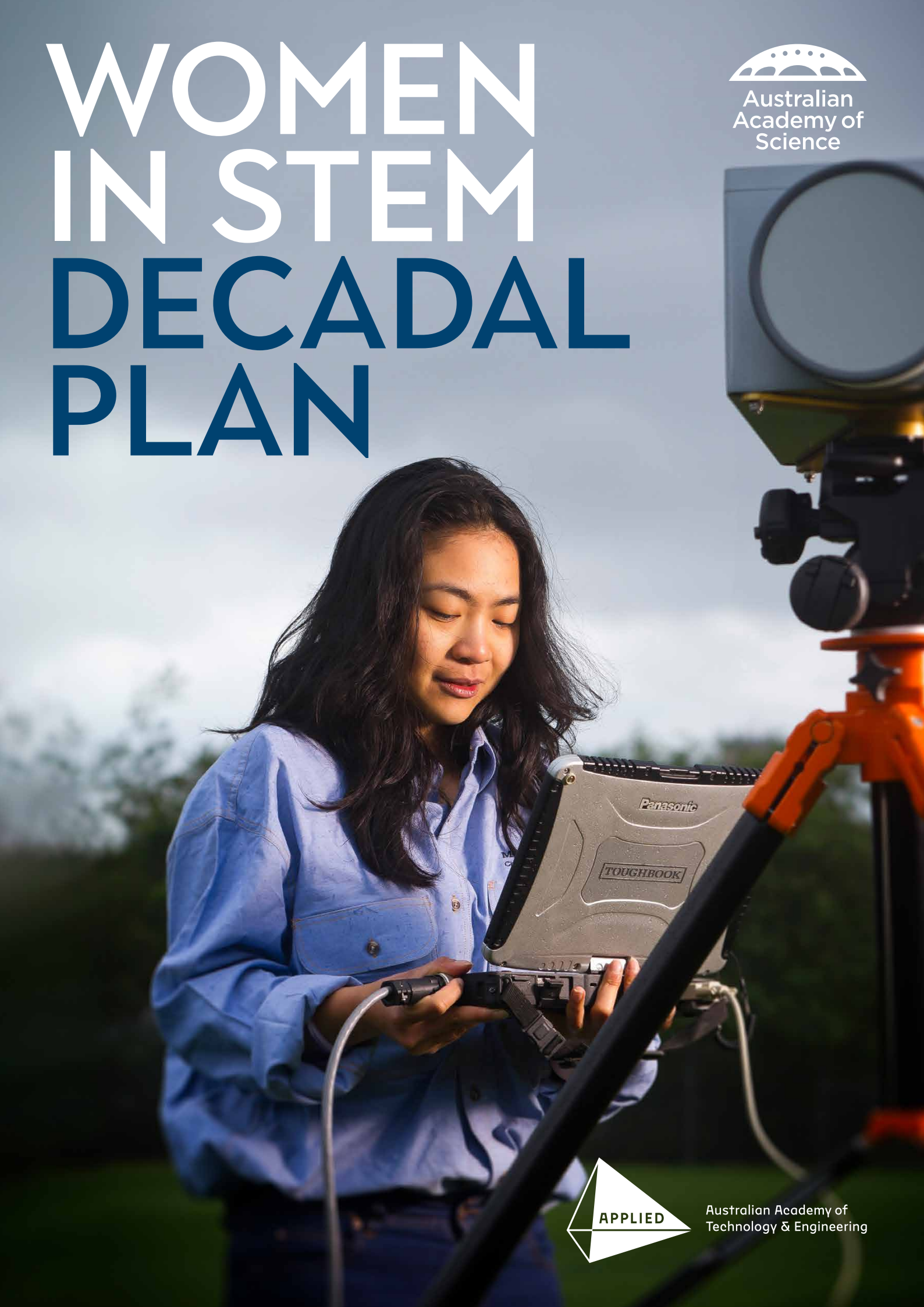
WOMEN IN STEM DECADAL PLAN



Australian Academy of Science

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Australian Academy of Technology & Engineering

Australian Academy of Science

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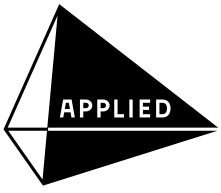


Australian Academy of Technology & Engineering

Acknowledgements

The Australian Academy of Science, the Australian Academy of Technology and Engineering, and the members of the Expert Working Group gratefully acknowledge financial support from the Australian Government that enabled the development of this report.

The academies and the Expert Working Group are also grateful to stakeholders who have contributed to the plan, including via written submissions, consultation workshops, surveys, interviews and feedback on exposure drafts. We also thank the many other members of the Australian STEM ecosystem who assisted or contributed to the decadal plan process, including those who provided photographs.

The contributions of staff from the Australian Academy of Science and the Australian Academy of Technology and Engineering to the project management, development and drafting of this plan are gratefully acknowledged. The project team included Dr Emily Finch, Dr Sandra Gardam, Ms Madison Hartill-Law, Dr Chris Hatherly, Ms Bianca Le, Dr Merryn McKinnon and Dr Matt Wenham.

Editorial, design and communication assistance provided by Ms Robyn Diamond, Mr Andrew Berthold, Ms Jen van Dijk, Ms Michelle Tapper, and Dr Tom Carruthers is gratefully acknowledged.

ISBN 978 0 85847 673 8

How to cite this document:
Australian Acadmy of Science. (2019) *Women in STEM Decadal Plan* (Australian Academy of Science)

Also available online at **www.science.org.au/womeninSTEMplan**

Note: This April 2019 reprint contains small changes from the original March 2019 publication, including page numbering. No substantive changes were made.

Front cover photo: Ms Mei Sun Yee making measurements with a microwave scintillometer by Monash University ©

Back cover photo: Dr Collette Burke, RMIT University and Victoria's first Chief Engineer by Eamon Gallagher ©

CONTENTS

FOREWORD

Science, technology, engineering and mathematics (STEM) skills are the foundation on which the Australian workforce, industries and the economy will thrive.

The rate of adoption of automation based on big data, the internet of things, and artificial intelligence, across all Australian industries, is escalating.

As a result the demand for a STEM-skilled workforce to power our industries is escalating and showing no signs of slowing down.

Every organisation in Australia is increasingly reliant on STEM skills to thrive, whether they operate in government, academia, industry, or the education sector. All these stakeholders face a common challenge: the need to tackle the significant under-representation of women in the STEM workforce, because we can ill afford to under-utilise all of the nation's available talent.

To achieve this requires removing barriers to participation at every point of the STEM pipeline. We must create an environment where girls and women can readily engage in STEM education and then use those skills to progress through their careers to senior levels.

No sector can solve this alone.

Leadership is required and it must be accompanied by accountability.

As a nation we have an opportunity to build on strong foundations and a raft of initiatives that have already stepped us closer to gender equity in STEM in Australia. We have much to learn from each other. One initiative is Science in Australia Gender Equity (SAGE), which is now showing measurable changes in organisational culture, and the progression of women to senior levels in higher education and research institutions. Leadership linked to frameworks such as SAGE offers learnings to other sectors. Equally, the leadership shown by the STEM Male Champions of Change provides guidance for all STEM leaders.

We must work together, redouble our efforts, be ambitious, and above all, be intolerant to stagnation.

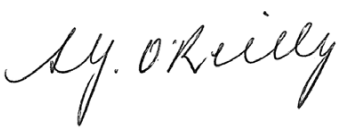
As both authors of this decadal plan and stakeholders within it, the Australian Academy of Science and the Australian Academy of Technology and Engineering heed this call.

The Academies stand ready to assist organisations in implementing the Women in STEM Decadal Plan for the benefit of our nation.

We look forward to working with you as partners relentlessly chasing the shared vision articulated in this decadal plan.

Professor John Shine AC PresAA
President
Australian Academy of Science

Professor Hugh Bradlow FTSE
President
Australian Academy of Technology and Engineering



Professor Sue O'Reilly FAA
Chair, Equity and Diversity Reference Group
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EXPERT WORKING GROUP

The development of this decadal plan was overseen by an expert working group including Fellows of the Australian Academy of Science, Fellows of the Australian Academy of Technology and Engineering, leading academics, industry professionals, early- and mid-career researchers and education experts.

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Ms Kathryn Fagg FTSE FAICD	Board member of Boral Limited, Incitec Pivot Limited, Djerriwarrh Investments Limited and CSIRO
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Dr Danielle Kennedy	Director, Active Integrated Matter Future Science Platform, CSIRO Manufacturing
Professor Peter Koopman FAA	Professor of Developmental Biology, Institute for Molecular Bioscience, The University of Queensland
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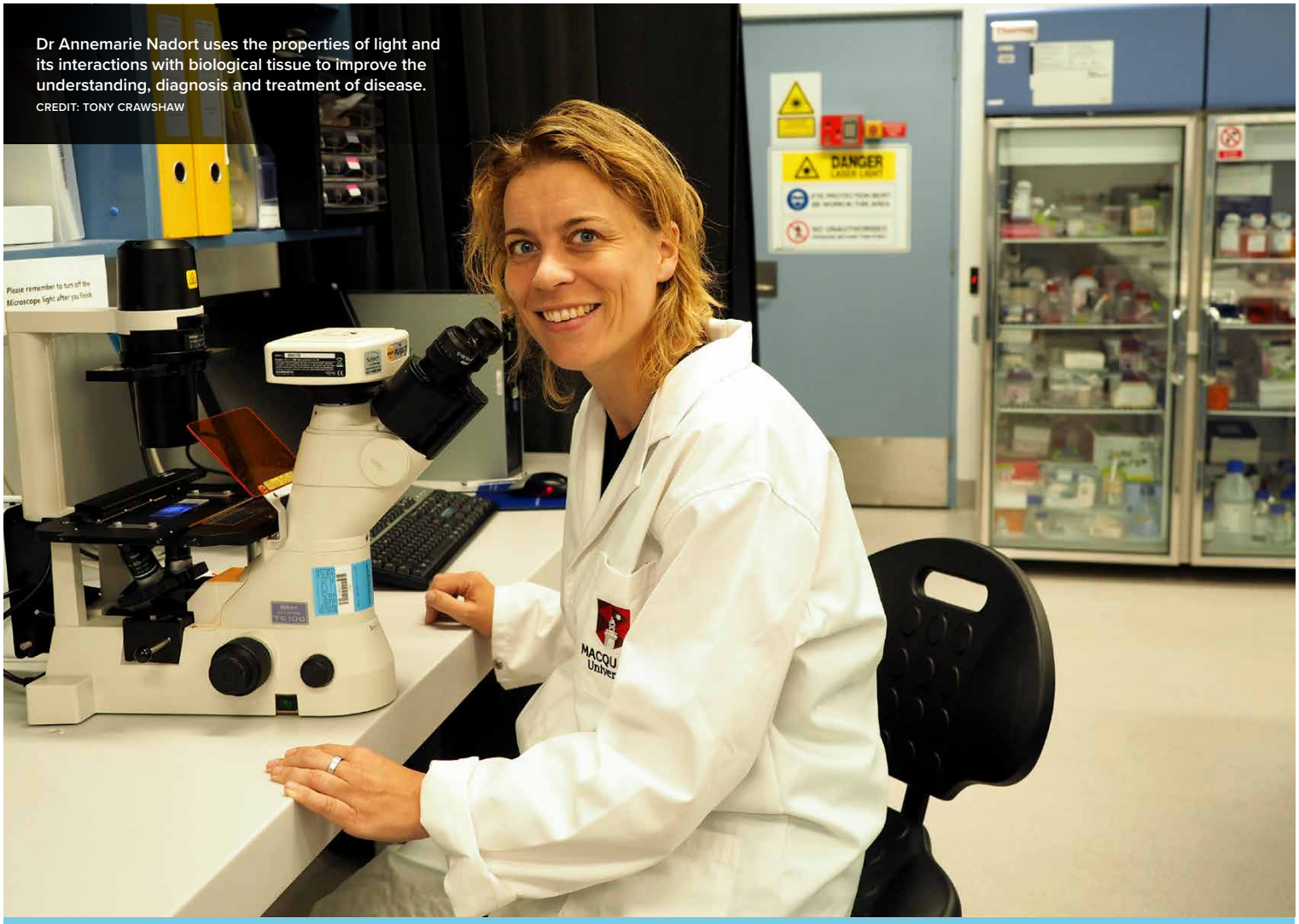


Dr Annemarie Nadort uses the properties of light and its interactions with biological tissue to improve the understanding, diagnosis and treatment of disease.
CREDIT: TONY CRAWSHAW

CONTEXT

A STEM skilled workforce is essential to realising Australia's innovation and productivity potential.

Demand for STEM skills is high and will continue to grow as society tackles the challenges of a digital and technologically-enabled world. Yet the demand cannot be met unless cohesive and collective action is taken to maximise the attraction, participation and retention of women and men in the workforce. Women in particular face barriers at all levels of the pipeline including in their years of education and at all levels in the workforce, with pronounced barriers presenting at senior levels.

Attracting women and girls to STEM and providing an environment for them to thrive and progress is a shared responsibility of government, academia, industry, the education sector, and the community.

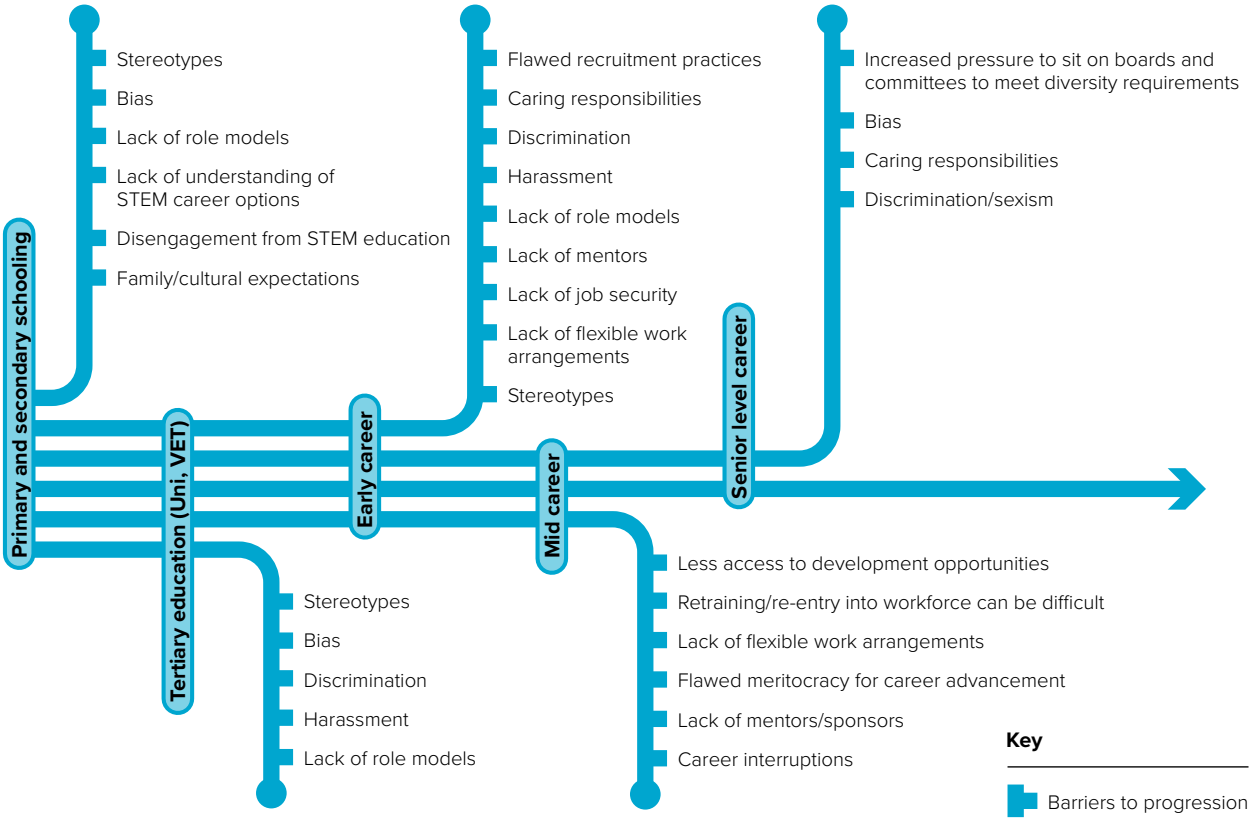
The Women in STEM Decadal Plan is the first time these stakeholders have come together to collectively achieve gender equity in STEM.

In doing so, we acknowledge no single sector can solve the under-representation of women in STEM nor remove the barriers they face.

We acknowledge the critically important role of the education system in starting a healthy pipeline of STEM students, and in providing learning and teaching environments in which girls choose and relish all STEM subjects. We acknowledge the important influence parents, career counsellors and societal behaviours and values have on the choices made by girls and young women.

However, starting a healthy pipeline when girls engage in STEM education will not on its

CAREER PROGRESSION PIPELINE



Further information on barriers is in appendix 1 on page 46.

own facilitate retention and progression through their careers.

All employers of STEM professionals must curtail the attrition of women from the STEM workforce by removing obstacles, barriers and biases which are disincentives for women to remain in STEM careers or return to them after career interruptions. The current situation is also impacting businesses' prosperity.

The pipeline for women is leaky at every point. There is no silver bullet, and that is why this decadal plan offers a unique opportunity for everyone to drive the change needed to achieve gender equity in STEM.

The decadal plan demands bold, sustained and cohesive effort across the entire STEM ecosystem. Above all, it demands leadership and accountability.

This Women in STEM Decadal Plan was announced in the 2018–19 Federal Budget and was prepared by the Australian Academy of Science in partnership with the Australian Academy of Technology and Engineering.

The recommendations from the decadal plan will inform the Women in STEM National Strategy that will be published by the Australian Government in 2019.

The decadal plan was developed through research and consultation covering every state and territory and involving written submissions, stakeholder interviews and roundtable discussions.

Its development was overseen by an expert working group comprising Fellows of both academies, industry professionals, early- and mid-career researchers, education experts and Australia's Women in STEM Ambassador.

Collectively, we have designed a shared vision for the future to attract, retain and progress girls and women in STEM.

The decadal plan offers a vision and opportunities to guide all stakeholders as they identify and agree on specific actions they must take to build the strongest STEM workforce possible to support Australia's prosperity.

The opportunity to achieve a transformative, systematic and sustained change in STEM in Australia begins now.

THE CURRENT STATE OF PLAY

Dr Ranmalee Bandara using the a soil sensor to measure the soil moisture on the surface.
CREDIT: MONASH UNIVERSITY

Gender equity in STEM in Australia (2019)

The lack of gender equity within STEM in Australia is well known and long established. In 1995, the Women in Science, Engineering and Technology (WISET) advisory group, established by the then Minister for Science, asked 'What is it about the environments of science, engineering and technology, and society's perception of them, that they do not attract and keep girls and women?'[1]

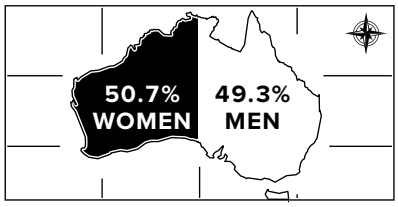
The **attract**–**retain**–**progress** framework provides a useful construct to understand the issues and challenges faced by women and girls in STEM in 2019.

Attraction relates to encouraging girls and women to pursue STEM education and careers and ensuring they see STEM as a viable and exciting career pathway. Attraction is affected by societal norms, methods of teaching and perceptions of eventual careers. Societal norms and stereotypes affect girls from a young age, having a negative impact on their belief in their abilities in STEM subjects and on their aspirations to STEM careers.

The STEM gender gap first becomes easily measurable in Australia in the middle of secondary school when students begin to choose areas of study. In the final years of secondary school, young men are choosing to study advanced and intermediate mathematics, physics and chemistry at much higher rates than young women.

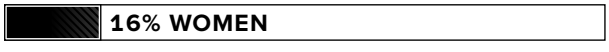
STEM WORKFORCE

TOTAL AUSTRALIAN POPULATION: **23.4 MILLION**



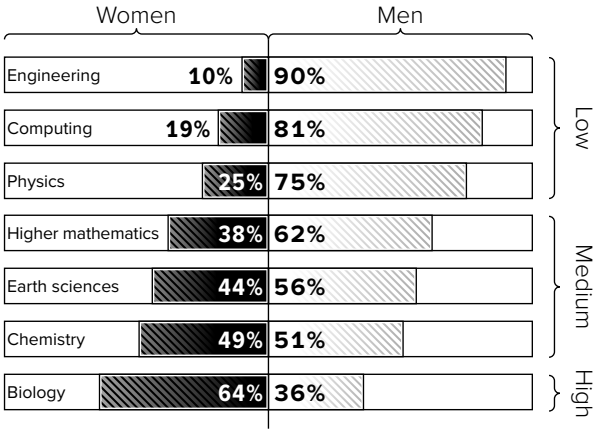
AUSTRALIA'S WORKFORCE[2]

AUSTRALIA'S STEM-SKILLED WORKFORCE[3]

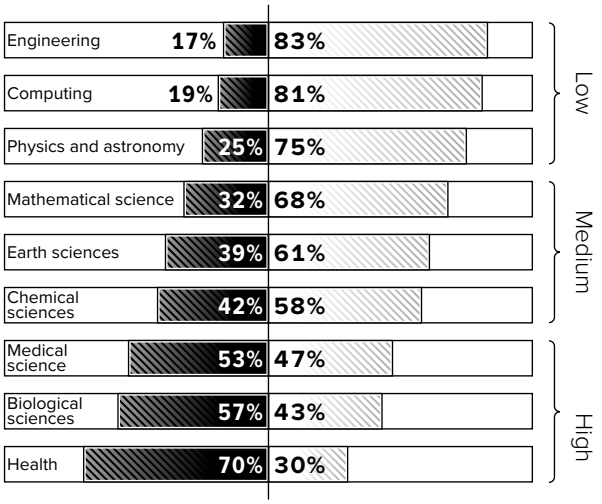


PARTICIPATION RATES IN STEM EDUCATION AND TRAINING

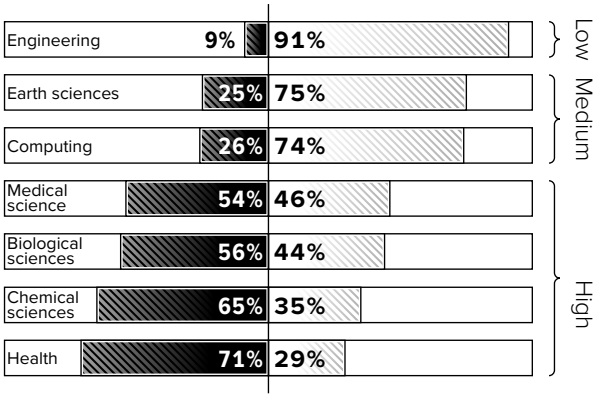
YEAR 12 SUBJECT ENROLMENTS [4, 5]



UNIVERSITY ENROLMENTS [6]



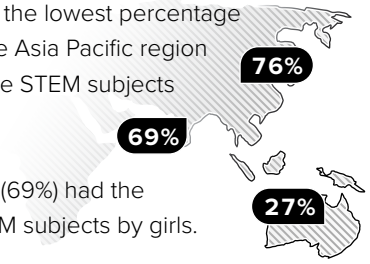
VET ENROLMENTS [7]



STEM EDUCATION IN THE ASIA PACIFIC REGION [8]

In 2016, Australia had the lowest percentage among countries in the Asia Pacific region for girls electing to take STEM subjects in school (27%)

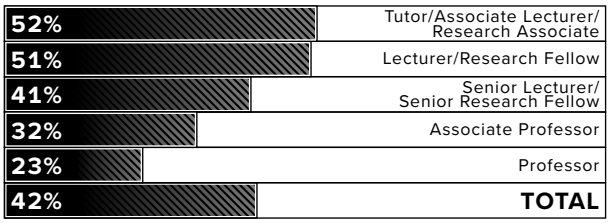
China (76%) and India (69%) had the highest uptake of STEM subjects by girls.



WOMEN IN STEM LEADERSHIP

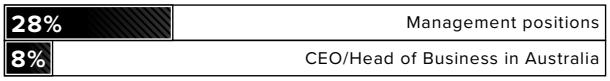
WORKFORCE IN STEM RESEARCH SECTOR [9]

Proportion of women



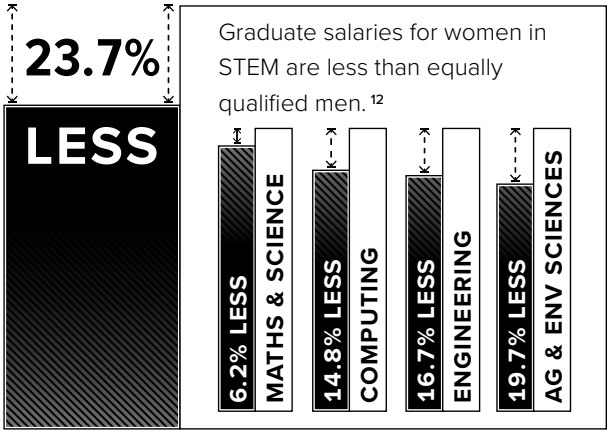
WORKFORCE IN STEM ORGANISATIONS [10]

Proportion of women



PAY GAPS IN STEM

Women in professional, technical and scientific services industry earn 23.7% less than men. [11]



This trend continues into tertiary education where women are particularly under-represented in certain STEM disciplines in vocational education and training (VET) and university courses, despite more women earning degrees than men overall.

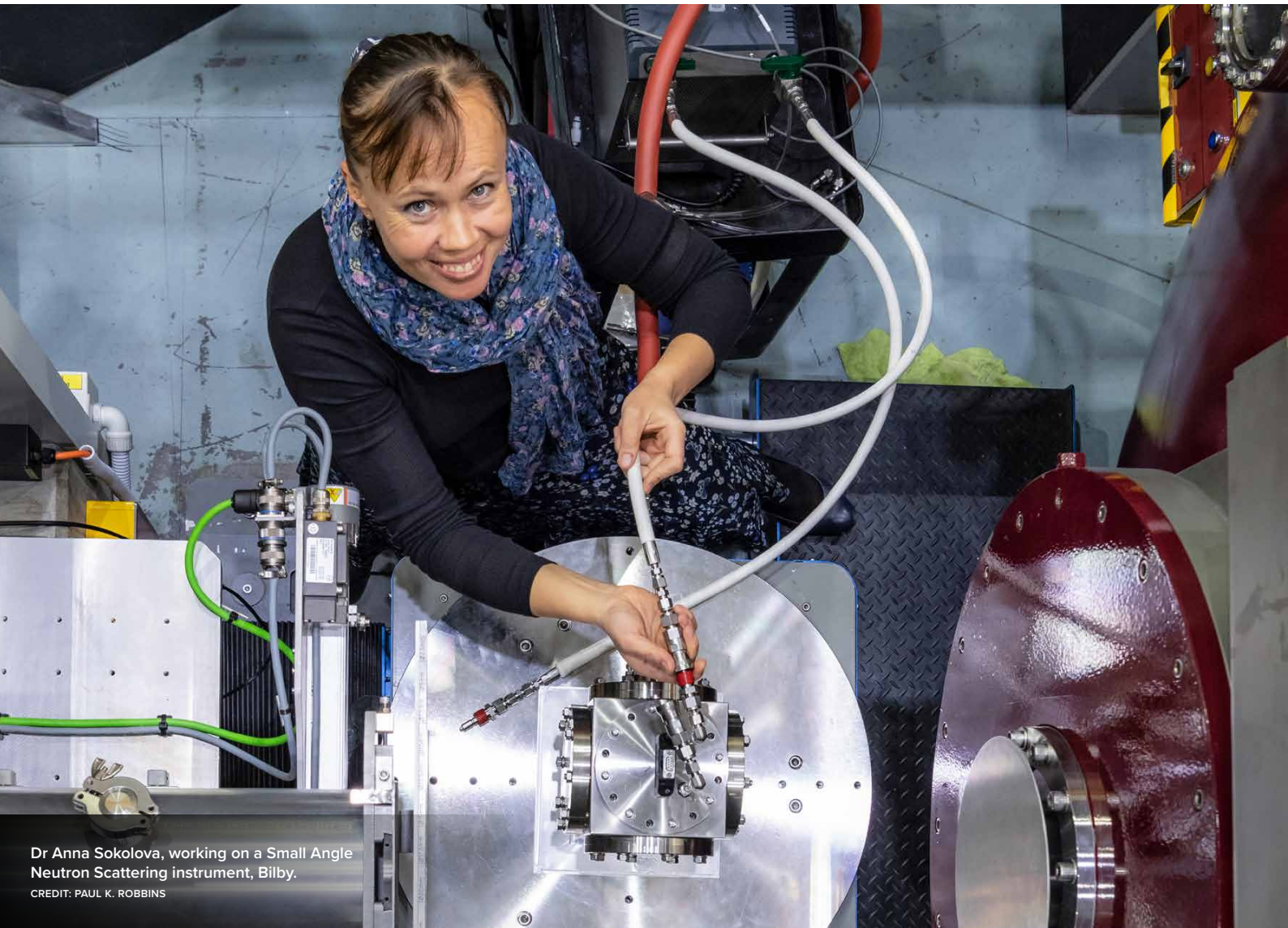
Australia has around 5000 registered VET providers and 43 universities, and Australia's STEM-skilled workforce comprises 68% VET qualified, and 32% university qualified workers[13]. Of those with VET qualifications, only 9% are women. Of university qualified workers, 29% are women. Tertiary courses in engineering, computing, physics and astronomy all have low (less than 25%) participation rates for women[14].

Even in disciplines where women have greater than 50% representation at the undergraduate and postgraduate levels, such as in agriculture and environmental sciences, and health sciences, the proportion of women in these fields significantly decreases after the early- to mid-career stage[15]. This clearly demonstrates the problem of **retention**, ensuring the experiences of girls and women pursuing a career in STEM are conducive to them remaining in a STEM career.

Progression is the third broad category of challenges faced by women in STEM and relates to the ability of women to move equitably to the highest levels of their chosen career. Retention and progression are closely related; while women leave STEM for a variety of reasons, one of the main ones is lack of career progression[16].

Employers of STEM-skilled workers in Australia consist of a broad range of organisations across government, research and industry. The research sector is largely publicly funded and incorporates universities, research institutions and publicly funded research agencies (PFRAs). In addition to PFRAs, government also employs a variety of STEM-skilled workers across the various departments and statutory agencies of the federal, state and territory public services.

Industry employers of Australian STEM-skilled workforce include more than half of the ASX 200 listed companies[17] plus large multinationals that operate in Australia, as well as a range of businesses from start-ups to small- and medium-sized enterprises (SMEs).



Dr Anna Sokolova, working on a Small Angle Neutron Scattering instrument, Bilby.
CREDIT: PAUL K. ROBBINS

The Workplace Gender Equity Agency (WGEA) requires all non-government businesses with more than 100 employees to report on the gender breakdown of their workforce[18]. In 2016–17, 1487 of the 4479 reporting organisations (33%) were STEM organisations[19].

The future of work will shift the majority of organisations' core business, requiring them to increase the number of employees with STEM skills. With this rapid change in workforce requirements many organisations in the next decade will transform into STEM organisations. All Australian organisations have a role to play in ensuring girls and women are attracted, progress and retained within STEM careers.

As women strive to succeed in STEM careers, they are often met with systemic barriers, including but not limited to gender-based discrimination, bullying and harassment, gendered expectations around caring responsibilities, lack of flexible work options, biased assessments of merit that impact on their ability to progress, and a lack of access to effective mentoring or sponsoring opportunities. All of these issues combine to lead to a significant reduction in the proportion of women at every stage of professional progression in STEM fields, particularly in research and industry.

Women make up 47.5% of the Australian workforce[20] and 16% of the STEM-skilled workforce[21], but only 8% of Chief Executive Officers (CEO) and heads of business in STEM businesses in Australia[22].

The professional, scientific and technical services industry is one of the five industries with the highest gender pay gap in Australia at 23.7%[23]. Agriculture and environmental studies exhibit the largest pay gap at the graduate level, despite having more women than men graduating[24]. Gender pay gaps persist in Australia despite various legislative instruments that require employers to ensure and report on gender equity in the workplace.

Students from low socioeconomic and rural and regional areas, and those from Aboriginal or Torres Strait Islander backgrounds, are especially under-represented in STEM throughout the entire pipeline[25].

Women's participation in STEM areas varies across different parts of the education sector but low (<25%), medium (<50%) and high (>50%) participation areas can be identified in Year 12, VET and university enrolments (see figure: participation rates in STEM on page 7). It must be noted that these broad categories can mask large variations in sub-disciplines. For example overall engineering enrolments for women at university are 17%, which includes process and resources engineering with a moderate participation rate for women (29%), and automotive engineering and technology with a very low participation rate for women (2%).

Attraction is a particular issue for the areas of STEM that have low and medium participation of women. In high participation areas of STEM there is no problem attracting girls and women and in some areas they outnumber men in studying and in early career roles.

Retention and progression are issues for all areas of STEM; even in high participation areas, women are not reaching senior levels in STEM organisations in Australia.

To take a strategic approach and avoid unintended consequences, we need to ensure that the actions taken under this decadal plan relating to **attracting** girls and women to STEM focus on the low and medium participation areas of STEM.

Actions focused on **retention and progression** should be applied across STEM.

Intersectional issues create additional barriers to the participation of individuals in STEM. People who identify as Aboriginal or Torres Strait Islander, culturally and linguistically diverse, and lesbian, gay, bisexual, transgender, queer or questioning, and intersex (LGBTQI), and those who have a disability, are under-represented in STEM. Intersectional issues are unique in each country, and little research has been conducted on understanding intersectional barriers to STEM participation in the Australian context.

This decadal plan focuses on gender equity. It is acknowledged that more needs to be done to improve diversity beyond gender and to address intersectionality. The decadal plan offers the opportunity to undertake in-depth research into intersectionality in STEM in Australia. All actions developed under the umbrella of this decadal plan should consider intersectionality.

THE CASE FOR CHANGE

Professor Kerrie Mengersen FAA leading an expedition to Peru to help ensure Jaguar survival through the use of statistics, mathematical modelling, virtual technology and knowledge from Indigenous people living in the Amazon.
CREDIT: VANESSA HUNTER

STEM skills are the foundation on which the Australian workforce, industries and the economy will thrive and prosper. A workforce delivering science, technology and innovation and the national advances they bring must make use of all available talent. Yet women and girls face a myriad of systemic barriers and cultures which result in their under-representation across the breadth and depth of STEM disciplines and careers. Under-representation and under-utilisation of the workforce are threats to Australia's prosperity.

The economic case for gender diversity is clear. The 2017 World Economic Forum's 'Gender gap report' estimates that closing the gender gap in economic participation by 25% by 2025 could add as much as US$5.3 trillion to global gross domestic product (GDP) in the same timeframe[26]. Shifting just 1% of Australia's workforce into STEM jobs would add $57.4 billion to the nation's GDP over 20 years[27].

Evidence shows that companies with gender-diverse leadership teams and boards are more successful than those without gender diversity[28]. Women enable teams to perform more effectively[29], including in innovation-oriented businesses[30].

A recent study found women entrepreneurs achieve better financial performance over time[31]. Start-ups founded by women generate revenue of 78 cents for every dollar of start-up funding, in comparison to the return of 31 cents per dollar of funding reported by start-ups founded by men. Yet, companies founded by men receive on average more than twice the level of investment than women-founded companies, despite their weaker financial performance.

Organisations with larger numbers of women in leadership positions yield better economic performance and outcomes[32]. When women's representation in leadership teams exceeds 30%, business gains are reported irrespective of company size[33].

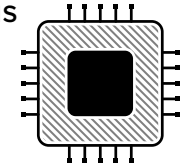
Diversity also benefits scientific outputs, with a large-scale study finding the greater the diversity of scientists involved, the greater the performance and impact of the research produced[34].

At a time when Australia needs to utilise all of our available talent, we must create and ensure a healthy pipeline of STEM-skilled women who can go on to work in inclusive and respectful workplaces.

WORKFORCE NEEDS OF THE FUTURE [35, 36, 37, 38]

DIGITAL SYSTEMS

50%



50% of workers will need to know how to use, build and configure digital systems

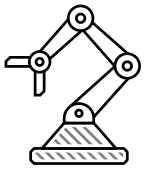
JOB LOSS

18%

18% of workers have a serious chance of losing their job because of technology

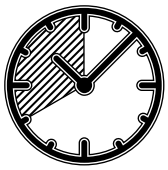
AUTOMATION

70%

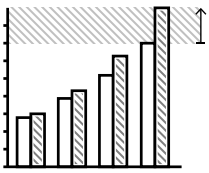


70% are training for a job set to be replaced by automation

77%



Australian workers will spend 77% more time using science and maths skills



1.5 TIMES FASTER

STEM skilled jobs are growing at 1.5 times faster than any other job sector

SKILLS SHORTAGES

In 2018, Australia had skills shortages in geology and geophysics, agricultural science, mechanical, aeronautical and civil engineering, surveying and architecture, some for the first time in over five years

"In a technology-led economy the distinction between STEM and non-STEM jobs is increasingly blurred"

Based on insights gathered from extensive stakeholder consultations, combined with data gathered from Australia and internationally, there is abundant evidence that many organisations are taking actions at an individual level to support the attraction, retention and progression of women in STEM.

However, Australia has not yet made the national and systemic changes required to bring about the step change essential to achieve diversity in STEM.

Significant gains at every stage of the STEM pipeline will require bold and cohesive action by all stakeholders: government, academia, industry, the education sector and the community.

It will require leadership from each stakeholder and collaboration between them.

Above all it will require accountability.

This decadal plan offers six key opportunities for Australia to strengthen gender equity in STEM over the next 10 years, beginning early by strengthening education systems which support and inspire girls to choose STEM disciplines and continuing over a lifetime to enable women to thrive in STEM careers.

Against each opportunity are strategic recommendations that government, academia, industry, the education sector and the community can individually and collectively customise to their own sectors.

Importantly, the opportunities provide a framework that can guide our nation, ensuring efforts and energy move in one direction towards a national vision for Australia.

Professor Jean Armstrong looking through a hemispherical lens which is used in visible light communication and visible light positioning experiments.
CREDIT: MONASH UNIVERSITY

A VISION FOR GENDER EQUITY IN STEM IN AUSTRALIA

We share a national vision to establish a thriving STEM-skilled workforce that is fit for the future, globally recognised, powered by a diverse and gender-balanced pipeline, and supported by an inclusive and respectful workplace culture.

Six opportunities

1 LEADERSHIP AND COHESION

Stronger cohesion and leadership across the Australian STEM ecosystem will amplify and strengthen diversity outcomes.

2 EVALUATION

Establishing a national evaluation framework will guide decision making and drive investment and effort into measures that work.

3 WORKPLACE CULTURE

A significant cultural shift in workplaces is necessary to create gender equity for women in STEM. A culture that is inclusive and respectful, challenges traditional stereotypes, is free of discrimination and bias, enables flexibility and accommodates career interruptions and changes will maximise women's participation in the workforce.

4 VISIBILITY

Seeing women in diverse STEM careers, and equally represented in the media, in public events, and in other forums like boardrooms and classrooms will provide role models for girls and women and inspire a nation.

5 EDUCATION

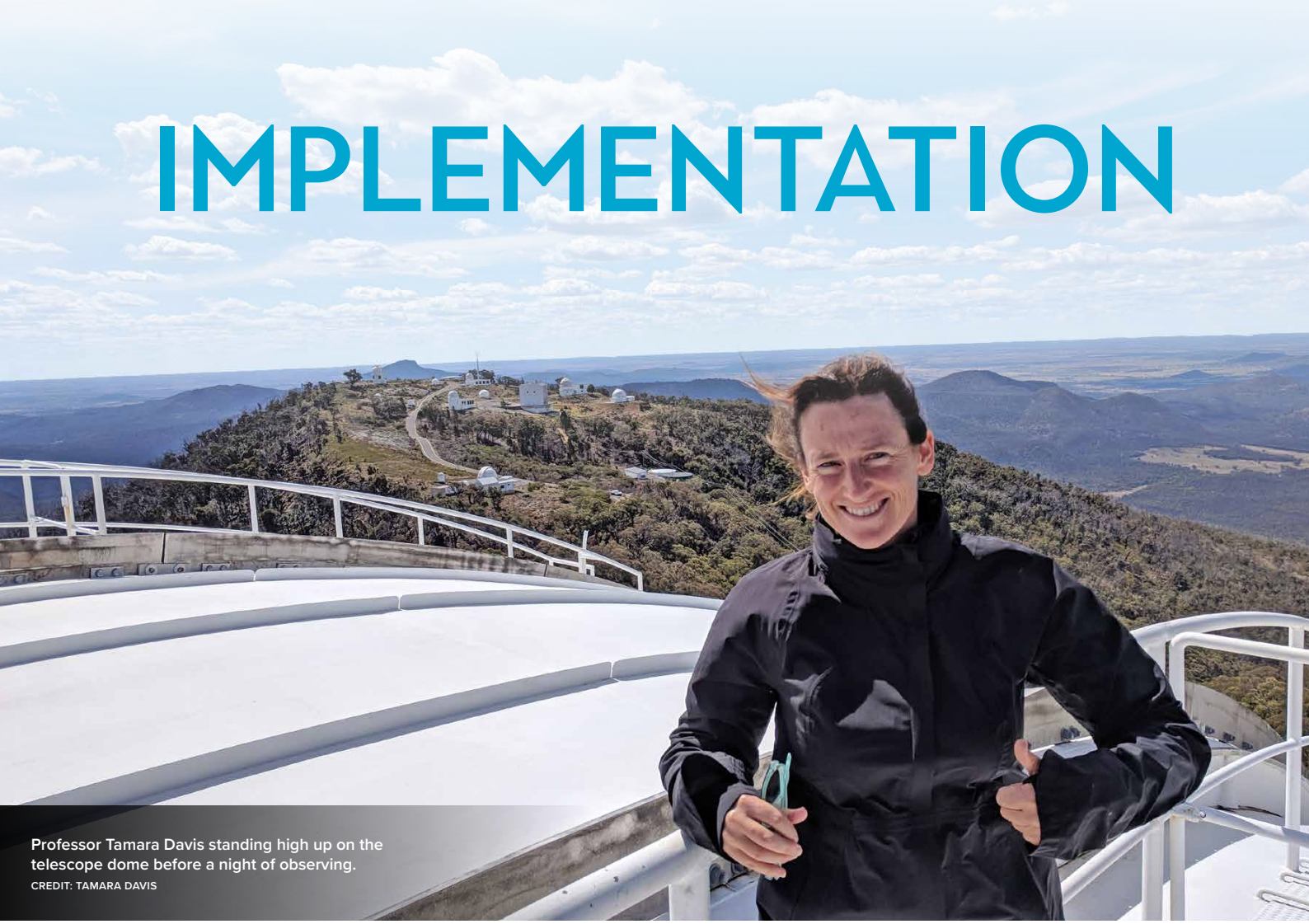
Strengthening the education system to support teaching and learning on a national scale will enable and encourage all girls and women at all levels to study STEM courses and equip them with the skills and knowledge to participate in diverse STEM careers.

6 INDUSTRY ACTION

Establishing a national framework that guides and provides tools to address gender equity amongst SMEs will impact the vast majority of businesses not reached by existing programs.

Each opportunity is expanded from page 19 of the decadal plan.

IMPLEMENTATION



Professor Tamara Davis standing high up on the telescope dome before a night of observing.
CREDIT: TAMARA DAVIS

Taking the six opportunities outlined in the Women in STEM Decadal Plan and turning them into actions will require commitment from all stakeholders: government, academia, industry, the education sector and the broader community.

Each opportunity is elaborated to offer strategic recommendations and implementation guidance so that stakeholders can benefit from the research and consultations undertaken in developing the decadal plan.

Appendices include a number of suggested initiatives that were offered in the consultation phase of developing the decadal plan, as well as case studies and data that have been drawn from the Australian and international published literature in this area.

To achieve the ambition presented in this decadal plan will require leadership from STEM stakeholders and collaborative efforts between them, to tailor, implement, and evaluate actions that work and effect sustained change.

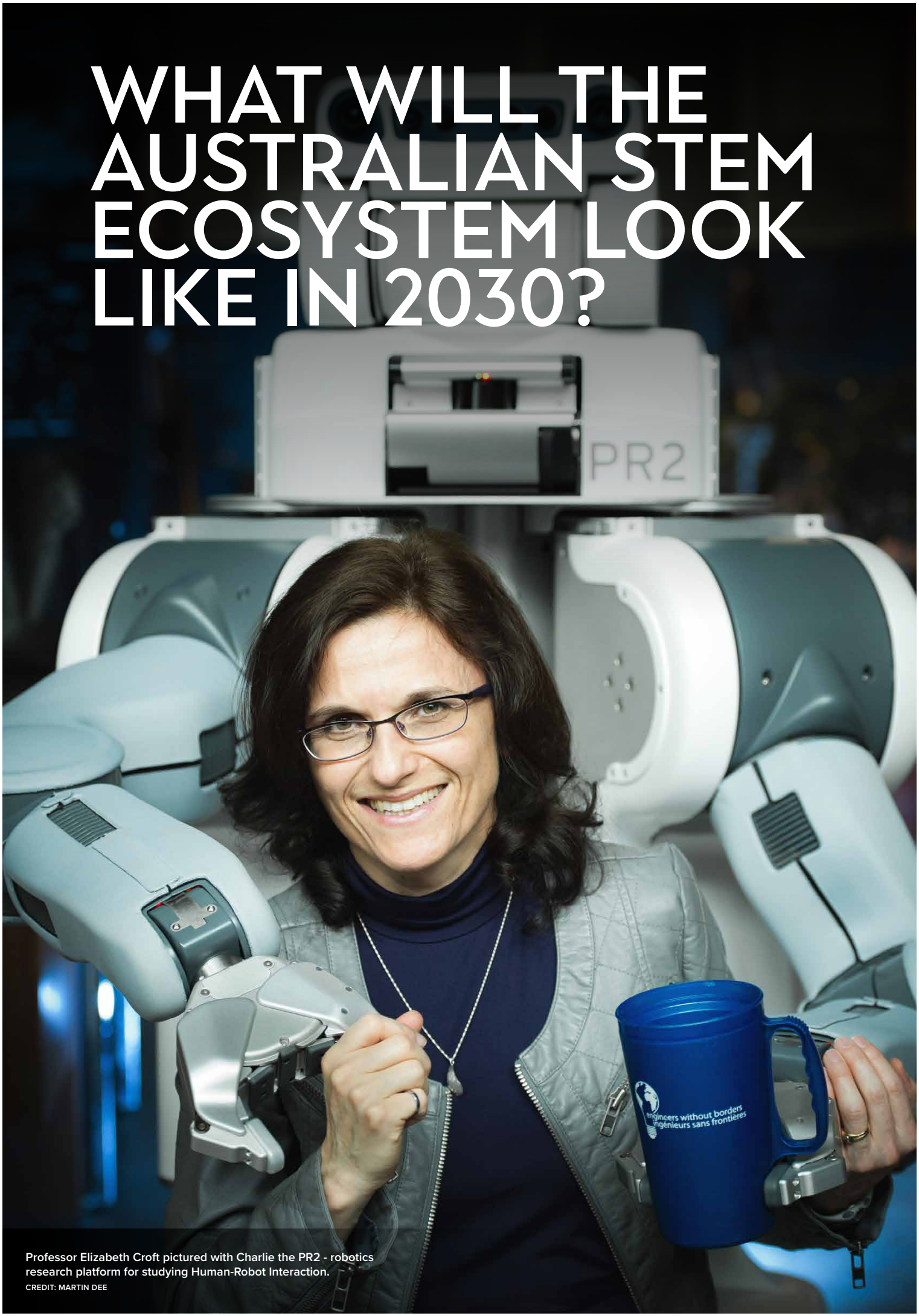
The decadal plan offers a framework to develop those actions. In developing sector-specific actions, it is suggested that the following principles be applied:

- proposed measures align with the decadal plan
- they are fit for purpose
- specific
- measurable
- achievable
- relevant, and
- time bound.

The Australian Academy of Science and the Australian Academy of Technology and Engineering—both as authors of this decadal plan and as stakeholders who will contribute to achieving its national vision—are committed to working with all stakeholders to facilitate implementation of the decadal plan.

Dr Ayse Zengin takes a 3D scan of the tibia.
CREDIT: GERARD HYNES

WHAT WILL THE AUSTRALIAN STEM ECOSYSTEM LOOK LIKE IN 2030?



Professor Elizabeth Croft pictured with Charlie the PR2 - robotics research platform for studying Human-Robot Interaction.

CREDIT: MARTIN DEE

It's 2030.

If the decadal plan and the opportunities contained within it are realised, the STEM graduates of 2030—9- and 10-year-olds making their way through primary school in 2019, as well as those entering the workforce from other life journeys—will join workplaces that are respectful, free of harassment and discrimination, value diversity, and structured to support the needs and preferences of their diverse and professional employees.

These workplaces will have invested the time, the resources and the leadership required to systematically eliminate harassment and sexism, to promote and realise equity, and to create cultures in which all employees are empowered and motivated to succeed.

Women as well as people from diverse backgrounds will hold management and leadership positions from the board and CEO down, bringing different ideas and approaches to innovation, communication, discovery, performance and conflict resolution, among many other domains. With more diverse teams, these workplaces will be more creative, productive, profitable and successful and these teams will make objectively better decisions at junior, middle and executive or board levels.

Workplaces will actively promote, not just allow, flexibility in work practices and conditions. Men will take parental or carer's leave as often as women, and all genders will be supported and empowered to rejoin the workforce with no disadvantage.

Systematic efforts will have been made to remove bias from recruitment and promotion practices. Widely-available tools will screen for gendered language in job ads and selection criteria, merit will be carefully defined, and selection and promotion panels will be equitable and transparent in their composition and practices.

Leaders will examine and report on gender outcomes within organisations, to their boards and shareholders, and they will be accountable for delivering against diversity key performance indicators (KPIs) for their businesses. They will be accountable because there will be a deep understanding that lack of diversity costs their business in terms of profitability, creativity and the ability to compete.

Men across the country will be engaged as part of the solution, intolerant of inappropriate behaviour, challenging entrenched beliefs, and equally taking up parental leave thereby breaking down stereotypes and better able to balance their own careers with raising a family.

Because they've invested this effort in their cultures, their staff and their practices, these workplaces will be realising the benefits. They will be innovative, generate greater profits and returns, win more grants and publish more highly-cited papers, deliver better STEM training and education, and achieve better policy and public outcomes.

These workplaces will be publicly recognised and rewarded for their efforts in national and international accreditation schemes through programs such as the Science in Australia Gender Equity (SAGE) Initiative and WGEA Employer of Choice Gender Equality awards, as well as new programs arising from this decadal plan.

Every part of the economy and the industries within it will actively implement and monitor the progress of gender equity policies. Publicly available evaluations of the efforts made to achieve gender equity in STEM will drive informed decisions and investments and will be a source of national pride and a benchmark against which other nations measure themselves.

By 2030, the national and coordinated approach we took to achieve gender equity will have been applied to other forms of diversity as well as to address intersectionality.

The health of our society, our environment, and our global interactions will be stronger. Globally we will have drawn on all available talent and resources to achieve the Sustainable Development Goals.

And, as a nation, we will be proud and prosperous.

Dr Pauline Treble and Ms Carol Tadros in Jenolan Caves collecting water samples.
CREDIT: ANSTO

OPPORTUNITIES

Striving towards our shared vision for gender equity in the Australian STEM ecosystem will deliver many benefits, including greater preparedness for the future, greater workforce participation, better economic performance, greater scientific impacts, and greater creativity and entrepreneurial activities.

Australia will be better able to create and inspire cutting edge science, technology and innovations.

A fair playing field will generate opportunities for all.

Achieving this will necessitate significant reform, and stakeholders in the Australian STEM ecosystem will need to adapt. Leadership, accountability, robust governance structures, funding and cultural shifts will all be required to achieve the step change that an increasingly technologically enabled environment demands.

Six key opportunities will drive that change over the next decade and equip Australia's STEM workforce for the future.

The way in which these opportunities are adopted and refined by stakeholders—government, academia, industry, the education sector and the community—will differ and will be customised. To maximise the opportunities, the decadal plan offers implementation guidance that emerged as a result of its development and the consultations.

All the strategic recommendations are designed to facilitate change that is systemic and sustained and that will bring about the step change needed to achieve gender equity in STEM in Australia.

1 LEADERSHIP AND COHESION

Stronger cohesion and leadership across the Australian STEM ecosystem will amplify and strengthen diversity outcomes.

2 EVALUATION

Establishing a national evaluation framework will guide decision making and drive investment and effort into measures that work.

3 WORKPLACE CULTURE

A significant cultural shift in workplaces is necessary to create gender equity for women in STEM. A culture that is inclusive and respectful, challenges traditional stereotypes, is free of discrimination and bias, enables flexibility and accommodates career interruptions and changes will maximise women's participation in the workforce.

4 VISIBILITY

Seeing women in diverse STEM careers, and equally represented in the media, in public events, and in other forums like boardrooms and classrooms will provide role models for girls and women and inspire a nation.

5 EDUCATION

Strengthening the education system to support teaching and learning on a national scale will enable and encourage all girls and women at all levels to study STEM courses and equip them with the skills and knowledge to participate in diverse STEM careers.

6 INDUSTRY ACTION

Establishing a national framework that guides and provides tools to address gender equity amongst SMEs will impact the vast majority of businesses not reached by existing programs.

Opportunity 1 Leadership and cohesion

Stronger leadership and cohesion across the STEM ecosystem in Australia will amplify and strengthen diversity outcomes.

Critical to the success of any initiative is leadership. More than ever, individual leaders across the STEM ecosystem, including in government, academia, industry, education, and the community, must come together to drive action to achieve gender equity in STEM and be accountable for it.

Change can commence at the grassroots and this should not be discouraged. However, the systemic and sustained actions required to make a step change in achieving gender equity in Australia will primarily occur when led and championed from the top.

Equally, cohesion and coordination across the STEM ecosystem is critical. No single activity or stakeholder can shift the barriers faced by women in STEM. More than half of participants in the consultation process flagged the lack of cohesion and the small scale of programs as major barriers to achieving better outcomes for girls and women in STEM. Numerous case studies show the benefit of collaboration between stakeholders, for example the positive impact of the education sector and industry working together to strengthen the STEM pipeline.

Leadership and cohesion must also be accompanied by accountability. Leaders must monitor and report on gender outcomes within organisations, to their boards and shareholders, and should be accountable for delivering against diversity KPIs for their business. Such practices would reflect deep organisational understanding that lack of gender equity costs businesses in terms of profitability, creativity and ability to compete.

To properly address issues of gender equity, workplaces must ensure they are measuring the right things to track progress and enable identification of areas requiring attention.

Accreditation programs that provide a broad organisational framework have been shown to be effective mechanisms to encourage organisations to set goals and work towards change across the multitude of issues that impact on women in STEM. Organisation leaders should be encouraged to choose such a program that suits them.

WGEA offers a good example of how national frameworks for accountability and data collection (in this case legislative) can yield positive outcomes for gender equity across a range of industries. Organisations that report to WGEA are eligible to apply to be recognised as an Employer of Choice for Gender Equality (EOCGE).

SAGE is the only transformative gender equity program of its kind in Australia designed to achieve sustained cultural change via a national accreditation framework. Measures to enable SAGE to be adopted by all higher education and research (HER) institutions across Australia would bring unparalleled impact.

Examples of other global accreditation initiatives include the Economic Dividends for Gender Equality (EDGE), with which some multinationals operating in Australia are accredited, and the United Nations Development Program Gender Equity Seal, which operates globally but not currently in Australia. Neither program STEM specific.

Government, as a driver of policy, funder of programs and large employer of STEM professionals, has a significant opportunity to model leadership by adopting best practice. This could include making the adoption of diversity measures and evaluation a condition of government funding, or incorporating them in procurement guidelines to encourage the adoption of best practice in gender equity to flow through the supply chain and the economy.

Many effective initiatives, such as those coordinated and led by the Male Champions of Change (MCC), Chief Executive Women (CEW) and the 30% Club, offer a strong foundation for further action.

"SAGE is the only transformative gender equity program of its kind in Australia designed to achieve sustained change via ongoing evaluation and a national accreditation framework."

Aspiration

In Australia, leaders in government, academia, industry, the education sector and the community are accountable for monitoring, evaluating, coordinating and influencing improvements in gender equity practices across their sphere of influence.

Strategic recommendations	Detail
1.1 Incentivise and promote accountability amongst leaders	WGEA offers a good example of how national frameworks for accountability and data collection can yield positive outcomes for gender equity across a range of industries. Government should develop incentives to encourage voluntary reporting from organisations with fewer than 100 employees.
1.2 Rollout the SAGE pilot nationally to facilitate the involvement of all higher education and research institutions in Australia and provide a pathway towards Gold Athena SWAN accreditation	SAGE is the only transformative gender equity program of its kind in Australia designed to achieve sustained cultural change at a national scale. Measures to enable SAGE to be adopted by all HER institutions across Australia would bring unparalleled impact and scale. Consideration should be given to piloting SAGE in the vocational education and training sector. Consideration should be also given to leadership training across universities to complement SAGE and provide institutions with tools and mechanisms to bring about meaningful and measurable improvements in gender equity.
1.3 Address diversity in government funding and procurement	Government as a driver of policy, funder of programs and large employer of STEM professionals has a significant opportunity to show leadership by adopting best practice. This could include making the adoption of diversity measures and evaluation a condition of government funding, or incorporating them in procurement guidelines to encourage adoption of best practice in gender equity to flow through the supply chain and the economy.
1.4 Government as a key employer of STEM professionals adopt best practice in gender equity as outlined across this decadal plan	Government is uniquely positioned to be a best practice employer.
1.5 Develop and adopt national guidelines on best practice in all selection processes	This is intended to provide comprehensive guidance and set a national benchmark for all entities administering awards, fellowships or other recognitions of achievement, including government, academia, industry, learned academies, professional societies, and not-for-profit organisations. Organisations administering awards and fellowships should draw on and adopt evidence-based best practice to remove barriers to nomination and selection of girls and women and to promote and celebrate diversity of recipients. Demographic information from applicants should be collected so clarity can be gained on where diversity is lacking in processes, and improvements can be tracked.
1.6 Develop national standards to require accreditation bodies to meet national benchmarks	A rise in the number of accrediting bodies across the nation can lead to confusion as to whether the benchmark reached genuinely reflects the adoption of best practice by the accredited organisation. National standards would provide confidence to organisations seeking accreditation that their actions to improve gender equity are meaningful, will have impact and lead to sustained change in gender equity. Government has a responsibility to lead this body of work, taking learnings from WGEA and SAGE.
1.7 Leaders across all STEM professions and organisations adopt and adapt learnings from proven measures such as those developed by MCC, CEW and the 30% Club	The Male Champions of Change Panel Pledge is a signed commitment for organisation leaders to only be involved in panels that involve women in a meaningful way. This has led to 95% of Male Champions of Change members supporting the pledge, enhancing the diversity and quality of perspectives presented in public discussions and encouraging event organisers to reassess their own approaches and diversity messaging[39]. MCC and CEW have developed a resource with approaches to avoid the 'merit trap', which is now being routinely used by 70% of MCC organisations in recruitment, promotion and related processes[40]. Leadership teams can make a significant difference to the culture, equity and diversity efforts of their organisations, especially when these efforts are informed by meaningful measurements to identify areas requiring attention. Practices such as these should be adopted by all leaders (refer also to opportunity 4 on page 29).

Implementation guidance

- WGEA currently collects data from all non-public organisations with more than 100 employees[41]. Five years of open reporting of gender equity data has seen gains in gender equity initiatives—such as an increase in the number of women in management roles (3.9%) and increases in employer actions in regards to gender equality policies (2.8%) and strategies (14.6%), pay equity (21.9%) and flexible work (9%)—and identifies areas where further work is needed[42]. It is likely in the future that WGEA will accept voluntary reporting from organisations with fewer than 100 employees. In 2016–17, 1487 of the 4479 reporting organisations (33%) were STEM organisations[43].
- Similarly, the SAGE initiative offers a national framework to encourage performance improvement in HER through self-assessment and ongoing evaluation. SAGE is being piloted nationally and is the Australian adaptation of the Athena Scientific Women's Academic Network (SWAN) Charter in the UK. Formative evaluation of the SAGE pilot is already demonstrating the value and positive impact of this initiative on gender equity in HER (see case study 5 on page 41).
- Independent evaluations of UK Athena SWAN have demonstrated that this accreditation program has benefited staff and positively influenced institutional practices as well as cultural and attitudinal changes, and these changes are sustained[44].
- Since its inception, the SAGE initiative has engaged with around 50% of Australia's higher education and research sector[45] and has been instrumental in commencing cultural change within those institutions.
- The self-evaluation undertaken as part of the SAGE accreditation program not only informs change within an institution but contributes to a growing evidence base of what works and what does not across STEM.
- Programs such as Aurora in the UK—a women-only leadership development program for women in higher education institutions—provide training and development opportunities that assist women's retention and progress and support institutions' efforts to achieve accreditation. The impact of Aurora has been consistently measured through a five-year longitudinal study which shows the power of the program's ability to increase a woman's self-belief in her leadership skills (see case study 10 on page 44).
- The 30% Club, which regularly reports on women's representation on publicly listed organisations, has demonstrably increased representation of women[46]. Amongst ASX 200 companies for example, the percentage of women on boards has risen to 29.7%, a substantial increase from 8% representation in 2008[47]. Programs such as these allow organisations to identify and meaningfully address the issues which are most pertinent to them.
- Women are typically under-represented as recipients of awards and fellowships in STEM fields, despite making up one-third of the world's research and development workforce. Women continue to be represented in low numbers in the nomination or application pool.
- Development of best practice guidelines should consider assessment criteria that go beyond research metrics (e.g. impact, outreach, industry engagement, patents, policy contributions, mentorships, supervision, teaching); acknowledgement of impact of career interruptions (as per the Australian Research Council Research Opportunity and Performance Evidence (ARC ROPE) guidelines); transparency in decision making; inclusive selection criteria; methods to address unconscious bias; diverse selection committee composition; use of blind assessment of applications; avoidance of complex nomination processes; showcasing and celebratiion of diverse awardees; and use of tools to attract a diversity of applicants including appropriate marketing and advertising that has reach and enlisting mentors and sponsors in identifying diverse candidates. Consideration should also be given to measures such as quotas and women- only awards or appointments.
- Evaluation of all measures is essential to continually improve practice. This is further elaborated in opportunity 2 on page 23.

Opportunity 2 Evaluation: understanding what works

If you can't measure it, you can't improve it. The majority of gender equity programs in STEM lack useful performance data and formal evaluation, making it difficult to determine which initiatives are effective and which should be extended or scaled up.

Only three of more than 330 Australian gender equity initiatives identified during the research phase of the decadal plan had publicly available evaluation findings at the time of publication[48].

Evaluation needs to be a priority, and government and other funders can support this by requiring rigorous evaluation of impact, using a standardised framework, as a condition of funding.

The ideal first step for all organisations seeking to address issues of gender equity is to conduct a baseline audit of their current STEM workforce to understand the issues within their context, and the gaps in their existing efforts. Based on this they can prepare a plan of action going forward.

Aspiration

Australia leads the world in the use of evidence-based activities and policy settings to support a diverse and inclusive STEM ecosystem.

Strategic recommendations	Detail
2.1 By 2022, establish a consistent national evaluation framework that guides evaluation efforts across all existing and future gender equity initiatives in STEM in Australia	Government, in collaboration with other parts of the STEM ecosystem, should co-design a national evaluation framework that enables project-level evaluation and demonstrates what works to attract, retain and progress girls and women in STEM.
2.2 Organisations who fund STEM gender equity initiatives support evaluation and evidence-based approaches by requiring evaluation as a condition of funding	A paradigm shift in the culture of evaluation is required, with an opportunity for leaders in business, research, education and government to make evaluation, and its open reporting, a priority throughout their spheres of influence. Funding organisations such as government, academia, industry, community groups and philanthropic organisations should support evaluation by providing funding and evaluation guidance as part of funding agreements. This will support a culture of evidence-based practice, by enabling activities to be refined and improved based on evaluation data.
2.3 Improve awareness of existing programs and their efficacy	Programs should be published and collated, including evaluation data, in a national repository supported by government to inform decision making about what works and what should be scaled up and/or funded across sectors. Collaboration should be supported and incentivised between providers of programs. Cross-sector collaborations should be enabled to enrich programs and processes.

"Many gender equity programs in STEM lack performance data and formal evaluation, making it difficult to know which work and which should be scaled up."

Implementation guidance

- Using existing data collections as the foundation, opportunities should be explored to improve coherence, relevance, reporting to a common standard and to identify and address any gaps. These should be guided by existing national statistics from the Australian Bureau of Statistics including the Australian and New Zealand Standard Industrial Classification, the Australian Standard Classification of Education, and the Australian and New Zealand Standard Research Classification.
- This decadal plan offers the opportunity for Australia to commit to long-term and comprehensive evaluation of gender equity initiatives in STEM. In Australia the benefits of early evaluation are demonstrated in the formative evaluation of the SAGE pilot which has allowed meaningful and measured enhancement of the pilot.
- Such an approach is not common for gender equity initiatives, but guidance may be drawn from similar approaches to improve teaching and learning:
  - The UK Education Endowment Fund provides funding for trials and evaluation of promising but unevaluated programs to generate evidence of what works to improve teaching and learning. Information on programs and their evaluation data is publicly available (see case study 1 on page 39).
  - In response to recommendations in the STEM Partnerships Forum 2018 report, Optimising STEM Industry–School Partnerships: Inspiring Australia's Next Generation[49], the Australian Government funded the development of a National STEM Education Resources Toolkit to be published in 2019. The toolkit will be an online resource to assist schools and industry design and establish new STEM initiatives, and evaluate existing and future initiatives. It will provide information on successful partnerships and the important role of intermediaries, and advice to support schools and industry in designing, implementing and evaluating partnerships.
  - A national evaluation framework should be flexible enough to take into account local circumstances to ensure that small initiatives which meet local needs are not disadvantaged.
- Consideration should be given to how a national repository of gender equity initiatives in STEM would link to existing related infrastructure. For example the showcasing of STEM education activities via STARportal, an initiative of the Office of the Chief Scientist, supported by the Australian Government.
- It will be essential to identify a standard definition of STEM subjects that can be applied across the 10 years of the plan to track girls' participation, particularly in low and medium participation areas of STEM.

A student from Meekatharra District High School observing sunspots with a solar telescope.
CREDIT: PETE WHEELER

Opportunity 3 Culture: inclusive and respectful workplaces

A significant cultural shift in workplaces is critical to creating gender equity for women in STEM. This includes making workplaces more inclusive and respectful, and challenging traditional stereotypes of the roles of women and men inside and outside of work, through proven methods that are tailored to work in different environments.

Attracting and retaining women in the STEM workforce requires addressing a range of factors including workplace culture, discrimination and bias, a lack of flexibility in work options[50], and providing for re-entry to the workforce after career interruptions (see figure: career progression pipeline on page 5). Each is briefly considered below with a more comprehensive evidence base provided in appendix 2 on page 47.

All actions developed under the umbrella of this decadal plan should consider intersectionality.

Career interruptions: A significant finding of the decadal plan is that while organisations may be taking actions at an individual level to support women who experience career interruptions, Australia does not have a system-level method to retain women who may be disadvantaged by career interruptions. The pipeline of schooling to tertiary education to workforce is clearly defined, but re-entry or switch points are not as obvious. Importantly, at a time when the Australian economy requires a diverse range of STEM skills, Australia can ill afford inaction in this area. Opportunities to (re) enter the STEM ecosystem must be made available to both women who have experienced career interruptions and women who have not previously worked in STEM.

Discrimination: Australia has legal frameworks that are intended to prevent discrimination based on gender, but the existence of such frameworks is not sufficient to prevent discrimination.

Harassment and bullying: Sexual harassment is a significant issue within STEM organisations in Australia and impacts women at a much higher rate than men. Taking strong actions to improve reporting mechanisms and reduce the prevalence of harassment in the STEM-skilled workforces will create safer working environments for women encouraging them to be retained within the STEM workforce. It is the responsibility of every employer to ensure a workplace culture that does not tolerate bullying and harassment.

Societal expectations and stereotyping: These are broader societal issues, but the impacts are keenly felt by women in STEM and cannot be ignored. The societal expectation that women will be primary caregivers has implications for women's participation in the workforce generally, as well as in STEM, and for their career progression. Child care remains the biggest barrier to women entering or re-entering the workforce or working more hours[51] which was reinforced by feedback during the decadal plan consultations. Possibly as a result of caregiving expectations, flexibility in working hours and locations was cited as one of the most important workplace components for attracting and retaining women in STEM roles.

Rather than focusing only on increasing women's workforce participation, it is also important to increase men's participation in caring responsibilities[52]. In countries where family policies incentivise men to take caring roles, the impact is seen both in the rate of men accessing leave and in societal attitudes towards parenting (see case study 9 on page 44).

As flexible work and caring responsibilities are taken up equally by men and women in our STEM workplaces, a cultural shift will be created which will highlight the impact of caring responsibilities on work and raise the value of part-time and flexible work.

Overall, women will benefit when we give Australians of all genders more choice in balancing their careers with other priorities.

Supporting career progression: Mentors and sponsors play an important role in career development. Good mentors and sponsors at an appropriate level can have a significant influence on mentees' career choices and progression opportunities. The relative lack of women at senior levels in STEM organisations acts as a barrier to ensuring availability of appropriate mentors and sponsors to early- and mid-career women in STEM. It also highlights the importance of men at senior levels demonstrating leadership by mentoring and sponsoring early- and mid-career women. The decadal plan consultation process revealed strong support for a formal national

program to foster mentorship and sponsorship of women in STEM.

In Australia there is no overarching structure or best practice guidelines for mentoring, rather multiple independent programs. Mapping of Australian STEM participation initiatives for girls and women found six mentoring programs and 16 leadership and career progression programs[53].

In the UK, Aurora was established by Advance HE to provide an overarching leadership and mentoring program for the higher education sector (see case study 10 on page 44). This structured process with organisational buy-in led to increased self-belief of women's leadership skills with 79% of the latest cohort seeking out leadership roles[54]. A longitudinal study of this program highlights the personal impact and changes but recognises that mentoring and leadership programs need to be accompanied by structural and cultural change such as those brought about by programs such as the Athena SWAN Accreditation Framework (see opportunity 1 on page 20).

Aspiration

Leaders in all Australian workplaces have adopted and are accountable for implementing tailored measures that create inclusive and respectful workplaces.

Strategic recommendations	Detail
3.1 Make each STEM organisation responsible and accountable for establishing a non-discriminatory workplace culture that does not tolerate harassment and bullying	This requires comprehensive baseline assessment and evaluation of policies and practice. The Athena SWAN Accreditation in the UK and the Australian adaptation (SAGE) illustrate the effectiveness of this approach. KPIs for business should include adoption and active implementation of policy and processes to boost diversity, reduce discrimination and address bullying and harassment. This must include accountability measures for organisational leaders. Such practices would reflect deep organisational understanding that lack of diversity costs businesses in terms of profitability, creativity and ability to compete. Learned academies, STEM associations and other volunteer-based STEM organisations have a role to play in adopting transparent diversity policies and in tackling discrimination and harassment, for example, by putting in place and maintaining best practice codes of conduct including transparent mechanisms to identify and report inappropriate behaviour, access to justice for all parties and visible consequences. Government and funding bodies should consider implementing and enforcing policies on bullying and harassment, where funding bodies can remove perpetrators from funded projects and restrict them from future grant applications.
3.2 Develop a system-level approach to retain and retrain women in STEM careers	Leaders of all STEM organisations should consider what return to work practices work best for their sector, drawing on evidence and best practice. Measures should also enable those making career changes to retrain to join the STEM workforce, offering STEM organisations a way to address skill shortages and pipeline issues in an accelerated time frame. Measures may include flexible work arrangements; creation of part time positions; destigmatisation of career interruptions; equalised uptake of measures so that men and women can benefit; and initiatives to allow continuation of research during career interruptions (e.g. financial assistance to employ research assistants or to support caring needs). With a larger proportion of their workforce engaged in flexible work, part-time work and career interruptions should become the norm for men as well as women.
3.3 Develop best practice guidelines for mentoring and leadership programs across the STEM ecosystem and support initiatives that work	Formal mentoring programs for women in STEM should be promoted with a view to increasing participation and sharing information on what works. STEM organisations across government, academia, industry, the education sector and the community have an opportunity to incentivise mentorship by senior staff through formal programs as well as through outcome and performance evaluation, and to train mentors to understand the difference between mentoring and sponsoring. The Australian Government should consider opportunities to support development of formal mentoring programs through grant programs.

Strategic recommendations	Detail
3.4 Identify measures to appropriately address intersectionality	This decadal plan focuses on gender equity, but more needs to be done to improve diversity beyond gender and to address intersectionality. There is an opportunity to undertake in-depth research into intersectionality in STEM in Australia. All actions developed under the umbrella of the decadal plan should consider intersectionality.

Implementation guidance

- Consideration needs to be given to that fact that merit and discrimination are linked. Merit has become synonymous with fairness but can be highly discriminatory. Merit is hard to quantify and is often defined and measured inaccurately. Merit tends to be defined by deeply held beliefs based on characteristics innately familiar to those evaluating the merit[55].
- In the research sector, there is a significant disparity in the number of applications to Australia's competitive grants programs from women and men in STEM research. This trend in part reflects the disparity in numbers of researchers between genders at senior levels, and is also likely to be influenced by unconscious bias in selection processes, including assessment of merit and consideration of career interruptions.
- Measures to address bullying and harassment within research funding frameworks should draw on learnings from the Wellcome Trust, the US National Science Foundation and the US National Institutes of Health (see case study 6 on page 42).
- Non-inclusive, gendered language in job advertisements can deter women from applying for positions, and measures of merit can be inconsistently adopted.
- Measures to address sexual harassment should draw on findings of the 2018–19 Australian Human Rights Commission's National Inquiry into Sexual Harassment in Australian Workplaces examining the economic impact of sexual harassment, the drivers of these behaviours and the adequacy of the existing legal framework[56].
- Multiple sources provide evidence that there are high levels of sexual harrassment and bullying in STEM workplaces (see appendix 2 on page 47).
- Societal stereotypes continue to be a large barrier impacting women in STEM. Policies designed for all genders will be most effective. Australian men express a desire to spend more time caring for their children, and yet 99.4% of those taking up the Australian Government Paid Parental Leave scheme are women. Only one-third of men take the additional two weeks paid leave offered specifically to dads and partners[57] and more women than men access carer's leave and flexible working arrangements in STEM organisations.
- One issue specific to STEM researchers is that caring responsibilities can limit their ability to conduct research, publish, disseminate research results and build networks by attending conferences, and secure grant funding. These are the components that contribute to a successful track record which is inexorably linked to progression in STEM research. It is essential to ensure that when 'track record' is assessed for whatever reason it is done so using consistently applied 'relative to opportunity' principles to ensure that those with caring responsibilities or who have career interruptions are not disadvantaged.

"Australia needs a systemic way to attract and retain women who are disadvantaged by career interruptions."

Dr Narissa Bax after the final trawl of the Antarctic Circumnavigation Expedition.
CREDIT: JEAN-FRANÇOIS LAGROT

Opportunity 4 Visibility: you can't be what you can't see

Role models count. What children and young adults see of STEM professionals shapes their beliefs and career aspirations, so the value of role models to aspiring STEM professionals cannot be overestimated. Yet, public representation of STEM is predominately male-dominated. This partly reflects the gender disparity at senior levels, and partly the fact that event organisers tend to invite known speakers or struggle to identify suitable women. Steps need to be taken to improve the representation of women in all areas including in leadership positions, on boards, on conference panels and in the media.

The decadal plan consultations supported this finding. Participants cautioned that STEM professionals involved in outreach activities and public engagement often do so in a voluntary capacity, and women from under-represented groups in particular feel they are expected to step up and take on these roles despite the lack of recognition and the negative impact this can have on their career progression.

Conversely, it is recognised that enabling greater attendance and involvement of women in conferences and public events in a supported way can have a positive effect on the retention and progression of women in STEM, as participation in these events can positively contribute to career progression, for example the opportunity for international collaboration that can arise from participation in international conferences.

To create systems that showcase diverse STEM role models and avoid unintended disadvantages, it is important to support and incentivise STEM professionals to participate and to share the load. Until more women are choosing to remain in STEM careers and are able to progress to senior levels, ensuring gender balance will require a concerted effort to engage a broader range of speakers, so that representation is not constantly expected of a small number of women.

Women STEM professionals are also under-represented in Australian mainstream media. Women are quoted as sources in 26% of science and technology related news stories[58]. Media outlets worldwide have traditionally under-represented women in STEM, and where they were represented the focus tended to be either on their appearance or their roles as wives and mothers[59]. While some media agencies are striving to improve the representation of women, there has not been a consistent national effort to achieve gender equity in media representation of STEM.

Social media is also a powerful influence. Research indicates that scientists' social media accounts can have a significant reach outside the scientific field[60] and influence young people making career choices.

The absence of significant change worldwide highlights the need for innovative approaches to both empower women to reach out to media, and hold the media accountable for who they present.

Aspirations

The Australian STEM ecosystem is characterised by diverse role models who fully represent, engage with and inspire society.

By 2025, gender equity has been achieved in STEM-related media content.

"Concerted effort must be made to engage a broader pool of women so that public representation is not expected of a small few."

Strategic recommendations	Detail
4.1 Utilise policy and other levers to facilitate participation of women in STEM conferences and events as well as require gender equity on panels and programs of STEM-related conferences and events	Leaders in government, industry, academia, the education sector and in the community should ensure grant and sponsorship support for STEM events and conferences is conditional on adoption of gender equity and diversity policies, as well as a requirement to report gender and diversity outcomes. Particular attention should be given to reward and recognise efforts made by members of under-represented groups. Government, industry and academia, as employers of STEM professionals, should apply rules of fair representation on externally and internally facing activities they organise.
4.2 Establish mechanisms for media agencies to identify and represent diversity in reporting	Media and STEM organisations should work together to ensure diverse media content and representation. Media organisations should make concerted efforts to ensure diversity in their reporting, and STEM organisations should nurture and put forward diverse individuals for media opportunities. Implementation should be led by stakeholders, including: • the Australian Government as an employer of STEM professionals and via its governing role of the ABC as the national broadcaster • all STEM organisations supporting media and communication training, including social media, for employees wishing to participate in the media • all STEM organisations ensuring their communication and outreach activities consider issues of diversity Public and private media organisations should audit the gender component of their public reporting of STEM and draw on existing resources such as Science Media Exchange (SciMEX) and the STEM Women directory to diversify their sources.
4.3 Establish mechanisms for representing diversity in social media	Social media is a powerful influencer, particularly among younger audiences. Of people aged 18–29, 26% identify social media as their most trusted source of news compared to traditional sources such as radio, television and print media[61]. Male Champions of Change STEM organisations that have audited their own public presence, including social media, are taking steps to improve gender balance in these areas[62]. Trends show a rising number of STEM individuals and organisations maintain their own impactful social media presence, with an estimated 48,000 scientists worldwide having a Twitter account, of which 38% are women[63]. STEM organisations should audit their social media presence to encourage equity of representation of women in STEM.
4.4 Make concerted, coordinated and sustained efforts to celebrate the depth and breadth of STEM and the diversity within it	All STEM organisations should harness existing national initiatives to promote and recognise diversity in STEM. Opportunities should also be sought to showcase diversity in STEM and non-STEM-specific events and environments to reach and inspire new audiences, particularly girls, and to make visible and celebrate diversity in STEM.
4.5 Position STEM in Australia as a viable and vibrant career option for girls and women	The face of STEM should reflect the diversity of people who choose STEM careers. STEM professionals of all genders can and should have the opportunity to be role models. There should be recognition of efforts made by role models and leaders for actively contributing to outreach activities to assist students' awareness of the diversity of career paths available to them. A consolidated government-led national campaign offers one mechanism to challenge stereotypes in STEM, illustrating that a career in STEM can be exciting and an option for people of all genders and from all backgrounds, focusing on those areas where women are particularly under-represented. Such a campaign should demonstrate to girls, women, their families and the broader community that STEM offers exciting, diverse and meaningful career pathways for both girls and boys.

Implementation guidance

Conferences and events

- To encourage identification of a broader range of women in conferences and events, all public and private STEM organisations should take guidance from the Male Champions of Change Panel Pledge, a signed commitment for organisation leaders to only be involved in panels that involve women in a meaningful way (see recommendation 1.7 on page 21).
- Complementary activities should include provision of onsite child care or care support bursaries at national and international conferences.
- Science & Technology Australia is ideally placed to enable the sharing of best practice and encourage the collection of data by scientific societies and associations that run conferences and events.
- The Australian Academy of Science, Commonwealth Scientific and Industrial Research Organisation (CSIRO) and other relevant organisations should continue developing and promoting directories such as STEM Women and Expert Connect to facilitate identification of women speakers and panellists.

Media

- Journalists report that time is a limiting factor in finding new talent, and meeting tight time constraints can take priority over diversity of representation.
- Consideration should be given to the fact that similar structural inequalities common to STEM may also be at play in journalism. A 2015 survey by Women in Media found that women make up 48.5% of broadcasting and 51% of Australia's publishing industries, yet are named or acknowledged as journalists in only 30.8% of media coverage.
- There is a lack of data on the number of women put forward to the media by STEM organisations and the number of women quoted in STEM-related news stories by the media.
- Media should consider setting targets and use learnings from trials such as those adopted by 774 ABC Melbourne (see case study 3 on page 40) and monitor and evaluate over time to determine if efforts are effective at diversifying media sources and encouraging women to participate in media activities.
- In the absence of robust data, implementers should draw on learnings from a growing number of projects to provide media organisations and event organisers with a diverse talent pool, such as Women's Leadership Institute Australia's Women for Media database; the Australian Science Media Centre's SciMex database; the Australian Academy of Science's STEM Women database; Science & Technology Australia's Superstars of STEM program; ABC News's establishment of a database of women across industry to increase the diversity of its sources in February 2019[64]; and, internationally, 500 Women Scientists.

Harnessing existing opportunities

- Opportunities exist for all stakeholders to harness existing national initiatives such as National Science Week—Australia's largest festival of science, which each year attracts over one million people nationwide to over 1000 events[65]—to showcase diversity and to proactively address stereotypes in STEM. The success of National Science Week relies on collaboration between government, academia, industry, libraries, museums, media, schools and community groups to deliver events designed to showcase Australian science and scientists, as well as encourage an interest in STEM. However, a broader and more consistent national effort is required beyond National Science Week.
- Opportunities should also be sought to showcase diversity in STEM in non-STEM-specific events and environments as they provide opportunities to reach and inspire new audiences, particularly girls.

National campaign

- A national campaign should be based on the best available evidence on gender stereotypes and influencers at different age levels, and it should incorporate learnings from related Australian and international campaign activities.
- The campaign should be sustained over the long term, and include rigorous evaluation of reach, impact on attitudes and behaviour and general efficacy in order to inform and guide future efforts to address societal gender stereotypes regarding STEM.

Students building an electronic windmill as apart of the STELR program.
CREDIT: EAMON GALLAGHER

Opportunity 5 Education: strong beginnings

Attracting girls to STEM careers starts early in their education. Research shows that children begin to aspire to careers in early primary school[66], and teachers, careers advisors and families are their key influencers[67]. Families in particular are critical in either reinforcing or changing stereotypes associated with subject and career choices. Yet, very few programs target these groups in view of improving awareness of life and career opportunities that arise from studying STEM.

There is no shortage of reports that outline how the education system can best support STEM teaching, including the National STEM School Education Strategy[68] agreed by all Commonwealth and state and territory education ministers. However, no decadal plan for women in STEM would be complete without strong recommendations to draw on the proposed measures in these reports. The measures were supported by the decadal plan consultation process and are reflected in the following strategic recommendations.

Little or no action has been taken to boost participation of women in vocational education and training. VET qualified workers make up 68% of the total STEM workforce, and of VET qualified STEM workers only 9% are women[69]. The greatest gap is in engineering, which has a ratio of enrolled men to women of 10:1[70].

Students from low socioeconomic and rural and regional areas, and those from Aboriginal or Torres Strait Islander backgrounds, are especially under-represented in STEM throughout the entire pipeline[71].

Transformational and sustained change to improve gender equity in STEM will not occur unless all stakeholders relentlessly pursue the activities recommended in published reports, including redoubling efforts for government, the education sector and industry to work together. The effectiveness of adopted measures must be evaluated.

Aspirations

The Australian education system inspires, enables and encourages girls and women at all levels to study STEM courses and equips them with the skills and knowledge to participate in STEM and related careers of the future.

By 2030, we see a measurable change in the number of girls and women enrolled in and completing courses in low and medium participation STEM disciplines across secondary and tertiary education sectors.

Strategic recommendations	Detail
5.1 STEM-skilled teachers teach STEM courses	All teachers of STEM courses should be provided with adequate STEM-specific professional learning for pre-service and in-service teachers with priority given to those courses where girls' participation is lower than boys'. Consideration should be given to accreditation for STEM-specific professional learning per teacher.
5.2 Strengthen STEM teaching pedagogy, practices and resources to enable girls and women to engage with contemporary STEM content	Girls should enter secondary school with knowledge of the diversity of STEM careers, and should be encouraged by the strength of their own skills and the real-world applications of STEM to pursue STEM when they begin selecting subjects in mid secondary school. State and territory education departments, along with teacher and career advisor and development provider associations, should ensure provision of appropriate information, training and resources on STEM careers. Partnerships between STEM stakeholders such as the education sector and industry should be strengthened to contextualise and make STEM learning relevant. Opportunities to strengthen STEM education through formal and informal education should be explored. Mechanisms to challenge biases and stereotypes should be explored, such as embedding inclusive language and content across the education sector, and supporting teachers and career counsellors. Similarly, parents and carers should be supported so they can discuss career options with their children in an informed, unbiased way and from a young age.

Implementation guidance

- Given broad categories of fields of education can mask large variations in sub-disciplines, it will be important to set targets that account for these differences at the sub-disciplinary level.
- With support from the Australian Government, Education Services Australia is developing a national Girls in STEM Toolkit as a resource to help students, teachers, careers advisors and caregivers better understand STEM career options. This resource should be subject to evaluation, the learnings from which should inform its further development.
- Research shows that curricula and teaching strategies that focus on 'real-world' STEM scenarios can make material more engaging and contribute to increased levels of motivation through informal learning opportunities[72,73].
- Industry has an important role to play in knowledge transfer by supporting education programs that give students an insight into real STEM problems, skills and practices. This includes building on work undertaken by the STEM Partnerships Forum to identify ways that industry can work with the education sector to support and promote STEM learning (see case study 4 on page 40).

"Children begin to aspire to careers in early primary school, and teachers, careers advisors and families are their key influencers."

Ms Estee Tee showing a young child the wonders of science.
CREDIT: NAOMI HAWLEY

Opportunity 6 Industry action

Small and medium enterprises (SMEs) are a key gap in industry efforts to address gender equity. This was highlighted by the decadal plan consultations.

Many components of the STEM ecosystem, particularly in higher education and large businesses, have recognised the importance of gender equity and initiated programs to address this. These efforts are supported via established or developing national frameworks (SAGE for HER and WGEA for companies with greater than 100 employees). These frameworks encourage performance improvement through self-assessment and ongoing evaluation.

SMEs make up more that 99% of Australian businesses, employ 70% of the labour force, and contribute 56% of value to GDP[74]. While SMEs underpinned by STEM are a subset of this, small businesses can be at the cutting edge of technology and design in Australia (30% of small businesses engage in product innovation and SMEs make up 17% of business expenditure on research and development[75]).

The vast majority of SMEs are not covered by WGEA reporting and their smaller size and resource constraints often mean they do not have ready access to guidance or solutions to address gender equity. Yet growing digital and technologically-enabled advances across the decade will bring with them an increasing dependence on STEM skills. Consequently, access to a broader pool of skilled workers will become essential for business success.

A national gender equity framework tailored for SMEs must be developed and implemented to ensure SMEs are productive and profitable, and meet growing expectations for diverse and inclusive workplaces.

Aspiration

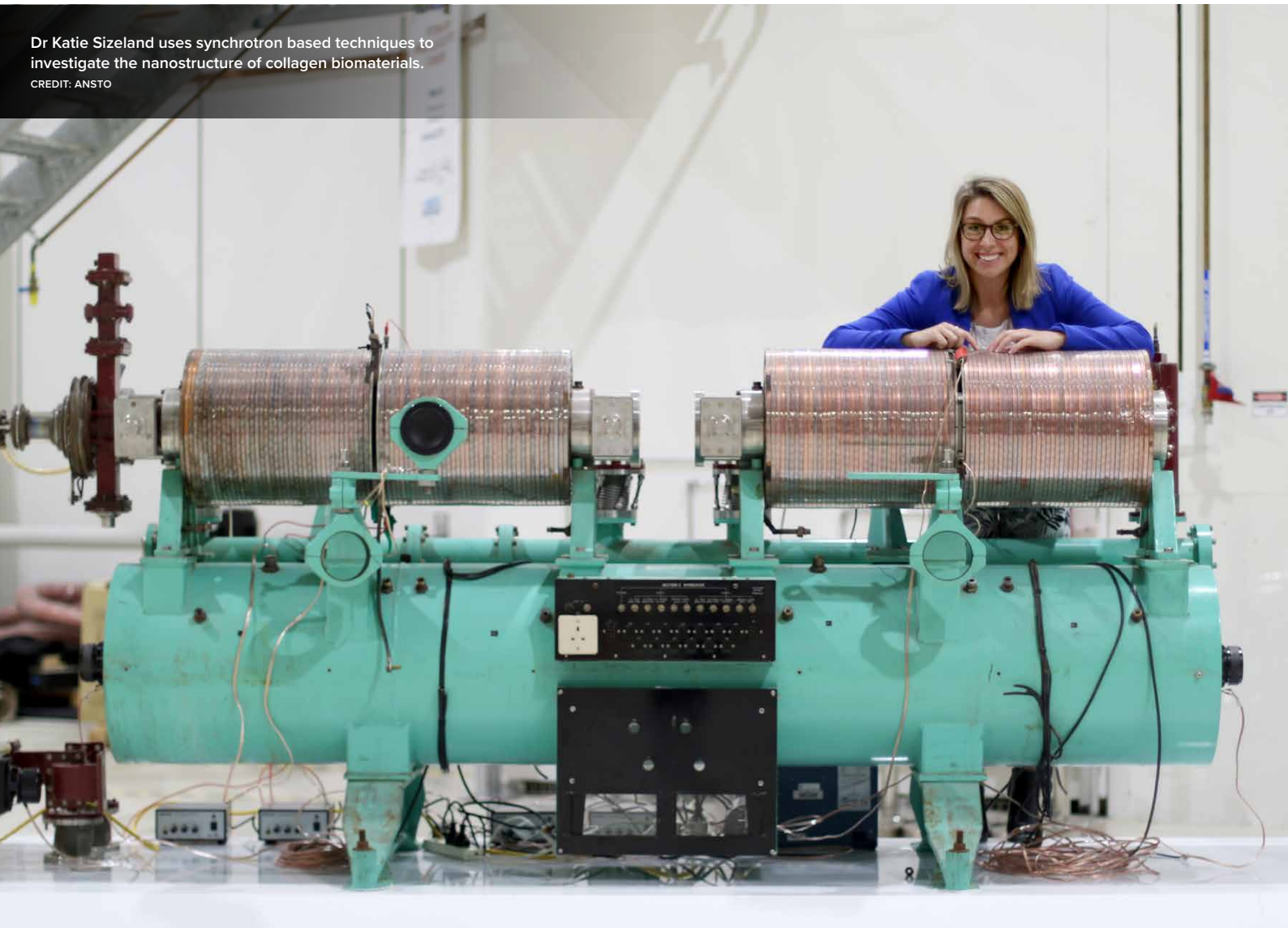
As a mechanism to maintain viability and profitability, by 2030 SMEs routinely draw on and adopt a suite of policies and tools within a national framework to improve gender equity in their workforce and business practices.

Strategic recommendations	Detail
6.1 Develop a framework and toolkits to help SMEs recognise and address gender imbalance	Diversity and inclusion programs and activities should be identified and combined to create a national framework for SMEs to address gender equity. The framework should be simple, low cost, and not impose any regulatory burden. The framework should provide access to practical tools and strategies that guide businesses to self-assess progress towards gender equity.
6.2 Government provides incentives for SMEs to address gender equity via funding and procurement requirements	To encourage progress towards gender equity, access to government funding and procurement contracts should become contingent on SMEs having a gender equity policy and strategies in place.
6.3 Larger companies and universities using SME products and services provide incentives via procurement requirements	To show leadership in gender equity, access to procurement contracts should become contingent on SMEs having a gender equity policy and strategies in place.

> “Industry could benefit from drawing on successful existing frameworks which encourage performance improvement through self-assessment and ongoing evaluation.”

Implementation guidance

- The Australian Academy of Technology and Engineering in collaboration with industry should develop a framework that draws on existing proven models and programs, with components including leadership; strategy and actions; measurement and reporting; evaluation; and a commitment to progress towards gender equity and inclusion.
- The framework should be informed by and incorporate lessons from:
    - existing initiatives such as: Male Champions of Change, Chief Executive Women's Your Leadership Shadow, the 30% Club, SAGE and its members, WGEA Employer of Choice for Gender Equity, and specific industry-led programs such as Pharma Australia Gender Equity (PAGE) being led by the pharmaceutical industry
    - exemplar companies with strong diversity and inclusion commitments and well-formulated action plans
    - evidence-based international models, such as UK Science Council and Royal Academy of Engineering's Diversity and Inclusion Progression Framework
    - consultation with industry (roundtables, surveys).
- Development of the framework could include a pilot trial of its practical 'toolkit' for SME use incorporating the resources of proven actions and approaches for gender equity in STEM-skilled workforces. Evaluation of the pilot would allow enhancement of the framework so that it is fit-for-purpose for SMEs.
- Once developed, the use of the framework could be deemed a minimum standard required for SMEs to be eligible to access government and larger company procurement contracts.
- This self-assessment framework would provide SMEs with an opportunity to contribute to the sector's commitment to diversity and inclusion without requiring significant resources or imposing unreasonable burden.
- The benefit to the SME sector is viability and profitability driven by gender equity.



Dr Katie Sizeland uses synchrotron based techniques to investigate the nanostructure of collagen biomaterials.
CREDIT: ANSTO

Looking to the future, Professor Emeritus Doreen Thomas FTSE with an electric vehicle, which the Department of Environment and Energy currently predicts will make up one-fifth of new vehicle sales by 2030.

CREDIT: EAMON GALLAGHER

CASE STUDIES

Dr Ayesha Tulloch trapping mulgara in the Simpson Desert - contributing to a 30-year long-term monitoring dataset on changes to arid zone fauna populations over time.

CREDIT: AL HEALY

Case study 1 Public evaluation of education programs

WHAT UK Education Endowment Foundation (EEF) **www.educationendowmentfoundation.org.uk**

WHEN 2011–present

WHY To improve the educational attainment of students, especially those facing disadvantage, by providing evidence-based resources to teachers and schools.

HOW EEF funds rigorous trials of promising but unevaluated programs to generate evidence of what works to improve teaching and learning. Evaluation results are available online catalogued by project cost, evidence strength and the lasting impact on students. EEF provides funds, resources and campaigns to assist schools facing particular challenges to implement evidence-based programs. They are currently investigating international expansion.

IMPACT EEF has committed more than £96 million since 2011 to evaluate 160 projects reaching over one million children and young people in one-third of schools across England. An independent analysis highlighted that the lifetime gain for participating students amounted to a threefold return on the investment of the cost of running the program trial and evaluation.

LESSONS LEARNED Transparent evaluation of education programs is possible and cost-effective. The foundation understands what is occurring in English schools and ensures the information is publicly available, allowing the private and research sectors to contribute, collaborate and fill gaps.

CONTEXT Evaluation of programs often occurs internally. EEF was one of the only organisations found internationally that explicitly funds and publishes education evaluations publicly. LUMA Centre Finland also focuses on evaluation of its funded national education STEM programs and publishes them in LUMAT journal. An Australian version of EEF, Evidence for Learning, has been recently piloted.

Case study 2 Highlighting our STEM superstars

WHAT Science & Technology Australia Superstars of STEM program **www.scienceandtechnologyaustralia.org.au/superstars-of-stem**

WHEN 2017–present

WHY To create highly visible public role models, work towards equal representation in the media for women in STEM, and change the ‘scientist’ stereotype.

HOW More than 350 women in STEM across Australia applied for 30 positions in the inaugural 12 month program. Expanded in 2018 to take an additional 120 women through a two-year program over the next four years, the program provides advanced communications and media training to women from a diversity of experiences, ages, sexuality, cultural and ethnic backgrounds, career stages, geography, ability/disability, sectors and disciplines.

Participants are empowered with skills, opportunities, mentoring and networks to build their public profile. In the first year they undertake structured training through workshops and initiate mentoring relationships with senior women across a range of sectors. In the second year participants engage with secondary students and the public through social media, news media and speaking opportunities in schools and on stage.

IMPACT The program’s first 30 participants spoke in person with more than 12,000 school students in 83 Australian schools. The inaugural Superstars of STEM program achieved more than 1400 news media mentions, reaching an estimated audience greater than 330 million people. 70% of participants experienced career progression, 80% are now very or extremely confident speaking to media and 93% felt the program helped them make a difference.

LESSONS LEARNED The success of Superstars of STEM highlights what can be achieved when women are supported, empowered and encouraged to smash stereotypes. One of the biggest strengths of the program is the support network offered as a member of the Superstars’ sisterhood that provides the confidence and avenues to collaboratively challenge the status quo and directly inspire girls and young women.

CONTEXT Superstars of STEM is a world first, similar programs have not been found.

Case study 3 Secret project to hear more women's voices

WHAT Mornings with Jon Faine, 774 ABC Melbourne setting gender targets **www.smh.com.au/opinion/our-secret-project-to-give-women-equal-media-airtime-20161024-gs93hk.html**

WHEN 2016–2018

WHY To ensure that equitable and diverse voices were being heard on the radio.

HOW The production team collected data on the gender of guests and realised that only one-third were women. They set a target of 50% guests who are women on-air and actively sought women's voices, using resources such as the Women's Leadership Institute of Australia's Women For Media database.

IMPACT This approach prompted other ABC programs like The Drum to set targets and be transparent about their guest diversity.

LESSONS LEARNED Finding diverse talent took the production team extra time and they often found that the individual needed to be convinced of the value they could add to the conversation. Therefore, a strong commitment from all the program team was needed to meet the target. They also found that achievement of their target on a weekly basis was hindered by structural problems, such as the dominance of men as government representatives.

CONTEXT This project is the only publicly known attempt by an Australian media organisation to audit and set gender targets. In 2014 Matthew Winkler, Bloomberg's editor-in-chief, demanded women be mentioned in every enterprise story[76]. No further details were publicly available.

Case study 4 An industry education partnership

WHAT Cessnock Academy of STEM Excellence and iSTEM program **www.chslccase.org/istem**

WHEN 2013–present

WHY To improve STEM teaching by including real-world industry experiences and perspectives.

HOW The Cessnock Academy of STEM Excellence (CASE) is a collaboration between local schools, business and government to run workshops and activities established by Dr Scott Sleap, 2018 winner of the Prime Minister's Prize for Excellence in Science Teaching in Secondary Schools. One exemplar program is iSTEM, a student-centred program for students in Years 9 and 10. Working in teams with industry partners, students in this program develop solutions to STEM-related problems.

IMPACT CASE has been replicated in two other areas and iSTEM has been adopted in more than 260 schools across New South Wales. Girls in the region where CASE was first developed are 3.5 times more likely to take engineering studies than elsewhere in NSW.

LESSONS LEARNED Innovative and successful education programs are often generated within a school. National awards, such as the Prime Minister's prize for science teaching, help highlight these programs which can enable them to be scaled up across the nation.

CONTEXT In 2018 the Education Council collated research on industry–school partnerships, highlighting a number of local and international collaborations[77]. Each of these programs contribute to providing students with real-world experiences and perspectives. CASE is an exemplar of these programs, currently being scaled-up across NSW with evidence highlighting it has significant impact on subject selection.

"Girls in the region where CASE was first developed are 3.5 times more likely to take engineering studies than elsewhere in NSW."

Dr Emma Beckett is exploring the genetic secrets behind microbiomes and whether you really are what you eat.
CREDIT: EDDIE O'REILLY

Case study 5 Gender equity accreditation process for the higher education and research sector

WHAT Science in Australia Gender Equity (SAGE) **www.sciencegenderequity.org.au**

WHEN 2015–present

WHY To encourage HER institutions to adopt an accreditation process to address gender equity.

HOW The SAGE initiative is an adaptation of the Athena SWAN Charter, which evolved from the work of the Athena Project and the Scientific Women's Academic Network (SWAN) in the UK. The UK Athena SWAN Charter is a successful enabling mechanism, providing a framework for organisations to plan and enact work to create gender equity under an award scheme, offering bronze, silver and gold level accreditation at departmental and organisational levels. The SAGE version of the charter outlines 10 key principles which institutions must adopt within their policies, practices, action plans and culture to achieve accreditation as a bronze institution. Bronze accreditation requires institutions to establish an internal cross-disciplinary self-assessment team (SAT) to perform an analysis of the gender diversity within their institute and devise an actionable four-year plan. SATs then submit this information in yearly application rounds which are assessed by a broad range of peer reviewers and moderators. Since 2015, Australian research sector institutions have been recruited in phases to submit an initial application for accreditation.

IMPACT In 2018, 75% of the initial cohort received a Bronze Institution Award. By the end of 2019, 50% of research sector institutes will have applied for this initial accreditation. Independent evaluation of the SAGE pilot found strong support from senior leaders for the program, and that SAGE is a catalyst for change through a coordinated national approach.

LESSONS LEARNED Within the Australian research sector an externally established public accreditation process is supported by the majority of senior leaders and is generating change. Strong support from senior leadership, especially within SATs, national leadership from government, coordination and collaboration are crucial to delivering and sustaining change.

CONTEXT Established in 2005, the UK Athena SWAN Charter has now be adapted and implemented in Australia, Canada, USA and Japan[78].

Case study 6
Funding agencies zero tolerance policy on harassment

WHAT Wellcome Trust policy on bullying and harassment **www.wellcome.ac.uk/funding/guidance/policy-bullying-and-harassment**

WHEN 2018–present

WHY To promote a safe and productive research environment for current and future STEM researchers.

HOW Any institute that receives Wellcome Trust funding is required to notify the Trust if any employee associated with a Wellcome Trust grant has allegations of bullying or harassment upheld against them. The institute is required to highlight any actions they have taken, such as placing the individual on administrative leave. The Trust may also apply sanctions such as removing the individual from the funded project or restricting them from future grant applications. In addition, institutions that fail to respond appropriately to upheld allegations or to inform the Trust may be subject to sanctions from the Trust including restriction of new grant applications or, in extreme cases, suspension of all funding to the institution.

IMPACT This measure was welcomed by the research community with many researchers highlighting that it will make research sites safer environments.

LESSONS LEARNED Funding agencies are a central cog in the research process. By setting a standard for the cultural expectations within the research sector and holding institutes accountable they can create sustained change.

CONTEXT Wellcome Trust was the first funding agency to introduce a zero tolerance policy on harassment, with public instances of enforcement[79]. In the US the National Science Foundation has implemented similar reporting policies[80] while the National Institutes of Health revoked funding from 14 scientists over sexual harassment allegations in 2018[81].

Dr Ania Paradowska mounting a sample on the Kowari residual stress neutron diffractometer at the OPAL reactor.
CREDIT: ANSTO

Case study 7 An alternate approach to IT recruitment

WHAT MYOB developer training program **www.myob.com/au/careers/myob-developer-program**

WHEN 2016–present

WHY Software developers are in demand, but skilled software developers are in short supply.

HOW Starting as a pilot program, this return to work initiative recruited three women with no information technology experience and provided them with scholarships. The women spent the first eight weeks of the part-time program learning basic coding and then further developed their coding skills by working one-on-one with a computer development team member. Each woman was offered a full-time position at MYOB after the program's completion.

IMPACT Success of the developer pilot has led to MYOB offering it as a full-time six-month program in conjunction with Coder Academy, providing participants with a formal accreditation and automatic entry into their existing graduate program. Participants are offered a scholarship for the duration of the program and a full-time position on acceptance of the scholarship, providing employment certainty. Through this program, along with other targets and cultural changes, 41% of MYOB employees are women.

LESSONS LEARNED Return to work programs offer opportunities for working women to retrain in STEM professions without having to take a financial risk of leaving work to pursue additional study. This program also highlights what individual organisations can do to address 'pipeline issues' more immediately.

CONTEXT Developer is the only STEM return to work program identified in Australia. However organisations may run internal programs that are not made public. Women Returners Professional Network lists all UK organisational 'returnship programs'[82].

Case study 8 Supporting researchers on parental leave

WHAT Queensland Government Women's Academic Fund **www.advance.qld.gov.au/universities-and-researchers/womens-research-assistance-program-wrap**

WHEN 2015–2017

WHY To support the retention, development and progression of researchers who are women in Queensland's universities and publicly funded research organisations.

HOW The program provided additional funding to a researcher taking maternity leave. The funding could contribute to the employment of a research assistant to continue their research while they were on leave, or to hire a research assistant immediately after the return from leave to fast-track their progress back into the workforce. The program supported 125 researchers using $1.5 million of funding.

IMPACT In a survey of recipients, all indicated that the funding made it much more likely that they would return to their researcher role after their leave. The funding also helped recipients feel that detriment and delay to their careers from the leave were minimised or removed.

LESSONS LEARNED The program evaluation recommended the adoption and implementation of gender equity policies by all employers, and a move to a co-funding arrangement between government and employers, which has been implemented as Women's Research Assistance program (WRAP).

CONTEXT An increasing number of organisations in the research sector offer financial and/or assistive support during parental leave. Queensland is the only state to lead an initiative to support researchers whose organisations may not offer these services.

> "The funding made it much more likely that they would return to their researcher role after their leave"

Case study 9 Swedish parental leave model

WHAT Sweden's parental leave entitlements **www.sweden.se/society/10-things-that-make-sweden-family-friendly/**

WHEN 1995–present

WHY To encourage parents to share parental leave responsibilities when a child is born or adopted.

HOW Each parent is entitled to 240 days of paid parental leave when a child is born or adopted. Of this, 150 days can be transferred to the other parent, but the remaining 90 days will be lost if not taken by the parent it was originally assigned to. Parental leave can be taken up until the child is 8 years old, and parents can take up to 30 days of paid parental leave at the same time until the child reaches one year of age. Paid leave at the highest rate (77.6% of earnings) requires parents to have had a certain level of daily income for 240 days before the expected date of delivery or adoption. A parent receives the same level of compensation for parental leave if an additional child is born or adopted within 30 months of an earlier child. This supports parents who reduce working hours (and income) after the first child.

IMPACT The policy gives a powerful incentive for fathers to take leave when their child is born or adopted. Mothers in Sweden now take 75% of parental pay compared to 99.5% in the 1970s. Swedish parents claim it has transformed national attitudes to child care and gender.

LESSONS LEARNED By making a portion of the leave non-transferable to the other parent, it encourages child care duties to be shared by both parents. This challenges the stereotype that child care is the responsibility of women.

CONTEXT Sweden was the first country to introduce gender-neutral parental leave and implement leave reserved exclusively for fathers. Thirty-two other countries offer father-specific leave, including Australia, but Sweden has the highest proportion of use[83].

Case study 10
UK leadership development and mentoring program

WHAT Advance HE UK's Aurora women-only leadership development program for women in higher education institutions **https://www.lfhe.ac.uk/en/programmes-events/equality-and-diversity/aurora/**

WHEN 2013–present

WHY Representation of women at the senior levels of higher education institutions is minimal. In 2014–15 across the UK, only 24% of professors were women, despite making up 49% of the academic workforce. This lack of representation is also seen in the Australian STEM workforce.

HOW Delivered by Advance HE, an organisation focused on improving the management and skills of future leaders of higher education, Aurora is a multi-part leadership development initiative. Institutions identify women up to senior lecturer level and send them to a five-day leadership development conference. The participant is then partnered with a mentor within the institution. Mentor and participant selection are carried out by the institute, with guidelines provided by Advance HE.

IMPACT In the first five years, 4613 women from over 170 institutions across the UK and Ireland participated in the program. The impact of the program was consistently measured through a five-year longitudinal study clearly highlighting the power of the program to increase a woman's self-belief in her leadership skills. Despite surveys revealing that participants were more likely to seek out leadership roles, the study showed that cultural and structural institutional change was still needed to see dramatic shifts in leadership diversity across the sector.[84]

LESSONS LEARNED Programs such as Aurora provide an opportunity for organisations and their employees to learn from each other and build powerful networks. Longitudinal studies allow for the impact of a program to be measured, with the potential to alter focus to address identified barriers, such as institutional structures and practices, that continue to prevent change.

CONTEXT Multiple mentoring and leadership development programs exist in Australia and across the world, although Aurora is one of the only programs to have publicly available longitudinal evaluations and focus on an entire sector rather than within an organisation.

APPENDICES

Ms Erin Brodie who researches additive manufacturing (3D printing) of mandible implants to improve the success rate of maxillofacial surgeries.

CREDIT: MONASH UNIVERSITY

Appendix 1
Barriers to girls' and women's participation in STEM in the Australian context

The following barriers were identified during consultations and from examining existing research. Not all barriers are specific to women or girls, but all were highlighted as having a significant impact on women's and girls' participation in STEM education and careers in Australia.

Barriers	Detail
Stereotypes	Includes gendered views of career choice, discipline choice and caring roles
Family/cultural expectations	Includes gender roles
Lack of role models/mentors	Has an impact at all stages, from early childhood to women in senior leadership positions
Socio-economic status	Can limit an individual's access to quality programs and opportunities which support pursuing STEM studies and careers
Lack of understanding of career options	Students, as well as their key influencers—teachers, parents, caregivers, and careers counsellors—can lack a clear understanding of career options available to those who study STEM courses
Disengagement from education	Students can disengage from teachers, teaching styles, the curriculum and/or educational resources. This can be due to a variety of factors including the content being perceived as not inclusive or irrelevant because of gendered expectations
Ineffective communication of current initiatives	Results in targeted groups not benefiting from programs available to them and limited sustainability of quality programs due to short-term or inconsistent resources
Access to care facilities	Access may be limited by a variety of factors such as cost, location and hours of operation which may prevent or preclude the carer from participating fully in the workplace
Lack of flexible work arrangements	Flexible work arrangements are important to enable caring and other responsibilities, and their uptake should be normalised for people of all genders
Impostor syndrome	When an individual feels undeserving of their own success and has a persistent fear of being exposed as a 'fraud'
Discrimination	Can be based on gender and perceptions of gendered roles
Bullying, harassment, sexual harassment	Includes during education or employment, and coming from peers, colleagues or those in positions of power and/or authority
Flawed recruitment/meritocracy	Includes methods and criteria used to assess suitability for recruitment, progression and recognition
Career interruptions	Includes insufficient recognition of the value of part-time contributions
Access to career development	Includes a lack of opportunities for career development due to discrimination or bias, part-time or contract work, and lack of leadership from employers
Lack of job security	Can result from higher rates of contract work for women in STEM
Bias	Includes unconscious and conscious bias
Increased pressure to do 'extra'	Women tend to be more frequently asked to undertake work that is secondary to their core role and often does not benefit them professionally
Toxic workplace culture	Includes, but is not limited to, any form of bullying, harassment or exclusion

Barriers	Detail
Resistance to change	Includes fear of change and can come from people of all genders
Disengagement of men	Men are not participating in, or contributing to, gender equity initiatives and discussions in large enough numbers. Includes, but is not limited to, men in leadership positions not leading change in gender equity
Funding models for research	Includes a variety of barriers that affect the number of women applying for and receiving research funding
Workplace not physically accessible	Includes lack of women's toileting facilities in some workplaces such as mining sites, not catering for physical disabilities, and lack of breastfeeding facilities

Appendix 2
Existing research relating to women and girls in STEM

The following describes key insights into the issues which affect girls' and women's participation in STEM education and careers, including current participation rates.

Key insights	Evidence
Attitudes to STEM	
Stereotypes affect the perception of STEM subjects and careers	• Young adults have a strong interest in science but this does not translate into STEM subject selection or career aspirations[85] • Long-held stereotypes of the STEM profession as male orientated, obsessive and socially isolated negatively impact students' career aspirations[86] as do perceptions of limited involvement of women in STEM[87] • Continued exposure to these stereotypes can create a loss of interest and career aspirations in these fields for girls[88]
Women are not visibly represented in STEM	• Women are under-represented as speakers at public events and conferences as a result of gender bias and lack of effort in selecting speakers[89] • Women are quoted as sources in 26% of science and technology related news stories[90] • Women are the central focus in 14% of health and science stories and 19% of quoted experts[91] • An estimated 48,000 scientists worldwide have a Twitter account, of which 38% are women[92] • Only 21 women have won a Nobel Prize for science—just 3% of the total science prize winners[93] • In 2018, only one woman received one of the Australian Prime Minister's Prizes for Science out of seven available prizes. Only one individual woman has ever received the main Prime Minister's Prize for Science since its inception in 2000[94] • Under-representation of women as award winners is likely due to lack of women in the nomination pool, and biases (unconscious and other) in prize committees[95]

Key insights	Evidence
STEM education	
Biases affect an individual's decision to pursue a STEM career	• The strongest influences on career selection are personal interest, perceptions of being good at STEM, and a curiosity about the world[96] • Gender biases of teachers impact the opportunities, instruction and feedback these teachers provide students, and gender gap in school performance increases when students are being taught by teachers with higher bias[97] • Explicit gender stereotyping of math abilities from teachers and parents appears as early as Year 2[98,99,100]. As a result, girls are more likely to express strong anxiety towards maths and tend to rate their own ability in maths as lower than boys, regardless of ability[101,102]
Caregivers, teachers and careers counsellors should be informed to discuss careers with children from an early age	• Career guidance from teachers, careers counsellors, families and caregivers needs to commence during primary education[103]
Occupational interest is formed at a young age	• Children begin to aspire to careers in early primary school[104] and schools and families are their key influencers[105] • Children and their parents lack an awareness of the range of STEM careers[106] • Gendered societal norms influence children from a young age and are not easily changed[107]
Parents, teachers and careers counsellors shape children's career aspirations	• Teenagers are most likely to discuss their career plans and aspirations with their parents[108] • Students, teachers, parents and careers advisors may be relatively uninformed about opportunities that further education in STEM fields may offer[109]
A gender gap exists in STEM education participation	• Students from low socioeconomic and rural and regional areas and those from Aboriginal or Torres Strait Islander backgrounds are particularly under-represented in STEM throughout the entire pipeline[110] **Secondary education** • The proportion of young men choosing to studying engineering, ICT and physics focused subjects in Year 12 is far greater than young women[111] • Low participation rates of girls in STEM subjects are due to social expectations placed on school children[112,113] • Low motivation for and enjoyment of mathematics shown by girls during primary education is associated with lower levels of maths participation in secondary school and therefore less interest in maths-related career choices[114,115] **Tertiary education** Universities[116] • Women are completing more university degrees overall; women completed 59.5% of all undergraduate and postgraduate degrees completed in 2017 • Women are under-represented in some areas of STEM: in Australia, fewer than one in five students enrolled in tertiary degrees in engineering (17%) or information and communications technology (ICT) (19%) are women • Variations within disciplines exist, for example, process and resources engineering has a moderate participation rate for women (29%) and automotive engineering and technology has a very low participation rate for women (2%) • Physics and astronomy (25% women) and mathematical sciences (32% women) have moderate participation rates for women Vocational education and training • Women are under-represented in VET courses in engineering (9%), agriculture, environment and related studies (27%), earth science (25%), and computing (26%), but over-represented in VET courses in health (71%)[117]

Key insights	Evidence
STEM careers	
Women are under-represented in STEM careers	• VET qualified workers make up 68% of the total STEM workforce, and of those VET qualified STEM workers only 9% are women[118] • The majority of STEM graduates in industry have engineering qualifications[119], of which women comprise 12.4%[120] • The proportion of women significantly reduces at every stage of the professional ladder in STEM fields due to a range of factors including workplace culture, discrimination and bias, and a lack of flexibility in work options[121] • Lack of career progression opportunities is one of the main reasons why Australian women in STEM leave the profession[122]
Gender discrimination is prevalent in STEM workplaces	• A survey of women in the US found 50% of women in STEM jobs had experienced gender discrimination at work, compared with 41% in non-STEM jobs[123]. Of the women respondents who worked in male-dominated workplaces, 78% reported experiencing gender discrimination • In Australia, 51% of women in STEM jobs have reported being discriminated against on the basis of their gender[124]
Biases affect women applying and being hired for STEM jobs	• Wording in job advertisements for male-dominated areas, such as computer science, are more likely to include words associated with male stereotypes such as 'leader', 'competitive' and 'dominant'[125] • The higher the number of masculine-attributed words (such as advanced, extensive and strong) in job advertisements, the lower the number of women who applied for those positions[126,127] • Words like 'supportive' and 'collaborative' tend to be associated with women and men are less likely to apply for roles with these words in job advertisements[128] • When presented with identical resumes for both genders, both men and women evaluate applications from men as describing more competent and employable candidates than applications from women, and select a higher starting salary and more career mentoring for the man[129]
'Merit' can be discriminatory	• Merit tends to be defined by deeply held beliefs based on characteristics innately familiar to those evaluating the merit[130] and so discriminates against diversity[131,132]
Barriers exist to women participating in research funding schemes	• In 2017, success rates for ARC and NHMRC grants were approximately even across genders, but significantly more men applied than women (for example 331 submitted applications relating to STEM research across all ARC schemes from women, in comparison to 821 from men[133]). This cannot solely be explained by the number of women in each field • When the total numbers of men and women in each field in the research sector are taken into account, a significantly higher proportion of men are leading ARC and NHMRC grant applications than women, in some cases more than double
Sexual harassment and bullying are pervasive issues in Australian workplaces including Australian STEM workplaces	• One in four Australian women experienced sexual harassment at work in 2018; only 17% of people experiencing workplace sexual harassment made a formal complaint[134] • Of sexual harassment incidents, 40% are witnessed by at least one other person, and in the majority of cases (69%) witnesses did not intervene[135] • Half of women and one in ten men in Australian STEM workplaces have faced sexual harassment during their career. Of people experiencing sexual harassment 70% had chosen not to report it due to fear of reprisal or reputational damage, and concerns about the adequacy of organisational policies and procedures[136] • Of women who had been bullied in their STEM workplace, 25% responded by leaving the workplace[137] • In Australia in 2016, one in five university students were sexually harassed in a university setting. Women were three times as likely as men to have been sexually assaulted, and almost twice as likely as men to have been sexually harassed. Of these reported cases, 94% of those who were sexually harassed and 87% who were sexually assaulted did not make a formal report or complaint to their university[138]

Key insights	Evidence
There are gendered expectations of caring responsibilities	• Child care is the biggest barrier to women either entering the workforce or working more hours[139] • Australian men express a desire to spend more time caring for their children, but 99.4% of those taking up the Australian Government Paid Parental Leave scheme are women[140] • Only one-third of men take the additional two weeks paid leave offered specifically to dads and partners from the government[141] • Only 4–5% of heterosexual fathers are the primary caregiver, which has remained largely unchanged for the last two decades, likely because of gendered views of caring[142]
Gender bias can affect mentoring	• If women have executive level mentors they are just as likely to be promoted as men[143], however, women are less likely to have these high level mentors, despite being equally likely to have a mentor as men. Men's mentors are typically better placed to advocate for their mentees so men receive more promotions and salary increases early in their career, establishing a gender gap from the outset[144] • The mapping phase of this project found that fewer than 5% of the initiatives to support women's participation in STEM in Australia include mentoring, and the majority focus on secondary and tertiary levels[145].

Appendix 3
Suggested solutions from consultations

The following are solutions suggested during consultations, mapped to the barriers they aim to address. Organisations and sectors wishing to consider adopting these or other approaches should also refer to appendix 4 on page 54 for insights from research and practice regarding what works.

Suggested solutions from consultation	Mapped against identified barriers
Evaluate the impact of existing gender equity initiatives and make findings publicly available	Ineffective communication of current initiatives
Mandate evaluation when funding gender equity initiatives and make evaluation public	Ineffective communication of current initiatives
Establish a national STEM evaluation framework to allow prioritisation and improvement of STEM education programs	Ineffective communication of current initiatives
Highlight successful and evaluated initiatives to improve attraction of girls to STEM through available platforms such as the Australian Government's STARportal	Ineffective communication of current initiatives
Establish a one stop portal with all resources available to support women in STEM education or careers.	Ineffective communication of current initiatives
Prioritise funding and expansion of proven pilot and small-scale STEM education and outreach programs for girls and women	Stereotypes Lack of role models/mentors Socio-economic status Lack of understanding of career options Disengagement from education

Suggested solutions from consultation	Mapped against identified barriers
Ensure a diversity and inclusion policy is an integral component of communication strategies and ensure this extends to social media	Lack of role models Stereotypes Bias Access to career development
Include public engagement and outreach achievements as measures for recruitment and promotion	Increased pressure to do 'extra' Flawed recruitment/ meritocracy
Provide media and communication training, including social media, to all relevant employees	Access to career development Lack of role models Stereotypes Bias
Implement a national Women in STEM social media and marketing campaign to challenge gender stereotypes in STEM	Stereotypes Lack of role models Lack of understanding of career options
Collaborate between stakeholders to provide diverse role models across STEM outreach and engagement programs, guided by evidence-based best practice	Lack of role models Stereotypes Lack of understanding of career options Disengagement from education
Establish a body of scientists who inform science entertainment (for example movies and tv shows) and monitor gender representation in these portrayals. Inspiration can be taken from the Science and Entertainment Exchange in the United States	Stereotypes Lack of role models Lack of understanding of career options
Incentivise increases in the visibility of women in STEM roles in the media by introducing new grant programs or introducing quotas to existing grant programs	Stereotypes Lack of role models Lack of understanding of career options
Call out conferences with male-majority panels, speakers and keynotes by providing organisers with resources on how to achieve diversity	Stereotypes Bias Lack of role models/mentors Disengagement of men
Implement and report on a gender equity policy when organising conferences and events. Consider initiatives such as onsite child care and care support bursaries	Access to care facilities Stereotypes Bias
Sign the Male Champions of Change Panel Pledge, a signed commitment for organisation leaders to only be involved in panels that involve women in a meaningful way	Stereotypes Bias Lack of role models Disengagement of men
Restrict funding, sponsoring or participation in events to those with demonstrable gender equity policies	Bias Lack of role models Disengagement of men
Establish a national award for inclusive STEM teams and leaders	Lack of role models

Suggested solutions from consultation	**Mapped against identified barriers**
Adopt best practice when assessing and awarding scientific awards. Consider mechanisms such as unconscious bias training, blind assessment of applications, and removing gendered language from award applications and advertisements	Stereotypes Bias Flawed meritocracy
Support professional learning for teachers and career advisors to increase awareness of STEM career options and the impact of unconscious bias	Bias Stereotypes Lack of understanding of career options
Support teachers from early years through to tertiary education to implement pedagogy and practices, using resources that encourage girls and women, particularly those from under-represented groups, to engage with contemporary STEM content	Disengagement from education Stereotypes
Establish a STEM teacher network to share and develop ideas for engaging girls in STEM	Disengagement from education
Publish gender ratio of enrolment in STEM courses to introduce transparency and encourage competition between education providers to be seen as the institution of choice for gender equity	Bias Stereotypes Disengagement from education
Review teaching and learning resources and materials for inclusive language and content	Bias Stereotypes Disengagement from education
Provide educational resources with real-life examples to school educators to improve engagement	Lack of understanding of career options Disengagement from education
Provide incentives for STEM graduates and professionals to train as educators in primary and secondary schools	Disengagement from education Lack of role models Lack of understanding of career options
Develop incentives to encourage STEM skilled workers leaving their current position to retrain into education	Disengagement from education Lack of role models/mentors Lack of understanding of career options
Develop a program for early- and mid-career researchers to connect with local schools and help develop STEM education programs. Include a report component for early- and mid-career researchers that is recognised with the same level of prestige as a journal article to overcome potential loss of career momentum due to participating in this program	Disengagement from education Lack of understanding of career options Lack of role models/mentors Flawed recruitment/ meritocracy
Offer PhD scholarships and early-career fellowships with a mentoring component	Lack of role models/mentors Lack of understanding of career options Access to career development
Make STEM subjects compulsory until end of secondary education. Require STEM subjects as pre-requisites for tertiary education enrolments	Disengagement from education

Suggested solutions from consultation	Mapped against identified barriers
Establish an in-school industry mentor program as a collaboration between schools and industry	Lack of understanding of career options Lack of role models
Provide parents with basic science skills and understanding to creating positive attitudes to STEM which they can pass on to their children	Family/cultural expectations
Support development of resources to increase parents' awareness of STEM career options and the impact of their own unconscious bias on their children's career choices	Bias Stereotypes Lack of understanding of career options Family/cultural expectations
Offer work placement opportunities for girls to showcase the variety of STEM career options	Lack of understanding of career options Stereotypes
Award government contracts only to organisations with gender parity or formal accreditation for gender equity practice	Cross-cutting across many barriers in workplaces
Adopt a gender equity accreditation process appropriate for your own organisation's needs, such as SAGE or WGEA Employer of Choice	Cross-cutting across many barriers in workplaces
Be transparent about your diversity and inclusion goals and publicly report on changes	Cross-cutting across many barriers in workplaces
Ensure your workplace is taking appropriate measurements to track progress towards gender equity and publicly highlight areas needing attention	Cross-cutting across many barriers in workplaces
Provide high-quality training to support cultural change related to diversity and gender within organisations	Resistance to change
Embed mentoring opportunities for staff into professional development schemes at all career stages, with explicit focus on matching women with appropriate and skilled mentors	Lack of role models/mentors
Offer STEM retraining scholarships for mature aged students seeking requalification	Access to career development
Provide equal access to career development and funding opportunities for both contract and permanent staff	Access to career development
Offer paid return to work programs targeting STEM women and men who have experienced career interruptions	Career interruptions
Introduce programs to support employees' career trajectories during parental or carer's leave, such as covering research assistant costs in the research sector, or creating a culture where keeping in touch days are normalised	Career interruptions
Conduct internal campaigns to normalise men accessing flexible working arrangements and actively encouraging and facilitating men's access to parental leave entitlements	Lack of flexible work arrangements Family/cultural expectations Stereotypes
Seek a ruling from the ATO to exempt employers from fringe benefits tax liability in cases of direct or indirect support for children or care recipients to travel with employees on professional activities	Access to care facilities
Provide incentives such as child care and grant writing assistance in return for taking part in activities that don't contribute to promotion, for example serving on committees, speaking at events and mentoring	Increased pressure to do 'extra'
Review recruitment processes to ensure no steps in the process are under-valuing or disadvantaging anyone. Consider reviewing job advertisements for the presence of non-inclusive or gendered language, introducing de-identified review panels, and unconscious bias training	Flawed recruitment/ meritocracy Bias

Suggested solutions from consultation	Mapped against identified barriers
Develop a quantitative method to make relative to opportunity assessments which allow consistently applied, equitable assessment of candidates with differing career pathways	Bias Career interruptions Flawed recruitment/ meritocracy
Introduce quotas for women in hiring processes in STEM organisations. Allocate places in STEM tertiary education for women in areas which currently have low participation rates for women	Bias Discrimination Flawed recruitment/ meritocracy
Include behavioural expectations alongside performance when assessing for promotion, funding and awards	Bullying, harassment, sexual harassment Funding models for research Toxic workplace culture
Establish a workplace culture that does not accept bullying and harassment. Consider mechanisms to call out inappropriate behaviour, safe reporting practices, people-centred policies, access to justice for all parties, and visible consequences for transgressions	Bullying, harassment, sexual harassment Toxic workplace culture
Adopt recommendations made through the Human Rights Commission National Inquiry into Sexual Harassment in Australian Workplaces	Bullying, harassment, sexual harassment
Establish mechanisms to address instances of proven bullying or harassment in the research sector through removal of funding, and/or exclusion from applying for funding. Consequences to be extended to organisations if they are found to have acted inappropriately	Bullying, harassment, sexual harassment Funding models for research
Review research funding to examine the influence of funding policies, programs and structures on gender equity to identify and eliminate potential barriers for women in STEM research	Funding models of research Flawed meritocracy Bias
Expand the collection of demographic data undertaken by funding agencies to enable an understanding of intersectionality and how it impacts women in STEM research	Funding models of research Bias
Remove track record component from research funding assessments	Funding models for research

Appendix 4
Insights from research and practice

The following provides insights from existing practice and research and is intended to inform the design and implementation of current and future gender equity initiatives, practices and processes.

Key insights from existing practices	Evidence from peer reviewed literature and as illustrated by existing initiatives
Evaluation of STEM education programs	
STEM education programs can be transparently evaluated and this can contribute to overall efficiency of the system	• Independent analysis of STEM education program outcomes on a large scale is possible, and is cost-effective once programs that work are identified and implemented[146] (see case study 1 on page 39)

Key insights from existing practices	Evidence from peer reviewed literature and as illustrated by existing initiatives
Attitudes to STEM	
Role models can be used to both attract and retain women in STEM from all ages and stages	• Short standalone interactions with anti-stereotypic role models results in an immediate increase in STEM interest[147] • Women and men, and a diversity of ages, cultural backgrounds and appearances, should all be used as role models as each can make a contribution towards girls' and women's perception of, and interest in, STEM[148] • More evaluation is needed on the sustained effect of role models, especially on career choices[149]
Mechanisms exist to address the under-representation of women as speakers at STEM conferences and public events	• Tools for conference organisers to achieve gender balance exist[150]
Increasing representation of women in STEM media and social media has positive impacts	• Increasing women's representation in the media can have positive effects on their careers, including career progression[151] (see case study 2 on page 39) • Projects to provide media with a diverse talent pool exist, such as Women's Leadership Institute Australia's Women For Media database, Australian Science Media Centre's SciMex database, Science & Technology Australia's Superstars of STEM program or, internationally, 500 Women Scientists (see case study 3 on page 40)
Promotional campaigns can be used to tackle gender stereotypes	• Promotional campaigns can increase the number of students actively engaging in STEM[152]
STEM education	
Targeted initiatives can improve STEM participation of secondary students, including those from disadvantaged backgrounds	• Targeted programs developed in partnership with industry and incorporating real-world experience can lead to increased pursuit of STEM studies in subsequent years[153] (see case study 4 on page 40) • Internationally, programs targeting students from disadvantaged backgrounds that incorporate work placements, skills development, and tailored support and information on university access and STEM careers resulted in a significant increase in the proportion of students applying and being accepted to university courses[154] • In Australia, programs targeting students who identify as Aboriginal or Torres Strait Islander have shown an increase in student aspirations to pursue STEM studies at university, and an improvement in student test results in STEM[155]
STEM careers	
Hiring and promotion practices can be made more equitable	• Bias can influence hiring decisions at different stages of the hiring process[156] and can be mitigated by unconscious bias training along with transparent institutional hiring and promotion policies • Advertising women-only positions works to rapidly increase the proportion of women in a workplace, and assists with inclusion where women are hired in groups[157] • A recruitment team that reflects the diversity goals of the hiring organisation can create a more welcoming context for women and candidates from under-represented groups[158]
Leadership is key in addressing biases and achieving diversity	• Organisations require clear support and commitment to diversity from top, senior and middle level management in order to create an inclusive and equitable organisational culture[159] • Management accountability is critical for the successful achievement of diversity targets[160]

Key insights from existing practices	Evidence from peer reviewed literature and as illustrated by existing initiatives
Reporting and accreditation programs are effective in making positive changes towards gender equity in workplaces	• Independent evaluations of Athena SWAN have demonstrated that this accreditation program has benefited staff, positively influenced institutional practices as well as cultural and attitudinal changes, and these changes are sustained[161] (see case study 5 on page 41) • Gender equity data reporting can lead to an increase in the number of women[162], particularly in management roles, increased employer actions in regards to gender equality policies and strategies, pay equity, flexible work, and identification of areas where further work is needed[163]
Harassment and bullying in the research sector can be tackled through research funding	• Funding institutions such as Wellcome Trust, the US National Science Foundation and the US National Institutes of Health have implemented and enforced policies on bullying and harassment, where funding bodies can remove perpetrators from funded projects and restrict them from future grant applications[164,165,166] (see case study 6 on page 42)
Return to work and retraining programs are effective in bringing people in to the STEM workforce, including returning following a career interruption	• Return to work programs offer opportunities for women returning to work following a career interruption to refresh their skills and ease them back into the workplace. This can lead to increased retention of women[167] • Targeted training programs for women from other fields allow them to retrain in STEM professions without having to take a financial risk of leaving work to pursue additional study, resulting in increased recruitment of women[168] (see case study 7 on page 43)
The detrimental career impact of parental leave can be reduced through targeted funding in the research sector	• Funding for researchers on parental leave can be used to contribute to the employment of a research assistant to continue their research while they are on leave, or to hire a research assistant immediately after their return from leave. This can fast-track researchers' progress back into the workforce and make it more likely that they would return to their researcher role after their leave. This funding also helps recipients feel that detriment and delay to their careers from the leave were minimised or removed (see case study 8 on page 43)
Caring responsibilities can be better shared	• Uptake of leave by men increases when entitlements are generous and there is flexibility in when they can be used[169]. However employers play a crucial role in normalising men's use of these policies[170] (see case study 9 on page 44)
Mentoring and sponsorship can be effective	• Peer mentoring programs can contribute to the retention and advancement of women, influence institutional reform[171], and increase the STEM self-efficacy beliefs of undergraduate students[172] • Effective formal mentoring requires tailored assessment of participants' needs, and careful matching with mentors[173] (see case study 10 on page 44) • Sponsorship is important to help women access powerful networks to accelerate their career[174]

Appendix 5
Glossary

Term	Definition
Academia	Higher education and research institutions, including universities and independent research institutions, and related organisations such as associations and peak bodies. There is overlap with the education sector
Diversity	The differences between people including their cultures, experiences, identities and skills. Diversity in the workplace also includes a range of experiences, thoughts, ideas, philosophies and ways in which knowledge is processed
Education sector	Organisations involved in providing or supporting primary, secondary and tertiary education, including both university and VET. Also including providers of resources or extra-curricular activities. There is overlap with academia
Equality	Ensuring individuals or groups of individuals have the same rights and responsibilities, are given the same opportunities and resources, and are not treated less favourably on the basis of their specific characteristics, including race, gender identity, disability, religion, belief, sexual orientation, intersex status and age
Equity	The practices and ways of thinking that assist in working towards equality, including ensuring individuals or groups of individuals are given opportunities and resources that are proportional to their needs. Equity differs from equality in that it acknowledges that under-represented groups do not start from the same point, may face different systemic barriers, and therefore may require additional support to overcome these barriers
Government	State and federal government departments, research funding agencies, regulatory bodies and publicly funded research agencies. Government interacts with STEM in a variety of capacities and therefore has a variety of roles to play with respect to this report. This includes, but is not limited to: as an employer of STEM-skilled professionals; as a funder of research; in maintaining a regulatory role; in ensuring adherence to relevant legislation; as a funder of gender equity initiatives; and through its various supports and interactions with all other stakeholders in the STEM ecosystem
Inclusion	Acceptance, respect and equal participation of all individuals, regardless of gender identity, race, age, religion, ethnicity, sexual orientation, intersex status, socio-economic status, physical abilities and political beliefs
Industry	Businesses, including start-ups, small and medium-sized enterprises, large Australian-based business and global business, that operate in Australia. Also includes related organisations, such as associations and peak bodies
Intersectionality	The ways in which multiple systems of inequality compound to shape bias. Gender, like race, class and sexual orientation, does not operate independently from other aspects of life. Intersectionality is a conceptual framework from which to understand and articulate the multiple barriers that all under-represented groups face
Low and medium participation areas of STEM	Areas of STEM where women's participation is significantly lower than men's. They are defined here as low (less than 25% participation) and medium (less than 50% participation of women)(see figure: participation rates in STEM on page 7). It should be noted that participation rates for the same fields or discipline can vary across different parts of the education sector and workforce. Furthermore, examining participation rates using broad categories may mask larger variation and/or differences in sub categories
STEM	Refers to science, technology, engineering and mathematics, and is used here as an umbrella term for scientific and technical fields. Medical research is included in the definition of STEM used here; however, the practice of health professionals is excluded. STEM skills are those taught and used in STEM disciplines, but the term is used more broadly to encompass the creativity and ways of thinking necessary to promote innovation and problem-solving in any discipline or industry

Term	Definition
STEM ecosystem	All STEM organisations in government, academia, and industry; the education systems that support STEM education and training; and relevant support structures including peak bodies, scientific societies and community groups involved in STEM activities. Participants in the STEM ecosystem often interact in multiple ways, for example as providers of education, funders or sponsors of outreach activities and employers of STEM-skilled workforce
STEM leaders	Individuals employed at a level within a STEM organisation capable of implementing change. In industry and government, this refers to CEOs and senior management. In academia, this definition extends to STEM-related executive team members and professors
STEM organisation	Any organisation that employs a STEM-skilled workforce and/or uses science, technology, engineering and/or mathematics as part, all, or in support of, its core business. This includes organisations that currently rely on technology and mathematics for their core functions—such as in finance, software development, online customer service and broadcasting—as well as those who are likely to rely on STEM in future, for example using augmented reality, big data and artificial intelligence
STEM professional	A person utilising their STEM skills in their profession, including those working in government, academia, and industry
STEM researcher	A person utilising their STEM skills to perform research who is regularly applying for research grants and funding, and publishing their research in articles in scientific peer-reviewed journals and/or as patents
VET	Vocational education and training
Woman/Women	Anyone who identifies as a woman, including cisgender (personal gender identity corresponds with sex assigned at birth), transgender (personal gender identity does not correspond with sex assigned at birth), non-binary and intersex persons who identify as a woman (or girl)

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STEM organisation in the ASX 200 were defined as those in the following sectors: materials, healthcare, energy, industrial. Industrial and information technology sectors.

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