

## **SOUTH AUSTRALIAN GOVERNMENT SUBMISSION TO THE SENATE INQUIRY INTO THE SHORTAGE OF ENGINEERING AND RELATED SKILLS**

### **INTRODUCTION**

The South Australian Government has recognised that for all South Australians to benefit from our high value emerging industries, it is critical that we attract and develop a workforce with stronger skills in science, technology, engineering and mathematics (STEM). In order to do this, we must focus on improving participation and attainment in STEM from schooling, into vocational education and training (VET) and further education, and on into workforce attraction and retention.

Accordingly, the South Australian Government has developed a Science, Technology, Engineering and Mathematics (STEM) Skills Strategy for South Australia.

The STEM Skills Strategy was developed in the context of declining enrolments in science and mathematics fields of study at senior secondary school, university and VET in South Australia, coupled with an increasing demand for STEM professionals, and South Australia's growth in industries dependant on STEM skills, including resources and defence.

Accordingly, our approach has focused on the entire pathway from school to tertiary education and careers, with the specific goal of improving the supply of South Australians with qualifications in STEM in order to meet current and future workforce demand.

This submission details the approach taken in South Australia, including research, modelling of supply and demand of STEM skills, and mapping STEM activity. Accordingly, it principally deals with the following terms of reference of the Inquiry:

(c) Options to address the skill shortage for engineers and related trades, and the effectiveness and efficiency of relevant policies, both past and present.

(e) Effective strategies to develop and retain engineering talent in the private and public sectors through industry training and development, at enterprise, project and whole-of-sector levels.

It describes the key aspects of the STEM Skills Strategy, including the setting of policy and program priorities to guide future investment and policy development and mechanisms for joint decision making.

We hope that the approach taken to this issue by the South Australian Government may inform your inquiry and provide evidence of strategies undertaken to improve participation in engineering and related disciplines.

### **THE SOUTH AUSTRALIAN APPROACH**

As part of developing the STEM Skills Strategy for South Australia, several key areas of preparatory work were undertaken, which may be of interest to, or replicable by, the Commonwealth Government. Each of these were important in gaining a complete picture of the nature and effects of the decline in participation and attainment in STEM.

#### **Contextualising the problem**

In approaching this issue, it is important to consider the broader context in which it occurs.

A decline in enrolments in STEM subjects at school and in higher education have been observed across OECD nations for the last 20 years. This is not a problem unique to particular Australian states – despite differences in education systems – nor even Australia alone.

The systemic nature of this problem shows that it is more than a simple or single policy failure, and that it is related to changes in societal attitudes, access to VET and further education, and education, training and migration policies.

### **Accurate and detailed modelling of supply and demand in STEM**

In order to gain an accurate picture of the nature and effect of the decline in participation and attainment in STEM, and the consequence of this decline on the South Australian workforce, the South Australian Government analysed data from several different sources and at several different levels of granularity.

The South Australian Government collected and analysed data on subjects studied by students completing Year 12 or equivalent in South Australia, university enrolments and completions, and VET enrolment and completions over the last ten years. These were analysed as discrete subject areas, including life sciences such as biology, medicine and veterinary science; physical and mathematical sciences, such as physics and geophysics, ICT and engineering; and other mathematics-based subjects including accounting and econometrics. This provided a detailed picture of which subject areas had suffered from a decline in participation.

As the key concern for South Australia was the availability of skilled persons to fill key STEM occupations, using the Training and Skills Commission of South Australia modelling, we developed detailed forecasts of the effective supply of South Australians moving from qualification and into STEM occupations. Rates of employment growth, workforce up-skilling and replacement demand have been determined for each of the prescribed STEM occupations.

This modelling revealed that though other STEM disciplines - including health and biological sciences, finance, economics and accounting - may experience a small shortfall in supply of skilled workers, the most acute and dramatic forecast shortfall occurs in the physical and mathematical sciences, ICT and engineering disciplines. Moreover, the most marked decline in higher education completions occurs in these same disciplines.

There is a particular demand for engineers in South Australia, including in civil, electrical, electronic, industrial, mechanical, mining, chemical and materials engineering

The immediacy of the demand for these skills highlights the need to focus on both short- and long-term approaches to improving STEM skills.

An increase in demand for skills which is unmatched by supply has the potential to harm South Australia's growth in key industries, employment and economic development.

It is important to note that the STEM occupations in high demand now and into the future are not just professional occupations. Demand for STEM-enabled trades workers, such as electricians, diesel mechanics, and ICT technicians is strong and will continue to grow.

Accordingly, we would recommend that the Committee commission and consider accurate modelling into the demand for engineering skills by both type and location, and the likely supply of Australians with these qualifications, including through skilled migration.

Obtaining detailed and accurate modelling of the demand for and effective supply into these occupations is critical to understanding the problem and designing appropriate interventions.

The Department for Further Education, Employment, Science and Technology (DFEEST) is also currently conducting a substantial research project centred on women's participation and achievement in science, technology, engineering and mathematics (STEM) fields of education. Examining data from SACE and IB completions, SA tertiary offers, university enrolments and completions, and graduate destinations, the research project will consider transitions between senior secondary school, higher education, and the workforce to examine the points at which women's participation in STEM fields of education decrease. The project will provide a more comprehensive understanding of the patterns of female participation in STEM areas of learning and work, and the critical transition points between school and university student, and from university study into the workplace. The research is designed to identify at which of these critical transition points women cease to participate in STEM study or work. Work on this project is continuing, though we hope to be able to share the key findings from this research when complete.

#### *Review of international research*

The decline in participation in science and mathematics at school and beyond, and its causes and effects, have been much studied across the developed world. There is a wealth of evidence into teaching and learning of STEM subjects, STEM participation, career aspirations, and further study.

Given this strong evidence base, it is essential that policy makers consider the findings of research in designing policy approaches.

In South Australia, we have developed a comprehensive summary of the relevant research evidence, consistently updated as new research is published, and used this to form the basis of our policy approach. Note also that this summary includes research on improving scientific literacy, increasing participation in science and mathematics in senior secondary school and beyond is principally a question of influencing choice: choice of which subjects to study, choice of which degree to pursue, choice of career. Accordingly, we have sought out research into what factors are most influential in making those choices at each of the key decision points along education and career pathways.

#### *Mapping STEM activity in South Australia*

The South Australian Government also undertook to map of all STEM activity in South Australia, whether delivered by government, industry or the non-profit sector.

As part of this process, we also investigated other strategies and interventions in other Australian jurisdictions and overseas. Though there are some interesting innovations in program and policy development, this review found that overwhelmingly programs and policies considered only one aspect of the pathway, such as school education or university education, or only considered one discipline or career, such as mathematics, or engineering.

### **THE SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS (STEM) SKILLS STRATEGY FOR SOUTH AUSTRALIA**

The South Australian STEM Skills Strategy recognises that while there has been substantial government investment in improving the supply of people with STEM skills into the workforce, a more strategic approach to investment is required in order for the supply of these skills to match forecast industry demand in the timeframes required.

Moreover, an approach which recognises the cross-portfolio and cross-departmental nature of the problem is necessary, overseeing the entire STEM pathway from school through to VET or university, and into the workforce.

To provide this, the STEM Skills Strategy proposes a framework of joint decision-making between key government departments based on evidence-based criteria.

Accordingly the strategy comprises two distinct elements:

- A governance model of a Cabinet Task Force, and an Executive Reference comprised of Chief Executives from relevant departments
- A set of STEM Policy and Program Priorities to be consistently applied by the Executive Reference Group

### **STEM Cabinet Task Force**

A Cabinet Task Force has been established, including Ministers responsible for science and information economy, education, skills and further education, employment, trade, defence and mineral resources.

The Task Force meets quarterly and provides high-level oversight to connect STEM activity across all phases of education and work, and ensure that government supported programs is coordinated and complementary.

### **STEM Skills Decision Making Framework**

Under this framework, the Chief Executives of Department of Further Education, Employment, Science and Technology (DFEEST), Department of Education and Child Development (DECD), Department of Manufacturing, Innovation, Trade, Resources and Energy (DMITRE), Department of Primary Industries and Regions (PIRSA), Office for Women and Defence SA meet bi-monthly as the STEM Skills Strategy Executive Reference Group.

This group makes joint decisions concerning funding for STEM programs. New and existing programs are assessed against the STEM Policy and Program priorities, described in detail below. Using this mechanism, the Reference Group has been undertaking a rolling evaluation of STEM programs. Funding for programs that do not achieve outcomes consistent with the policy and program priorities will instead be directed into programs with positive, measurable skills outcomes.

Over time, this will allow us to channel spending into the most efficient and effective programs with the best outcomes.

The Executive Reference Group also has an important role in developing and recommending new policy approaches and cross-government activities to improve participation in STEM to the Cabinet Task Force.

### **STEM Skills Policy and Program Priorities**

In developing the STEM Skills Strategy, a comprehensive review of Australian and international research has been undertaken to establish a robust evidence base focusing on what factors influence people to choose STEM study, training and career pathways.

Based on this evidence base and the mapping of current South Australian activities, we have identified areas of priority for future government action. These priorities have been divided into policy priorities, concerning the types of activities that would secure the best skills outcome for South Australia, and program priorities, which focus on program delivery best-practice.

The STEM Policy and Program Priorities which will be used as the mechanism to assess existing programs and areas for future government investment are set out below. The Priorities will allow us to

identify the programs that achieve the best outcomes to build on and grow. They are shown in the attached strategy.

The policy priorities ensure that we focus on policies with a clear goal of increasing participation, rather than awareness; that we focus on the most readily-convertible groups of South Australians, who already have an interest in and aptitude for STEM but do not pursue careers or further study in this area; that we focus on adults who may wish to retrain or up-skill to meet the immediate, short-term skills shortage; and concentrate on retaining people in careers as well as improving supply.

The program priorities are designed to ensure that programs funded by the South Australian Government meet the policy priorities; are innovative and avoid duplication; are evaluated for their success in improving participation in science and mathematics; delivered across the state; and connected to formal education frameworks such as curricula.

### **Government initiatives in South Australia**

Though no additional funding was committed through the Strategy, South Australia has developed a variety of interesting programs designed to improve participation and attainment in STEM. A full list is provided in the attached Strategy, but highlights include:

- Professional development and mentoring of science and maths teachers, through:
  - the \$51 million Primary Mathematics and Science Strategy, to provide teachers with professional development in maths and science and develop the skills of children
  - the C-Change program, which gives science and maths teachers incentives to teach and provide leadership in rural, remote and low socio-economic metropolitan schools
  - the Step 9 Teacher increment, which rewards experienced teachers with higher salaries, and requires them to mentor less experienced teachers
  - a professional learning program for teachers through the Australian Science and Mathematics School.
- Establishing the Australian and State Government Advanced Technology Industry Schools Pathway program to provide the maths, science and technical skills that students need to pursue advanced technology careers in defence-related industries.
- Guaranteeing minimum instruction times in primary science and mathematics:
  - From the start of this year, Year 3 students spend a minimum of 1.5 hours a week on science and a minimum of 5 hours a week on mathematics.
  - From the start of this year, Years 4 -7 students will spend a minimum of 2 hours a week on science and 5 hours a week on mathematics.
  - By 2013, Reception to Year 2 students will spend a minimum of 1.5 hours a week on science and a minimum of 5 hours a week on mathematics.
- The Teach SA program, with funding of more than \$8 million over four years, will target up to 155 teachers to recruit, renew and retrain teachers of maths and science by:
  - Recruiting more teachers with specialist skills in science and maths; up to 40 maths and science graduates will be offered financial support to train as teachers, as well as a guaranteed job in a State school and support from a mentor teacher.
  - Renewing the existing teaching workforce; up to 100 teachers will be supported to gain a specialist qualification in science or maths teaching and improve their knowledge of the subject, teaching methods, and new technologies.
  - Retraining teachers; up to 15 senior secondary teachers will be supported with scholarships and time out of the classroom to undertake a specialist tertiary qualification in science or maths over one year.

- Scholarships of \$5000 a year, for 75 students undertaking a defence-related Honours course each year.

## **Engineering in Vocational Education and Training**

### ***Skills for All***

The South Australian Government has also committed to provide 100,000 new training places through the \$194 million *Skills for All* initiative to transform South Australia's vocational education and training system. The program targets priority skills in high value-add industry sectors which will underpin strong sustainable economic growth for South Australia into the future. *Skills for All* will provide subsidised VET places for high-demand qualifications.

Part of *Skills for All*, Skills in the Workplace subsidises accredited training, focussing on the skill demands and needs of SA employers. It will fund training for skills in urgent need, industry-critical skills and specialised occupations.

The program is a co-investment with South Australian industry to develop skills through subsidised accredited training. It will capitalise on rigorous workforce planning which clearly identifies training needs. The program will respond to skills needs identified by South Australian industry, and in partnership, develop up-skilling and reskilling solutions tailored to local circumstances.

### ***15 Percent Policy***

The South Australian Government is raising skill levels and generating employment through its major building and civil infrastructure works throughout the state.

From 1 January 2011, 15 per cent of total, on-site labour hours on South Australian Government building and civil works over \$5 million and 6 months duration must be worked by apprentices, trainees, Aboriginal people, local people with barriers to employment and through upskilling.

### ***Engineering and Related Skills Training at TAFE SA***

With industry leaders predicting an acute shortage of skilled tradespeople due to South Australia's developing resources boom and the building of the Air Warfare Destroyers (AWD), TAFE SA is responding by training welders in the latest welding technologies at its Port Adelaide Campus.

TAFE SA, the Maritime Skills Centre (MSC) and DFEST have combined to facilitate various Australian AWD training programs that align with workforce development training needs.

The facilities are designed to enable both practical use of a wide range of commercial welding plant and space for larger build projects using the welding skills learnt. As a result, students can put their skills and knowledge into a very real practical application, resulting in a nationally recognised qualification that is highly sought after by industry.

The campus also services metal trade businesses in western Adelaide that have a particular focus on the defence, mining and marine manufacturing and maintenance industries.

The training programs are particularly focused on pre-employment training, apprenticeship training and specialist skills training, and covered both technical and non-technical training. Particular attention has been given to provide welder up-skilling training programs at TAFE SA's Port Adelaide Campus to overcome the shortage of skilled welding experts required by the AWD shipbuilder - the Australian Submarine Corporation (ASC). The success of the training programs have helped to

provide the ASC and associated defence companies with a highly skilled workforce, including apprentices and tradespeople with specialist skill sets.

These programs can also meet other training needs, most of which are delivered at TAFE SA's Elizabeth, Regency and, in particular, Port Adelaide Campuses. At MSC, we look forward to working with TAFE SA in supporting the training needs of the AWD shipbuilder, ASC and the other AWD Alliance partners.

TAFE SA's Port Adelaide Campus workshop is also used for the VET in Schools program which focuses on fabrication for the marine and defence industries. This includes students from St Michaels College, Mount Carmel College, Oceanview High School and Portside Christian School who are currently building a 5.4 metre plate aluminium 'Oceantech' cuddy cabin boat and gaining skills in planning, layout and welding. The finished project is great preparation for students hoping to gain an apprenticeship in one of these emerging industries.

Programs offered at the Port Adelaide Campus include apprenticeships in boiler making (welders) and up-skilling welding programs including pipe welding and welding for the defence sector.

### **Limits of government intervention**

While these initiatives are important, we have also been careful to recognise the limits of government intervention in improving STEM participation. It is a problem that cannot and will not be solved by government alone. It requires active participation by education institutions, industry and employers.

Involving industry and other stakeholders will be a challenge for the Commonwealth Government also.

Accurately modelling the problem and investigating the key decision making factors has been general in beginning to attract this involvement. Setting priorities for government investment has ensured that interested industry partners and education institutions can direct their effort in a way that is complementary to state government activity.

### **Current status**

The STEM Skills Strategy for South Australia was launched on 31 August 2011 to over 150 industry representatives, and workshops were held for providers of Science, Technology, Engineering and Mathematics enhancement and enrichment activities.

The Executive Reference Group and Cabinet Task Force have met, and are focusing on considering new policy changes, as well as the evaluation of new and existing programs against identified STEM skills policy and program.

With the Strategy articulating government priorities in this area, its publication has been the strating-off point for comprehensive consultation with industry and education institutions about how the goals of the STEM Skills Strategy can be achieved collaboratively.

### **The need for a high-level, national approach**

While a supply of Australians skilled in the physical and mathematical sciences, engineering and ICT is critical to Australia's employment growth, productivity and ability to compete internationally, as a complex issue it has not received the attention it deserves at a national level.

Given the increased demand for these workers nationally and internationally, and the increased mobility of skilled labour around the world and between states, this is an issue that requires national intervention and coordination.

This issue has been largely absent from discussions at both Ministerial Councils covering VET and higher education, and that covering school education. COAG's Human Capital Reform Agenda and the recommendations of Australia's report into building innovation, Venturing Australia, only touch on the broader issues of foundation skills in science and mathematics.

Whilst there are participation and education/training targets in national agreements and partnerships covering schooling, VET and higher education, none of these recognise systemic STEM attainments as a coherent response to a critical and growing failure in national productivity.

Improving the supply of Australians with STEM skills is consistent with the goals and methodology of the COAG Human Capital Reform Agenda, specifically developing the capability of Australians through education and training. It requires the improved policy integration central to this agenda, and is derived from the same imperatives for reform, including international competitive pressures, productivity growth and participation rates.

The issues associated with declining enrolments in STEM subjects and qualifications, declining interest in science and the supply of Australians into STEM occupations has been recognised in various disparate initiatives across Australia.

At the Commonwealth level, these include the establishment of the Australian National Engineering Task Force, which recognises that addressing the potential shortfall in qualified engineers is critical to Australia's future productivity; the Research Workforce Strategy, which highlights the importance of growing our research workforce in supporting innovation; and Inspiring Australia, which focuses on the broader aim of improving science engagement across the Australian population.

At a state level, the Victorian Department of Education and Early Childhood Development has delivered a strategy to improve foundation skills in science and mathematics, and participation in senior secondary STEM subjects, called Energising Science and Mathematics Education in Victoria. Queensland's Smart State Science State also represented a significant investment in improving science education.

Each of these efforts is important in addressing the specific aspect of the spectrum they seek to improve – whether that is attitude, schooling, or workforce.

But improving engagement with science generally will not be enough to ensure that Australia's future skills demands are met.

Accordingly, South Australia recommends that the issue of STEM skills and participation be elevated to COAG for discussion and development of a national approach, as recommended by South Australia at the Commonwealth States and Territories Advisory Council on Innovation (CSTACI).

A national approach should

- Address the whole spectrum from teaching and schooling, to university and VET, as well as workforce attraction and retention
- Focus on the broader issue of improving the supply of qualified Australians to participate in STEM occupations, rather than focusing on limited aspects of supply, such as STEM participation in senior secondary school or the workforce requirements of a single STEM profession such as engineering.
- Coordinate action between States and the Commonwealth so that all Australians stand to benefit equally from strategies to improve participation and attainment in mathematics and science.