

ENGINEERS  
AUSTRALIA

# National STEM strategy 2019 - 2023

'Create Tomorrow's Engineers' strategic priority

November 2018



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# The importance of engineering in STEM

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Analysts throughout the world have argued that the way to achieve a technologically based economy is to develop the mathematical, technological and scientific skills of the future workforce. These views have been supported in Australia by the work of the Chief Scientist and have given rise to a broad wave of support for STEM (science, technology, engineering and mathematics) skills in the development of Australia's future workforce<sup>2</sup>. Indeed, it is already apparent that the number of jobs being created which utilise these skills is substantially greater than in areas of traditional skills and unskilled jobs<sup>3</sup>.

New and innovative ideas are the beginning of technological advancement, but it is engineers that translate new ideas into products and services that are commercially attractive in domestic and overseas markets. Engineering and its continuous development over recent decades effectively uses knowledge of mathematics and science to solve real world problems. Australia's ideas boom depends on the skills of engineers to bridge the gap between idea and practical products and services that will drive productivity and economic growth.

Australians have a positive impression of engineers<sup>4</sup>, but few in the community and few political decision makers understand what engineers actually do, how this contributes to community well-being and prosperity and the critical role played by engineers in achieving technological progress.

In the United States, the National Academy of Engineering found that the public did not see engineers as engaged with societal and community concerns as other professions<sup>5</sup>.

Besides turning these views into a more positive perception of engineering, the Academy identified several other important reasons to improve community understanding of engineering including<sup>6</sup>:

- Sustaining national capacity for technological innovation; a better understanding of engineering would educate policy makers and the community as to how engineering contributes to economic development, quality of life, health and national security;
- Improving technical literacy; to be capable, confident participants in a technology dependent society, people must know something about how engineering and science, among other factors, lead to new technologies; and
- Attracting more young people to careers in engineering; a better understanding of what engineers do will encourage students to pursue careers in engineering.

Engineers Australia's role must be to promote engineering and its influence on society, the engineering profession's ability to solve real world problems for policy and decision makers, and to educate tomorrow's engineers on their ability to change the world through engineering. The role of engineers is pivotal, and without sufficient engineers, good ideas will remain just that – good ideas gone nowhere.

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***'Engineering is the knowledge required, and the processes applied, to conceive, design, make, build, operate, sustain, recycle or retire something of significant technical content for a specific purpose'<sup>7</sup>.***



*'No profession unleashes the spirit of innovation like engineering. From research to real world applications, engineers constantly discover how to improve our lives by creating bold new solutions that connect science to life in unexpected, forward thinking ways. Few professions turn so many ideas into so many realities. Few have such direct and positive effect on people's everyday lives. We are counting on engineers and their imaginations to help us meet the needs of the 21st Century.'*<sup>1</sup>

# Engineering skills in demand



Seemingly every week we are greeted with a new piece of research about the importance of building STEM skills in the workforce to secure economic growth in the face of increasing globalisation and automation. Research conducted by the National Centre for Vocational Education Research (NCVER)<sup>8</sup> acknowledges that additional STEM skills are required to support national productivity and prosperity.

Over the five years to 2022, the second largest jobs growth will be in professional, scientific and technical services, (the largest being health care), with only 10% of job vacancies currently reported in this area<sup>9</sup>. The considerable jobs growth in this industry, together with current job vacancies would suggest there is, and will continue to be, a need for graduates from both the higher education and VET sectors with STEM skills.

Further, engineers are far more adaptable than STEM graduates in other fields. This view has been apparent to Engineers Australia for some time and has now been substantiated by a Grattan Institute<sup>10</sup> report which found that this attribute applied both to the areas of their training and in the wider economy. This is because in a modern society, practically every good and service consumed or used in production embodies engineering to some extent.

# Engineers Australia's activity to date



Engineers Australia is the peak body of the engineering profession. We are a member based professional association with about 100,000 individual members. Established in 1919, Engineers Australia is a not-for-profit organisation, constituted by Royal Charter to advance the science and practice of engineering for the benefit of the community.

One of Engineers Australia's key strategic priorities is to 'create tomorrow's engineers', focusing the organisation on the future pipeline of engineers and building STEM skills capability within the workforce of tomorrow.

Engineers Australia has been committed to education and diversity and actively promoting STEM activities nationally. Our state and territory divisions have been dedicated to working across primary and high schools and with workplaces and universities to support programs and activities that promote engagement with foundation STEM subjects. Our division staff and active community of volunteers have been hard at work delivering programs at a local level.

Nationally, Engineers Australia formed the Women in Engineering Group to guide our diversity agenda and provide female engineers a support network in an otherwise male dominated field. We have a national primary school program Engquest that has been actively engaged in primary and early high school classrooms for over 15 years, we developed the STARportal, in collaboration with the Office of the Chief Scientist, Australia's first national, searchable online database of STEM activities. And we continue to support other programs at a national level that engage with teachers and students across the country.

The purpose of this strategy document is to streamline our approach further, to optimise our efforts into a national approach to ensure we maximise opportunities and deliver successful outcomes.

Engineers Australia's key strategic role is of facilitation, to bring the key stakeholders together and work on the scope of the current level of activity, provide guidance on scaling programs and to investigate measurement processes to ensure the programs that are being supported are delivering outcomes.





# The issue starts at school



Australia's capacity to produce its own engineers begins at school. For Australia to develop more of its own engineering workforce we need a sufficient flow of high school students who are interested in engineering and have studied the subjects that engineering relies upon, a firm grounding in science and mathematics. Similarly, if engineering is to increase the number of women in the profession, we need a sufficient flow of young women with these attributes. There is concern about the development of Australia's engineering capability and current high school trends in STEM subjects has put a spotlight on this issue.

A review by the Australian Academy of Science identified over 340 programs available around the country targeting Women in STEM, and with more than 700 STEM based activities available nationally on the STARportal, there is no shortage of programs available.

What we lack is a national approach to STEM. Increasing the awareness of STEM related careers, as well as other career opportunities that can be unlocked by those with STEM skills, will assist in overcoming the negative stereotypes of lab coats and hard hats that the term 'STEM career' evokes. Students can then consider what careers would contribute to solving real world problems, and the skills and knowledge they need, so they can make subject choices that will equip them with relevant skills for a changing work environment.

When looking at the high school numbers in science and mathematics, linked to acceptances of places in university engineering courses and the subsequent number of students accepting places in engineering, the results suggest that Australia's capacity to develop more of its own future engineers is limited by falling participation in year 12 science and mathematics. In the case of women, this is impeded by alarmingly low participation. There is an urgent need to reverse these trends to overcome these limitations.

# The importance of early engagement

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Research shows that fostering engagement in STEM education in primary school positively influences later participation in STEM disciplines, particularly in the senior secondary years<sup>11</sup>. As early as Year 4, the vast majority of students expressed interest in real occupations. This demonstrates that career aspirations start early in life. The challenge is achieving and maintaining these early aspirations in STEM careers so they become a reality. Primary school students were significantly less tentative about careers they might pursue than students in secondary school<sup>12</sup>. This suggests career education should commence in primary school before students are required to choose elective subjects that may propel them on a certain career path<sup>13</sup>. It is particularly important for girls who aspire to STEM careers in engineering or physics, as they are less likely to participate in STEM education in advanced mathematics and physics than boys<sup>14</sup>.

Through the consultations conducted by the COAG STEM Partnerships forum, education and industry stakeholders agreed that targeting high school students with STEM programs is too late. Student attitudes to STEM are established in primary school and this is when the work on engagement and excitement needs to begin.

It was also found that interest in STEM disciplines in early secondary school is a key predictor of interest in later school years, reinforcing the importance for teachers to maintain student interest and achievement levels in STEM skills from an early age, particularly for girls<sup>15</sup>. Several studies point to the lack of female role models in STEM related occupations as a reason for the lack of female interest in STEM careers<sup>16</sup>. There is a similar theme across other underrepresented groups which include Aboriginal and Torres Strait Islanders, low socio-economic students and students in regional and remote areas<sup>17</sup>.

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*“STEM brings the opportunity to integrate classroom activity with ‘real world’ learning” – Australian Primary Principal’s Association.*





*'29 per cent of University qualified STEM graduates are female' <sup>21</sup>*

# Diversity in STEM

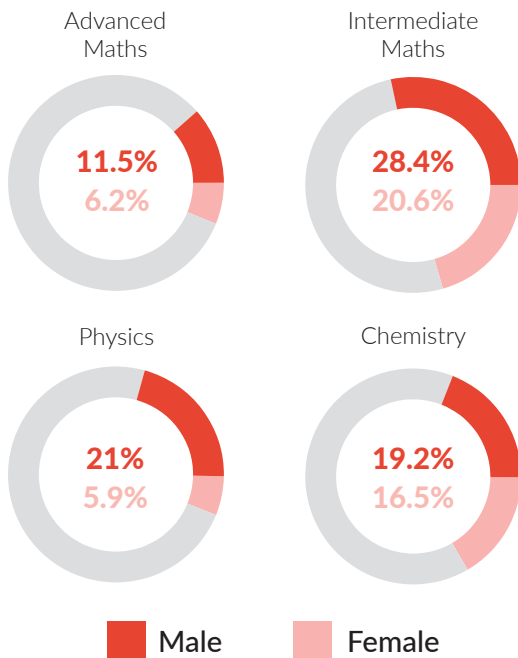
The equitable participation of women in STEM careers will ensure that Australia is drawing on all available STEM talent across the country and that all Australians are equipped for the jobs of the future.

The problem of gender equity in STEM careers is well known. Primary and high school education, subject selection and career awareness are key to increasing the participation of women in STEM based careers.

Participation in science and mathematics is typically far lower among young women than young men. In two year 12 subjects, advanced mathematics and physics, participation by young women is alarmingly low, a fact which requires significant attention.

Engineering has always been a male dominated profession with the current proportion of qualified female engineers at 13%. While recognising that there are numerous workplace and cultural problems that need to be resolved, these numbers suggest a more obvious problem. Participation by young women in critical foundation subjects for engineering is worryingly low and is in stark contrast to their participation in higher education, which is 30% higher than young men<sup>18</sup>. In effect, this low participation has created an environment in which the engineering profession recruits most engineers from half of the population, a situation that is unsustainable given our national ambitions.

## Year 12 Students in each subject (2015)



Research conducted in 2016 found that there is a persistent negative view that STEM disciplines are difficult and complex, require a great deal of effort, and that STEM related careers are predominantly male, resulting in an underrepresentation of girls<sup>19</sup>.

The research also found that students with an Aboriginal or Torres Strait Islander background or from a low socio-economic background were significantly less likely to express interest in a STEM discipline related career compared to other students.

Girls, Aboriginal and Torres Strait Islander students, students from low socio-economic backgrounds and students from regional and remote areas are underrepresented in the STEM workforce, are more likely to have negative perceptions of STEM disciplines and are less likely to aspire to STEM careers<sup>20</sup>.

This is a fundamental issue that needs to be addressed as a national priority.

*'14 per cent of completing graduates were female in a Bachelor of Engineering 2015'<sup>22</sup>*

# Retaining our talent



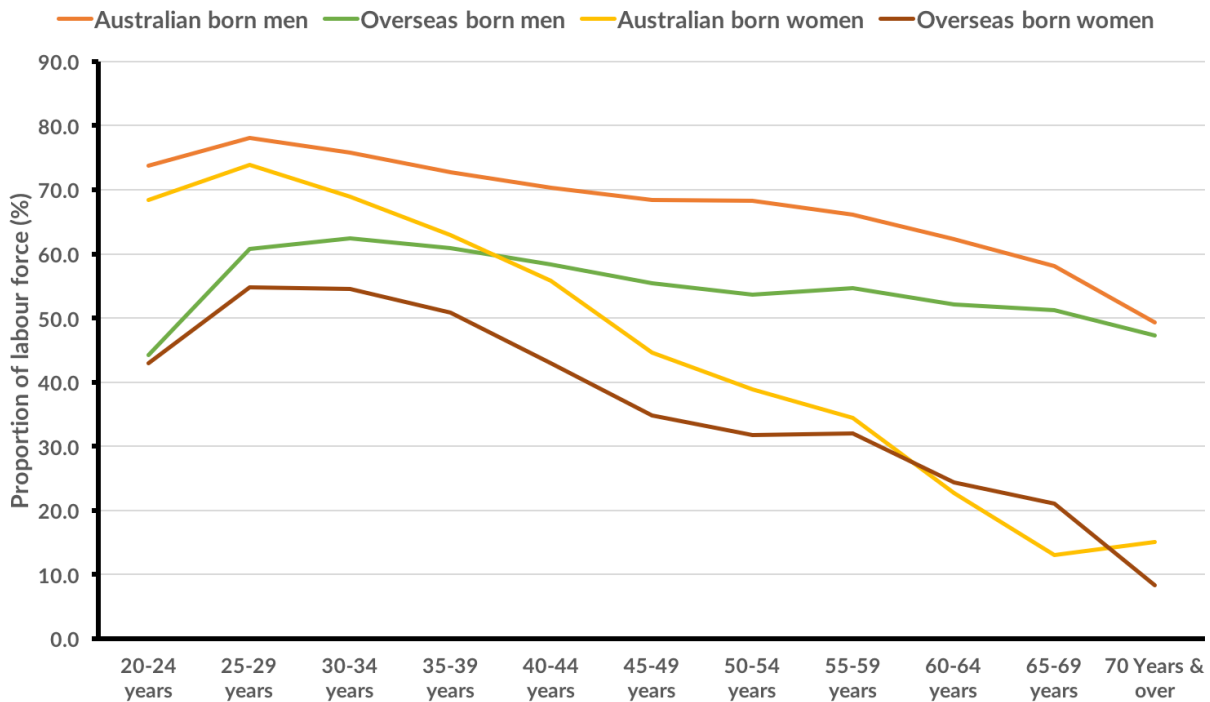
Australia’s engineering capability also relies on retaining qualified engineers in the profession. Engineers Australia’s report <sup>23</sup> shows that retention within the profession falls with age. This suggests a need to focus on improvements to career opportunities to encourage more engineers in middle to older age groups to stay in engineering longer, to enable Australia to capitalise on their experience and expertise. Engineers are lost to the profession at a time when the benefits of that experience in advancing innovation and technological progress in Australia are most needed.

Using census statistics, the number of qualified engineers employed in engineering occupations in 2011 was estimated at 62.1 per cent of the engineering labour force. In other words, Australia’s engineering capability is less than two thirds of the pool of qualified engineers <sup>24</sup>.

Gender cannot be ignored. Even the small percentage of women who study engineering and move into the profession are more likely to leave their jobs than men. This usually occurs at a critical stage of their careers, which means they fail to make it into the pipeline for leadership positions, leading to a lack of female role models, a major issue within the engineering profession.

“*Less than two thirds of people with recognised engineering qualifications are employed in engineering.*”

Figure 2: Proportion of the labour force employed in engineering occupations falls by age, 2011





# The Strategy

## Purpose

- To develop a STEM strategy to support Engineers Australia's organisational priority to 'create tomorrow's engineers'.
- To define our area of influence in a crowded STEM landscape and determine how we can attract more students into engineering.
- To identify and address retention issues for engineers within the profession.
- To ensure our strategy aligns with both the National STEM agenda and the National STEM School Education Strategy.
- To identify key actions that can be measured and reported to key stakeholders.

## Key Objectives

There are three key objectives upon which our STEM strategy is built:

## BUILD. ATTRACT. RETAIN.

### BUILD

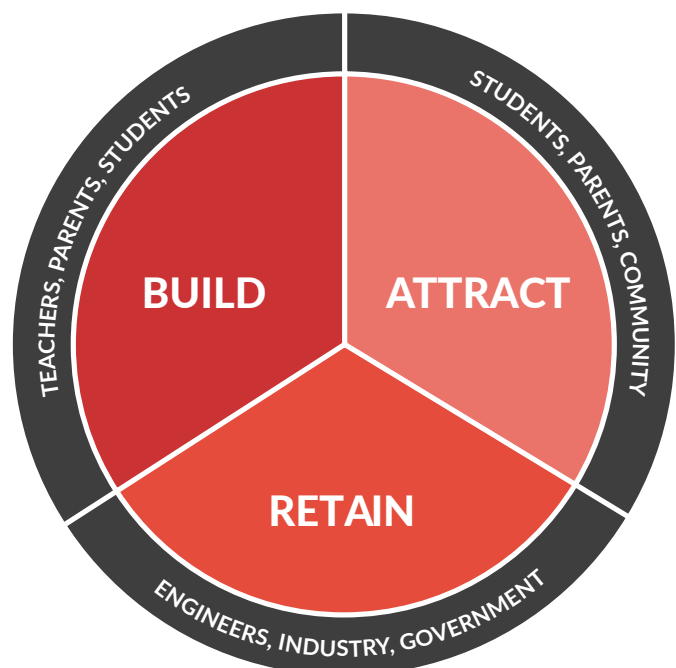
To build capability and availability of STEM based talent through increased participation of students through primary and high school in critical foundation subjects of mathematics and science study.

### ATTRACT

To attract and engage more students, with a focus on female students, into further STEM study and careers, specifically engineering.

### RETAIN

To retain engineers within the profession, with a focus on the retention of female engineers, throughout the life of their career.





# Key Actions

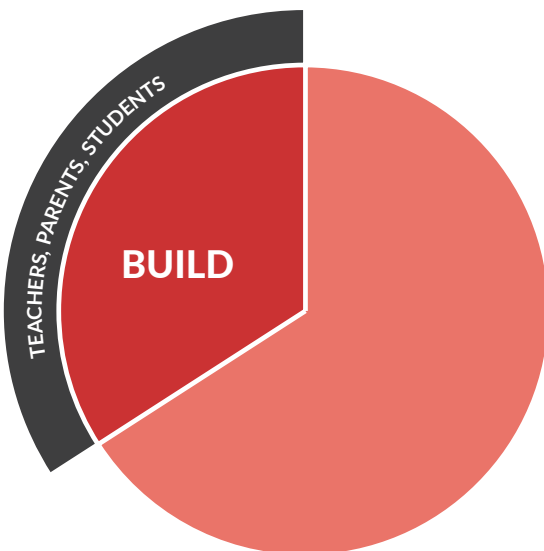
## BUILD

The need to build capability across our students in STEM based study needs to happen from early primary school education. The two main influences in the early engagement of a student are their primary carers and teachers. Engineers Australia's role is to support Education departments, both nationally and at a state and territory level and Teachers Associations to provide expertise and advice to teachers and to support and promote industry and other organisations in progressing their current and future school programs. Engineers Australia, with access to over 65,000 professional engineers, is perfectly positioned to offer this expertise and advice.

Engineers Australia is cognisant of our position within the education landscape. Our sphere of influence is career context and problem solving as well as to help the above organisations deliver to students, through teachers and parents the context of 'why' critical subjects like mathematics and sciences are important for future careers.

### Key actions to be undertaken:

- ① Ensure our interactions and communication with teachers, parents, careers advisors and students focus on 'why' STEM subjects are crucial for future career opportunities.
- ② Work with teachers on upskilling them in today's engineering disciplines and achievements.
- ③ Support in-school programs, where appropriate, that encourage participation in mathematics and science, ranging from early primary to high school.
- ④ Promote engineering and the value of STEM study at national education conferences and events.
- ⑤ Provide teachers, careers advisors, parents and students with access to Australia's first online searchable database of STEM activities, nationally.
- ⑥ Use our influence to facilitate communication and collaboration between government, industry and academia to support nationally measurable STEM initiatives and outcomes.



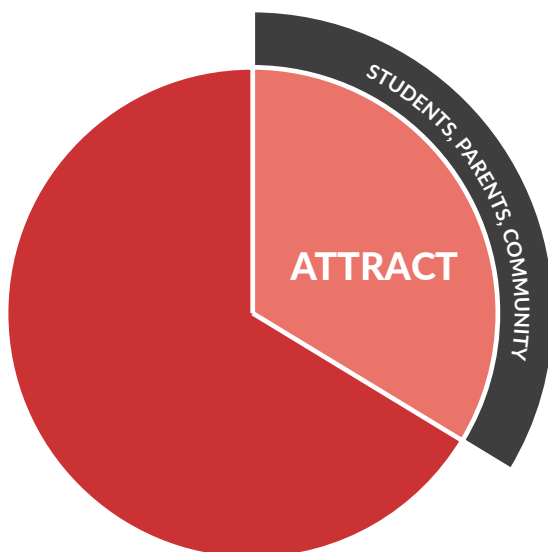
# Key Actions

## ATTRACT

Engineers Australia has a responsibility to promote engineering as a profession to students as early as primary school to ensure that gender biases are minimised in student's career aspirations. A program to promote engineering as a career of choice from primary into early high school, prior to senior school subject selection, that demonstrates the breadth and impact of engineering on the world stage, will attract the best talent into the profession.

Focusing our message around problem solving and humanitarian issues, more specifically for female students, will increase understanding and engagement of the profession. Our ability to provide role models, both male and female, to represent engineering in a progressive and engaging way within the primary and high school arenas, which will also increase engagement.

We also have a responsibility to increase public awareness of the impact that engineering has on community, health and innovation whilst debunking the gender stereotypes. The biggest influencers for subject and subsequent career selection are primary carers, so it is necessary to increase understanding at home.



### Key actions to be undertaken:

- ① Support national programs that increase awareness and understanding and encourage participation in engineering as a career of choice through promotion of engaging engineering role models.
- ② Develop a marketing program and support materials for schools that educate teachers, careers advisors and parents about engineering careers.
- ③ Work closely with government on the development and promotion of the Women in STEM strategy to increase female participation in STEM careers, specifically engineering.
- ④ Work with the Women in STEM Ambassador to ensure engineering receives appropriate representation.
- ⑤ Develop a role model program for female students to engage with STEM, funded by industry partnerships.
- ⑥ Support national programs that encourage participation in STEM study by Aboriginal and Torres Strait Islander students, students in regional and remote areas, and students from low socio- economic backgrounds.

# Key Actions

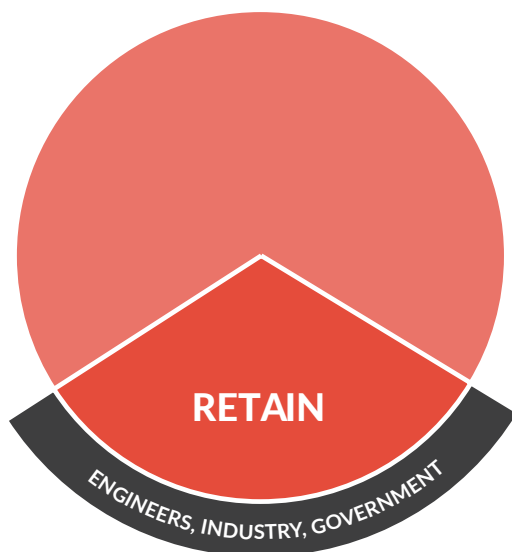
## RETAIN

The need to retain and progress qualified engineers throughout their careers is significant in building and maintaining our home-grown engineering capability. Engineers Australia can influence the retention and progression of engineers by working with industry on continuous professional development, career planning, mentoring and sponsorship programs.

It is imperative that we provide women with clear career pathways using mentors and role models and work with industry and government to facilitate more women in leadership roles in STEM disciplines. Engineers Australia needs to take a leadership position and work with industry to promote workplaces that encourage and promote diversity, and environments that are flexible and inclusive.

### Key actions to be undertaken:

- 1 Work with industry to promote inclusive and diverse work environments and provide workplace flexibility through all life stages of an engineer's career.
- 2 Ensuring engineers remain connected with the profession whilst on parental leave.
- 3 Work with industry to incorporate structured and positive career planning for female engineers into senior leadership roles, engaging sponsors and mentors to facilitate career advancement.
- 4 Use our influence with industry and government to support programs that encourage and recognise talent.
- 5 Use our expertise to help industry upskill and credential their workforce through Engineering Education Australia, CPD, Chartered and conferences as the engineering profession develops into new areas of speciality.
- 6 Promote opportunities for more experienced members to give back to the engineering profession.



# Outcomes



Some key internal outcomes of the development and roll out of this strategy are:

## Internal Alignment

- Engineers Australia organisational STEM strategy, a cohesive national strategy that is supported and implemented at a regional level
- The organisation understands why and what we are doing in STEM

## Clarity and focus

- Ability to clearly identify STEM activities to support at a national and regional level
- An idea of what we can realistically achieve, setting expectations amongst our members, government and industry partners

## Distinctive

- Ability to communicate Engineers Australia's practical outcomes in STEM
- Greater credibility with government, industry and education stakeholders
- Evidence to support policy development

# Summary



The implementation of this strategy will enable Engineers Australia to develop action plans, monitor progress and report outcomes in our contribution to the National STEM agenda.

This strategy will enable our staff and volunteers to confidently engage with external stakeholders and influencers to communicate our priorities and focus on current and future STEM projects.

# Author



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# Appendix

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