.infrastructureaustralia.gov.au/2021-australian-infrastructure-plan

5 Infrastructure Australia, *Delivering Outcomes: A roadmap to improve infrastructure industry productivity and innovation*, 2022 accessed 21 March 2022 https://www.infrastructureaustralia.gov.au/publications/delivering-outcomes

4. Collaboration

Industry also has a crucial role to play in building a healthy and progressive infrastructure sector in Australia. The swift transitions required in response to COVID-19 pandemic restrictions have highlighted the need to reassess our infrastructure requirements for the future.

There is an opportunity for government and industry to consider how we collaborate and compete while working towards a prosperous and secure future for our communities and businesses in a post-COVID-19 world.

Engineers Australia supports the work of independent statutory infrastructure bodies (iBodies) and their assessments of long-term infrastructure needs. However, meaningful integration requires cross-party and multi-departmental commitment to using iBody recommendations for priority projects.

In the United Kingdom, Project 13 is an industry-led response to infrastructure delivery models that have failed clients, suppliers, operators and users of infrastructure systems and networks.[6] The platform seeks to shift infrastructure delivery from a transactional model to an enterprising one. Its potential lies in promoting supply chain integration, enabling smart, collaborative working practices, and aligning commercial arrangements and incentives with customer and end-user outcomes. It emphasises the need to recognise infrastructure as an information-based industry. The benefits of Project 13 are greater certainty, productivity, performance and value in delivery and operation, and a more sustainable, innovative, and highly skilled industry. At its core, Project 13 relies on collaboration between owners, partners, advisers and suppliers through direct exchange, knowledge sharing and long-term alliances.[7]

Engineers Australia had the opportunity to provide engineering expertise to inform development of Infrastructure Australia's *Australian Infrastructure Plan 2021*[8]. *The recommendations contained in the Plan should be implemented according to the suggested sponsors and timelines.*

Recommendation 5: Governments at all levels must work collaboratively to implement the recommendations contained in Infrastructure Australia's Australian Infrastructure Plan 2021 particularly the sustainability and resilience recommendations outlined in Section 2.[9]

6 Project 13, *Project 13* [website], n.d., accessed 14 February 2022 https://www.project13.info/
7 Project 13, *About Project 13* [website], n.d., accessed 14 February 2022 https://www.project13.info/about-project13/
8 Infrastructure Australia, *Reforms to meet Australia's future infrastructure needs: 2021 Australian Infrastructure Plan*, 2021 accessed 15 March 2022 https://www.infrastructureaustralia.gov.au/2021-australian-infrastructure-plan
9 Infrastructure Australia, *Reforms to meet Australia's future infrastructure needs: 2021 Australian Infrastructure Plan*, 2021, p199, accessed 15 March 2022 https://www.infrastructureaustralia.gov.au/2021-australian-infrastructure-plan

5. Risk management

Pipelines need to reflect priorities, based on risk and value. However, as new information, technologies and risks develop or are identified, priorities may need to change. Such flexibility needs to account for works completed, costs incurred, and other commitments already applied. All political parties should commit to risk- and value-based prioritisation, derived from a risk assessment process, to provide a more objective list of project requirements and outcomes.

Major infrastructure projects are complex, lengthy and involve many diverse stakeholders at various stages throughout project lifecycles. These projects are regularly plagued by significant time delays, cost overruns, failed procurement, or funding difficulties. Many of these issues are avoidable, and result in significant losses to GDP and quality of life.

While some appetite for risk is necessary to encourage innovation, risk analysis is often undermanaged at various stages of the project lifecycle and value chain.

Thorough risk assessment in the initial project phase is critical to limiting risk in the next phase. Implementing continuous risk-management practices to monitor and control at each critical stage mitigates against realisation of identified risks at later project stages.

Proper consideration of appropriate risk allocation must consider the appetite and capability of potential owners to absorb risk. Those stakeholders should be engaged early and often to ensure responsibility and accountability throughout the project lifecycle. Inappropriate allocation of risk undermines the professional indemnity insurance market, breeding instability and contributing to a continuation of the boom–bust cycle. Risk management practices must be embedded into business-case planning and project lifecycle processes, and should include all stakeholders to monitor, control, mitigate and report on risks at each critical project stage.

Recommendation 6: Best-practice risk management processes must be embedded into business-case planning and project lifecycle processes. They should include all stakeholders to identify, control, mitigate and report on risks at each critical project stage.

Recommendation 7: Risk-informed management practices require frameworks to manage risk across the value chain and to ensure appropriate allocation, reporting and discipline, and proactive management of risk and return at all stages of the project lifecycle.

6. Best-practice procurement

Infrastructure projects are mostly medium-to-long-term endeavours, taking many years to reach completion. Procurement processes are often unreasonably complex, with tendering and contracting issues regularly preventing small-to-medium-sized enterprises (SMEs) from equitable participation.

Improving management and project procurement practices is essential as we move toward a more sustainable, productive, and resilient future.

Reform of tendering processes will be critical to providing SMEs with a chance to compete. Participation of SMEs is good for projects and good for the economy, but lengthy and costly processes have largely excluded such players from competing for large contracts. The cost to businesses of submitting a tender can sometimes outweigh the return on investment. Industry and government alike would benefit from greater visibility of how much it would cost a company to submit a tender. Early engagement with industry before tender should be encouraged to promote open dialogue between businesses and government. This would support greater transparency, knowledge capture and sharing, and equitable participation across the market. Including the estimated cost of the tender submission during pre-tender engagement processes would give the government insight into the cost barriers for some potential bidders. Solutions should then be explored to support reducing these costs, such as staged tenders or removing certain aspects from the tender and bringing those elements in-house, to allow for a healthier and more diverse market.

The procurement process sets the tone for the project. Setting the standard and behaviours of the project early, focusing on quality and safety, rather than lowest cost, is critical to developing the right project culture. Without compromising on quality and safety, the acceleration of decision-making in the awarding of tenders and commencing work is critical to hastening economic recovery in response to COVID-19. With government commitments to accelerating shovel-ready projects to stimulate the economy after restrictions ease, common projects that have been successfully delivered in the past could also be considered for acceleration. Provided that lessons learned have been captured, some cost savings could be achieved by simplifying tendering processes for such standard projects.

Ensuring that project bidders are shortlisted promptly can also assist in limiting the time and money spent by companies that are identified as unsuitable. Prequalification schemes must be reviewed to allow for greater diversity of potential bidders, and where existing bidders are prequalified, any requirements for previously provided material should be removed. Review and reform of procurement processes to improve national consistency will be essential to enhancing Australian productivity in infrastructure delivery. Stage-based tendering can and does work well in some industries. 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.

Due diligence activities must be applied in the early stages of all infrastructure projects for them to succeed. Engineers Australia supports Infrastructure Australia's recommendation to 'Uplift quality of infrastructure decision-making through development of delivery and training for key decision-makers on due diligence and de-risk, construction innovation, timing of project announcements, commercial and legal and project governance'.[10] While such training would be undeniably beneficial and is considered essential, the importance of engaging broad technical expertise in these early-phase processes cannot be overstated.

10 Infrastructure Australia, *Reforms to meet Australia's future infrastructure needs: 2021 Australian Infrastructure Plan*, 2021, p62, accessed February 2022 https://www.infrastructureaustralia.gov.au/publications/2021-australian-infrastructure-plan

It is impossible to deliver the breadth of training required for complex infrastructure projects in one program. So, while it is recommended that decision-makers are trained in the areas above, they must continue to engage and rely upon multidisciplinary infrastructure experts, including engineers, to advise on aspects where they do not possess the technical knowledge. Appropriate technical expertise in decision-making is vital to project success. Relevant expertise also assists with ensuring products sourced are fit-for-purpose and of suitable quality. Without adequate technical expertise, it will be difficult to maximise benefits and minimise risks.

The Office of Projects Victoria established the Australian Major Projects Leadership Academy to build and maintain the capability in complex infrastructure project delivery. This 12-month program has been developed and delivered in collaboration with the Oxford Saïd Business School and provides leaders of complex major projects with best-practice training. Current participants include state government and infrastructure agencies across Australia, to develop public sector capability. Similar training should be made available to private-sector clients to promote project success in both public and private infrastructure investment and planning. Ideally, the Victorian model should be emulated and accessible across all jurisdictions, and brought in-house in the various state and territory project offices and departments. Such models also provide access to a valuable network of project leaders with a platform to share insights, lessons, and case studies in a non-adversarial way.

Although states and territories have implemented asset management plans based on recommendations contained in the *Australian Infrastructure Plan 2016*, the four phases of the asset lifecycle – acquire, operate, maintain and dispose – are not embedded into planning, design, delivery, and operations. Governments need to implement a consistent framework across all levels and between all departments associated with interrelated infrastructure. Engineers Australia recommends applying the ISO 55000 series of standards for asset management to optimise management of Australian infrastructure assets, maximise value and make asset management consistent across states and territories.

Recommendation 8: Essential reform of tendering processes should be considered. This would include: providing visibility of cost to tender bidders; early engagement of potential bidders before the request for tender stage; acceleration of the shortlisting and awarding processes, and of common projects that have been successfully delivered previously; and consideration of stage-based tender processes and in-house design teams to allow equitable participation of a broader bidder market.

Recommendation 9: Engineers Australia recommends governments implement a consistent procurement framework across all levels and between all departments associated with interrelated infrastructure, applying the ISO 55000 series of standards for asset management for consistency across states and territories.

Recommendation 10: 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.

Recommendation 11: In addition to iBodies providing training to decision-makers, relevant technical experts must be incorporated into all project planning, procurement, and decision-making processes at all stages of the project lifecycle.

7. Lessons learned

An essential component of driving desired behaviours in infrastructure project management, delivery, and operations is access to lessons learned. Increasingly, technical and specialist knowledge is being subcontracted out. At the completion of the project, the contractor moves on, along with their knowledge, and without this type of feedback, critical lessons are lost and are at risk of repetition in future projects.

Having core knowledge embedded in government agencies is important for oversight across major projects, to guard against repeated mistakes and to promote replication of project successes.

Greater collaboration is needed on this issue between government, contractors, and industry if it is going to be solved, but ensuring in-house technical capability is also vital.

Best practice requires continuous improvement, with an initial and ongoing cyclical review. When partnering, consultants and contractors can showcase work during the tendering process, exploring what was done last time and how it could be improved. Sharing lessons learned should be a condition of project funding and capturing further lessons in post-completion reviews should be a condition of final payment. Reviews should also be made available as a form of knowledge that is applied to future projects. Engineers Australia advises incentivising the review of past lessons at project kick-off and in post-completion evaluations. Lessons learned must be adequately captured in the closing report to ensure transfer of knowledge across major projects. Providing a platform for lessons learned with limited intellectual property controls would promote continuous improvement and avoid repeated mistakes.[11]

Recommendation 12: Engineers Australia recommends the Australian Government consider use of funding and payment withholding mechanisms to incentivise knowledge capture and sharing at project kick-off and completion.

Recommendation 13: Engineers Australia recommends that the Australian Government develop and implement a widely accessible, centralised database for lessons learned, with limited intellectual property controls.

11 Other modes of sharing lessons learned include programs for decision-makers, such as the Australian Major Projects Leadership Academy, and industry-led programs such as Project 13, as described earlier in this document.

8. Depoliticised whole-of-life investment

Engineers Australia believes new models for infrastructure planning, funding and delivery are critical. A firm pipeline provides continuity, which is imperative to long-term planning, particularly given that projects can take 10 to 15 years from strategic planning to commencement of operations. However, politically induced changes and/or shifting project plans create ambiguity. The infrastructure schedule of works should have committed project funding for at least the first five years of work, with additional prioritised projects for the following five years.

This is a challenge under the Australian federal system of government, where funding is allocated by both the Australian Government and the states/territories, but once a project is listed in the immediate schedule or forward works program, it should be committed for completion. There is the risk of a few mega-projects consuming budgetary allocation to the detriment of broader outcomes. However, the pipeline needs to balance budgetary constraints by prioritising projects across a range of asset classes (with predetermined proportion allocations – not solely based on a benefit–cost ratio criteria) and a range of project values.

Unfortunately, during election campaigns, political parties are incentivised to promote projects that appeal to electorates, as opposed to those which have been properly tested through impartial analysis. If viewed only at the electorate level, communities can tend to prioritise initiatives that meet their local needs, rather than taking a state- or nationwide perspective.

Futureproofing infrastructure requires a whole-of-life assessment of risk, cost, and schedule to extract maximum value for money. Whole-of-life assessment must embed resilience and sustainability in infrastructure across the lifecycle and plan for more frequent and extreme weather events associated with climate change. Australia supports *Infrastructure Australia's Australian Infrastructure Plan 2021* recommendation that advises state and territory treasuries to develop a '...nationally consistent whole-of-life infrastructure cost and schedule benchmarking tool and mandate its use on projects of national significance'.[12]

Recommendation 14: State and territory treasuries should develop a whole-of-life infrastructure benchmarking tool and mandate its use on projects of national significance.

12 Infrastructure Australia, *Reforms to meet Australia's future infrastructure needs: 2021 Australian Infrastructure Plan*, 2021, p62, accessed 14 February 2022. https://www.infrastructureaustralia.gov.au/publications/2021-australian-infrastructure-plan

9. Capability and diversity

The lack of diversity and the strain on the capability and capacity of teams, leading to poor mental health outcomes and poor project outcomes, is highly detrimental to attracting and retaining essential expertise in the infrastructure industry. Homogeneity in teams, particularly in decision-making roles, not only demonstrates a lack of inclusivity but also limits innovation and leaves blind spots in planning and risk-management practices. People with similar skill sets are incentivised to change roles, often to assist in tenders, and can find themselves overloaded.

Since early 2020, bushfires, floods and the impact of the pandemic have meant the collective mental health of Australians has suffered. Some industries have found themselves more overloaded than others, and with infrastructure set to pave the way to economic recovery, many construction companies are feeling the pressure to exert resources to support these endeavours. Businesses are calling on clients to support a blackout on tenders during the holiday period to allow recuperation and reconnection with family and friends. Engineers Australia supports these recommendations to halt requests for tenders between 24 December and January 4, recognising the wellbeing of project teams is essential to innovation, quality, and good project outcomes.

The engineering capability challenge must be addressed to harness existing skills, encourage greater participation in tertiary education, and retain talent. This can include providing strategic support for engineers at all stages of their careers for development opportunities and through the creation of an attractive, safe, and inclusive culture. Without the available expertise and skills to deliver projects successfully, model planning will be insufficient in delivering inclusive infrastructure that meets the needs of diverse communities across Australia. Federal, state and territory government's forecasting of infrastructure spending and work such as Infrastructure *Australia's Infrastructure Priority List*, can assist to predict the skills needed in the future.[13] This information can be used to lessen future skills shortages. The technical expertise necessary to deliver efficient, effective, and sustainable infrastructure is multifaceted and requires a mix of graduates, early-career, mid-career, and seasoned experts from varied backgrounds. The sector needs to look at how it can invest in the skills required for tomorrow's infrastructure. This includes investment in young people through promoting engineering early in their education, development of early career graduates and having a greater understanding of the value of migrant engineers.[14] Diversity delivers. Without the inclusion of people from a range of different socioeconomic and sociocultural backgrounds, with different genders, abilities and experiences, projects risk failure to fulfil the broad needs and expectations of Australian communities in infrastructure delivery.

Federal, state and territory governments have implemented programs at various levels to support migrants and refugees to find employment. Barriers exist for skilled immigrants across the engineering sector, and particularly in senior leadership roles. Engineers Australia's *Barriers to employment for migrant engineers*[15] research report has analysed these barriers and delivered recommendations to address them. However, with so many skilled migrant engineers employed in roles that do not reflect the breadth of offshore qualifications and experience, there is an opportunity for state and territory governments to provide specialist programs to connect with skilled migrants who can fulfil the skills supply needs of industry.

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13 Infrastructure Australia, *Infrastructure Priority List 2021*, accessed 11 March 2022 https://www.infrastructureaustralia.gov.au/publications/Infrastructure_Priority_List_2021

14 M Bell and P Briggs, 'Engineering Skills Supply and Demand: Discussion Paper' *Engineers Australia* March 2022, Accessed 11 March 2022 https://engineersaustralia.org.au/government-and-policy

15 J Romanis, 'Barriers to employment for migrant engineers', *Engineers Australia*, October 2021, accessed March 2022 https://engineersaustralia.org.au/Government-And-Policy/Policy-Reports

The lack of gender equality in design has been well documented, with data bias and the design of seatbelts, other protective gear, and virtual reality headsets just some of the examples of products that can result in inconvenient or even fatal consequences for women. The consequences of gendered design and planning extend to infrastructure, and unintentionally impact women disproportionately. A lack of consideration of the way in which gender influences our prioritisation, use and engagement with infrastructure must be considered, and can be addressed by ensuring equitable representation in decision-making roles and at all levels and stages of project lifecycles. The Organisation for Economic Co-operation and Development (OECD) published an Issues Note in March 2019 focused on Gender Equality and Sustainable Infrastructure,[16] which highlighted that infrastructure is essential in providing equal opportunity through connected, safe, and efficient structures and services. Engineers Australia supports the OECD's call for integrated policy towards quality sustainable infrastructure development with a gender lens.

Encouraging greater access to education, training, and employment for First Nations Australian engineers will provide an essential cultural perspective to major infrastructure. The relationship of First Nations Australians to land and country will assist in bringing cultural protections and environmental management principles to major infrastructure projects.

Grant Maher, Chair of the Engineers Australia's Indigenous Engineering Group, believes that incorporating Indigenous perspectives in project planning will help to **'reduce our consumption and waste and come back to that original thinking where you are at one with the lands'.**[17]

Yuin man, Michael Hromek, the technical executive of Indigenous architecture at international professional services firm WSP, advises that 'avoiding building on cultural sites is important, but rather than Aboriginal knowledge being something that shouldn't be disturbed, we should think about how to tap into that knowledge and use it to change the built environment'.[18] *There is an opportunity to bridge the 'gap between concrete and Country'*[19] *through the incorporation of First Nations Australians' history and art into our built environment. With 39 per cent of Aboriginal and Torres Strait Islander people living in outer regional, remote, and very remote Australia, engagement with First Nations Australians representatives is essential when planning infrastructure for these communities.*[20]

Approximately 15 per cent of the global population are living with a disability.[21] Inaccessible infrastructure has a direct impact on the ability of individuals to contribute to society and the economy.

16 OECD Council on SDGs, *Issues Note: Gender Equality and Sustainable Infrastructure*, Organisation for Economic Cooperation and Development, March 2019, accessed 14 February 2022 https://www.oecd.org/gov/gender-mainstreaming/gender-equality-and-sustainable-infrastructure-7-march-2019.pdf

17 M Bower, 'Meet two Indigenous engineers helping to change the profession', *Create*, 12 November 2020, accessed February 2022 https://createdigital.org.au/indigenous-engineers-helping-to-change-profession/

18 R Cooper, 'Incorporating Indigenous knowledge into infrastructure projects', *Create*, 17 November 2020, accessed14 February 2022 https://createdigital.org.au/incorporating-indigenous-knowledge-infrastructure-projects/

19 R Cooper, 'Incorporating Indigenous knowledge into infrastructure projects', *Create*, 17 November 2020, accessed February 2022 https://createdigital.org.au/incorporating-indigenous-knowledge-infrastructure-projects/

20 Australian Bureau of Statistics, *Estimates of Aboriginal and Torres Strait Islander Australians* [data set], ABS website, June 2016, accessed February 2022 https://www.abs.gov.au/statistics/people/aboriginal-and-torres-strait-islander-peoples/estimates-aboriginal-and-torres-strait-islander-australians/latest-release

21 A Agarwal and A Steele, *Disability Considerations for Infrastructure Programmes*, Evidence on Demand and UK Department for International Development, piv, accessed February 2022 https://assets.publishing.service.gov.uk/media/57a08954ed915d3cfd0001c4/EoD_HDYr3_21_40_March_2016_Disability_Infrastructure.pdf, doi: http://dx.doi.org/10.12774/eod_hd.march2016.agarwaletal

Transport and digital technology and energy access are critical, but inclusion of people with disability in all infrastructure planning and design processes is essential in all contexts to ensure accessibility in line with all user expectations. Improving access for people with disability can also benefit a whole range of other users, like cyclists, people with prams, the elderly, and pedestrians. In transport, whole-of-journey assessments must be made to ensure that people with disability are not excluded at any stage of a journey, whether it is multi-destination or requires mixed-mode transportation.

Recommendation 15: Engineers Australia supports a halt on tenders between 18 December and 4 January to allow for holiday leave, recognising that the wellbeing of project teams is essential to innovation, quality, and good project outcomes.

Recommendation 16: State and territory governments should provide specialist programs to support skilled migrants to transition into occupations that align with their skills and qualifications, and should provide greater opportunities for them to engage in leadership roles across the sector. Where such programs exist, they should be subject to five-yearly review to determine efficacy and allow for continuous improvement.

Recommendation 17: People from various socioeconomic and sociocultural backgrounds, with different genders, abilities, and experiences, must be included in the planning and design of infrastructure assets to maximise accessibility for all users.

10. Common design and industrialised construction

Common design implies that design is reduced to selection from a palette of pre-assessed and pre-manufactured options. There needs to be clarity on the applicability of this approach, and more scope for customised solutions.

While industrialised construction seeks to collect building information modelling to mine processes and data in search of efficiencies, and prefabrication reduces on-site construction time, project designs necessarily differ according to geographical and other requirements. Materials applicable to a dry inland climate may not work in a wet coastal environment. Engineers Australia recommends that government, in collaboration with industry, nominate specific processes or products to be purchased across the project pipeline, while providing mechanisms for implementing customised solutions as required.

Standardised infrastructure across states and territories makes longer-term integration and connectivity easier and saves money through high-volume procurement activities. There are benefits to automated design and production processes, but detailed testing, assessment and development of implementation strategies will be necessary before approving proposed solutions. Where government is the asset owner, consideration of strategic allocation of resources through standardised acquisition processes and the creation of a centralised data bank and decentralised flow of information is recommended and may assist in the short term. Transparency and accountability of these processes are essential to market confidence, as is depoliticised consensus-based decision-making.

Increased interstate cooperation and an increased focus on leveraging the supply chain should be key tenets of the infrastructure pipeline.

Research suggests that industrialised construction practices can reduce accidents, costs, time, labour, and waste. Automated systems can work in environments that may be dangerous, thereby reducing safety risks. There is evidence to support improved profitability and better outcomes for the end user achieved through application of industrialised construction principles, which clearly demonstrates the benefits of this approach. This will require development of a clear set of specifications, including guidelines on the development of specifications, quality control, and purchasing. Rather than focusing on common designs, Engineers Australia recommends focusing on national design standards, guidelines, and specifications, which would drive efficiency and control cost.

Recommendation 18: Engineers Australia recommends government and industry collaborate to nominate specific processes or products to be purchased across the project pipeline, while providing mechanisms for implementing customised solutions as required.

Recommendation 19: Engineers Australia recommends government and industry collaborate to ensure consistent national design standards, guidelines, and specifications, which would drive efficiency and control cost.

11. Digital infrastructure and innovation

Broad uptake of digital technologies at all phases of asset lifecycles will enhance productivity in infrastructure delivery and operation. 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. The use of technology has numerous positive impacts on the sector. These inlcude enabling more collaboration and coordination between teams and stakeholders and increasing innovation through improved data capture, enabling a more detailed view of projects.[22]

The Australian Government's Digital Economy Strategy includes some promising measures, such as the Digital Atlas and a pilot program to develop data inventories for government agencies, which will promote transparency and provide evidence to support appropriate investment in infrastructure. However, greater emphasis must be placed on integrating nationally consistent digital approaches to infrastructure project planning and operations now if Australia is going to be ready for the demands of the future. Engineers Australia recommends the establishment of a unit focused on Australia's digital infrastructure future to support agile development and the rollout of digital infrastructure tools.

The exponential rate of technological change is driving a huge disparity between cutting-edge robotic and artificial intelligence (AI) technologies in laboratories and the more manual traditional processes run on-site. To guard against the widening gap, which will make it difficult for some industries to catch up, government and industry must allocate funding for training and upskilling the labour force. Engineers Australia can work with universities to ensure course content provides graduates with knowledge of up-to-date practices and emerging technologies.

Industry 4.0 refers to the Fourth Industrial Revolution, where automation and smart technologies are applied to traditional manufacturing and industrial practices. Industry 4.0 talks extensively about smart data and sensors implemented in workshops or on sites to gather useful data. At first glance, this can be intimidating to businesses, but universities could devise a small sensor and data collection module. Working with industry associations to approach SMEs, universities could provide subsidised technology to fix a sensor on one piece of equipment to demonstrate the ease with which smart systems can be implemented. This would educate SMEs and build confidence, while also providing key data on hidden non-value-added tasks and inspiring the gradual integration of more sensors on other equipment.

Seamless integration of studies and training into existing business structures to support the use of AI, smart sensors, industrialised construction practices, and other new and innovative technologies and processes, will reinforce an innovation-positive work culture. Programs and tools for businesses to benchmark their status will assist in determining the benefits of innovative and new technologies.

22 H Hawkes, 'How digital engineering tools helped bring this major infrastructure project to life' *Create* 14 July 2021, accessed 10 March 2022
https://createdigital.org.au/digital-engineering-tools-level-crossing-removal-project/

Risk and innovation need to be rewarded in the same way that standardisation is rewarded – through cost savings. Government, as the primary client for infrastructure, needs to take more risks on Australian innovation. Specifically, there is a need to take more risk on local SMEs and start-ups rather than relying on subcontractors to large corporations. This is particularly important as the sector faces new challenges such as an increased focus on low carbon infrastructure, ways to support population growth and integration of renewable energy. There is too much focus on de-risking, which pushes providers to do what they know works, rather than focusing on opportunities. In project management, the risk needle needs to be pushed more towards medium rather than low-to-negligible risk and planning to manage that level of risk needs to occur.

Increased commitment to targets dedicated to projects in innovation, practice improvement and development resulting in long-term benefit, will ensure Australia is not left behind as the world moves to a more connected and digital future.

Having certainty of pipeline will encourage innovation and ultimately efficiency, as research and investment will be able to be undertaken in an environment of certainty.

COVID-19 has forced a rethink of the way Australians live, work, and communicate. It has required a rapid response and adaptation in industries and communities everywhere. There is an opportunity for governments and the private sector to invest in research and development and emerging technologies, industries, and careers. There is also the chance to do so with a start-up mindset, which is less constrained than what has worked in the past, and instead reimagines what the future could be. In response to global supply chain disruptions, governments should support measures to improve the capability of Australian manufacturers. In the short term, implementing 'buy local' policies will help domestic suppliers in the procurement phase.

There are further opportunities to link to the innovation sector and set up innovation hubs in regional areas, for example, in agriculture and water. Maintenance upgrades and renovation, as well as a focus on reinvigorating manufacturing industries, will unlock regional growth and provide support for growing populations. Some examples include Gippsland, Victoria, where there is an opportunity to repurpose existing skills and capacity as forestry and power industry activity decreases, and the former car-making city of Geelong, which could be reinvigorated towards the production of electric and automated vehicles.

Recommendation 20: Governments must allocate funding for training and upskilling the labour force and subsidise programs to promote collaboration between industry and academia to encourage greater integration of current and emerging technologies. This will be essential to designing a better future for Australian infrastructure.

Recommendation 21: Governments must provide a streamlined grants process and additional funding for start-ups and scale-ups to support innovation (for more information, refer to Engineers Australia's Commercialisation of Engineering Innovation Discussion Paper).

12. Conclusion

Infrastructure facilitates trade and investment, drives economic growth and mobility, connects communities, and ensures Australians have access to reliable energy, transport, telecommunications, health care, and water.

Longstanding challenges in infrastructure project governance, planning, collaboration, risk management, procurement, review, data gathering and dissemination, capability, design, sovereign supply chains and technology can be addressed through further development and implementation of the recommendations contained in this paper. There are significant opportunities for reform to enhance productivity and outcomes at all stages of infrastructure project lifecycles.

Collaboration across government, industry, tertiary providers, and the community, underpinned by diverse multidisciplinary technical expertise at all stages of the infrastructure project lifecycle and harmonised standards and guidelines, will deliver better outcomes for our cities, regions, and remote communities.

Engineers Australia is committed to supporting government, academia, industry, and the community to achieve best practice for whole-of-life infrastructure investment, risk analysis, governance, and design towards a safe, productive, and resilient Australia.

For further information, contact policy@engineersaustralia.org.au

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Enhancing productivity in infrastructure delivery

Policy directions paper

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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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Chief Executive Officer

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.

ENGINEERS
AUSTRALIA

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%

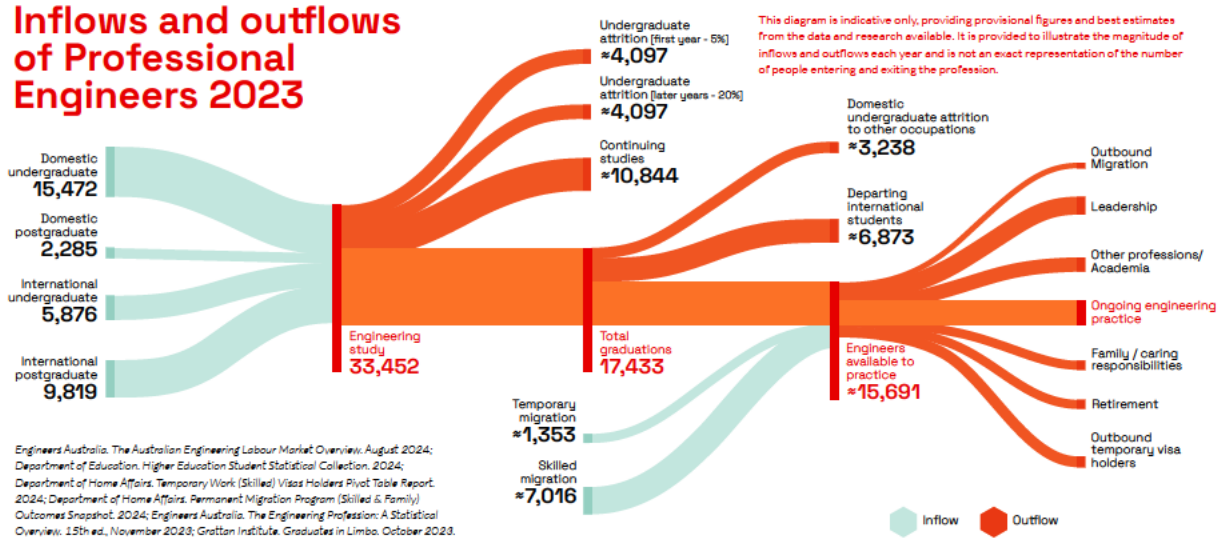
Top 20 occupations

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

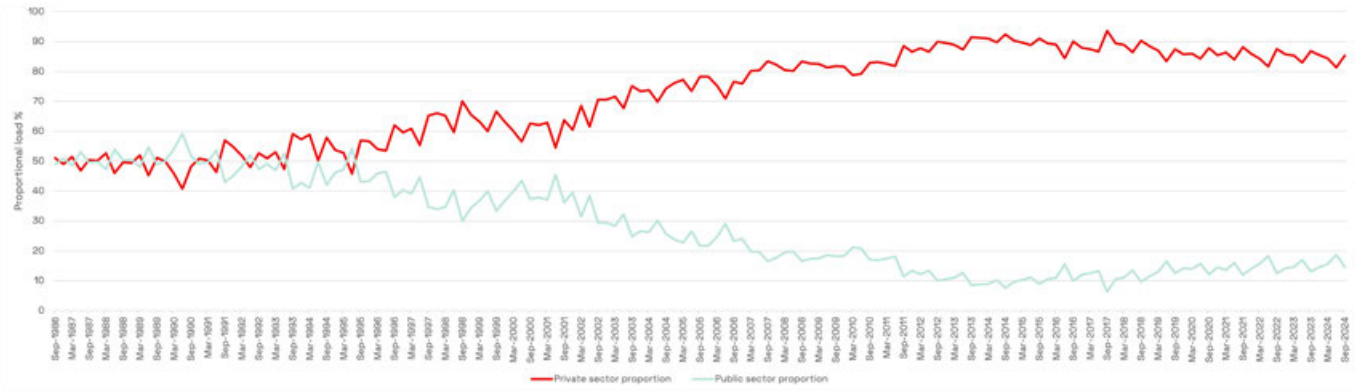
4.0 The declining representation of engineering in government

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

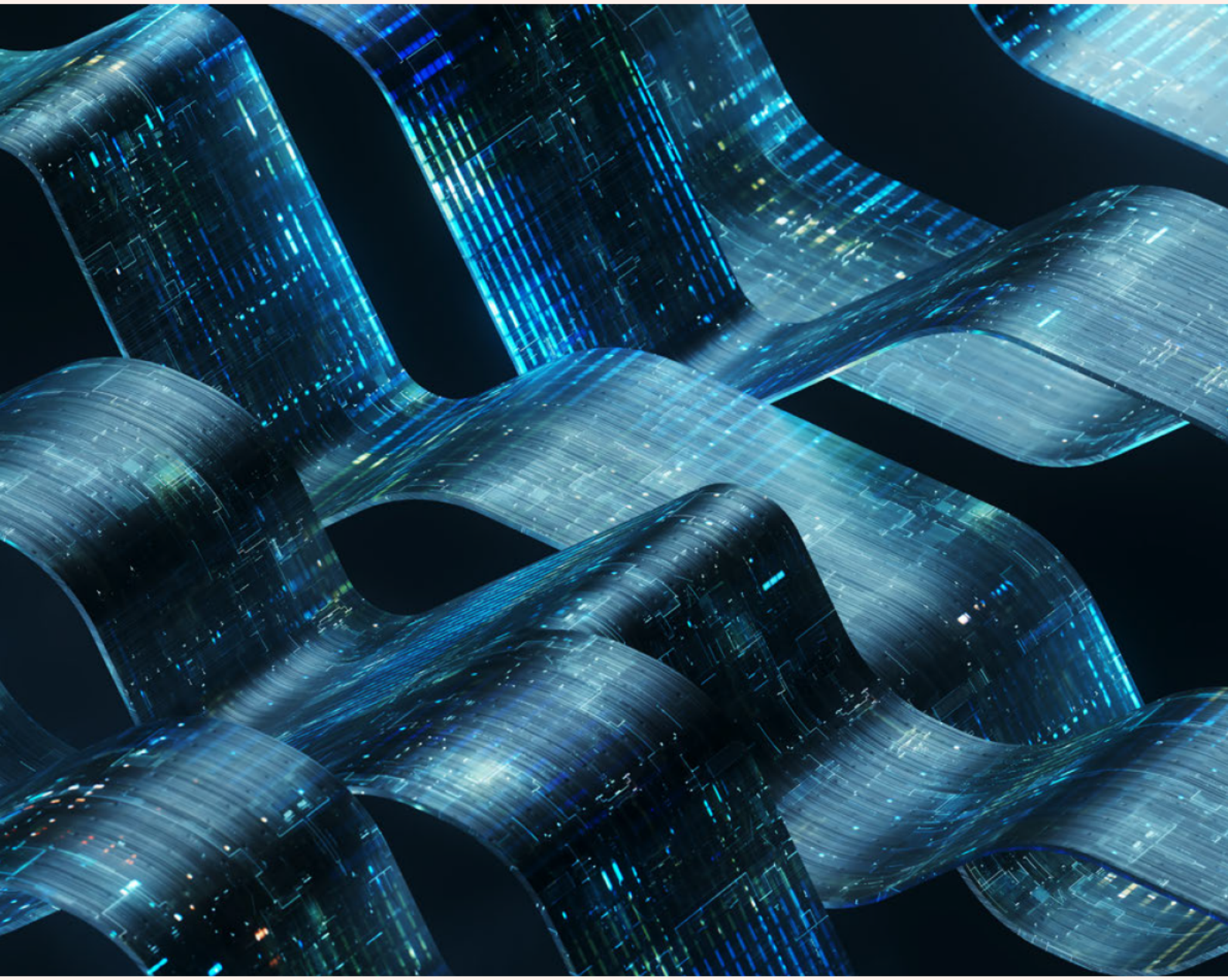
The engineering profession is central to the development of sovereign capability in several defence-adjacent sectors, where engineering expertise is pivotal to advancing national interests. Engineering expertise assists in the creation and maintenance of essential technologies and infrastructure required 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.

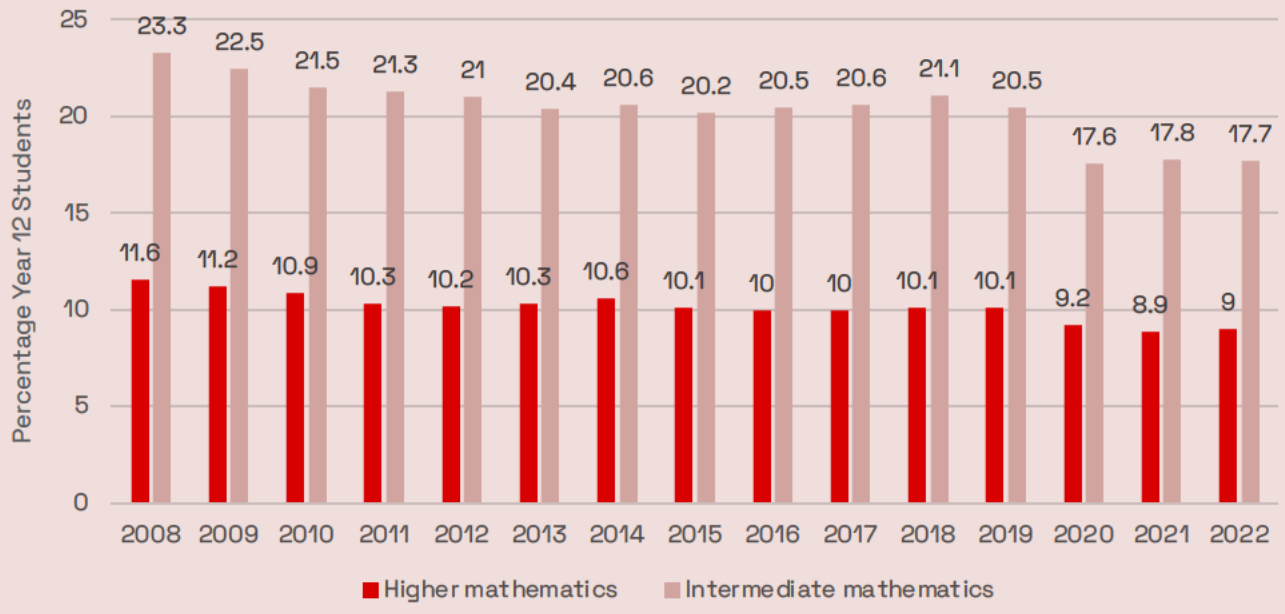
Labour supply challenges

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.

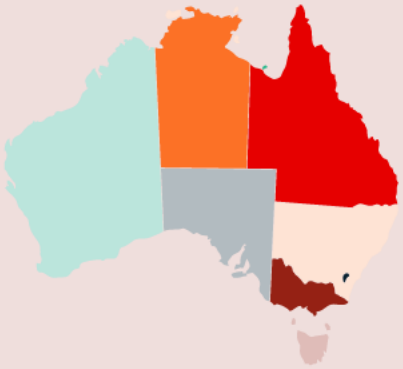
[98] Engineers Australia, Engineering Profession Statistical Overview, 15th Edition, November 2023, https://www.engineersaustralia.org.au/publications/engineering-profession-statistical-overview-15th-edition.

[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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