

Australian Academy of Science Response to the Boosting the commercial returns from research Discussion Paper

Contents

1	Summary points of submission	3
2	Introduction	4
3	Response to specific discussion paper proposals	5
3.1	Creating stronger incentives for research-industry collaboration.....	5
3.1.1	Discussion paper proposal—Modify rules for competitive research grants to appropriately recognise industry-relevant experience	6
3.1.2	Discussion paper proposal—Develop research block grant arrangements that retain a focus on quality and excellence while supporting greater industry and end-user engagement ...	6
3.1.3	Discussion paper proposal—Leverage greater collaboration between publicly-funded research agencies and industry	7
3.1.4	Discussion paper proposal—Consolidate existing programs that focus on collaboration with industry to increase their scale and effectiveness.....	8
3.1.5	Discussion paper proposal—Consider whether the R&D Tax Incentive sufficiently encourages collaboration between industry and researchers	8
3.2	Supporting research infrastructure	10
3.2.1	Discussion paper proposal—Strengthen the existing focus on the NCRIS on outreach to researchers and industry	10
3.2.2	Discussion paper proposal—Undertake a reassessment of existing research infrastructure provision and requirements, in line with the recommendations of the National Commission of Audit.....	10
3.2.3	Discussion paper proposal—Develop a roadmap for long-term research and infrastructure investment, in consultation with the research sector and industry	10
3.3	Providing better access to research.....	10
3.3.1	Discussion paper proposal—Strengthen IP guidelines for researchers.....	10
3.3.2	Discussion paper proposal—Examine the potential to link research funding to the dissemination of IP.....	10
3.3.3	Discussion paper proposal—Establish an online point of access to commercially-relevant research for business.....	11
3.3.4	Discussion paper proposal—Develop a whole-of-government policy to open up access for business and the community to publicly funded research	11
3.4	Increasing industry relevant research training	12
3.4.1	Discussion paper proposal—Take steps to ensure that the research workforce is equipped to work with industry and bring their ideas to market	12
3.5	Measurement of outcomes	12

3.5.1	Discussion paper proposal—Improving assessment of the research system, including measuring and publishing collaboration and commercialisation outcomes, as well as research outcomes and impact.	12
3.6	Capitalising on the Medical Research Future Fund	13
4	Response to other areas of the discussion paper	13
4.1	Recognising the importance of public good research	13
4.2	Science strategy and national research priorities.....	14
4.3	Blue sky research	14
4.4	Positive business environment for start-up companies	14

1 Summary points of submission

1. The government should consult further with the sector to develop a well-considered plan that will help deliver improved end-user outcomes from research.
2. The ROPE framework, and other similar policies relating to the assessment of competitive grants, to be strengthened so that they are explicit in stating that industry-relevant experience supported by performance evidence will be appropriately recognised within the grant application process.
3. In making any changes to the block grant framework, a continued focus on research excellence must be maintained.
4. Any changes to university block grants be developed in a methodical manner and phased in over time, with a focus on incentivising future behaviour, rather than rewarding past endeavours from many years ago.
5. If further incentives within the block grants are to be placed on industry collaboration, then we must ensure that the primary focus on research quality and research excellence is not diminished.
6. Universities should be consulted to explore current attitude towards category 2-4 funding, and their future intentions in terms of pursuing funding in this area.
7. It is recommended that a consolidation of the range of research and industry collaboration and commercialisation programs take place, but that as these programs are important for the translation of early-stage research into industry there should not be a reduction in the size and scope of services available.
8. Australia should maintain the indirect incentives for industry research and development and ramp up support for direct incentives that would promote engagement between industry and the research sector.
9. The Academy strongly supports the call in the discussion paper for a long-term research infrastructure roadmap, and the need for long-term, stable support for major research infrastructure. Major research infrastructure is an investment that needs to be properly managed for the whole of its lifetime including management of the capital asset and the staff and resources to extract maximum value from the asset.
10. Institutions should be encouraged to follow the National Principles for Intellectual Property Management so that commercial outcomes from publicly funded research can be pursued, where a commercial outcome is appropriate.
11. The Academy strongly supports the efforts of some institutions to make their IP more accessible to industry by purposefully not adopting a strong (and restrictive) patenting strategy for all IP. Making university IP more freely available to industry actually unlocks IP and releases it into industry where it can actually be exploited and drive activity in the economy.
12. The Academy suggests that the default position be that publicly funded research be disclosed in confidence to industry for commercial development by researchers or industry unless the research organisation has a clear roadmap and the commercial resources to exploit the IP itself.
13. Efforts that would provide commercially-relevant research to end-users such as business should be encouraged, and it is suggested that further engagement with industry is necessary to understand how the proposed online portal would work best. This portal should also provide details on the different research-industry collaboration programs.

14. The free and fair dissemination of publicly funded research outputs to the broader community should be supported, and the Academy is encouraged by the efforts of the ARC and NHMRC in this area.
15. There is a need to explore new options for doctoral training and the training of early career researchers to make available more opportunities for them to spend some time in an industry setting.
16. Up-to-date data needs to be collected and reported on a range of key science system indicators so that the impact of policy measures can be determined in a timely fashion.
17. Any assessment of the research system, including measuring and publishing collaboration and commercialisation outcomes, should apply to all publicly funded research agencies, research institutes and universities. These measures must include an element that recognises both research for the public good and capacity building.
18. Care needs to be taken when developing and using measures of research commercialisation and collaboration to avoid creating perverse incentives that could have unfortunate unintended consequences. The focus must be on encouraging added value from commercialisation and collaboration opportunities, rather than pursuing routine research and consultancy activities which are best delivered in the private sector.
19. A separate consultation process needs to take place exploring how the Medical Research Future Fund will operate and fund research.
20. Public good outcomes from research should be recognised within any assessment of the outcomes of publicly funded research. Furthermore, end-user engagement should be encouraged across all sectors so that research can be utilised by different end-users to improve both public-good and commercialisation outcomes.
21. The development of strategic research priorities will help focus Australia's research efforts on those areas of strategic benefit.
22. Continued strong investment in pure basic research is needed so that Australia has a solid foundation of basic research, which will be the very foundation of future research commercialisation developments.
23. Consideration should be given to ensuring that the business environment in which start-up companies operate in the science, research and innovation sphere is competitive compared to other developed nations, and nations within our region. This should include ensuring that Australia has the right level of tax incentives, the tax treatment of share options, and direct assistance in place to encourage angel investors and venture capitalists.

2 Introduction

The Industry Innovation and Competitiveness Agenda outlines the Government's desire to enhance the commercial returns from Australia's investment in research and development¹. The associated discussion paper *Boosting the commercial returns from research* puts forward a selection of proposals to try and help achieve this. The Academy supports efforts that seek to increase the benefits that Australia derives from its outstanding research, and offers the following comments on the discussion paper. The Academy would be happy to discuss in further detail the points raised in this submission and to contribute to further policy development in this area.

¹ Department of Prime Minister and Cabinet (2014) *Industry Innovation and Competitiveness Agenda*. Available at: [http://www.dpmc.gov.au/publications/Industry Innovation and Competitiveness Agenda/docs/industry_innovation_competitiveness_agenda.pdf](http://www.dpmc.gov.au/publications/Industry%20Innovation%20and%20Competitiveness%20Agenda/docs/industry_innovation_competitiveness_agenda.pdf)

Many of the issues raised in the discussion paper relate to areas where Australia is currently perceived to be underperforming within the innovation system, relative to other nations. These issues are not new and have been frequently identified by successive governments² and yet action to tackle these problems has lacked the scale and focus required to make a substantial difference³. Whilst the need to act in this area is pressing, and the desire by government to do something is welcome, the Academy notes that the long-term solution is not something that can be achieved quickly and that a methodical and constructive approach is needed. There must be stronger engagement with the sector so that the best ideas and solutions can be identified to avoid embarking on programs unlikely to make a substantial difference or that could lead to negative unintended consequences.

The Academy urges the government to consult further with the sector to develop a well-considered plan that will help deliver improved end-user outcomes from research.

3 Response to specific discussion paper proposals

3.1 Creating stronger incentives for research-industry collaboration

The Academy supports efforts to provide more incentives for research–industry collaboration. Such incentives need to exist for both the research sector and for industry, so that collaboration is seen as mutually desirable and productive for both parties. While the discussion paper goes to great lengths to discuss how universities and other publicly funded research agencies might better collaborate with industry, it does not really explore the reasons behind such lack of collaboration from an industry perspective, or the incentives and actions required for industry to see collaboration as desirable. Furthermore, there is no analysis as to why industry in Australia appears to be behaving differently to that overseas, and whether the industrial base currently exists to pursue such collaborations.

Australia has a different industrial structure to many other advanced economies, and it could be lacking a culture that values the role of R&D within business and the benefits it delivers. This is indicated by Australia’s relatively low levels of business R&D^{4 5}, and is a major issue when attempting to improve research–industry collaboration. Australia has a high proportion of small to medium enterprises (SMEs) relative to other developed economies, and the research indicates that SMEs throughout the world usually invest proportionally less in innovation and research activities compared to large businesses⁶. Given the greater proportion of SMEs in Australia, it is not surprising that there are lower levels of research–industry collaboration. In addition to this, of the large firms that are present in Australia the proportion collaborating on innovation in general, and specifically collaborating with universities, is considerably lower than large firms overseas. Research has shown

² For example see Department of Industry (2013) *Australian Innovation System Report 2013*. Available at: <http://www.industry.gov.au/science/policy/AustralianInnovationSystemReport/AISR2013/index.html>

³ The ACOLA (2014) report states that compared to other nations Australia has been more likely to switch programs and focus compared to other nations. See ACOLA (2014) *The role of science, research and technology in lifting Australian productivity*. Available at: <http://www.acola.org.au/index.php/news/59-research-and-innovation-critical-to-future-australian-industries-finds-new-acola-report>

⁴ OECD (2014) *Main science and technology indicators*. Available at: http://stats.oecd.org/Index.aspx?DataSetCode=MSTI_PUB

⁵ See Figure 4.7 in ACOLA (2014) *Op. Cit.* page 105

⁶ Department of Industry (2013) *Op. Cit.*

that part of the reason for this is an absence of science and research skills within the workforce⁷, and addressing this must be seen as a priority.

It must also be recognised that the current industrial base in Australia is different to many other advanced economies, and lacks the highly innovative science and technology firms prevalent in other nations with there being no equivalent to a Silicon Valley, or Cambridge Cluster, within Australia. Every effort needs to be made to broaden Australia's industrial base so that it has the innovative science and technology firms that can deliver real productivity gains across the economy as a whole. This will be possible through investing in science, research and education, as well as direct action to encourage the development of new innovative and entrepreneurial industries.

3.1.1 Discussion paper proposal—Modify rules for competitive research grants to appropriately recognise industry-relevant experience

The discussion paper proposes that competitive grant bodies, including the ARC and NHMRC, could be required to recognise industry experience as a complement to research excellence (as defined by existing metrics such as publication and citation rates). Presumably the purpose is to ensure researchers moving between the university sector and industry, or university researchers spending time collaborating with industry, are not disadvantaged by 'publication breaks' on their CV.

The Australian Research Council already utilises a process whereby all eligible researchers have fair access to competitive funding, with the aim of recognising research excellence in the context of the diversity of career and life experiences⁸. The Research Opportunities Performance Evidence (ROPE) framework takes into account working arrangements, career histories and personal circumstances such that researcher track records are compared on a fairer basis. The assessment of grant applications already takes into account research opportunities and experience in the context of employment situations including those outside academia and the research component of employment conditions.

The Academy recommends that the ROPE framework, and other similar policies relating to the assessment of competitive grants, be strengthened so that they are explicit in stating that industry-relevant experience supported by performance evidence will be appropriately recognised within the grant application process.

We also note that there are also some significant obstacles, barriers and disincentives (such as variations in terms and conditions of employment, superannuation and tax disincentives, amongst others) to people moving freely between industry and academia.

3.1.2 Discussion paper proposal—Develop research block grant arrangements that retain a focus on quality and excellence while supporting greater industry and end-user engagement

In making any changes to the block grant framework, a continued focus on research excellence must be maintained. A focus on excellence is essential if Australia is to continue to be a competitive science nation, attracting the very best and brightest scientists, and to ensure that we have the tools to meet the economic, social and environmental challenges into the future.

The three most important drivers within the current university research block grants are: research category 1 income (generally ARC and NHMRC research council income), category 2-4 income (other

⁷ Department of Industry (2013) *Op. Cit.*

⁸ Australian Research Council (2014) *ARC Research Opportunity and Performance Evidence (ROPE) Statement (version 2014.1)*. Available at: http://www.arc.gov.au/applicants/rope_statement.htm

public sector, industry and other income, and CRC income), and higher degree student load/completions. Research publication output plays only a minor direct role in block grant allocation and industry income is already captured as a significant driver for block grant allocations (under Category-3 income). If further incentives within the block grants are to be placed on industry collaboration, then we must ensure that the primary focus on research quality and research excellence is not diminished.

The Academy recommends:

- **a continued focus on research excellence must be maintained in making any changes to the block grant framework**
- **that any changes to university block grants be developed in a methodical manner and phased in over time, with a focus on incentivising future behaviour, rather than rewarding past endeavours from many years ago.**
- **if further incentives within the block grants are to be placed on industry collaboration, then we must ensure that the primary focus on research quality and research excellence is not diminished.**

The current block grant system already encourages universities to pursue industry engagement through the use of increased block grant funding for category 2-4 income received. For universities, the financial incentive for pursuing industry income is already significantly greater than that for research output as measured by either quantity or quality of research publications. For example, within the Joint Research Engagement program, engagement with industry (as measured using Category 2-4 grants as a proxy) is already weighted at about six times the value of research publications. As incentives already exist within the block grant system to pursue industry collaboration, other new measures need to be introduced to encourage the growth of new innovative science and technology enterprises.

Given that Category 1 grants have limited scope for growth⁹, there is already a strong incentive for universities to pursue other (uncapped) Category 2-4 funding.

The Academy recommends that universities be consulted to explore current attitude towards category 2-4 funding, and their future intentions in terms of pursuing funding in this area.

3.1.3 Discussion paper proposal—Leverage greater collaboration between publicly-funded research agencies and industry

Opportunities for collaboration between publicly-funded research agencies and industry that deliver mutual benefits should be encouraged. Many of Australia's publicly-funded research agencies have already increased their levels of collaboration with industry to a substantial level. In the last year, CSIRO had a 20 per cent increase in its number of long-term industry partnerships, and a 13 per cent increase in active licensing of its technologies¹⁰. It now works with 1200 Australian small and medium companies, 500 large Australian companies and 450 multinationals¹¹. However, the

⁹ As expressed as the cash total of ARC and NHMRC appropriations detailed in Department of Industry (2014) *Science, Research and Innovation Budget Tables*. Available at: <http://www.industry.gov.au/AboutUs/Budget/Documents/SRIBudgetTables2014-15.pdf> and as set out in the Australian Government's (2014) *Portfolio Budget Statements*. Available at: <http://www.budget.gov.au/2014-15/content/pbs/html/index.htm>

¹⁰ CSIRO (2014) CSIRO Annual Report 2013-14. Available at: <http://www.csiro.au/Portals/About-CSIRO/How-we-work/Budget--Performance/Annual-Report/Annual-Report-2013-14.aspx>

¹¹ Ibid

significant reduction in resources directed to CSIRO, and the reported 20 per cent reduction in its workforce¹², will mean that Australia must be prepared to expect lower rates of research–industry collaboration in the coming years. As we invest less in science, the returns and benefits from science investment will be reduced for both science and end-users, including industry.

3.1.4 Discussion paper proposal—Consolidate existing programs that focus on collaboration with industry to increase their scale and effectiveness

The discussion paper notes that while there have been a number of previous business innovation programs, with the exception of the R&D Tax Incentive they have lacked scale. The Government has already moved to consolidate a number of programs that have provided assistance for collaboration and commercialisation activities. The Innovation Investment Fund has been eliminated, and both Commercialisation Australia and Enterprise Solutions are being wound up. In their place there is now a single program (with reduced funding), the Entrepreneurs Infrastructure Program. While it is reasonable to have a single and easily identifiable point of call where industry can more easily access opportunities, the program supports the translation of early-stage research into industry and needs to be properly resourced.

The Academy recommends the consolidation of the range of research and industry collaboration and commercialisation programs, but notes that as these programs are important for the translation of early-stage research into industry, there should not be a reduction in the size and scope of services available.

There are several research programs that aim to increase researcher end-user collaboration or focus on commercialisation or directly transforming research into end-user benefits. The largest of these programs include ARC Linkage Grants, ARC Centres of Excellence, the ARC Industrial Transformation Program, NHMRC Development grants, NHMRC Translating Research into Practice Fellowships, the NHMRC Partnership program, the CRC program, and Rural Research and Development Corporations. Each of these programs is valuable in fostering engagement between industry and the research sector. Each program fills a specific need, focused on achieving quite different outcomes and on different stages of the research pipeline, and on different industry sectors. While there might be some opportunity to consolidate the number of programs available within particular departments or agencies in the short term, it would be very difficult to achieve consolidation across Government given that they are scattered across at least four different Government portfolios and are subject to different sets of legislation.

There does need to be better coordination of the different schemes and it would be useful to have a single portal where information on all such industry collaboration and commercialisation opportunities could be found. The portal could be combined with the proposed online point of access to commercially-relevant research for business, so that it provides information on research-end-user collaboration programs.

3.1.5 Discussion paper proposal—Consider whether the R&D Tax Incentive sufficiently encourages collaboration between industry and researchers

It is important that appropriate incentives exist within the tax system to encourage industry investment in R&D. When the R&D tax incentive was introduced, Australia had woeful levels of business expenditure on R&D, just 0.45 per cent of GDP compared to an OECD average of 1.49 per

¹² See ABC (2014) *Claims nearly 900 jobs to go at CSIRO as Australia aims to boost farm production*. Available at: <http://www.abc.net.au/news/2014-11-25/nrn-csiro-cuts/5916092>

cent¹³. Even though Australia is still below the OECD average it has lifted its performance with business expenditure on R&D in 2011 lying at 1.23 per cent of GDP, compared to an OECD average of 1.59 per cent¹⁴. The R&D tax concession program has been a successful incentive through which Australia has lifted its game over the past 18 years. This improvement shows that making a substantial difference to R&D investment levels requires scale, focus and crucially, time, for impact to come through.

In recent times, investment through the R&D tax incentive has grown significantly as a proportion of Australia's investment in science, research and innovation. Australian Government support through the R&D tax incentive is set to be \$2.4 billion, or about 26 per cent of the total government investment in science, research and innovation budget for 2014-15 (noting that this is foregone revenue rather than expenditure), while ten years ago it represented just under 15 per cent of total government investment in science, research and innovation¹⁵. It is quite possible that this growth in industry R&D might in recent years be leading to greater university–industry collaboration, noting that the figures relied on in the discussion paper to express concern about Australia's collaboration performance are now nearly seven years out of date. The R&D tax incentive has shown what is possible through indirect support to improve business R&D when both the scale of investment and long-term commitment are focused on the issue. A similar investment should be considered for direct measures, including those that seek to enhance research – end-user collaboration.

The recent ACOLA (2014) report into the role of science, technology and research in lifting productivity shows that Australia invests a far greater proportion of its government support for business R&D through tax incentives rather than direct government funding compared to other developed nations¹⁶. Other nations are finding that direct government intervention is starting to have an impact¹⁷, and Australia should increase the role of direct impact programs that focus on research commercialisation to the scale of the R&D tax incentive¹⁸.

The Academy recommends that Australia maintains indirect incentives for industry research and development and ramps up support for direct incentives that would promote engagement between industry and the research sector.

¹³ OECD (2014) Main Science and Technology Indicators. Available at:

http://stats.oecd.org/Index.aspx?DataSetCode=MSTI_PUB#

¹⁴ Ibid

¹⁵ Department of Industry (2014) *Science, Research and Innovation Budget Tables*. Available at:

<http://www.industry.gov.au/AboutUs/Budget/Documents/SRIBudgetTables2014-15.pdf>

¹⁶ ACOLA (2014) *The role of science, research and technology in lifting Australian productivity*. Available at:

<http://www.acola.org.au/index.php/news/59-research-and-innovation-critical-to-future-australian-industries-finds-new-acola-report>

¹⁷ Ibid

¹⁸ Ibid

3.2 Supporting research infrastructure

3.2.1 Discussion paper proposal—Strengthen the existing focus on the NCRIS on outreach to researchers and industry

3.2.2 Discussion paper proposal—Undertake a reassessment of existing research infrastructure provision and requirements, in line with the recommendations of the National Commission of Audit

3.2.3 Discussion paper proposal—Develop a roadmap for long-term research and infrastructure investment, in consultation with the research sector and industry

The discussion paper rightly notes concerns within the research sector that ‘uncertainty around funding for fundamental components of the research sector, including stop-start funding of the National Collaborative Research Infrastructure Strategy (NCRIS), may have reduced the sector’s productivity and risked affecting our research excellence over the long-term’¹⁹. The failure of previous governments to commit to long-term research infrastructure planning not only damages research sector confidence, but undermines efforts to use such facilities to engage with industry. The incentive for industry to make any financial commitment to undertaking longer-term project collaborations or utilisation of equipment involving NCRIS facilities is severely hampered when uncertainty hangs over the facility.

The Academy strongly supports the call in the discussion paper for a long-term research infrastructure roadmap, and the need for long-term, stable support for major research infrastructure. Major research infrastructure is an investment that needs to be properly managed for the whole of its lifetime including management of the capital asset and the staff and resources to extract maximum value from the asset.

3.3 Providing better access to research

3.3.1 Discussion paper proposal—Strengthen IP guidelines for researchers

The existing National Principles for Intellectual Property Management provide a solid and reasonable set of principles that will help improve the commercial outcomes from publicly funded research, where a commercial outcome is appropriate²⁰. It would be very difficult to develop a national IP policy that works for all institutions given that IP issues are managed at the institutional level and that the focus of research within organisations can differ markedly.

The Academy recommends that institutions be encouraged to follow the National Principles for Intellectual Property Management so that commercial outcomes from publicly funded research can be pursued, where a commercial outcome is appropriate.

3.3.2 Discussion paper proposal—Examine the potential to link research funding to the dissemination of IP

The Academy supports all efforts that encourage research organisations and researchers to avoid intellectual property rights issues that result in barriers to future research. It is important that commercial opportunities are exploited where appropriate and in the national interest, but it is also important that IP issues are handled in a way that permits research to continue without impediments. Protecting intellectual property is time consuming and expensive. Given that the

¹⁹ Department of Education & Department of Industry (2014) *Boosting the commercial returns from research*. Available at: <https://submissions.education.gov.au/Forms/higher-education-research/Documents/Boosting%20Commercial%20Returns%20from%20Research%20%20-%2024102014.pdf>

²⁰ See ARC (2013) *National Principles of Intellectual Property Management for Publicly Funded Research*. Available at: http://www.arc.gov.au/about_arc/principles_ip.htm

resources required to pursue intellectual property rights are limited, institutions should be encouraged to identify potential commercial entities and researchers willing to champion patents and develop them further, and this can include offering the right to exploit patents on an initial gratis basis, with any revenue sharing to take place at a later stage.

The discussion paper outlines the potential to link research block grant funding with industry and end-user engagement. Care must be taken here that any proxy measures used to measure such engagement, for example the number of patents developed or contracts entered into with businesses, have the potential to drive perverse behaviour and to give rise to unintended consequences in terms of the dissemination of IP. It is vital that perverse incentives within the research funding system are avoided so that universities are not inadvertently encouraged to overly protect IP because IP-related metrics that could be used within future block grant funding models.

The Academy strongly supports the efforts of some institutions to make their IP more accessible to industry by purposefully not adopting a strong (and restrictive) patenting strategy for all IP. Making university IP more freely available to industry actually unlocks the IP and releases it into industry where it can actually be exploited and drive activity in the economy.

The Academy suggests that the default position be that publicly funded research be disclosed in confidence to industry for commercial development by researchers or industry unless the research organisation has a clear roadmap and the commercial resources to exploit the IP itself.

3.3.3 Discussion paper proposal—Establish an online point of access to commercially-relevant research for business

The Academy welcomes efforts that would provide commercially-relevant research to end-users such as business, and suggests that further engagement with industry is necessary to understand how such an online portal would work best. This portal should also provide details on the different research–industry collaboration programs.

3.3.4 Discussion paper proposal—Develop a whole-of-government policy to open up access for business and the community to publicly funded research

The Academy believes that the advancement of scientific knowledge is best served through the free, open and online distribution of high quality peer-reviewed research, and supports recent efforts that have sought to ensure that publicly-funded research is freely available and without restriction. Managing the transition to open access publishing will be complicated, as existing publication arrangements are the product of many models, developed in many countries over many years. In transitioning to different models of publishing, it is vital that high quality peer review and the ongoing publication of scientific knowledge should not be impeded.

The Academy believes that despite the many challenges that need to be overcome, the benefits of research being made freely available are considerable and worth pursuing. The transition to an open access publishing environment will require government, funding councils, research councils, learned societies, universities, researchers, librarians and publishers to work together to develop a sustainable, transparent, cost-effective and high quality open access publishing environment.

The Academy strongly supports efforts that promote the free and fair dissemination of publicly-funded research outputs to the broader community, and is encouraged by the efforts of the ARC and NHMRC in this area.

3.4 Increasing industry relevant research training

3.4.1 Discussion paper proposal—Take steps to ensure that the research workforce is equipped to work with industry and bring their ideas to market

The discussion paper notes that, compared to other OECD countries, Australia employs a greater proportion of its researchers within the higher education sector (60 per cent), and employs a lower proportion within the business sector (31 per cent). While there has been some encouraging growth in the proportion of researchers employed in the business sector, increasing from 25 per cent in 2000 to 31 per cent in 2008, the latest year for which figures are available²¹, further improvement is needed. As already noted, businesses have been increasing their use of the R&D tax incentive since this time. More current data is really required so that policy decisions are not made on data which is now nearly seven years old.

The Academy's Early- and Mid-Career Researcher Forum put forward a number of ideas to make doctoral training more relevant to pursuing opportunities in industry in its recent submission to the Senate Economics References Committee inquiry into the Australia's Innovation System, and these are worth consideration²². Given that most research students will not be engaged in research within the public research system over the long term, it is essential that they gain industry-relevant skills, enabling them to apply their substantial research skills in broader settings. New innovative approaches need to be considered, such as ensuring that doctoral students have the opportunity to gain core competencies valued by industry, and creating more opportunities for doctoral researchers to spend some time in an industry setting. This would both increase the range of skills that doctoral students gain and show potential employers the value of employing doctoral-trained researchers.

The Academy recommends exploring new options for doctoral training and the training of early career researchers to make available more opportunities for doctoral research students to spend some time in an industry setting.

3.5 Measurement of outcomes

3.5.1 Discussion paper proposal—Improving assessment of the research system, including measuring and publishing collaboration and commercialisation outcomes, as well as research outcomes and impact.

Up-to-date data on the research system is essential to help inform important policy decisions and to monitor the progress and impact of policy actions in a timely fashion.

The Academy recommends that up-to-date data be collected and reported on a range of key science system indicators so that the impact of policy measures can be determined in a timely fashion.

There is a high level of collaboration and commercialisation within many of the publicly-funded research agencies. It would be appropriate to include both publicly-funded research agencies, the research institutes and universities in any future measures or assessment of end-user engagement, knowledge transfer or research impact.

²¹ Department of Industry (2013) *Australian Innovation System Report 2013*. Available at: <http://www.industry.gov.au/science/policy/AustralianInnovationSystemReport/AISR2013/index.html>

²² For further details see Early- and Mid-Career Researcher Forum (2014) *Response to the Senate Economics References Committee Inquiry into Australia's Innovation System*. Available at: <https://www.science.org.au/sites/default/files/user-content/emcrforumsenateinquiryintoaustraliasinnovationsystem.pdf>

The Academy notes that the Government has made a commitment to reduce red tape and the burden of reporting, and any future exercise to measure knowledge transfer and impact should make use of existing data (or replace existing data collections) rather than lead to the development of new reporting requirements.

The Academy recommends that any assessment of the research system, including measuring and publishing collaboration and commercialisation outcomes, should apply to all publicly funded research agencies, research institutes and universities. These measures must include an element that recognises both research for the public good and capacity building.

Measures of collaboration and commercialisation outcomes within the research system need to be given careful thought; particularly so if they are used to drive future resource allocations within the research system. Any measures of collaboration should be current (not too retrospective) so they represent current and future activity rather than historical activity.

Care has to be taken to avoid ‘perverse incentives’ being introduced into the funding system. As the discussion paper notes, universities are very sensitive and quick to respond to changes in funding mechanisms and care has to be taken to prevent ‘gaming of the system’.

The purpose of the exercise is to provide incentives to increase collaboration and maximise potential commercial outcomes, but there is no mention within the discussion paper as to *what type of collaboration and commercialisation outcomes* are desirable. There must be a clear focus on what is the intended outcome to ensure that any mechanisms that are introduced to moderate behaviour will achieve that outcome. There is always a risk that universities will be overly incentivised to pursue what could be seen as publicly-subsidised routine contract research or routine consultancy activities, rather than value-added industry collaboration.

The Academy recommends that care be taken when developing and using measures of research commercialisation and collaboration to avoid creating perverse incentives that could have unfortunate unintended consequences. The focus must be on encouraging added value from commercialisation and collaboration opportunities, rather than pursuing routine (contract) research and consultancy activities which are best delivered by the private sector.

3.6 Capitalising on the Medical Research Future Fund

The Academy welcomes the Government’s intention to establish a Medical Research Future Fund (MRFF), and would like to see such leadership being extended to other areas of science. The MRFF has the clear advantage of being a perpetual and sustainable mechanism to support medical research. At this stage there are very few details available as to how the fund would operate. Given the scale and potential size of this investment it would be prudent to undertake a separate consultation process to explore the best ways to make use of this investment.

The Academy recommends that a separate consultation process is needed to explore how the Medical Research Future Fund will operate and fund research.

4 Response to other areas of the discussion paper

4.1 Recognising the importance of public good research

The discussion paper is heavily focused on increasing the *commercial* outcomes from publicly-funded research. It must be recognised that a commercial outcome (particularly with a short-term focus) is not always an appropriate outcome. There are large areas of research that contribute to addressing the most significant and pressing problems facing the nation, and when applied they

deliver substantial economic, social and environmental benefits. For example, there are many areas of public health research that can successfully reduce the impact of disease on the health system, but this is research without a commercialisation outcome. Care must be taken when encouraging a focus on commercialisation outcomes, not discourage the translation of research into important public good outcomes²³. There must be a healthy balance between industry-focused commercially-driven research and other important areas of research.

The Academy recommends that public good outcomes from research be recognised within any assessment of the outcomes of publicly-funded research. Furthermore, end-user engagement should be encouraged across all sectors so that research can be utilised by different end users to improve both public-good and commercialisation outcomes.

4.2 Science strategy and national research priorities

The Academy supports the development of strategic research priorities that will help focus Australia's research efforts on those areas of strategic benefit.

4.3 Blue sky research

Without the very best and brightest people pursuing basic research the development of commercially-useful applied research will stagnate, and so it is critical to ensure that Australia invests enough in basic research. Over the last 20 years, the proportion of Australia's research effort has systematically shifted away from basic research and towards applied research²⁴. In 1992 pure basic research accounted for about 40 per cent of Australia's research effort, and applied research 30 per cent, but by 2012 pure basic research accounted for 20 per cent of Australia's research effort, and applied research 45 per cent. It is worth considering whether this shift from pure basic to applied research has best served Australia in terms of both research output and commercial outcomes. While it can be tempting to try and drive 'outcomes' from research by increasing the focus on applied research, it is important to realise that commercial outcomes from research can only come from a very solid foundation of basic research. So many of Australia's most successful research commercialisation developments have their origins in blue sky curiosity-driven research undertaken in Australia, such as the gardasil vaccine, *helicobacter pylori*²⁵, resistance to influenza infection (Relenza) and contributions to wifi communication in handheld devices. It is imperative that adequate investment continues to be made in basic research so that Australia continues to have a sufficient body of knowledge in the innovation pipeline from which to draw.

The Academy supports continued strong investment in pure basic research so that Australia has a solid foundation for future research commercialisation developments.

4.4 Positive business environment for start-up companies

Australia needs to have a favourable environment for start-up companies so that investors, entrepreneurs and scientists are encouraged to commercialise research in Australia, rather than take their ideas, skills and investment overseas. For many technology start-up companies in the United States it is common to offer employees (or contractors) share options rather than money so that

²³ Whilst many parts of the discussion paper refer to 'commercialisation' and 'industry', the paper does mention 'end-user engagement'. The contrast in terminology is notable between page 15 and 22 of the discussion paper, and also extends to whether the proposed measures refer to engagement with industry, or producing research outputs of relevance to industry, two quite different motivations.

²⁴ Australian Bureau of Statistics (2012) *8111.0 - Research and Experimental Development, Higher Education Organisations, Australia, 2012*. Available at: <http://www.abs.gov.au/ausstats/abs@.nsf/mf/8111.0/>

²⁵ Group of Eight (2014) *Policy note: the importance of basic research*. Available at: https://go8.edu.au/sites/default/files/docs/publications/the_importance_of_basic_research- final.pdf

cash available within the start-up can be carefully targeted towards innovation activities, and growing the business. Such an approach is not common in Australia, and it would be worthwhile investigating whether the treatment of share options within the tax system is causing difficulties. The aim should be to break down barriers to transitioning good ideas from the laboratory to industry, and to encourage calculated risk taking, recognising that failure is part of the pathway to accumulation of experience and future success.

The Academy suggests consideration should be given to ensuring that the business environment in which start-up companies operate in the science, research and innovation sphere is competitive compared to other developed nations, and nations within our region. This should include ensuring that Australia has the right level of tax incentives, tax treatment of share options, and direct assistance to encourage angel investors and venture capitalists.