Duncan Ivison
Deputy Vice-Chancellor (Research)

30 May 2017

Mr Bill Ferris AC
Chair, Innovation and Science Australia
GPO Box 9839
Canberra ACT 2601

By email: office@isa.gov.au

Dear Mr Ferris,

2030 Strategic Plan Issues Paper

The University of Sydney welcomes the opportunity to provide feedback to Innovation and Science Australia (ISA) to assist with the development of its 2030 Strategic Plan.

We strongly support ISA's proposed vision for Australia in 2030 as a country that is *'counted within the top tier of innovation nations, known and respected for its excellence in science, research and commercialisation.'*

We agree that Australia needs to be bold in its aspirations for research excellence and in our goals for lifting our capacity for translating that excellence into social and economic outcomes that benefit *all* Australians. If we are to realise ISA's vision, the strategy must ensure that as a nation we are supporting the basic building blocks of the most successful research and innovation systems. These are:

- high quality education systems and outcomes, at all levels and in all disciplines;
- unstinting and sustainable support for the very best discovery-based research;
- well-planned and funded research infrastructure;
- robust and competitive research funding for our very best researchers;
- integrated policies designed to attract the best global talent and to enable Australian research students and researchers to engage internationally;
- strategies to encourage deep and long-term research partnerships between government, industry, universities and other non-government research organisations; and
- strong incentives and targeted initiatives to support the translation and commercialisation of research outcomes.

We are keen to work with ISA to develop its plan for 2030, and are especially interested in working with ISA, once the plan is settled, to help develop specific proposals for consideration by government and other stakeholders. Please do not hesitate to contact me if there is anything you think the University of Sydney can do to assist.

Yours sincerely,

(Signature removed)

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THE UNIVERSITY OF SYDNEY

30 May 2017

University of Sydney submission to Innovation and Science Australia's 2030 Strategic Plan Issues Paper, released 20 March 2017

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Executive summary

Technological change and innovation have and will continue to transform the way Australians live and work. While Australia's population continues to increase and age, our levels of national productivity – or output per person – have been slowing for more than a decade.

This combination of trends has given rise to increasing concern that unless we can turn the productivity equation around, the disparity between rich and poor in Australia will continue to grow, and that many Australians face futures of reduced opportunities and living standards. It has also led to calls for action to diversify and strengthen the economy by increasing our national capacity for innovation.

The University of Sydney welcomes the establishment of Innovation and Science Australia (ISA) as an independent statutory body to advise the Australian government on the national innovation, science and research system. We strongly support the ISA's proposed vision for Australia in 2030 as a country that is *'counted within the top tier of innovation nations, known and respected for its excellence in science, research and commercialisation.'*

We are keen to work with ISA to develop its plan for 2030, and especially to help ISA develop specific initiatives, by facilitating easy access to relevant experts from the university as required. We agree that Australia needs to be bold in its aspirations for research excellence and in our goals for lifting our capacity for translating that excellence into outcomes that benefit *all* Australians. If we are to realise ISA's vision, the

national strategy must ensure that we are supporting the basic elements of a successful research and innovation system. These essential elements are:

- high quality education systems and outcomes, at all levels and in all disciplines;
- unstinting and sustainable support for the very best discovery-based research;
- well-planned and funded research infrastructure;
- robust and competitive research funding for our very best researchers;
- integrated policies designed to attract the best global talent and to enable Australian research students and researchers to engage internationally;
- strategies to encourage deep and long-term research partnerships between government, industry, universities and other non-government research organisations; and
- strong incentives for the translation and commercialisation of research outcomes.

Securing these essential components for a strong research system will provide the bedrock for the truly transformative research discoveries and outcomes that will deliver the greatest social and economic gains for the nation through improved innovation and productivity. At the same time, we ought to consider bold targeted and strategic initiatives in some of the key research areas of our time in which Australia has both a strategic need and competitive advantage, and which have the potential for the greatest spill over effects across numerous domains. These key areas might include:

- quantum science and engineering (nano-scale science and technology in general);
- artificial intelligence, automated systems and robotics (including sensing, analytics and precision medicine);
- space science and technology;
- food and water security (including sustainable agriculture and aquaculture - climate resilience and adaptation);
- advancing human health (addressing the social determinants of health; cancer; obesity, diabetes and cardiovascular disease; mental health; infectious disease and biosecurity; and ageing well);
- defence technology; and
- Australia's future role in our region (economic development partnerships, understanding the region – its politics, cultures and languages, etc).

Most of these fields not only raise significant challenges for the underlying basic sciences, but also fundamental social, cultural and economic questions, as well as opportunities for building the new industries and jobs of the future. Any country that can get in front of these rising scientific and technological waves will enjoy an enormous competitive advantage in the new economies of the future. Australia has extraordinary research capability in each of these areas and we have a unique opportunity to capitalise on these capabilities over the next 10 years.

The ISA 2030 Strategic Plan Issues Paper and its six component key challenge areas cover a very broad range of issues. Our submission below provides brief answers to most questions, but here we highlight the key priorities as we see them in relation to each challenge:

1. For **Challenge 1: Moving more firms, in more sectors, closer to the innovation frontier**
    - Enhance efforts to increase Australia's levels of Business Expenditure on R&D (BERD) compared to international benchmarks.
    - Pursue new approaches to tax incentives to encourage deep discovery-research based collaboration between industry, Australian universities and other public research organisations.
    - Achieve joined-up planning between Commonwealth, state and local governments to establish and support dynamic innovation 'precincts' or 'clusters' in identified priority metropolitan and regional locations.

2. For **Challenge 2: Moving, and keeping, government close to the innovation frontier**
    - Ensure government levels of investment in R&D continue to grow compared to international benchmarks and that the weighting of our investment strikes an appropriate balance between discovery and applied/experimental development research.
    - Improve coordination between Commonwealth and state agencies with significant research investment programs.
    - Streamline government business processes to minimise barriers to research collaboration and provide seamless opportunities for staff mobility between agencies and non-government research organisations.

3. For **Challenge 3: Delivering high-quality and relevant education and skills development for Australians through their lives**
    - Lift primary and secondary school learning outcomes across the socio-economic and disciplinary spectrums.
    - Ensure funding adequacy for all levels of education and maximum public and private investment in R&D.
    - Encourage and incentivise life-long learning through tax and other measures.

4. For **Challenge 4: Maximising the engagement of our world-class research system with end users**
    - Ensure Australia's levels of public and private investment in R&D grow as shares of GDP to 2030 and thereafter.
    - Provide financial incentives focused on encouraging deep 'bottom-up' strategic research partnerships between industry and Australian universities and other publicly funded research organisations.
    - Reform the way the Australian PhD is structured and resourced to ensure that we are producing graduates of the highest international quality across the disciplines.

5. For **Challenge 5: Maximising advantage from international knowledge, talent and capital**
    - Ensure Australia is the destination for high qualified and skilled people from around the world.
    - Ensure that our visa and migration policies continue to allow Australian employers – especially those in knowledge-based industries such as universities – to recruit the best talent available globally to fill areas of skills shortage, and build outstanding local capacity in these fields.
    - Ensure that our educational and research organisations are adequately resourced and incentivised to provide opportunities for students and staff to engage internationally.

6. For **Challenge 6: Bold, high-impact initiatives**
    - Create and embed a robust national process for identifying and supporting the most outstanding and emergent research capabilities in crucial areas of scientific, economic, social and cultural transformation.
    - Develop and entrench a long-term (10-20 year) strategy for supporting investment in research infrastructure that has the greatest potential to deliver transformative scientific, social and economic change.
    - Make Australia *the* destination for the world's leading young researchers and entrepreneurs through a pro-active and integrated set of policies and initiatives.

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

Issues for discussion

What is your reaction to this challenge? What's missing, such as other opportunities? Can you nominate your three highest-priority responses to address this challenge?

Reaction. We agree that Australia's future prosperity will depend to a large degree on the continued success of existing firms in the face of intensifying global competition. It will also hinge on our capacity to take advantage of export markets – particularly in Asia, and on our ability to create new firms and high-value jobs in new industries.

What's missing? Aspirational targets for innovation performance benchmarks at the global (Global Innovation Index) and specific levels (key individual measures).

Three highest-priority responses to address this challenge.

1. Increase Australia's BERD to an internationally competitive level, whilst ensuring that our overall approach to business R&D policy fuels additional investment, rather than simply substitutes for R&D activity that would have occurred anyway.
2. Implement Recommendation 2 of the R&D Tax Incentive Review - to introduce a 20 per cent collaboration premium for the non-refundable tax offset for R&D undertaken in collaboration with publicly funded research organisations.
3. Achieve joined-up planning between Commonwealth, state and local governments to establish and support world-class innovation 'precincts' or 'clusters' in identified priority metropolitan and regional locations.

How should we strike the balance between supporting existing innovative leaders and allowing the emergence of the next generation?

Innovation should be encouraged and rewarded wherever it occurs. However, in terms of targeting, our approach to policy and funding should be focused on creating a fertile environment for the establishment of new firms and industries. We need to encourage and support the next generation of entrepreneurs to try and fail, and be able to try again and again.

How do we ensure our current (and future) workforce has the necessary skills to support firms in their ambition and realise Australia's vision to be a "top tier" innovation nation?

- Improve primary and secondary school learning outcomes compared to international benchmarks.
- Build science, technology, engineering and mathematics (STEM) skills.
- Strengthen national capacity for languages other than English - especially Asian languages.
- Level the playing field for the provision of post-secondary education, to foster competition and innovation.
- Ensure funding adequacy for all levels of education, and remove upfront barriers to participation (including living costs) to the greatest extent possible.

- Maximise public and private investment in R&D.
- Embed, support and incentivise lifelong learning.
- Ensure strong dialogue and collaboration between business and education sectors about skills needs and trends.
- Maintain a strong and responsive skilled migration program, which ensures Australia is able to attract the best and brightest from around the world into areas of strategic priority.

What role could 'clusters' of innovative activity play in fostering high-growth firms?

Innovation 'clusters' or 'precincts' can play an important role in fostering innovation and the creation of new high growth firms. The evidence is very clear that, while Australia should not attempt to replicate directly the Silicon Valley phenomenon, we should seek to build clusters where innovation thrives thanks to the density and diversity of activities and relationships, and the cross-pollination of ideas and knowledge that occurs amongst players in the innovation ecosystem – researchers, established industry, educators, entrepreneurs and new firms.

The success of these high-skill, high-creativity innovation clusters appears to turn on four preconditions:

- a catalyst in the form of strategic planning and investment in infrastructure by governments;
- fuel and nourishment in the form of a high volume of publicly funded R&D (in the United States the role of Defence related research has been particularly critical);
- a supportive host and regulatory environment for firms and in particular start-ups; and
- a critical mass of symbiotic relationships between diverse interdependent players.

Federal, state and local governments working together can play vital roles in catalysing and supporting such clusters.

Existing innovation clusters/precincts in California, Toronto, Munich, Boston, Cambridge, and London are excellent examples of what can occur when there is a bold vision and coordinated plan involving government, universities and industry collaborating to establish density and scale. Several universities in Australia have also been moving towards this model over recent years. The University of Melbourne's Carlton Connect precinct is one excellent example that is modelled on overseas successes. We are currently working with the NSW Government, the Greater Sydney Commission, local governments, Local Health Districts, Aboriginal and Torres Strait Islander communities, other universities and educational providers, and industry, to plan for the establishment of innovation districts - including on detailed proposals to transform our Camperdown and Westmead campuses.

What regulatory reform, and in what sectors, is required to help firms move closer to the innovation frontier and enable greater adaptability?

Reform of the R&D Tax Incentive should be a key priority for regulatory reform in Australia. At a cost of around $3 billion annually (and growing rapidly) the R&D Tax Incentive represents the single largest component of the approximately $10 billion the Australian government currently invests each year to support Australian science, research and innovation. Ensuring that our R&D tax incentive regime is performing well against its objectives is arguably more important to Australia than for competitor countries, as our program currently accounts for some 85 per cent of the total support for business R&D provided by the Australian government. This places Australia at the far end of the spectrum, in terms of the degree to which indirect measures (tax incentives) as opposed to direct strategies (for example competitive grant schemes) are used to support business R&D.

Notably, many competitor countries that are well known for their stronger overall performance in the innovation stakes – for example the United States, Sweden, Israel, Germany and Finland – rely much more on direct measures to stimulate business R&D, and in some cases do not use tax incentives at all.[1] From our consideration of the international literature on the most effective government strategies for fostering R&D additionality amongst private firms, success appears to lie in ensuring that policy addresses the following key factors:

1. **Provides policy stability and predictability**. The overall effectiveness of R&D tax incentive regimes depends upon the broader regulatory environment, in particular the broad taxation and migration regimes, and their stability and predictability over time. Stable and predictable incentives are likely to have a stronger impact on R&D investment.

2. **Steers away from attracting MNEs.** Using fiscal incentives with the sole purpose of attracting potentially mobile R&D by Multinational National Enterprises (MNEs) is likely to have only limited effects, and can lead to a dangerous "race to the bottom" among countries.

3. **Balances direct and indirect support.** Policy should balance indirect support for business R&D (tax incentives) with the use of direct support measures (competitive grants) to foster innovation where the market is less likely to deliver it on its own. It should also assess how well different innovation support instruments work together to incentivize the creation and maintenance of deep research partnerships between private firms, universities and other publicly funded research organisations.

4. **Focuses support toward new firms.**
    - Small or young firms react more strongly to R&D tax incentives than large firms, and are less likely to shift their profits abroad to avoid taxes.
    - Income-based incentives should be treated with caution, given the lack of evidence of their effectiveness and the risk that they will disproportionately benefit established, large firms, MNEs and innovations susceptible to protection by patents.
    - Business R&D tax incentives should be designed to ensure that young, innovative firms, without cross-border tax planning opportunities and profit-generating capacity, are not disadvantaged.
    - Incentives should include carry forward provisions, cash refunds or reductions in social security and payroll taxes, so that they also benefit small and young firms and projects involving basic research.

5. **Features ongoing monitoring and regular evaluation.** Governments should ensure that R&D tax incentive policies provide value for money, through effective evaluation, including of the impacts of any reforms.[2]

[1] https://www.oecd.org/sti/rd-tax-incentive-indicators.htm
[2] Appel S. *et al*. *R&D Tax Incentives: Evidence on design, incidence and impacts*, OECD Science, Technology and Industry Policy Papers, No.32. OECD Publishing, Paris, 2016

Challenge 2: Moving, and keeping, Government closer to the innovation frontier

Issues for discussion

What is your reaction to this challenge? What's missing such as other opportunities? Can you nominate your three highest-priority responses to address this challenge?

Reaction. We agree with the premise underlying this challenge: that governments have a significant direct and indirect role to play in strengthening the national innovation system.

What's missing? Emphasis on the need for a 'whole of government' approach to coordinating innovation policy – including public R&D investment and prioritisation. This applies at the Commonwealth level, but also in terms of coordination between the Commonwealth, states and territory governments through the Council of Australian Government (COAG).

The National STEM School Education Strategy is one good example of the type of coordinated approach Australian governments can take to address a national challenge.[3] The work of the Independent Hospital Pricing Authority (IHPA) to develop a coherent national system for funding teaching, training and research in our public hospitals is another. There are many other examples and there is great potential to achieve much more through more strategic and deeper collaboration between governments. The Cabinet's Innovation and Science Committee has an important leadership and coordination role to play, in concert with state and territory Ministers responsible for innovation and research policy.

Three highest-priority responses to address this challenge.

1. Maximise GOVERD, and ensure it is directed strategically toward agreed national research priorities, with an appropriate mix of basic and applied research.
2. Maximise levels of coordination between Commonwealth agencies, and between the Commonwealth, state and territory governments.
3. Agree national principles and standard templates for all government research agreements with universities, medical research institutes and other research organisations.

Where is innovation required to reduce the burden of partnering with government?

Our third highest priority response above relates to the continuing difficulty that we, and other Australian research universities, face as frequent providers of research services to government agencies, when negotiating the terms governing the conduct of research. This is by no means a new issue. The Group of Eight universities urged action on it almost a decade ago during *Venturous Australia* Review of the National Innovation system.[4]

While there have been some small improvements achieved with individual agencies entering into long-term strategic collaboration agreements with some universities (including Sydney) limited progress has been made towards agreeing a common national principles-based approach to the governments' procurement of

3 http://www.educationcouncil.edu.au/site/DefaultSite/filesystem/documents/National%20STEM%20School%20Education%20Strategy.pdf

4 https://go8.edu.au/sites/default/files/docs/go8_innovation_review_supp_sub_300408.pdf

research services. Addressing this issue strategically and consistently between Commonwealth and state governments would, we believe, do much to reduce wastage, and improve the efficiency and impact of governments' investments in R&D.

How could government seek to leverage greater social benefit and public value from major program expenditure?

The Issues Paper highlights the great potential for Defence's estimated $195 billion in expenditure over the next decade to deliver direct and indirect innovation dividends. For Defence to build stronger links across the innovation system it should look for guidance from the United States' highly successful model and develop a robust framework for funding advanced R&D from basic and applied research through to experimental development. In the United States, Defence is integrated into the innovation system and has the ability to steer research directions by being a known and significant funder of R&D.

We have numerous researchers with first-hand experience working with, or conducting research for, leading US Defence and other research agencies, and would be happy to introduce IPA to these people if that would be helpful.

Implementing key recommendations of the Productivity Commission's recent reports on Intellectual Property and Data Availability and Use will also assist great to leverage social benefit and public value from program expenditure across all Australian government agencies.[5]

Where can government reduce impediments to innovation within the public sector?

Impediments to innovation within the public sector will be reduced by focusing on strategies in the following areas:

- the skills and attributes of the public sector workforce; embedding a culture of innovation,
- risk-taking and constant improvement across the sector;
- improving the availability of government held/created data for research purposes; and
- breaking down barriers to collaboration with non-government organisations – for example through increased dialogue, staff secondments/exchanges, and streamlining requirements for research agreements/contracts (as mentioned above).

Challenge 3: Delivering high-quality and relevant education and skills development for Australians throughout their lives

Issues for discussion

What is your reaction to this challenge? What's missing? Can you nominate your three highest-priority responses to address this challenge?

[5] http://www.pc.gov.au/inquiries/completed/intellectual-property/report & http://www.pc.gov.au/inquiries/completed/data-access/report

Reaction. Unsurprisingly, we strongly endorse the inclusion of this challenge on the list. Ensuring Australia has the highest possible quality education and research systems is fundamental to securing an innovative and prosperous future for the nation.

What's missing? Aspirational input and outcome targets for educational performance compared to international benchmarks.

Three highest-priority responses to address this challenge.

1. Improve primary and secondary school learning outcomes across the socio-economic and disciplinary spectrums compared to international benchmarks.
2. Ensure funding adequacy for all levels of education and maximum public and private investment in R&D.
3. Encourage and incentivise life-long learning, enabling people to upgrade or reskill throughout their working lives.

How do we create a cohesive education and training system that is integrated into to the innovation and research system?

This can be achieved by pursuing measures such as:

- depoliticising education and committing steadfastly to evidence-based policy development;
- maximising collaboration between Commonwealth, state and territory governments;
- providing financial incentives for collaboration between schools, vocational education providers and universities; and
- ensuring that access to educational opportunity in Australia is based on merit, not capacity to pay.

How can we increase people and idea exchanges between industry and the education and training system?

Increasing levels of genuine collaboration between Australian industry and education providers will require a concerted effort to address cultural as well as structural policy and funding barriers. For-profit employers need to be convinced that contributing a proportion of their time and resources to educate and train the future workforce represents a sound economic and social investment. Policy and funding programs need to encourage and incentivise educational and research collaboration where the 'market' alone is not sufficient to ensure it occurs at an adequate scale.

Proposals currently under consideration such as the R&D Tax Incentive Review's proposed 20 per cent collaboration premium for the non-refundable tax offset for R&D undertaken in collaboration with publicly funded research organisations are strongly supported.

How do we create and support a culture of agile learning?

- Shift to transparent, needs-based funding for all Australian schools.
- Balance the need for testing of basic skills, with the need to ensure that our education system produces highly curious, creative, adaptable, entrepreneurial, and resilient students.
- Level the playing field for the provision of post-secondary education, to foster competition and innovation.

- Ensure that up-front barriers to participation in education are removed at all levels, and that participation and success rates of students from low SES, Aboriginal and Torres Straight Island, and other disadvantaged groups reach population parity.
- Allow tax deductions for self-education expenses arising from a person undertaking professional education not directly related to their current employment (as is currently required by Australian taxation law).
- Ensure strong regulation and quality assurance, but equally ensure that regulation of the education system does not itself act as barrier to innovation in educational offering and their delivery.

Challenge 4: Maximising the engagement of our world class research system with end users

Issues for discussion

What is your reaction to this challenge? What's missing? Can you nominate your three highest-priority responses to address this challenge?

Reaction. The statement that in 2030 a highly innovative Australia must have a well-supported and impactful world-class research base is strongly supported. The observation that achieving this will require appropriate levels of funding, including for world-class research infrastructure, is also strongly endorsed. The focus on ensuring Australia's system of research training is flexible and relevant to a knowledge-intensive future is appropriate, but ensuring our system produces PhD graduates of the highest quality compared to international benchmarks must be the highest strategic policy priority.

What's missing? Aspirational targets for research and research training investment and outcome benchmarks compared to relevant international benchmarks: including for levels of industry/university collaboration.

Three highest-priority responses to address this challenge.

1. Ensuring that Australia's levels of public and private investment in R&D grow as share of GDP to 2030, and are comparable with the top performing countries according to international benchmarks.
2. As for Challenge 1, providing financial incentives focused on encouraging deep 'bottom-up' strategic research partnerships between industry and Australian universities and other publicly funded research organisations.
3. In relation to the research training system, ensuring that the Australian PhD (including the education pathway to it) is structured and resourced to ensure that we are producing appropriate number of graduates across the disciplines and that they are the highest international quality.

How do we create a comprehensive research training system that is connected to the needs of end users?

This issue has been the subject of extensive and detailed review recently through the Australian Council of Learned Academies (ACOLA) Review of the Research Training System.[6] We engaged extensively with

[6] https://www.education.gov.au/review-australia-s-research-training-system

this review and are pleased the panel adopted key recommendations we made in relation to the need for reform to the standard educational pathway for the Australian PhD. Our submission, accessible here, discussed in some detailed the strengths and weaknesses of the current Australian PhD pathway, and proposed a new standard model designed to address our concerns that in many disciplines the Australian PhD is no longer competitive compared to leading international benchmarks.

The proposal, set out below in summary form, was broadly adopted by the ACOLA review, and has since been accepted by the government in its response to a key recommendation of the ACOLA review. Successful implementation of these reforms now hinges on ensuring that the government's reforms now proposed for the allocation of postgraduate Commonwealth Support Places, allows Australia's leading research universities to offer adequate numbers of 'Research-Track' Masters places in fields of identified national priority.

Preferred future pathway to the Australian PhD

Benefits of the model now broadly accepted by ACOLA and the Australian government

- The integrity of the PhD as the pinnacle qualification for an academic or research career is preserved.
- The new intensive research Master's broadens the scope of the full PhD pathway by supporting specialised coursework, teaching preparation and generic skills development, thus producing graduates with high level research and professional skills, better prepared for the workforce *or* a PhD.
- High-level professional skills training and industry engaged learning opportunities are provided predominantly at the Bachelor and Master's levels for some disciplines.
- The research Master's will also allow for embedding with research teams internationally and with industry where appropriate.
- There is stronger alignment with international models (Europe/North America).
- The quality of graduates is increased at all levels, making them more competitive internationally for academic *and* other professional careers.
- The new pathway strengthens the education and research system generally, underpinning new knowledge generation, innovation, and international education exports.

How can we increase people and idea exchanges between industry and research? How can we increase the multi-disciplinary engagement and exchanges across industries? Do we have the right incentives to encourage research translation?

The most impactful collaborations between universities and industry are based on deep strategic and long-term partnering to answer genuinely challenging discovery-based and applied research questions of strong mutual interest.

Such relationships are often built around the people-to-people links and trust that develop serendipitously between individuals through their educational, research training, and subsequent careers. Alternatively, they may arise after a firm identifies through their research or other processes, the university (or teams of researchers spread across the world) who are the best fit for the collaborative research they have in mind.

The R&D Tax Incentive Review's recommendation to introduce a 20 per cent collaboration premium for the non-refundable tax offset for R&D undertaken in collaboration with publicly funded research organisations has the potential to significantly improve the incentive structure for industry to partner with Australian universities and other publicly-funded research organisations. Such a measure will need to be designed

and implemented carefully, however, if it is to have the intended effect of growing the types of collaboration most likely to produce groundbreaking outcomes.

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

Issues for discussion

What is your reaction to this challenge? What's missing such as other opportunities? Can you nominate your three highest-priority responses to address this challenge?

Reaction. We certainly agree that Australia's innovation future will depend largely on the degree to which our publicly funded research organisations and private firms are internationally engaged.

What's missing? Aspirational targets for levels of international engagement.

Three highest-priority responses to address this challenge.

1. Ensure that Australia remains an attractive destination for highly skilled people from around the world.
2. Ensure that our visa and migration policies allow Australian public and private sector organisations to recruit the best talent available globally in areas of strategic priority, and build outstanding local capacity in these fields.
3. Ensure that educational and research organisations are adequately resourced, and incentivised, to provide opportunities for students and staff to engage internationally.

How can we ensure that Australia remains attractive to international firms and individuals as a place to study, work, live and invest?

For firms and foreign investors, our system of business taxation, and incentive structures for risk-taking and R&D by existing and new firms must be internationally competitive. Firms need to know that they will have ready access to a stable supply of appropriately educated and skilled employees (whether from the domestic market of overseas recruitment) at costs that are internationally competitive. They also need to know that they will be operating in country with a stable and transparent system of government, and one that has relatively stable policies and regulations.

For future international students, ultimately their study decisions will be based on perceptions of the relatively quality, value, affordability and safety of the educational experience they will have while in Australia. Ensuring Australia maintains competitive work rights for international students while they study and after graduation is also an important factor.

For students and other individuals, the quality and affordability of life Australia offers will be a key factor in ensuring its attractiveness compared to other potential destinations. This includes competitive salaries and affordable accommodation; fair access to employment, public health and education for family members; as well as clear and stable pathways to permanent residency and citizenship.

What specific measures may be needed to facilitate talent and capital flow and greater value chain engagement?
How can we maximise the value of international knowledge exchange?
Where are the areas where we are getting this consistently right and how?
What happens if the current protectionist mood in some major countries becomes a major trend and international mobility of knowledge, talent and capital reverses its recent trend of growth?

We have focused our response on the 'facilitating the flow of talent' and 'maximising the value of international knowledge exchange' aspects of these questions.

In relation to 'facilitating the flow of talent', it is absolutely critical that Australia's visa and migration system continues to allow our public and private sector organisations to efficiently recruit talent from overseas to fill roles in areas of skills shortage. We are very concerned that if implemented as proposed, the federal government's recently announced reforms to the 457 and 186 (Employee Nomination Scheme) visa programs, will impact on the international competitiveness of Australia's universities, other publicly funded research organisations, and private firms whose businesses depend on their capacity access to highly skilled staff.

In our own case we currently have more than 300 members of staff on 457 visas, and sponsor between 120 and 180 individuals under this scheme annually. We have some 276 permanent resident staff members recruited under the ENS, and sponsor between 15 and 40 staff members each year under this scheme. Approximately another 600 members of our staff are Australian citizens who have migrated to Australia through various pathways. This represents approximately 15 percent of our total workforce, with the vast majority of these people employed in academic teaching and/or research roles. These staff make an absolutely critical contribution to the quality and impact of the University's educational and research missions. Without them it is very likely that our levels of international engagement would be diminished significantly.

We are heartened by the federal government's assurances that its skilled migration reforms were not intended to create a barrier to the entry of highly skilled academics and researchers with skillsets not available in Australia, and welcome its commitment to work with the sector to minimise unintended consequences.

In relation to 'maximising international knowledge exchange', the highly globalised nature of the research system ensures there are strong non-financial incentives already in place that encourage the dissemination of knowledge. A key obstacle we face to achieving greater levels of international engagement is ensuring that Australian research organisations and researchers have access to adequate resources to allow them to participating meaningfully in international collaborations. It is one thing to have access to the research outcomes through the published literature, but much better to be involved with the research itself. In our assessment, this is an area where Australia's system for research funding falls short compared to leading international examples like the United States, and especially Germany through its longstanding, well-resourced and highly strategic Academic Exchange Program.

Dedicating new funding programs to support international academic research collaborations would certainly have a positive impact. However, in the current funding environment, we would prefer to see the Australian governments prioritise meeting more of the full costs of the research activities that are funded – especially through nationally competitive grant programs.

There could also be value in ISA recommending that the Australian government conduct a review all existing programs that support international engagement, with a view to consolidating these to ensure the maximum impact is achieved from the resources available.

Ensuring that Australia is regularly a significant participant in major strategic international research collaborations will also be critical for maximising our capacity to benefit from new knowledge, understanding and technology that flows from such initiatives.

Challenge 6: Bold, high-impact initiatives

Issues for discussion

What is your reaction to this challenge? What is missing? Are there other opportunities?

Reaction. Australia needs to be bold in its aspirations for research excellence and in our capacity for translating that excellence into outcomes that benefit all Australians.

What's missing? We need to ensure that we are supporting the basic elements of a successful research system through:

- high quality education systems and outcomes, at all levels and in all disciplines;
- unstinting and sustainable support for the very best discovery-based research;
- well-planned and funded research infrastructure;
- robust and competitive research funding for our very best researchers;
- integrated policies designed to attract the best global talent and to enable Australian research students and researchers to engage internationally;
- strategies to encourage deep and long-term research partnerships between government, industry, universities and other non-government research organisations; and
- strong incentives for the translation and commercialisation of research outcomes.

Securing these elements will provide the bedrock for the truly transformative research initiatives that will result in the greatest social and economic gains for the nation.

At the same time, we ought to consider bold targeted and strategic initiatives in some of the key transformative research areas of our time in which Australia has a competitive advantage, and which have the potential for the greatest spill over effects across numerous domains. These key areas might include:

- quantum science and engineering (nano-scale science and technology in general);
- artificial intelligence, automated systems and robotics (including sensing, analytics and precision medicine);
- space science and technology;
- food security (including sustainable agriculture and aquaculture - climate resilience and adaptation);
- advancing human health: addressing the social determinants of health; cancer; obesity, diabetes and cardiovascular disease; mental health; infectious disease and biosecurity; and ageing well;
- defence technology; and
- Australia future role in the Asia Pacific region (economic development partnerships, understanding the region – its politics, cultures and languages).

Most of these areas not only raise significant challenges for the underlying basic sciences, but also fundamental social, cultural and economic questions, as well as opportunities for building the new industries and jobs of the future. Any country that can get in front of these rising scientific and technological waves will enjoy an enormous competitive advantage in the new economies of the future. Australia has

extraordinary research capability in each of these areas and we have a unique opportunity to capitalize on these capabilities over the next 10 years.

Three highest-priority responses to address this challenge.

1. Create and embed a robust, national process for identifying the most outstanding and emergent research capabilities in crucial areas of scientific, economic, social and cultural transformation, and commit strategic and targeted funding to lift Australia's capacity substantial in these areas over a defined period.
2. Develop and entrench a long-term (10-20 year) strategy for supporting investment in research infrastructure that ensures our leading public research organisation can conduct the highest quality research in ways that have the greatest potential for transformative scientific, social and economic change. Harnessing the influence and capability of all the key stakeholders from industry, community and educational organizations would be crucial in this process.
3. Make Australia *the* destination for the world's leading young scientists, scholars and entrepreneurs through a pro-active and integrated set of policies designed to make Australia the place where they want to pursue their careers and lives.

What type of initiatives would achieve the greatest impact?

The initiatives that will achieve the greatest long-term impacts are those that build research capacity at scale in truly transformative areas that have the greatest potential for spill-overs into a wide range of domains.

Bold, high impact initiatives at regional, national and/or international scale? How should we decide?

We should aim to support initiatives that have both national and global scale given the nature of transformative research and innovation today (which is unavoidably global in nature). Ensuring stable long-term investment in quantum science, robotics and automated systems, for example, will enable Australia to continue to attract global talent, investment and industry partnerships, as well as address pressing national issues and develop new industries and jobs across diverse industry sectors.

Does Australia have a national "burning platform"? Do our regions?

The food security, population, environmental political stability challenges ahead for the Asia Pacific region are immense. Competing pressures on soil, water, nutrients, and space for agricultural production are only expected to increase as a result of population growth, economic development, and climate and environmental change. Achieving an optimal and sustainable level of food safety and animal welfare will not only require the application of new knowledge and technology, but innovation in partnership models and more effective collaboration between agribusiness, governments and universities.

Feeding the world is big business. As a large exporter of high quality, safe and nutritious food to countries in our region and beyond Australia has great opportunities and responsibilities to support sustainable economic development. Ensuring close collaboration and partnership between the public and private sectors, as across relevant government agencies, will be essential in this endeavour.

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What is the right balance of government and other sector involvement in leading and supporting bold high impact initiatives? What measures are required to achieve this?

Everyone has a role to play. The key to success is optimising for everyone's capacities and abilities, and creating the conditions to foster strategic collaboration for the long-term. Governments have funds, priorities and some levers they can use to incentivise or discourage activities and behaviour. Industry can translate and provide pull and focus for research problems. Public research organisations provide capacity, expertise, infrastructure and ideas.

In terms of measurement, monitoring levels of industry involvement/investment in long-term discovery-based research partnerships with Australian universities and other publicly funded research organisations may help.

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