Response by the National Chemistry Committee of the Australian Academy of Science to the 2030 Strategic Plan Issue paper

The National Chemistry Committee of the Australian Academy of Science welcomes the 2030 Strategic Plan Issue paper.

The Australian chemistry community recognises its role, as part of a prosperous country, to proactively respond to change and help the broader economy adapt with people, knowledge, materials, technologies and collaborations.

The National Chemistry Committee of the Australian Academy of Science published its Decadal Plan in 2016 highlighting the importance of chemistry as well as the challenges. Many aspects in this 2030 Strategic Plan Issue paper have also been discussed in the Decadal Plan:

Chemistry for a better life, The decadal plan for Australian chemistry 2016–25, available from the Australian Academy of Science

The chemicals and plastics industry currently employs 57,000 people in Australia. It has a share of almost 10% of the total Australian manufacturing industry, is approximately on par with the metal product manufacturing and the machinery equipment industries, and is only exceeded by the food product manufacturing industry (www.industry.gov.au). The chemical industry plays an important role in critical socioeconomic sectors including agriculture and food production, water, health, building construction, machine manufacturing, defence, renewable and efficient energy generation, and transport. The sector has also impacted significantly on high-end applications such as in the development of better energy and health products. There are new opportunities in the emerging market of the Asia-Pacific region, in which designer polymers are expected to make significant contributions to help alleviate the increasing demand for new materials.

The science and academia of chemistry is also a significant asset. Australia benefits from a mature network of 27 Universities offering chemistry courses in all capital cities and many major regional centres, often aligned with major sectors of State-based economies, and contributing to GDP. In addition, there is a significant national network of government and independent research organisations, notably CSIRO, ANSTO, DSTO as well as a network of professional bodies and academies. Collectively, these organisations are focused on technology development across the Technology Readiness Levels as well as the critical development of people equipped to investigate, develop and deploy this capability. Its institutions are mature, identifiable and working through the same economic and demographic shifts that the rest of its eco-system neighbours are working through.

These are just some of the examples which both the science and industry of chemistry offers Australian society, its economy and environment. With chemistry supplying inputs to 109 of 111 industry sectors, it is easy to then understand whey any improvements to our physical world in some way rely on chemistry to play a role. Meeting the challenges of the 21st Century will rely on people, their knowledge, technologies and willingness to collaborate and enable the broader economy to not only adapt to change, but thrive in it.

Challenge 1: Moving more firms, in more sectors, closer to the innovation frontier

It is envisaged that Australia's standing be strengthened by encouraging more business to engage on an international level, connecting high growth firms to a science and research base while encouraging some risk-taking and ensuring that suitable regulations protect the environment, safety and rights.

Although three important points have been identified here, no details are provided to show how interaction between industry and research & innovation will be stipulated, encouraged and facilitated. At the moment, Australia has one of the worst performances when it comes to connection between academia and industry.[1] Australia lies 34th out of 34 OECD countries in its ability to translate science into commercial outcomes. The chemistry decadal plan has proposed a range of actions that encompass a technology platform that is (i) accessible by industry and academia, (ii) will open up communication channels and (iii) enable better plans to be devised for research translation. Despite all the good-will, it should be noted here that without appropriate financial support from both sides, research translation, new developments and formation of start-up companies is unlikely. In particular the rate of establishment of new start-up companies in Australia is extremely low considering the high level of innovation in academia. This is most likely due to the absence of suitable mechanisms that translate an idea into a viable business. In general, most academics do not have the opportunity to be business-minded, and/or do not have suitable channels or support to translate their ideas into a viable product and/or cannot find suitable entrepreneurial industry partners that are willing to take on risks. Problem arising may be due to the lack of clear guidance on ownership of intellectual property and sufficient support for risk-takers, but more importantly there may not be suitable channels for the academics to communicate their idea with industry. The University sectors do not have the right people in place generally, nor the financial commitments to protect IP which is required if one is to attract venture capital. This will turn in particular younger academics off from engaging with industry. Australia can find inspiration from overseas systems where it can be common for academics to have their own start-up company, which was established with the help of Universities.

Contributing to this issue may also be the fact that most members of the current workforce have a poor understanding of both fundamental research and business principles. Even if suitable partners are found, there is still a learning curve required from both sides to understand each other's aims and needs.

As noted in the discussion paper, new developments require strict regulations and it is necessary to have an independent regulatory body that will oversee innovation and product development. Regulatory bodies do already exist in Australia, but care needs to be taken that they are not seen as an obstacle to innovation. It is therefore crucial that this new body will be seen as a supporter of new innovation. It should aim to remove unsafe work practises and to facilitate that will replace unsafe practises and to facilitate new innovation with the aim of improving environment and quality of life in Australia. A suitable example for this case would be the innovative recycling industry in Germany that was born out of the need to reduce waste.

Incentivizing commercially-driven and impact-focused R&D with a return for domestic GDP remains an important element of ensuring an efficient innovation-based economy. Governments, research and industry should be encouraged to make best use of all incentive mechanisms, including the R&D Taxation mechanisms to develop a more deliberate and efficient culture of accountable domestic R&D investment. It is important to recognise and support where this effort is already occurring, where people and organisations are willing participants, and to learn from new models of engagement. These begin with connecting leaders and enablers able to better establish programs and collaborations. For example, industry representation on the Academy's National Committee for Chemistry, research and academia participation on the Chemistry Australia Council and the Strategic Relationship Agreement between CSIRO and Chemistry Australia. These collaborations are fostering revitalised knowledge and technology development between industry, research and academia including ARC-focused collaborations and a network of chemistry industry innovation hubs.

Challenge 2: Government closer to the innovation frontier

This aim identifies the government as the main stakeholder in innovation. The points presented here focus predominantly on reducing research costs, increasing value for money and accountability. While these items are a prerequisites for any functioning organization, not only government research bodies, the value of research in the latter needs to be highlighted. Government research establishments are uniquely positioned as their sole purpose is the development of cutting-edge research without having to focus on undergraduate education and other tasks essential to Universities. Such bodies need to be a place for break-through research on top of an efficient research platform. The chemistry decadal plan however also identified the dangers of duplication of research at Universities and government organizations as well as the divide between basic and strategic research. The segregation between research organizations and Universities needs to be removed to enable better collaborations by allowing free exchange of ideas and staff. Issues such as IP and different funding models and funding uncertainties can hamper synergistic partnerships. It furthermore pointed to the danger of seeing leading researchers leaving for jobs overseas as a result of cost-cutting measures in research organizations nationwide.

Challenge 3: Delivering high quality and relevant education

Education, from early years to continuing education, was identified as one of the corner-stones that enable innovation and drive the development of entrepreneurial skills. This discussion paper however did not identify the fields that are crucial to enable such a success. While the paper mentions general skill sets such as creativity, logic and social interaction, it does not mention that innovation is built on STEM subjects, which have gained less and less attraction in schools and Universities. In particular fundamental science subjects such as mathematics, physics and chemistry should again be the focus of education as the student does indeed learn creativity and logic via these subjects if they are taught well. Furthermore, science projects can be the ideal base to teach team work and social skills. The chemistry decadal plan has identified the need for teachers who can teach STEM subjects including chemistry in a passionate way and are able to highlight the importance of chemistry in our life and as a foundation for innovation. The school system is essential to ensure that students have sufficient STEM skills, and are aware that progress cannot take place without innovation in these fields. It should be recognized that certain skills such as a solid understanding of mathematics is essential not only for STEM subjects, but also other areas such as business, and these subjects should therefore be compulsory throughout high school and should not be watered down.

It will also be important to ensure healthy feedback loops for course and curriculum design between the universities developing and delivering them, the industries they feed into and the evolutions they are working through as well as the students themselves dealing with rapid change in both these areas, as well as societal change. Strong links between science teachers and University academics could be a pathway to ensure that the latest research results will make their way back to school. This would help dissemination STEM research to a large population lifting the face of chemistry and other STEM subject as a vital part of better living.

Challenge 4: Maximising engagement with end users

It is proposed that internationally recognized research that has impact and translates into practical outcomes, requires sufficient funding and research infrastructure. It has been highlighted here that although Australian researchers are excellent in collaborating internationally, collaboration with business is weak. It is proposed that more movement between the two systems is needed to ensure better connectivity. Furthermore, it is highlighted that a more flexible research training system prepares the graduate better for an ever-changing workplace.

Key to challenge 4 is the impact of research, how to design an impactful research program together with business and to obtain funding to do so. The funding situation in Australia often does not allow for the creation of research with impact as often too little money is provided to too few researchers. Most researchers waste substantial amounts of time each year applying for funding (equivalent to 500 years' worth of time annually by some estimates[2]). Although the government provides an excellent scheme (ARC Linkage) to enable research between companies and Universities, most academics find it difficult to establish contact with businesses. There is currently also no real measure to express impact and researchers turn to journal impact factors and citation numbers to express their research impact. These metrics have their place but they do not assess the real world impact of science. The need for publications also stops academics from interrupting their University career to spend time in another sector. It may be time to revisit the Australian funding system to enable, on one side, applied research close to the end user while also providing sufficient funding for ambitious high risk- high return research. This needs to take place on a more efficient platform to minimize the time spent on the funding process. Shortened grant applications and pre-screening of grants prior to submission of a full application proposal would help in this endeavour. Double blind peer review of grants is recommended to ensure the best science gets funded, not just the big names. Inspiration for different systems can be found overseas. For example, the European model Horizon 2020 enables industries in Europe to engage better. The projects are multipronged with several partners from university, government departments, private research labs, which are coupled with industry.

Challenge 5: Maximising advantage from international knowledge, talent and capital

This challenge focuses on encouraging more international researchers, students and companies to come to Australia. While it is essential to ensure that international businesses find Australia to be a suitable place to carry out research, Australia cannot solely rely on international investors and workers. It needs to encourage local companies, for example via tax breaks, to invest more in research. Echoing challenge 1, the Australian government needs to provide a better platform to enable relatively risk-free establishment of home-grown start-up companies. Moreover, more needs to be done to prevent the movement of leading researchers to overseas institutions. While filling research gaps with overseas researchers may help in the short term it does not solve the underlying problem. There needs to be a viable pathway for science students to establish a career in research and development in either industry or academia in Australia and to move between the two without a career penalty.

Challenge 6: Bold, high impact initiatives

A funding platform for ambitious projects is indeed crucial to achieve grand successes and outcomes beyond incremental steps forward. Big research programs such as the ARC Centres of Excellence or NHMRC program grants are vital to achieve this goal. It would however be desirable to have a "burning platform", as it was coined in the strategic paper, for University-Industry linkages. Although the CRC program does try to address these gaps, the research carried out through this system has for the most part only complemented the daily business of companies and does often not ask for big research questions and challenges that may be relevant to the end-user, but which may need several years to develop. A good way forward is the newly established ARC industry transformation research hubs, but they can occasionally suffer from too many too small projects.

Bold, high impact initiatives need to be founded on real-world demands from the societies and economies that need to make use of them to live sustainably and well into the future. The national research priorities, and those listed in the Decadal Plan are good examples of macro-level research and should not be a surprise to any reader or reviewer. However, the enabling initiatives that progress these macro-level ideas need to be both drawn and distilled from at least two areas.

First, from the current research alliances and collaborations of willing and capable participants. These are in place and no doubt could be harnessed more effectively. The second opportunity is perhaps more directly from our communities themselves. Could a more effective channel between interested communities and a capable group of research, academia and industry identify some practical high impact initiatives?

Missing challenges: Equity and diversity

It was disappointing to see that there was not strategic plan in this white paper to encourage more women into leading positions and have a plan in place to ensure that the workforce in STEM reflects the make-up of the current population. In particular the under representation of women is a real concern that needs to be addressed. At present women, while making up 50% of STEM graduates, are very poorly represented at higher levels in academia and business. This is a lost opportunity, and initiatives to make the work culture and conditions more attractive to women, and to remove obstacles to success is essential. A prosperous Australia of the future needs to tap into these resources and have mechanism in place that can combine workforce and family.

Either way, the Australian chemistry community recognises its role, as part of a prosperous country, to help the broader economy adapt to change and opportunity with people, knowledge, materials, technologies and collaborations.

1. Chemistry for a better life, The decadal plan for Australian chemistry 2016–25, available from the Australian Academy of Science
2. http://www.smh.com.au/national/scientists-spent-500-years-grant-chasing-20130321-2gjpe.html