South Australian Productivity Commission

Final Report

Turning Research into Economic Competitiveness for South Australia

12 May 2023

Government of South Australia

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South Australian Productivity Commission
GPO Box 2343
Adelaide South Australia 5001
AUSTRALIA

Telephone: 08 8226 7828
Email: sapc@sa.gov.au
Website: www.sapc.sa.gov.au

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SAPC South Australian Productivity Commission
Government of South Australia

Wakefield House
Level 15, 30 Wakefield Street
Adelaide SA 5000

GPO Box 2343
Adelaide SA 5001

T: 08 8226 7828
E: sapc@sa.gov.au
W: www.sapc.sa.gov.au

DX56201
ABN 94 500 415 644

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12 May 2023

The Hon Peter Malinauskas MP
Premier of South Australia
State Administration Centre
200 Victoria Square
ADELAIDE SA 5000

Dear Premier

SAPC Inquiry into "Turning Research into Economic Competitiveness for South Australia"

In accordance with the terms of reference received by the Commission on 13 December 2022, I am now pleased to submit the South Australian Productivity Commission's Final Report on our inquiry into "Turning Research into Economic Competitiveness for South Australia".

The Commission's central purpose is to provide you with independent evidence based advice on how to improve our State's economic growth and in turn, South Australian household incomes.

The key conclusions of our report are as follows:

- notwithstanding nearly 40 years of State Government activist innovation policies, our State remains less innovative than the national average;
- this is economically significant for South Australian households. It explains why our wages remain materially lower than the national average;
- our State Government innovation policies need to change focus;
- that focus should for now be on South Australian Universities and their potential to shift South Australia to become an innovation state;
- more specifically, we recommend your Government pursue well-crafted and carefully implemented long-term reforms designed to support our Universities on their journey to becoming entrepreneurial universities that value their economic and social impacts on the state just as much as they value their excellent teaching and high-quality, internationally connected, research.

We believe our 48 findings and 17 recommendations are a framework for this important economic reform that will likely, over the long-term, increase the incomes of South Australian households and provide us all with more stimulating and interesting lives.

I take this opportunity to thank my colleagues, Christopher Findlay and Steve Whetton, and Steve's inquiry team, for their high-quality assistance on this assignment.

Yours faithfully

Adrian Tembel
CHAIRMAN

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Inquiry team

Commissioners

Mr Adrian Tembel, Chairman, South Australian Productivity Commission, and Presiding Commissioner for the Inquiry

Professor Christopher Findlay, Commissioner, South Australian Productivity Commission

Inquiry lead

Mr Steve Whetton, Chief Executive, Office of the South Australian Productivity Commission

Inquiry team

Dr Philip Chang, Director

Mr Mark Bode, Principal Analyst

Mr Paul Bryder, Senior Analyst

Mr Adam Marafioti, Principal Analyst

Mr Tyson Miller, Principal Analyst

Ms Simone Vanzati, Office Manager

Key messages

Our vision for the future

A South Australian looking back from 2050 may see the targeted investments that transformed the state's innovation capability as the starting point for a renaissance in the state.

In this South Australia of 2050, South Australians successfully captured the opportunities that arose from the green energy transition and the substantial expansion of the defence sector.

There are many more high-skill innovation jobs available in the state, and many more talented young South Australians are choosing to stay and build their lives and careers here. The effects of these high-skill, high pay jobs are felt across the state's economy, and wages have been boosted across industries and occupations, with South Australians no longer being paid less than residents of New South Wales and Victoria.

More of the state's businesses are engaged in transformative innovation and are high-growth firms, and the state's research institutions and industry are creating an increasing number of entrepreneurial, innovative, start-ups to create value from emerging technologies.

This transformation was driven by a preceding transformation of the state's universities, into entrepreneurial universities that value their economic and social impacts on the state just as much as they value their excellent teaching and high-quality, internationally connected, research.

Commercialisation of knowledge and inventions developed in the universities is seamless, and it is now commonplace for researchers to work freely across academia and industry, with academics jointly appointed into firms, and industry researchers jointly developing technologies in university facilities.

Applied research institutes focused on locally relevant critical technologies have built the capacity of local industry in using the emerging technologies and draw industry problems into the universities to be solved through co-designed, jointly implemented, research.

This inquiry's aim is to help realise this vision by identifying how to deliver more high-growth innovative firms, and more South Australians in highly skilled, highly paid jobs by reforming the way universities engage with the broader South Australian economy.

The case for change

South Australia's economy has been underperforming over the past three decades, with slower growth and lower wages than our peers in the eastern states.

South Australia's economy is currently performing strongly coming out of COVID-19, but the current strength appears to be cyclical not the start of an upwards structural trend. The longer-term picture is of a state stuck in a low growth trajectory, falling behind the eastern states in incomes. In 2021-22 economic output per person was just under $15,000 below the national average.

Annual average growth in GSP over the past three decades has been 2.1 per cent. And our long-term structural growth trend is not positive with the 2010s being the worst decade with growth averaging only 1.0 per cent.

Finding 1: Economic growth well below the national average over the past three decades has had a material impact on the incomes of South Australian households. The recent strong growth following the COVID disruptions appears to be cyclical.

This prolonged period of weak economic growth impacts on people's daily lives. Wages have declined relative to the rest of the country, with both private and public sector wages 8 per cent below the national average.

The South Australian economy shows little evidence of being high complexity. Exports are almost all in commodities and basic metals, while higher value-added exports are low and falling in real terms.

As well as being low growth, the South Australian economy shows little evidence of being internationally competitive outside of commodities. Exports are almost all in commodities and basic metals.

High value-added, complex, goods and services exports have actually fallen by over $1 billion in real terms over the last decade, and are $2.6 billion below their peak in 2018-19. This is despite the relevant sectors having been a significant focus of South Australian Government innovation and trade policy support.

Even if education and other travel are excluded to allow for the impacts of COVID, and beverages are excluded because of the impact of Chinese tariffs on the state's wine sector, complex exports are still down over $200 million over the decade (and down $850 million from the peak in 2017-18).

Finding 2: Businesses in high value-added export sectors are becoming less internationally competitive.

South Australia's recent productivity performance is weak

South Australian productivity has not grown at all in net terms over the past two decades.

Internationally, technological progress has been the main driver of productivity growth over the long term, and South Australia will not see sustained growth in productivity and incomes unless we can grow through technology and innovation.

Unfortunately, South Australian multi-factor productivity growth has been weak, with no net growth over the past twenty years.

Finding 3: South Australia's productivity growth has been poor over the past two decades, and this is an important factor in the weak economic growth over the same period.

Doing a better job of keeping pace with the global growth in technology would significantly increase average incomes in South Australia

If, over the last two decades, South Australia's innovation system had kept pace with the long-run average global growth of technology and knowledge GSP per person could have grown 1 percentage point faster per year over the last two decades (2000-01 to 2019-20). If this had happened, South Australia's GSP per person would be comparable to that of New South Wales's GSP per person in 2020, that is, about $13,500 higher than SA's actual level in 2020.

Wages broadly track economic output per person and productivity, so if South Australia *had* been able to achieve this sustained growth in productivity, then wages could also be expected to match those seen in New South Wales. For the average South Australian full-time worker this would mean earning $8,000 more per year than they actually did in 2020.

Finding 4: If South Australia's rate of innovation had been at the long-run US average over the past two decades, our output per person today would have been in line with New South Wales.

Knowledge and technology are turned into economically valuable innovation and growth primarily in the firm, and innovation policy should be focused on increasing the extent of business innovation.

However, most South Australian firms are small and targeted at specific local market niches. For these firms, innovation policy will generally not be relevant to their business's prospects.

South Australian businesses are generally very small…

64 per cent of South Australian businesses were non-employing businesses (e.g. sole traders) and a further 24 per cent employed one to four people.

A small proportion of firms are 'high-growth' firms and they account for a disproportionate share of net jobs growth and of innovation.

The potential drivers of transformative innovation are not all new entrants, or all small firms, but rather those firms with the potential to become high-growth firms. 'High growth' firms, despite only making up a relatively small share of firms**,** account for a disproportionate share of net jobs growth and of innovation. These firms should be the target (and objective) of policies aimed at driving economic outcomes from innovation.

Finding 5: Most net jobs growth, and most job creating innovation in Australia occurs in high-growth firms.

This means that enabling high-growth firms, and firms that have the potential to be high-growth firms, needs to be at the centre of any policy focused on using business innovation to increase economic competitiveness and growth.

Finding 6: Policy aimed at stimulating economic growth through encouraging business innovation should be targeted at enabling current and potential high-growth firms.

Unfortunately, South Australian firms are much less likely to be high-growth. This is true across industry sectors and so is driven by South Australian business dynamism

Analysis of firm level data by the Department for Industry, Innovation and Science shows that South Australian firms are significantly less likely to be high-growth firms than the national average, and this underperformance was consistent from 2002 to 2016. Related up to date data on relative economic performance suggests that this problem remains today.

Finding 7: South Australian businesses are less than half as likely to be 'high-growth firms' than the national average.

This underperformance relative to the national average doesn't (at least primarily) reflect differences in industry structure, with South Australian firms being less likely to be high-growth in each of the 19 included industry sectors had significant under performance relative to the national average.

Finding 8: South Australia's low rate of high-growth firms is not primarily a result of the state's industry structure, but is evident in every industry sector.

South Australia's business sector is smaller, less dynamic and South Australian firms are less likely to be high-growth than businesses in the eastern states.

South Australian firms are less dynamic that those in other states, with lower rates of business entry and exit. These results are suggestive of a lack of entrepreneurial dynamism within South Australia.

This is not to dismiss the achievements of the many entrepreneurial and innovative firms in South Australia. There are a number of firms doing world class innovative things here and creating high

quality jobs and wealth. But even to reach the national average we would need to have nearly twice as many high-growth firms as we do, and it is this shortfall in the number of high-growth entrepreneurial firms that means that on average our business sector is less dynamic that those in other states.

Finding 9: South Australia's business sector is much less dynamic than the national average. This reduces the scope for business innovation amongst the current SA business community compared with businesses in the eastern States.

South Australian firms also invest much less in the drivers of innovation

South Australian firms invest much less in the drivers of innovation than their peers interstate, with both investment in Research and Development (R&D) per person, and patenting rates well below the Australian average.

Finding 10: South Australian firms invest less than the national average in R&D and this gap has been widening. They are also less likely to patent innovations.

South Australian firms tend to be 'inward looking' in their innovation, with a particularly low likelihood to draw on universities as a source of ideas.

South Australian firms are outliers in several aspects of their innovation activities, in particular they:

- make relatively small use of government support
- are less likely to seek additional funds for innovation
- use a narrower source of funds for innovation
- are more likely to focus on one project at a time and have less activity in the innovation pipeline
- put more weight on lack of access to skills and on 'uncertain demand' as barriers to innovation
- make far less use of universities as a source of ideas – only 3 per cent of innovating firms in SA identify universities as a source of ideas for innovation;
- tend to source innovation ideas from within their own business or business group, and are much less likely to drawn on external sources of innovation ideas;
- undertake far less joint R&D with collaborators and focus more on sharing facilities or undertaking joint marketing.

Finding 11: South Australian businesses are very inward looking in their innovation, with significantly fewer South Australian innovation active firms drawing on universities as a source of ideas for innovation compared to businesses interstate.

Finding 12: South Australia's business sector is not in a position to be the main driver of innovation or of the research business connection at this stage.

South Australia's research workforce

South Australia has significantly fewer workers in innovation jobs

The number of people in a region with innovation relevant skills, and particularly the number of people in innovation jobs, can act as both an indicator of the level of current innovation activity in the region, and as a measure of the region's capacity to innovate.

The relative share of employees with innovation skills working in an industry, or the relative share of national employees working in an innovation occupation in the state can highlight areas of strength and weakness in the state's innovation system.

But skills are not just an indicator of current success, they also determine the extent to which firms (and industries) can draw innovation from other contexts into their firms, and develop novel innovations internally.

South Australian workers are just as likely to have a PhD as workers for Australia as a whole with 1.3 per cent of employed people in South Australia having a doctoral degree as their highest level of educational attainment.

But employment of people with a Masters degree is a different story. The share of the SA workforce with a Masters degree is well below the national average, and this is true for almost all industry sectors.

Finding 13: South Australian workers are less likely than average to have a post-graduate qualification, largely due to very low levels of South Australian workers with Masters degrees.

Postgraduate degree completions are in line with the national average.

Supply factors within the state do not appear to explain the disproportionately low levels of South Australian workers with postgraduate qualifications. Total postgraduate completions for domestic students at South Australian universities have been at or above our population share for some time.

Finding 14: The lower share of employees with postgraduate qualifications is not because fewer South Australians undertake postgraduate qualifications, instead it appears to be a lack of local employment opportunities.

There are however significant differences by field of education with significantly fewer South Australians (both in 2016 and in 2021) completing postgraduate degrees in Information Technology; Agriculture Environmental and Related Studies; Society and Culture; Engineering and Related Technologies; and Natural and Physical Sciences.

Finding 15: South Australian universities produce significantly fewer postgraduates in Information Technology; Agriculture Environmental and Related Studies; Society and Culture; Engineering and Related Technologies; and Natural and Physical Sciences than the national average.

Significantly fewer South Australians are employed in 'innovation' jobs.

South Australia was home to only 5.8 per cent of Australia's science and innovation workforce in 2021, well below the state's share of all employed persons (7.0 per cent). As a result, the capacity of the state to produce and implement new ideas, and to capture existing ideas and technology from the rest of the world, is diminished.

South Australia's deficit in the innovation workforce is relatively substantial. If we were even able to reach the national average, there would be 7,000 more South Australians employed as scientists, computer programmers, and engineers today.

If we were to achieve the concentration of workers in innovation occupations seen in NSW or Victoria there would be 10,000 more South Australians employed in these occupations.

Finding 16: South Australia has significantly fewer people employed in innovation jobs than the national average, indicating a lower level of innovation compared to other states, and a lower capacity to generate and implement innovations.

South Australia's workforce data confirms the state has innovation strengths in wine, agribusiness and defence. But it also highlights weaknesses in our innovation capacity in ICT (including cybersecurity), civil engineering and mathematics.

South Australia has innovation workforce strengths in the areas of agriculture, food, agribusiness, and electronics, with employment shares well above the state's population share.

On the other hand, the occupational profile reveals some areas where South Australia has a notable gap in workforce capacity. In particular, information and communications technology (ICT), software programming cyber security, civil engineers, and telecommunications engineers are poorly represented within South Australia's workforce.

Finding 17: South Australia has a strong workforce in key innovation occupations linked to the wine sector, agribusiness and defence, suggesting that those sectors are competitive nationally in innovation. But the state has significantly fewer people employed in innovation jobs in key occupations such as cyber security, software programming, and civil engineering suggesting important gaps in innovation capacity.

International students provide an underutilised pool of potential entrepreneurial ideas and skills for South Australia. As a state we should be doing all we can to support them in commercialising their ideas here in South Australia. However, we have heard that processing delays, and a limited number of positions available to South Australia, have significantly reduced the scope for this visa to be used to retain international students and attract inward migrants with plans to develop start-ups in areas of state government priority.

Global entrepreneurial talent, particularly people who have already built relationships with the state through studying here is an important potential source of the people who can drive the economic transformation of the state. However, at present a small allocation of 188E visa places for the state, processing delays, and barriers to international students accessing entrepreneur visas and other skilled visas with a pathway to permanent residence mean that this channel is not fulfilling its potential.

Finding 18: Difficulties in accessing visas with a pathway to permanent residence for entrepreneurs, and current international students, mean that migration is not fulfilling its potential role in supporting innovation in SA.

How to improve the connection between universities and the broader South Australian economy

Innovation within firms does not take place in a vacuum. The extent to which a firm can successfully innovate is significantly influenced by internal factors such as its financial resources, the level of competition in its industry sector, and the quality of its management and workforce. However, the potential to innovate is also affected by the range of external factors such as access to business services, the scale and quality of the local innovation workforce, local leadership and governance, access to finance, the amount of relevant research taking place in local institutions, and how easy it is for firms to connect to that research and knowledge.

Looking at the South Australian innovation system, some elements appear to be in good shape. Quality of governance and physical infrastructure are good, and business services are readily available (both in SA and from providers located interstate). The majority of feedback we have received is that venture capital funding is readily available to South Australian start-ups and scale-ups with a clear market opportunity, although a number of stakeholders identified gaps in the availability of seed funding.

The Commission's assessment is that there are currently gaps in some other key elements of South Australia's innovation ecosystem, including a lack of innovation leadership, less developed innovation networks (particularly between research institutions and business), and below average rates of R&D and new firm formation.

Finding 19: South Australia has gaps in its innovation system around innovation leadership, innovation networks, R&D and new firm formation.

Finding 20: Based on the evidence, the South Australian economy is materially less innovative than the national average. This is a significant structural economic weakness.

Government innovation policy

South Australian Government innovation and trade policy shows no evidence of overall effectiveness, and appear to be spread too thin

The supports currently offered by the South Australian Government can be broadly characterised as having significant breadth, but as a consequence many of the individual interventions have relatively limited resources allocated to them. This can also make the funding system harder to navigate for businesses or researchers seeking support.

Finding 21: South Australia has a large number of innovation programs, but most are small and have limited funding. This makes them harder for business to navigate, and reduces their impact.

The persistent weakness of business innovation in South Australia suggests that the current set of policies as a whole, including innovation precincts, have not been effective in achieving their objectives.

Finding 22 South Australian innovation programs in aggregate show no evidence to date that they have achieved their objectives.

These policies could usefully be consolidated both to make it easier for SA businesses to identify support available, and also to free up resources for higher priority activities. In the Commission's assessment, half of the current funding for innovation grants could be reallocated to support the recommendations of this inquiry

In considering where to potentially redirect funds from, any existing programs that deliver similar support to Commonwealth Government programs (such as many of the direct grants to business for export facilitation or innovation investment), operational funding (rather than outcome based, or competitive, funding) for independent research institutes, and programs where the spend is very small all warrant a thorough examination to ensure they are productive for the state and are delivering value for money.

South Australian Government assertion of rights to Intellectual Property (IP) arising from work funded through grants impedes commercialisation without any meaningful benefit to the government.

Consultations with universities and entrepreneurs on barriers to commercialisation of university generated IP have identified a potential blocking role of South Australian Government research grant agreement terms and conditions. Although it is by no means universal, stakeholders have identified a number of cases where grant agreements issued by the South Australian Government asserted the right to IP arising from the funded activity. This has made commercialisation of IP built on this initial South Australian Government funding much more difficult as potential investors or licensees require clear ownership by the university of any IP being commercialised. As the South

Australian Government role in innovation is not revenue generation, but broader economic and industrial benefits for the state, we see no rationale for the use of such clauses.

Finding 23: South Australian Government assertion of rights to IP in current or past research grant agreements is a barrier to the efficient commercialisation of research.

Australian Government investment in innovation policies is significant, with spending in 2022-23 expected to be over $12 billion including overs $3 billion dollars in direct support for business innovation through the R&D tax credits. With the implementation of the National Reconstruction Fund the support of business innovation will increase further.

Finding 24: Australian Government programs deliver substantial financial support to business innovation, and this support will become even more significant once the national reconstruction fund begins disbursing resources.

The role of research institutions in business innovation

Universities are potentially instrumental in supporting South Australia's transition towards a sustainable and productive economic future. By engaging with businesses, particularly small and medium enterprises (SMEs), universities can stimulate innovation, cultivate a dynamic workforce with future-ready skills, and promote regional economic growth. Academic start-ups and scale-ups significantly contribute to this process by generating new opportunities, enhancing regional competitiveness, and enabling knowledge transfer between academia and industry.

The concentration of research talent in research institutions including the universities, is a key asset for the state, with these skills being essential for the development of innovations and their translation into new contexts. However, the effectiveness with which universities connect to their local economy determines whether their research talent can deliver on its potential.

Approaches to management of IP; allocation of time to applied, business-focused research; and factors taken into account when considering academic staff for promotions can all affect the impact of universities on local business innovation.

Equally, universities that are located in a region with an innovation-active business community are more likely to find potential partners with sufficient absorptive capacity and have a greater economic impact as a result.

Talent is the key to university business collaboration and to innovation more generally

People, and their ability to transmit tacit knowledge, are the source of research spillovers generally, and the impact of research institutions in particular. This means that any set of policies aimed at strengthening the research business relationship around innovation needs to be primarily focused on talent: how it can be grown, how it can be fostered, how it can be attracted and how it can be retained.

Some of this is the traditional movement of graduates and post-graduates out into businesses. But less traditional movements can be incredibly effective, e.g. academics temporarily working in firms and industry researchers working in universities. It is important that university human resources (HR) and intellectual property policies facilitate these types of interaction.

> *To get more successful at research commercialisation, Australia needs to go beyond what we call 'bench-to-bookshelf' science.*
>
> *We need to take the next steps after doing great research at the lab bench and publishing it in top global journals.*
>
> *To do that, we need to train a much bigger community of 'bench-to-boardroom' scientists.*

Scientists who can take exciting lab bench discoveries into startups, industry partnerships and to venture capital investors.[1]

Finding 25: Innovation at its heart is about talented people, and talented people need to be the focus of future South Australian Government innovation policy.

Proximity between universities and potential business partners is important, but in this context proximity does not mean co-location, but rather being conveniently located, being in the same labour market, holding similar values and understandings, and facing similar incentives.

There is good evidence that proximity is a material factor in enabling university business links. Despite the increasing use of digital technologies to meet collaborators and colleagues across the world, there are still strong geographic patterns to the locations of industry and to university business collaborations.

But importantly, proximity here doesn't mean being located in the same building or even the same city block. Instead, because spillovers between university research and innovative businesses, and indeed between innovative firms using the same or similar technologies, develop from interactions of talented people, the geography of spillovers largely reflects local commuting patterns, e.g. no more than around 25-30 km apart.

This suggests that narrowly defined innovation districts are unlikely to provide any material additional value, making them a low priority for future State Government investment where budgets are constrained. This is particularly so in a city like Adelaide where a high commercial property vacancy rate means there is a significant stock of vacant space available within walking distance of the CBD campuses of the three universities available to potential research and industry tenants. State Government resources should instead be focused on investments that help build productive connections between university researchers and businesses located in their city.

There are a small number of limited cases where much closer proximity is justified. Access by business to research infrastructure located in universities (such as Flinders University's 'Factory of the Future') is a case where (temporary) co-location to facilitate joint research between a firm and an industry partner using the facility and associated laboratory space can create significant economic value. And research institutions and businesses collaborating with clinical staff will typically need research facilities located close to the relevant hospital as the clinicians need to be able to move between clinical work and research work through the day

Finding 26: Geographical proximity is important to university-business links around innovation, but in this context geographical proximity means being conveniently located, not co-location. Similarity of values, norms and technological understanding is more important, than geographic proximity in enabling successful business industry collaborations.

Finding 27: Given budget constraints, investment in buildings (including precincts) should be a low priority for future State Government innovation spending.

The role of universities in driving innovation is not purely a STEM story.

Most of our economy is services, and much of the innovation they need will draw on social sciences and humanities. Equally, the important skills for commercialisation are not just technical but also entrepreneurial. Building entrepreneurial education and experiences into the post-graduate (and possibly undergraduate) curriculum across university faculties and making such education available

[1] Professor Mark Hutchinson, President, Science and Technology Australia, National Press Club Address, March 2022, transcript available at: https://scienceandtechnologyaustralia.org.au/mark-hutchinson-npc-address/

to those academics who are interested, is likely to be an important enabler of university business collaboration.

Finding 28: Successful commercialisation of research does not only depend on great science or engineering; it also needs a range of non-STEM skills.

Incentives and structures developed to support research business connections need to be aligned to the objectives of policy, and the impact on incentives needs to be carefully considered.

Finding 29: Alignment of incentives between researchers and businesses is an important element of facilitating effective connections for innovation.

Use of intermediaries between universities and business is almost universal, but there are substantial variations in the types of intermediaries used

All advanced innovation ecosystems have one or more sets of intermediaries between research institutions and potential end-users of research, but these can take a number of forms and have a range of focuses.

For South Australia, given its business sector, intermediation functions targeted at research production, and organisation and system development and capacity building are likely to be most immediately useful. Potentially relevant models include the Fraunhofer Gesellschaft, the UK Catapult network internationally, and AIML and the Factory of the Future in South Australia. Many of the other intermediation approaches are structured to build on a base of engaged business users of innovation.

Finding 30: Intermediation between research and business in South Australia will be more successful if it is undertaken through jointly designed and implemented research projects.

South Australian research institutions

South Australia's three research universities – Flinders University, the University of Adelaide, and the University of South Australia – are the state's most significant research institutions. Between them they host 66,383 undergraduate students, 25,620 post-graduate students and employ 3,930 academic staff. [2]

These research staff, and the undergraduate and post-graduate students being educated at the universities, represent an important asset for the state's innovation performance. Student placements in particular are often an important first connection between universities and local businesses, and this can act as a seed for other forms of collaboration such as research.

As well as representing a future (and in some cases current) asset for the state, students can be an important link between universities and the business community particularly where the course involves and industry placement. All three universities have put significant effort into designing and implementing models of student placements.

Finding 31: Student placements play an important role in establishing and strengthening university-business connections.

South Australian universities are heavily reliant on student revenue for their financial sustainability, and the current Australian research funding model reduces the extent to which they can invest in long-term research capabilities.

[2] In addition to its research universities, South Australia also has a number of substantial public research institutions. Some of these such as SAHMRI are South Australian specific, some are local nodes of national bodies. In most cases through the report the use of the word universities should be taken to also encompass these public research institutes.

Finding 32: The revenue of South Australia's universities, and therefore the incentives that they face, is largely driven by student income.

Finding 33: South Australian universities have performed well in securing research funding over the past two years, partially reversing a long-term decline in share of national funding. The national cooperative research program, and funding from rural research and development corporations are areas of strength.

South Australian universities perform poorly in schemes targeted at the highest performing researchers, and early career researchers.

South Australia appears to be performing particularly poorly in schemes targeted at the highest performing researchers. In the last five years South Australia only secured two of the 80 Laureate Fellowships awarded (2.5 per cent of the national total).

South Australian institutions have also significantly underperformed in schemes supporting early career researchers. This creates potential barriers to sustaining areas of local excellence, and in providing opportunities for early career researchers to remain in the state and contribute to it.

Finding 34: South Australian universities have underperformed in grants targeted at the highest performing researchers, and those supporting early career researchers.

Each of South Australia's universities has areas of world class research strength. And a number of these strengths map well to key economic priorities for the state such as the green energy transition, and the defence sector.

Finding 35: South Australia has a number of areas of current world class research strength. And a number of these strengths map well to key economic priorities for the state such as the green energy transition, and the defence sector.

Business survey data and bibliometric analysis indicate that collaborations between South Australia businesses and the state's universities are low.

Commercialisation outcomes are also below the state's population share. Stakeholder feedback to the Commission through this inquiry reported that it can be very difficult identifying the appropriate contact at universities, that university engagement is often skewed towards large firms, and that reaching IP agreements are extremely time consuming and bureaucratic.

Finding 36: Rates of commercialisation of university IP at South Australian universities lag the national average.

CRC funding and contract research revenue paints a more positive picture of South Australian university engagement with business.

The university side of university-business connections should be the focus for South Australian Government innovation policy

The available data on the current scale of innovation activity in South Australian firms, and the below average share of high-growth firms in the state's private sector and the low share of innovation workers in the state outside of wine, agribusiness and defence leads the Commission to conclude that at this point in time the business sector is not the best place on which to focus state government policy effort. South Australia also lacks large national firms headquartered here which in many jurisdictions act as the main driver of the local innovation system.

Universities have several potential advantages that suggest they are a useful place for South Australian Government innovation policy to focus at this time, including a large number of innovation

workers employed directly in the sector, a small number of organisations that would need to be influenced making the process more efficient, and a number of concentrations of world-class research capability that can be built on. As organisations established through South Australian Acts, and because of their receipt of substantial funding from South Australian taxpayers (directly and indirectly via Australian Government grant programs), there is also a legitimate role for the South Australian Government to engage with the universities around their South Australian economic and social impacts.

Finding 37: Of all the mainland states, given its characteristics and structure, our universities are more important to the South Australian innovation system, meaning that South Australian Government innovation policy should, for the next few years at least, be focused on developing the university side of the university industry connection.

During consultations on the Commission's draft report stakeholder feedback was split on the Commission's proposed focus of policy on the university elements of the university-business connection. Some stakeholders strongly supported this focus, and the emphasis on better supporting and resourcing the universities' connections to the South Australian economy and society. Other stakeholders advocated for either a matching set of policies on the industry side of the relationship, or for the emphasis to be on business supports. We have considered the range of feedback carefully in finalising this inquiry. The Commission's judgement is that at this time, given our circumstances and historical innovation policy efforts, that the focus of South Australian Government innovation policy should be on the universities for the following reasons:

1) Putting the current focus of South Australian Government policy on the universities does not mean that businesses seeking to innovate would be left without support. There are well funded and diverse supports available for innovation in the firm funded by the Australian Government.
2) It is not possible to focus on both university and business elements of their connection, so if the South Australian Government were to focus on business support that would mean not focusing on universities.
3) Our recommendation to focus the South Australian Government's efforts on the university is not suggesting that industry elements of the connection should never be the focus. Instead, our judgment is that at this point in time there are not enough innovative entrepreneurial firms in SA for the industry side of the relationship to be its main driver. It is our expectation that the initial focus on universities would create 'market making' to help develop the absorptive capacity of SA firms, creating more effective partners for universities in the future.
4) South Australian Government innovation policies have had a firm level focus for the last forty years, and – despite individual successes – progress has not been sufficient overall to revitalise the South Australian economy's innovation capability. This leads us to the conclusion that a new approach is needed.

Entrepreneurial universities: The third mission for universities

Historically, universities have had two primary responsibilities: teaching and research. These missions have been at the core of higher education, but the rapidly changing world has led to a re-evaluation of universities' roles in society.

In recent years, a third mission for universities in developed economies has emerged, focusing on delivering broader social, economic, and environmental impact beyond their traditional roles in education and research and in particular, local impact. This changed focus reflects a growing awareness that higher education institutions should better align with contemporary society's needs and contribute to innovative and sustainable solutions to national and global challenges. Global exemplars of this approach include Stanford University and MIT in the US, Imperial College in the UK, and the University of Twente and Technical University of Munich in Europe.

Finding 38: Increasingly universities and local governments are shifting their focus to expect universities to become entrepreneurial universities delivering on a Third Mission of localised social, economic, and environmental impacts in addition to their traditional roles of teaching and research.

Entrepreneurial universities are not limited to globally elite universities. The University of Utah demonstrates that a small regional university can transform its role in its local innovation system and in the generation of businesses in its local economy.

With a much smaller funding base than Stanford and MIT, the University of Utah has one of the highest rates of firm-formation in universities in the US. Utah's main missions are to encourage start-ups, educating students, and performing research. The university has also created the structure and incentives to encourage academics to commercialise their research. Furthermore, junior academics are encouraged to be entrepreneurial because it is part of the academic reward structure.

The rate of start-up formation at the University of Utah increased from an average of 3 per year from 1970 to 2005, to an average of 15 per year from 2006 to 2021.

This transformation of the university was enabled by active engagement from the Utah state government to work with the university to develop less bureaucratic systems for technology transfer, to fund more academics, and to fund start-up incubation. Leadership right from the top at the university was also vital.

Finding 39: The University of Utah shows that local governments and universities working with a common purpose of delivering the third mission of the university can transform the impact of the university on its local economy.

Barriers to South Australian universities completing the transition to entrepreneurial universities

The barriers to research industry collaboration at the university side don't exist because universities are not aware of the benefits of industry collaboration, nor do they reflect poor implementation by universities. Instead, the focus of university activity on teaching and on peer-reviewed research are a response to the incentives they have been given, and the resources available to them.

If, as a state, we want universities to sharpen their focus on local industry engagement we will need to change the incentives the universities, their researchers, and their students, face.

Implementing these suggested reforms would not be costless for the universities, and whilst in our judgement they would deliver benefits for the universities, a significant share of the benefits will flow to the state more broadly. This means that it would be reasonable for the universities to be provided with financial support to facilitate the reforms being requested.

Some barriers have already been addressed by the universities, for example stakeholders reported that the contract research model of transferring academic knowledge into industry partners appears to have significantly improved over the past five to ten years, and now appears to be functioning relatively well.

However, consultations with stakeholders have identified several remaining barriers to the state's universities fulfilling their potential as entrepreneurial universities at the heart of the state's innovation. A non-exhaustive list of the types of barriers to university engagement with the South Australian economy that could be usefully addressed include:

- university approaches to spin-outs and licenses of IP are regarded as excessively bureaucratic, and very slow;

- relatively high equity shares South Australian universities require when spinning out IP risk diluting the incentive for on-going participation by inventors and deterring VC investment;
- promotion and recognition processes generally do not function well in rewarding academics for successful industry engagement;
- workload models at universities do not typically reflect the time needed to implement successful industry engagement; and
- too few higher degree students receive entrepreneurial training and/or opportunities as part of their studies.

Finding 40: South Australian universities' processes around commercialising IP, whether through spin-outs or licencing, are regarded as very slow and excessively bureaucratic, and well below world's best practice.

Finding 41: South Australian universities' default equity shares appear to be too high, and adopting a lower standard share could increase rates of scale-up and VC funding for start-ups with university researchers as founders.

Finding 42: The University of South Australia's has implemented an interesting academic employment model which allows academics to choose between research quality and engagement performance indicators.

Finding 43: For academic incentives to truly shift towards giving industry and social engagement equal weight, workload models within universities would also need to be amended so that industry engagement can be sufficiently resourced.

Finding 44: Entrepreneurship education and entrepreneurial opportunities should be routinely provided to postgraduate students. Similar courses should be offered as options to undergraduates across all faculties.

Making Universities the Engine of our Transition to a Dynamic, Complex Economy

Our vision of a transformed, innovative and entrepreneurial South Australian economy, where our people are capturing the opportunities arising from the green energy transition and the substantial expansion of the defence sector requires a fundamental transformation of university business connectivity with South Australia's businesses and economy.

Commercialisation of knowledge and inventions developed in the universities is seamless, and it is now commonplace for researchers to work freely across academia and industry, with academics jointly appointed into firms, and industry researchers jointly developing technologies in university facilities. Applied research institutes focused on locally relevant critical technologies are building the capacity of South Australian industry in using the emerging technologies, and are drawing industry problems into the universities to be solved through co-designed, jointly implemented, research.

This increased connectivity will require a transformation of the state's universities, into entrepreneurial universities, that value their economic and social impacts on South Australia just as much as they value their excellent teaching and high-quality internationally connected research.

The Commission's current inquiry in early 2023 is being undertaken against the backdrop of South Australian Government facilitated discussions about a potential merger between the University of Adelaide and the University of South Australia.

The potential implications to a university merger were not included in the Commission's terms of reference for this inquiry and so the Commission is unable to form a view on the relative merits of a merger.

However, we would note that a merger, if designed and implemented competently, with a clear focus on changing the way in which the new university engages with the SA economy and society, could create a catalyst for broader cultural change in the merged institution making our suggested reforms more likely to succeed. The merger could also potentially create cost savings for example through removing duplications of assets enabling more efficient use of facilities. If any such savings were used to fund applied, industry focused, research in the spirit of our reforms then the potential for the universities to drive improvement in the state's economy would be further enhanced.

Even if a merger does not proceed, by focusing stakeholders on the greater economic role the universities could play in the South Australian economy and society, the process has served a useful purpose.

Finding 45: In the South Australian context, the Government's focus on pursuing the benefits that may arise from a potential university merger is sound economic policy and the process of doing so has the potential to play an important role in transforming South Australia into a high innovation, high wage, state.

Proposed reforms by the South Australian Government

We propose the South Australian Government implement two broad reforms to help support South Australia's universities fully realise their potential as entrepreneurial universities, and to become drivers of the state's business innovation and economic transformation. The key reforms proposed are:

- Make impact on and engagement with the South Australian economy one of the central statutory objectives of our universities by proposing amendments to each of the university Acts;
- Establish a novel University Reform and Growth Fund that would help universities with the costs of implementing the reforms needed to transform them into entrepreneurial universities consistent with the above formal statutory objectives, ensure incentives are better aligned to universities undertaking their 'third mission', and help establish a new model of using world-class South Australian research to build local industry capabilities around critical technologies.
- Our recommendations align with a potential merger that acts as a catalyst for change and which unlocks synergies to be redeployed into helping a potential new university deliver on its third mission to the South Australian economy.

In any situation where reform is being contemplated it is important to weigh up the potential costs and risks of reform with the expected benefit should the reform succeed.

In undertaking this inquiry, the Commission has not just focused on whether there is a problem that could be usefully addressed. It has also carefully weighed up whether potential intervention is likely to deliver benefits that outweigh its financial costs and potential risks.

Undertaking the proposed interventions is not without risk. Universities operate in a complex national and international market for students and talented academics, and if implemented in the wrong way shifting them to a greater focus on their third mission could prove counterproductive.

Finding 46: In the Commission's assessment, the potential economic dividends from higher incomes and better jobs for South Australians mean that supporting universities to undertake reforms to deepen the connections between the local universities and the South Australian economy is justified.

There are several potential risks from the reforms proposed here. However, our proposed intervention includes a number of features aimed at sensibly managing these risks:

Make impact and engagement one of the central statutory objectives of our universities

South Australian universities receive considerable investment from South Australian taxpayers directly and indirectly. It is therefore entirely proper that as part of their broader social license to operate that the South Australian community should be able to expect our universities to deliver economic and social impacts for their home state. It is this context that informs the Commission's recommendation that a focus on delivering the third mission of universities for the benefit of the South Australian people be prescribed in each of the university Acts.

Finding 47: Delivering economic and social impacts on their local communities is an important part of the South Australian universities' social license.

Establish a University Reform and Growth Fund

We recommend that the State Government provide resources to support South Australia's universities on their journey to becoming entrepreneurial universities. To reduce uncertainty in year-to-year support, and to maintain a clear focus on the objectives of any such funding, we recommend that support be delivered through the novel instrument of a specifically established University Reform and Growth Fund.

This fund would provide the resources for South Australian Government interventions supporting South Australian universities on their journey to becoming entrepreneurial universities, including:

- Incentivising and rewarding university reform (which could include university merger costs) by helping to offset the costs of reforms to university structures, policies and practices; and
- supporting the establishment of a new model for building business university connections in critical technology areas.

Funding reallocated from existing South Australian Government innovation programs would be directed through the University Reform and Growth Fund. Should it choose to do so the South Australian Government could allocate additional resource for innovation through the fund.

Management of the University Reform and Growth Fund

Decisions on the release of resources from the fund should sit with Cabinet.

Advice to Cabinet on proposals from the universities should be prepared by a body specifically tasked with undertaking that assessment, with access to a combination of economic skills to assess the potential impact of any proposed reform, policy skills relevant to the operation of universities, and advanced legal and negotiation skills to ensure balanced and sound proposals.

In order to facilitate investments in innovation by universities and businesses, the University Reform and Growth Fund should be established with a ten-year funding commitment.

Finding 48: Stability in government innovation programs facilitates investments in innovation by universities and industry by reducing uncertainty.

Incentivising reforms in universities

The barriers to research industry collaboration at the university side don't exist because universities are not aware of the benefits of industry collaboration, nor do they reflect poor implementation by universities. Instead, the focus of university activity on teaching and on peer-reviewed research are an entirely reasonable response to the incentives they have been given by current funding systems and the available resources.

Implementing the reforms needed to help South Australia's universities deliver on their third mission will require financial support if it is not to impact on the quality of research or teaching. Providing funding to facilitate reform is an important focus of the University Reform and Growth Fund.

Our model for shifting these incentives is the national competition policy introduced by the Keating government in 1993. This was set up to facilitate a number of competition-enhancing national reforms that required changes at the state government level. As most of the potential benefits of the reforms would flow to the national economy the reform process included a set of payments to the states if they implemented the reforms.

Whilst this type of approach has proven very successful in Federal financial relations, we understand that its application to government university relationships is novel.

Each of the individual universities has their own strengths and weaknesses in terms of moving towards the third mission for universities. Therefore there will need to be flexibility around what reforms are implemented at a given point of time to best align the needs of South Australia and each of the universities.

We do, however, have several matters of broad principle which our analysis of other funding schemes suggest will increase the reform fund's prospects for success.

- Funding should be explicitly tied to the implementation of the reforms;
- Administration of the fund should be as seamless as possible; and
- The specific purposes of the funding could be broadly aligned with activities that will help support the universities in delivering their third mission such as addressing the barriers outlined in Section 2.5 of this report.

Critical Technology Applied Research Institutes: a new model for joint research and knowledge sharing with industry

South Australia needs a new model for translating research from universities to industry

Meeting the challenge of translating the knowledge generated in our universities into economic opportunities for the state will require research bodies that are focused on taking knowledge out of the universities into industry, and which are resourced to perform this role.

Organisations such as this can deliver significant benefits for relatively modest investments. For example, the Australian Research Council Centre of Excellence for Nanoscale BioPhotonics headquartered in Adelaide established with an initial Australian Government investment of $23 million has created 16 startups with a combined market capitalisation and market value of $519 million, and has impacts across industry sectors from IVF to meat quality to pain management.

Critical Technology Applied Research Institutes are our proposed model for this role

Allocations from the University Reform and Growth Fund would also be used to establish Critical Technology Applied Research Institutes located within universities (or research institutes). The proposed model is based around applied researchers specifically employed to co-design and deliver research with industry to address industry problems using critical technologies. Selection would be through a competitive process using the processes of the University Reform and Growth Fund.

The purposes of the Critical Technology Applied Research Institutes would be to:

1. Build understanding amongst South Australian industry of the potential of the critical technology;
2. Undertake technology driven research and development support for South Australian firms in translating the critical technology into innovation in their firm, including supporting start-ups and scale-ups; and
3. Providing South Australian employment opportunities for talented early career researchers, where they can not only develop their research skills, but also develop commercial skills and connections.

Summary of Recommendations

Recommendation 1: The South Australian Government should work with the Commonwealth Government to maintain a specific entrepreneurial pathway in the skilled migration system as part of the response to the 2023 Review of the Migration System, particularly for international students, and to improve pathways for international students more generally.

Recommendation 2: The South Australian Government should consolidate its existing broad portfolio of innovation grant and support programs (including export grants) into a much smaller number of more focused programs, using half of the current funding allocation. Funding freed up by this process can be redirected towards the university reform and growth fund (see Recommendation 10).

Recommendation 3: Any new funding allocated to independent research institutes by the South Australian Government should be managed through the University Reform and Growth Fund to deliver economically and socially significant outcomes for the state.

Recommendation 4: All South Australian Government research grant program agreements should assign IP to the research institution being funded.

Recommendation 5: Where previous South Australian Government funding schemes for universities have seen IP in the project vest with the government, that IP should be automatically assigned back to the university on request and free of charge to facilitate commercialisation. (Except in the case where a technology was being developed on behalf of, and for use by, the South Australian Government).

Recommendation 6: South Australia's research universities should be the current focus of South Australian Government innovation policy as they currently represent the greatest concentration of world-class innovation capability in the state.

Recommendation 7: In two years' time, once the recommended sets of activities working on developing the university side of the university business connection have had enough time to begin to be implemented, the South Australian Productivity Commission should be asked to review barriers at the business side of the connection and identify potential complementary policy options.

Recommendation 8: The South Australian Government should work with the state's universities to facilitate, and to help resource, their transition to entrepreneurial universities focused on delivering economic and social impacts as well as high quality education and research.

Recommendation 9: The South Australian Government should propose amendments to the enabling Act of each of the universities to explicitly prioritise a commitment to economic and social impact on South Australia as one of the objects and functions of each of the universities.

Recommendation 10: The South Australian Government should establish a University Reform and Growth Fund to incentivise and directly support economically significant reforms in South Australian universities which could include merger reform.

Recommendation 11: Decisions on release of reform funds should sit with the South Australian Cabinet. Cabinet should be supported in this by a body specifically tasked with providing independent advice on whether the proposed reforms are potentially economically significant and address one or more of the existing barriers to economic impact from the university.

Recommendation 12: The University Reform and Growth Fund should represent a ten-year commitment from the South Australian Government to give universities and industry confidence to build innovation investments around it.

Recommendation 13: One of the objectives of the University Reform and Growth Fund should be to enable South Australian universities to continue their journey to being entrepreneurial universities by providing financial incentives for reforms.

Recommendation 14: The South Australian Government should, over time, as part of the University Reform and Growth Fund, establish Critical Technology Applied Research Institutes, each of which would be tasked with bridging the gap between university research and industry needs around a specific critical technology, or key societal problem. Our expectation is that these would be progressively established over the ten years.

Recommendation 15: Each Critical Technology Applied Research Institute would have a mandate to undertake industry focused applied research in collaboration with industry partners in its technology area, with this joint research being the main way it acts as an intermediary.

Recommendation 16: Selection of the Critical Technology Applied Research Institutes should be through a competitive process, with decisions made using the structures developed for the University Reform and Growth Fund generally.

Recommendation 17: Any Critical Technology Applied Research Institutes established should be funded for a minimum ten-year period. It would be better to fund fewer properly rather than spread the available resources too thin.

About the South Australian Productivity Commission

The Commission's central purpose is to provide the Premier with independent evidence based economic advice on how to improve our State's economic growth and in turn, South Australian household incomes.

Premier and Cabinet Circular, *The South Australian Productivity Commission* (PC046) sets out the objectives and functions of the Commission; how inquiries are referred to the Commission, undertaken and reported on; and how the Commission and public sector agencies work together.

The Commission is supported by the Office of the South Australian Productivity Commission which is an attached office of the Department of the Premier and Cabinet.

Commission's approach

The Commission is required to take a broad perspective in developing advice for the South Australian Government. It must consider the interests of industry, business, consumers and the community, regional South Australia, social-economic implications and ecological sustainability.

The Commission conducts its own independent quantitative and qualitative analysis. It also draws on the experience, evidence and views of all inquiry stakeholders.

The release of this draft report supports interested parties to participate in the inquiry by highlighting the key issues and by raising questions to generate feedback.

It is important to emphasise that the Commission has no predetermined views on the matters covered by the inquiry. This draft report sets out the Commission's initial understanding of the relevant matters. Feedback from stakeholders will assist further analysis and review that will contribute to the development of the final report.

Confidentiality

Transparency is an important part of the Commission's independent process for gathering evidence and other elements of the inquiry process. The Commission will publish the submissions that it receives on its website unless the author clearly indicates that the submission is confidential or the Commission considers the material to be offensive, potentially defamatory, beyond the scope of the inquiry's terms of reference, or an abuse of process.

Disclosure

The Commissioners have declared to the South Australian Government all personal interests that could have a bearing on current and future work. The Commissioners confirm their belief that they have no personal conflicts in regard to this inquiry.

Key dates

13 December 2022
Notice of inquiry

February and March 2023
Initial public consultation

16 March 2023
Draft report published

Draft report public consultation

14 April 2023
Submissions due on draft report

12 May 2023
Final report presented to the Premier

10 August 2023
Final report made public

Adrian Tembel is the Chief Executive Partner of Thomson Geer, a major Australian law firm which represents a broad range of clients throughout Australia.

Thomson Geer has undertaken legal work for each of Flinders University, the University of Adelaide, and the University of South Australia, however Adrian Tembel has not been involved in any of these

instances of advice. No work has been undertaken for any South Australian university whilst the inquiry was being undertaken.

Christopher Findlay is an investor in a trust that provides early stage investment to South Australian start-ups.

More information

For more information on the Commission, including circular PC046, how to communicate with the Commission and details on the Commission's approach to handling confidential material visit our website at www.sapc.sa.gov.au, email to sapc@sa.gov.au or call 08 8226 7828.

Contents

Summary of Findings

Finding 1: Economic growth well below the national average over the past three decades, has had a material impact on the incomes of South Australian households. The recent strong growth following the COVID disruptions appears to be cyclical.

Finding 2: Businesses in high value-added export sectors are becoming less internationally competitive.

Finding 3: South Australia's productivity growth has been poor over the past two decades, and this is an important factor in the weak economic growth over the same period.

Finding 4: If South Australia's rate of innovation had been at the long-run US average over the past two decades, our output per person today would have been in line with New South Wales.

Finding 5: Most net jobs growth, and most job creating innovation in Australia occurs in high-growth firms.

Finding 6: Policy aimed at stimulating economic growth through encouraging business innovation should be targeted at enabling current and potential high-growth firms.

Finding 7: South Australian businesses are less than half as likely to be 'high-growth firms' than the national average.

Finding 8: South Australia's low rate of high-growth firms is not primarily a result of the state's industry structure, but is evident in every industry sector.

Finding 9: South Australia's business sector is much less dynamic than the national average. This reduces the scope for business innovation amongst the current SA business community compared with businesses in the eastern States.

Finding 10: South Australian firms invest less than the national average in R&D and this gap has been widening. They are also less likely to patent innovations.

Finding 11: South Australian businesses are very inward looking in their innovation, with significantly fewer South Australian innovation active firms drawing on universities as a source of ideas for innovation compared to businesses interstate.

Finding 12: South Australia's business sector is not in a position to be the main driver of innovation and of the research business connection at this stage.

Finding 13: South Australian workers are less likely than average to have a post-graduate qualification, largely due to very low levels of South Australian workers with Master's degrees.

Finding 14: The lower share of employees with postgraduate qualifications is not because fewer South Australians undertake postgraduate qualifications, instead it appears to be a lack of local employment opportunities.

Finding 15: South Australian universities produce significantly fewer postgraduates in Information Technology; Agriculture Environmental and Related Studies; Society and Culture; Engineering and Related Technologies; and Natural and Physical Sciences than the national average.

Finding 16: South Australia has significantly fewer people employed in innovation jobs than the national average, indicating a lower level of innovation compared to other states, and a lower capacity to generate and implement innovations.

Finding 17: South Australia has a strong workforce in key innovation occupations linked to the wine sector, agribusiness and defence, suggesting that those sectors are competitive nationally in innovation. But the state has significantly fewer people employed in innovation jobs in key occupations such as cyber security, software programming, and civil engineering suggesting important gaps in innovation capacity.

Finding 18: Difficulties in accessing visas with a pathway to permanent residence for entrepreneurs, and current international students, mean that migration is not fulfilling its potential role in supporting innovation in SA.

Finding 19: South Australia has gaps in its innovation system around innovation leadership, innovation networks, R&D and new firm formation.

Finding 20: Based on the evidence, the South Australian economy is materially less innovative than the national average. This is a significant structural economic weakness.

Finding 21: South Australia has a large number of innovation programs, but most are small and have limited funding. This makes them harder for business to navigate, and reduces their impact.

Finding 22 South Australian innovation programs in aggregate show no evidence to date that they have achieved their objectives.

Finding 23: South Australian Government assertion of rights to IP in current or past research grant agreements is a barrier to the efficient commercialisation of research.

Finding 24: Australian Government programs deliver very substantial financial support to business innovation, and this support will become even more significant once the national reconstruction fund begins disbursing resources.

Finding 25: Innovation at its heart is about talented people, and talented people need to be the focus of future South Australian Government innovation policy.

Finding 26: Geographical proximity is important to university-business links around innovation, but in this context geographical proximity means being conveniently located, not co-location. Similarity of values, norms and technological understanding is more important than geographic proximity in enabling successful business industry collaborations.

Finding 27: Given budget constraints, investment in buildings (including precincts) should be a low priority for future State Government innovation spending.

Finding 28: Successful commercialisation of research does not only depend on great science or engineering; it also needs a range of non-STEM skills.

Finding 29: Alignment of incentives between researchers and businesses is an important element of facilitating effective connections for innovation.

Finding 30: Intermediation between research and business in South Australia will be more successful if it is undertaken through jointly designed and implemented research projects.

Finding 31: Student placements play an important role in establishing and strengthening university-business connections.

Finding 32: The revenue of South Australia's universities, and therefore the incentives that they face, is largely driven by student income.

Finding 33: South Australian universities have performed well in securing research funding over the past two years, partially reversing a long-term decline in share of national funding. The national cooperative research program, and funding from rural research and development corporations are areas of strength.

Finding 34: South Australian universities have underperformed in grants targeted at the highest performing researchers, and those supporting early career researchers.

Finding 35: South Australia has a number of areas of current world class research strength. And a number of these strengths map well to key economic priorities for the state such as the green energy transition, and the defence sector.

Finding 36: Rates of commercialisation of university IP at South Australian universities lag the national average.

Finding 37: Of all the mainland states, given its characteristics and structure, our universities are more important to the South Australian innovation system, meaning that South Australian Government innovation policy should, for the next few years at least, be focused on developing the university side of the university industry connection.

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Acknowledgements

The South Australian Productivity Commission would like to acknowledge the assistance of all of those business people, university staff, public servants and representative of peak industry bodies who contributed to the Inquiry through participating in consultations, making formal submissions, or through the provision of data. In particular, we acknowledge the productive engagement we have received from Flinders University, the University of Adelaide and the University of South Australia throughout this Inquiry.

The Commission would like to thank the South Australian Department for Industry, Innovation, and Science for providing range of relevant background information, briefings and program documents. We also acknowledge the South Australian Department for Trade and Investment, and the South Australian Department of the Premier and Cabinet for providing a range of program documents.

Analysis was commissioned for this report from the SA Centre for Economic Studies at the University of Adelaide and expert input was commissioned from Professor Hein Roelfsema of Utrecht University, Netherlands.

Acronyms and Definitions

Accelerator	A training and support program designed to help a start-up increase its scale quickly, for example by providing its owner with better skills and networks around accessing finance, validating and prototyping business ideas etc.
ARC	The Australian Research Council (ARC) is the Commonwealth Government's principal funder of non-medical research. Funding is allocated through a range of specific schemes using a peer review process.
Business innovation	A business innovation is a new or improved product, business process, *or* business model (or a combination thereof) that differs significantly from the firm's previous products, processes, or business models that has been introduced on the market or brought into use by the firm.[3]
Commercialisation	The means of delivering research benefits to the community and creating economic benefits through the commercial process of converting science and technology, new research or an invention into a marketable product.
High growth firm	A firm with average annualised growth rates in turnover and/or employment of more than 20 per cent, sustained for at least a three-year period.[4]
ICT	Information and Communication Technology.
Incubator	Incubators are a space (typically physical although they can be virtual) in which a start-up can locate and access a range of specially designed supports whilst developing its business idea
Intellectual property:	Intellectual property (IP) is the result of someone, or an entity (for example, a company), using their individual or collective minds and intellect to create an invention, design, method or process that is deemed to be novel or original.5
MRFF:	Medical Research Future Fund, a relatively recent Commonwealth Government scheme for supporting health and medical research.
NCRIS:	The National Collaborative Research Infrastructure Strategy is a Commonwealth Government funding scheme that supports priority large-scale collaborative research infrastructure, which is expected to be available for use by researchers from universities, public research institutes, and business.
NHMRC:	The National Health and Medical Research Council (NHMRC) is the Commonwealth Government's principal funder of health and medical research. It allocates funding through a range of schemes using a peer review process.
OECD:	Organisation for Economic Cooperation and Development

[3] OECD/Eurostat (2018), *Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition, The Measurement of Scientific, Technological and Innovation Activities*, Paris: OECD Publishing/Luxembourg: Eurostat
[4] OECD/Eurostat (2018), *Oslo Manual 2018*
[5] For more information, see https://www.turnbullhill.com.au/articles/intellectual-property-in-australia-explained/.

Patent	A patent is a right that is granted for any device, substance, method or process that is new, inventive and useful. It is a legally enforceable right to commercially exploit the invention for the life of the patent.
Productivity	Productivity refers to the combined effect of the use of inputs in a production process to produce valuable output. It reflects both the technology (i.e., the available knowledge about how inputs can be used to produce output), and the efficiency (i.e., determined by how inputs and technology are actually used) in producing output. Productivity is typically expressed in terms of Labour Productivity – the output produced for a given input of labour, or multi-factor productivity – the output produced for a given set of capital and labour.
R&D	Research and Development (R&D) is activity carried out to generate new knowledge, irrespective of its purpose, which could be economic benefit, addressing societal challenges or simply having the knowledge itself.[6]
Seed funding	Seed funding is a form of equity funding provided to start-ups at an early stage when their scale is too small to make accessing venture capital feasible.
Spillovers	Spillovers refer to benefits from research and development experienced by individuals or organisations other than those conducting the R&D.
STEM	Science, technology, engineering and mathematics.
STEMM	A slightly broader grouping of knowledge than STEM, also incorporating medicine.
Start-up	A start-up is new firm established specifically to commercialise new technology or knowledge, such as new product or service or a new business process. As a start-up increases in size and moves towards focusing on addressing its market (rather than developing its product) it is often referred to as a scale-up. Where a start-up has been launched by a research institution to commercialise technology developed in the institution it is often referred to as a spin-out.
Tacit knowledge	Tacit knowledge is knowledge required to use an innovation which is only be available in the minds of people who use it. This is contrasted with codified knowledge which is knowledge that is easy to communicate to new users such as through a product manual.
TRL:	Technology readiness level (TRL), an approach to classifying the commercial readiness of a potential product or service, typically into 9 stages.[7]

TRL 1	TRL 2	TRL 3	TRL 4	TRL 5	TRL 6	TRL 7	TRL 8	TRL 9
Basic principles observed (basic research)	Technology concept formulated (applied research)	First assessment – feasibility concept & technologies	Validation – integrated prototype in lab environment	Testing prototype in user environment	Pre-production product	Low scale pilot production demonstrated	Manufacturing fully tested, validated & quantified	Production & product fully operational
◄——— Invention ———►		◄——— Concept validation ———►		◄——— Prototyping & incubation ———►	◄——— Pilot production & demonstration ———►		◄——— Initial market introduction ———►	◄——— Market expansion ———►

[6] OECD (2015), *Guidelines for Collecting and Reporting Data on Research and Experimental Development, The Measurement of Scientific, Technological and Innovation Activities – the Frascati Manual*, Paris: OECD Publishing.
[7] European Association of Research and Technology Organisations EARTO (2014), 'The TRL Scale as a Research & Innovation Policy Tool, EARTO Recommendations'

Venture capital	A form of private equity funding that is provided to start-ups and emerging firms perceived by the investors as having high-growth potential, in exchange for an equity stake in the firm.

1. Background

… the importance of universities to the regions desolated by the decline of traditional industries such as coal, steel, shipbuilding, cars and tyres should be clear.

These areas cannot be regenerated by economic protection and trade barriers to try to bring back the old industries. Even if that approach might ever have worked, and we doubt it, the stable door was open and the horse has well and truly bolted.

Nor can these areas be regenerated by state actions, or a series of welfare protections, important though they may well be in the short term. They all need to find again the competitive advantage that coal, steel, mass industrial production or transport gave them in the past and that brought them the prosperity that lasted for perhaps 150 years before it declined.

… The old industries will not provide a sustainable economic and social future for the communities we are considering. That will only come from the industries and economics of the future, whatever they may be. ***It is universities, working locally, that give the best possibility of helping that change to take place, and building the new community****.*

The most likely source of resilient competitive advantage in the future comes from the creativity and innovation in new industries that universities are best placed to offer, properly stimulating and properly stimulated. *And, in addition, the universities, possibly with associated schools and colleges, such as further education colleges, are best placed to provide the education and training those communities need to provide the new workforce that will be required.*

That is why we believe that universities should adopt a strong local approach and play a very important role in counteracting the impact of globalisation in those localities that have suffered most from it*.[8]]*

1.1 The case for change

Our economy is currently performing strongly coming out of COVID-19…

South Australia is currently enjoying a strong economy coming out of the COVID 19 pandemic, with growth in economic output well above its long-run average. Unemployment at 3.9 per cent (trend terms as at March 2022) is lower than it has been since the mid-1970s, though still above the national average.

There is also considerable potential upside, on which the current SA economic strategy is focused:

- ‘green minerals’, driven by commodity prices and the demands of decarbonisation;
- increased defence spending linked to the geopolitical context; and
- the scope to capture a share of the potential international trade in green hydrogen, driven by the global response to climate change.

but this current strong growth appears to be cyclical not the start of a significantly improved structural trend.

It could, of course, be the case that the two years of strong growth coming out of COVID-19 mark a shift in the economic position of the state. However, SA has had single high-growth years before which failed to convert to sustained growth. And data suggests that this current upturn is driven by cyclical factors and national conditions, with strong consumer spending and strong government spending (essentially residual stimulus from COVID) being particularly important. There are no signs of a change in the industry mix, in the nature or scale of non-commodity exports, or degree of

[8] Byrne, E. and Clarke, C. (2020), *The University Challenge: Changing universities in a changing world*, Pearson International Content, e-book, emphasis ours.

innovation in SA which might suggest structural barriers to growth had been addressed and that the recent strength represented a change in the long-run trend.

The longer-term picture is a state stuck in a low growth trajectory, falling behind the eastern states in incomes.

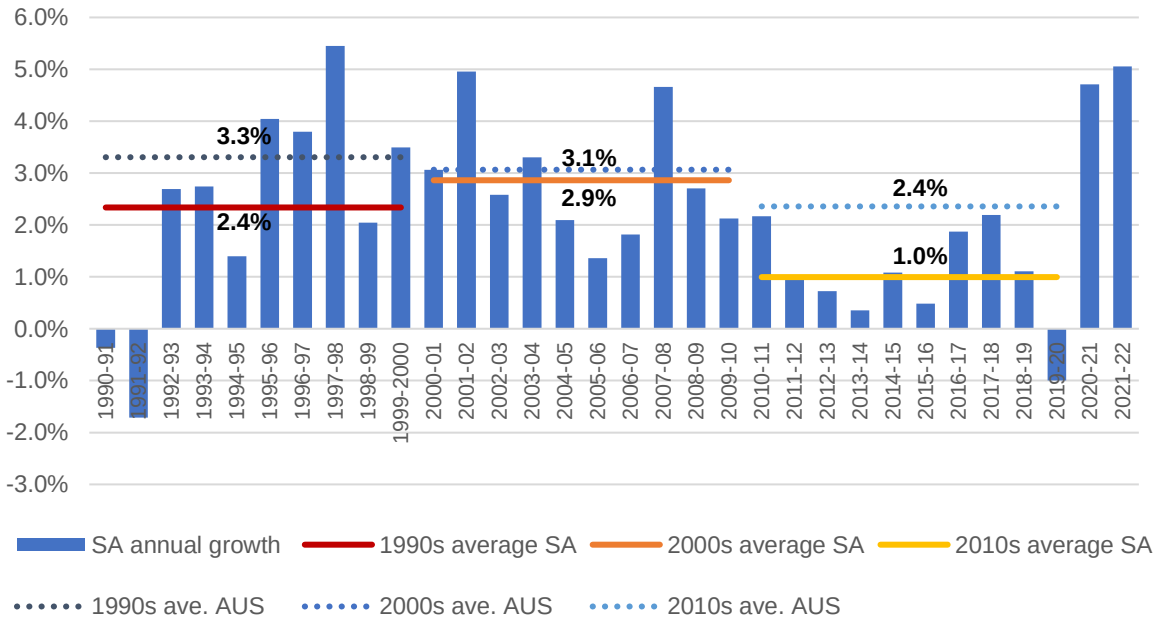
The longer-term economic performance of the state has been much weaker, with the lowest economic output per capita of the mainland states. In 2021-22 economic output per person was just under $15,000 below the national average.

Annual average growth in GSP over the past three decades has been 2.1 per cent. And our long-term structural growth trend is not positive (see Figure 1). Looking across the last three decades it is not the "State Bank decade" of the 1990s that is weighing the average down. In fact, it's the 2010s that was the worst, averaging only 1.0 per cent.

Without competitive growth, it is much harder for our state government to match the quality of education, hospital and law and order services delivered by other States with a stronger tax base.

Finding 1: Economic growth well below the national average over the past three decades has had a material impact on the incomes of South Australian households. The recent strong growth following the COVID disruptions appears to be cyclical.

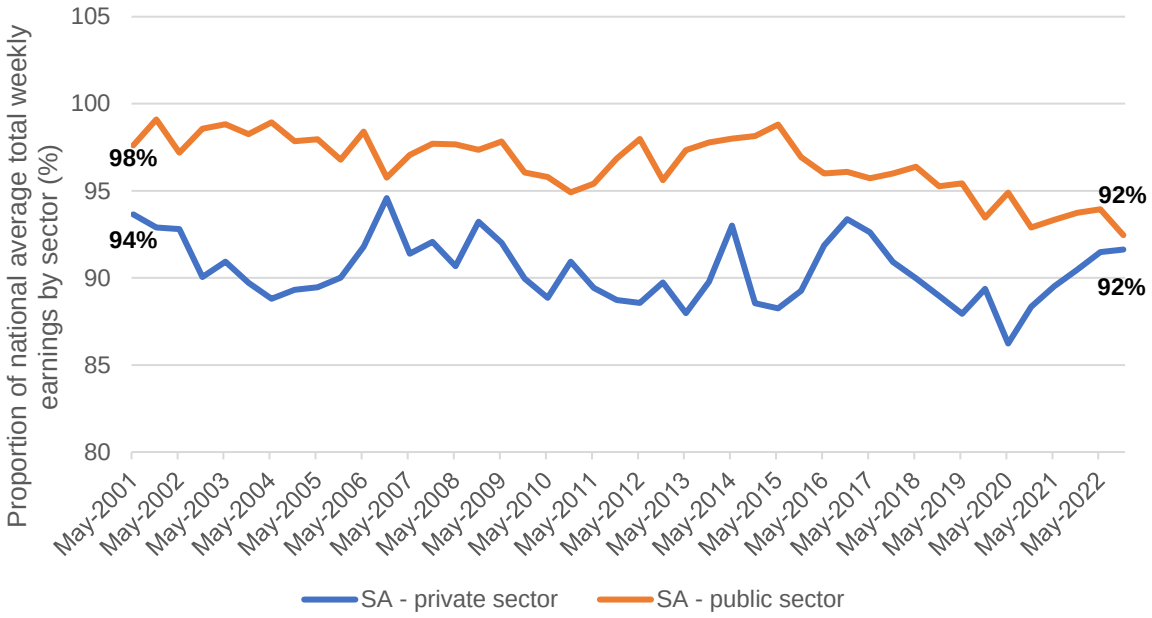
Figure 1: South Australia's economic growth has been well below the national average for the last 30 years
Annual GSP growth SA, and decadal averages SA and Australia, % per year



Note: 2020-21 and 2021-22 growth is not included in the 2010s decadal average as they are the first two data point of the 2020s decade
Source: Australian Bureau of Statistics (2021), 'Australian National Accounts: State Accounts'

This prolonged period of weak economic growth impacts on people's daily lives. Wages, both public and private sector, have also declined relative to the national average, with both private and public sector wages 8 per cent below the national average (see Figure 2).

Figure 2: South Australian wages are now 8% below the national average
Average weekly total earnings, public and private sector, South Australia as a share of the Australian average



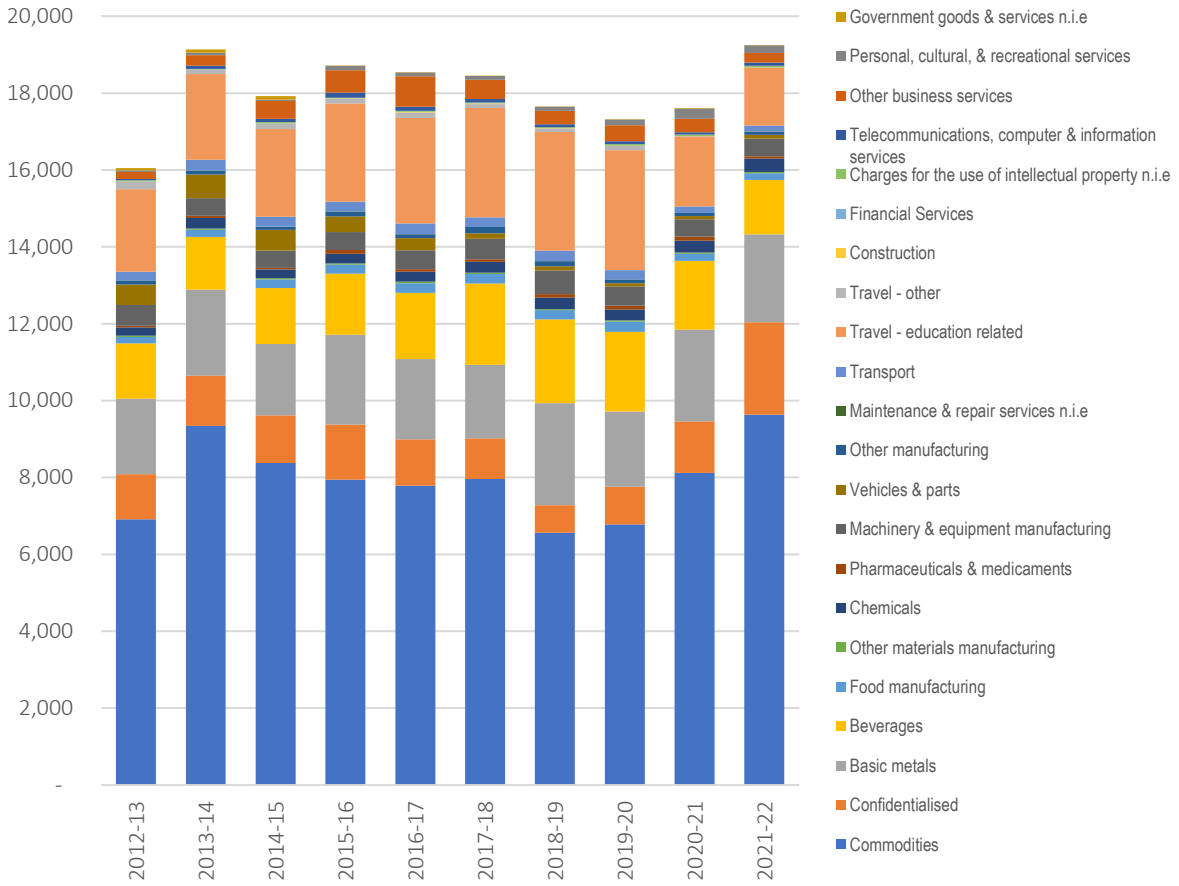
Source: Australian Bureau of Statistics (2022), Average Weekly Earnings, Australia

The South Australian economy shows little evidence of being high complexity. Exports are almost all in commodities and basic metals, while higher value-added exports are low and falling in real terms.

Exports data provides another perspective on the South Australia business sector. Exports can be a useful guide as to relative strengths in an economy as they will only occur when the local product has an advantage (whether price, quality, timing or marketing) over its international competitors.

Figure 3 presents export data over the past decade in real terms (i.e. removing the impact of inflation) to reflect the impact exports had on the disposable incomes of South Australians. This demonstrates the extent to which the state's trade is dominated by the 'primary' sectors exporting agricultural goods, ores and hydrocarbons, and basic metals.

Figure 3: South Australian exports are dominated by commodities and basic metals
South Australian goods and services exports by broad SITC category, real 2022 $'million



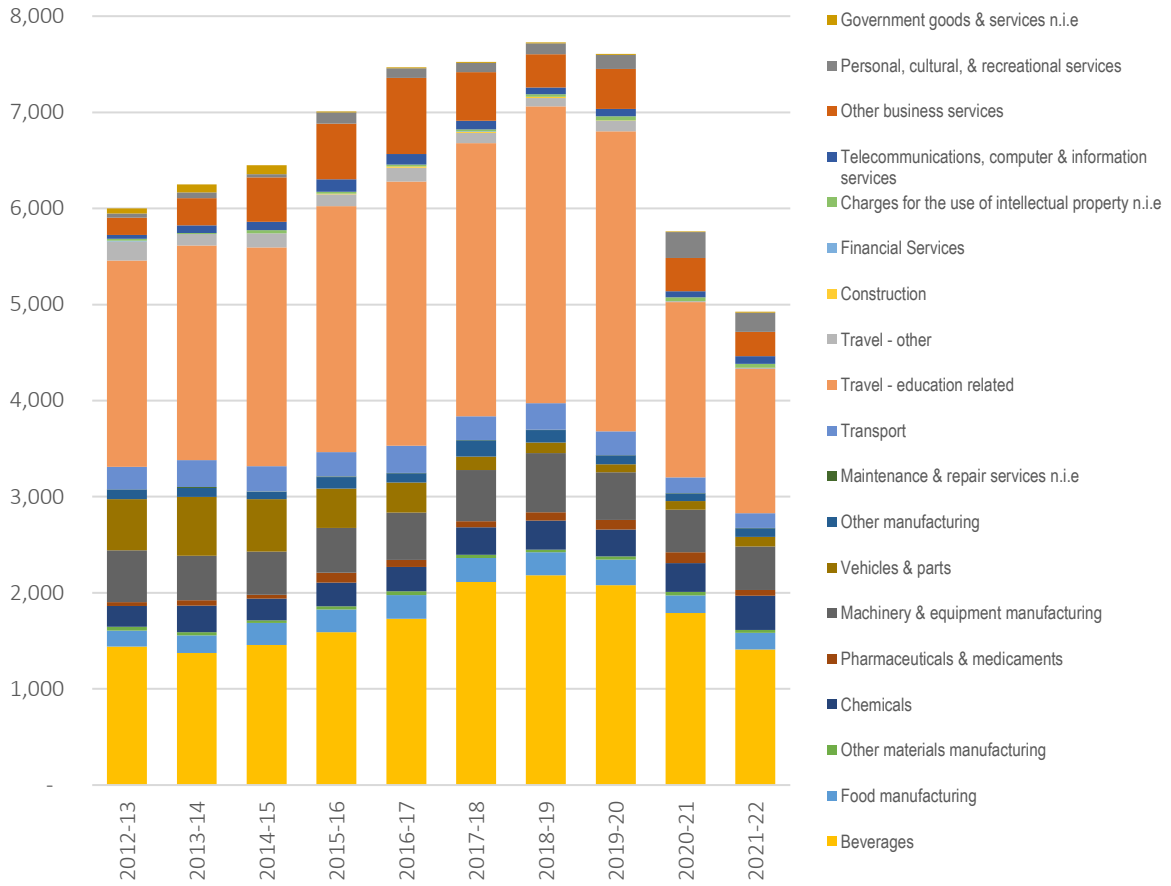
Source: Goods data based on DFAT State & Territory pivot table (https://www.dfat.gov.au/trade/trade-and-investment-data-information-and-publications/trade-statistics/trade-statistical-pivot-tables), services data from Australian Bureau of Statistics (2022), 'International Trade: Supplementary Information, Financial Year, 2021-22'

If these 'primary' goods are removed, it becomes apparent that the high value-added goods and services exports from South Australia have actually fallen by over $1 billion in real terms over the decade (Figure 4), and by $2.8 billion from their peak in 2018-19. This is despite many of these subsectors having been a significant focus of South Australian Government innovation and trade policy supports over the past several decades.

The biggest falls since 2012-13 have been in 'Travel – education related' (-$644 million), 'Vehicles and parts' (-$434 million), 'Travel – other' (-$181 million), and 'Machinery and equipment manufacturing' (-$85 million).

Only three 'value-added' export categories grew by more than $50 million over the decade; 'Personal, cultural, and recreational services' (+$156 million), 'Chemicals' (+$140 million; with growth coming from inorganic chemical elements and salts), and 'Other business services' (+$71 million).

Figure 4: High value-added exports have actually fallen in real terms over the last decade
South Australian value-added goods and services exports by broad SITC category, real 2022 $'million

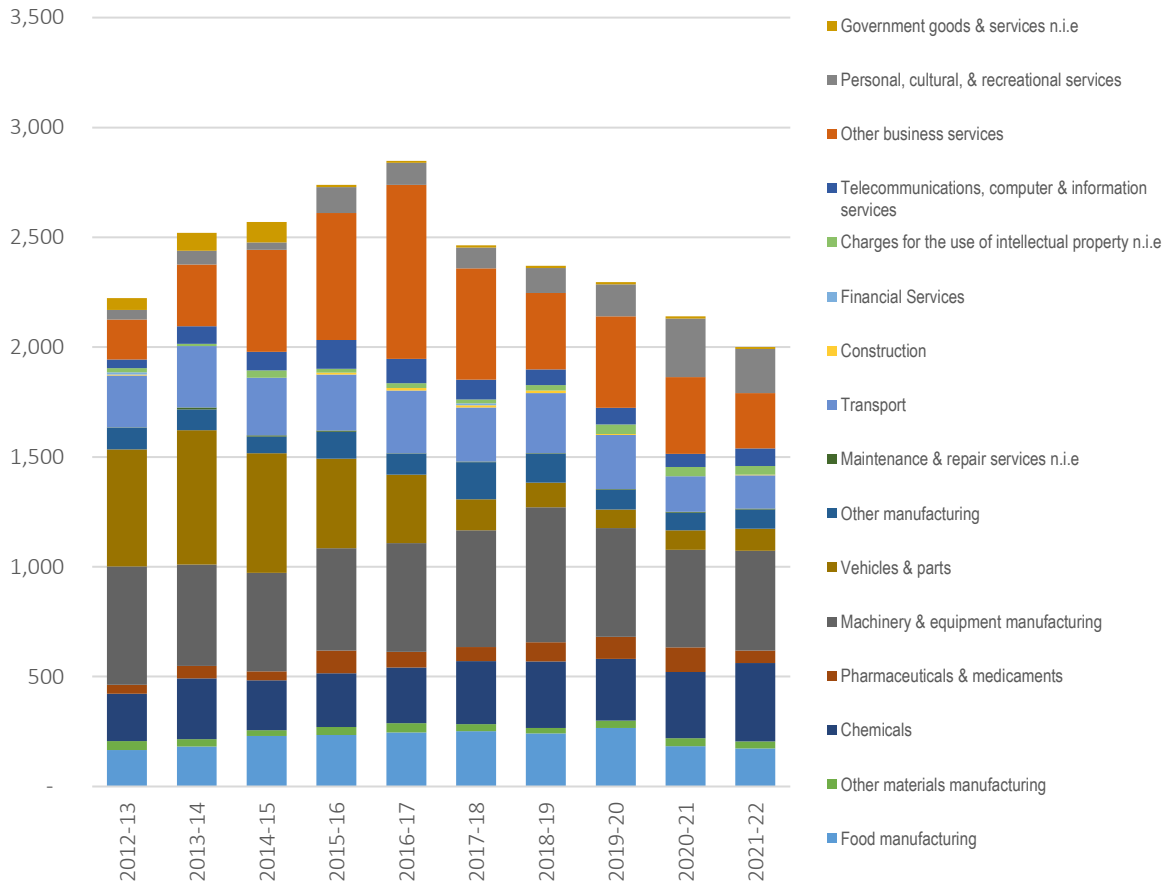


Note: chart excludes Agricultural goods, minerals and ores, confidentialised (which is largely barley and copper) and basic metals.
Source: Goods data based on DFAT State & Territory pivot table (2022), services data from Australian Bureau of Statistics (2022), 'International Trade: Supplementary Information, Financial Year, 2021-22'

A significant contributor to the overall decline of value-added exports has been the impact of COVID-19 on international education and other travel and the impact of geopolitical tensions with China on the state's wine exports. However, even with these export categories removed, the remaining categories of high-value exports still show a decline over the past decade, suggesting widespread underlying weakness (see Figure 5).

Finding 2: Businesses in high value-added export sectors are becoming less internationally competitive.

Figure 5: The fall in high value-added exports remains even if those sectors particularly affected by COVID are removed
South Australian value-added goods and services exports by broad SITC category, excluding sectors particularly impacted by COVID and geopolitical tensions real 2022 $'million



Note: as per figure 4, this excludes Agricultural goods, minerals and ores, confidentialised (which is largely barley and copper) and basic metals; Travel – education and travel – other are excluded as much of the decline is due to the impacts of COVID; beverages are excluded as the decline is caused by the significant increase in the tariffs on Australian wine exports imposed by the Chinese government.
Source: Goods data based on DFAT State & Territory pivot table (2022), services data from Australian Bureau of Statistics (2022), 'International Trade: Supplementary Information, Financial Year, 2021-22'

1.2 South Australia's recent productivity performance is weak

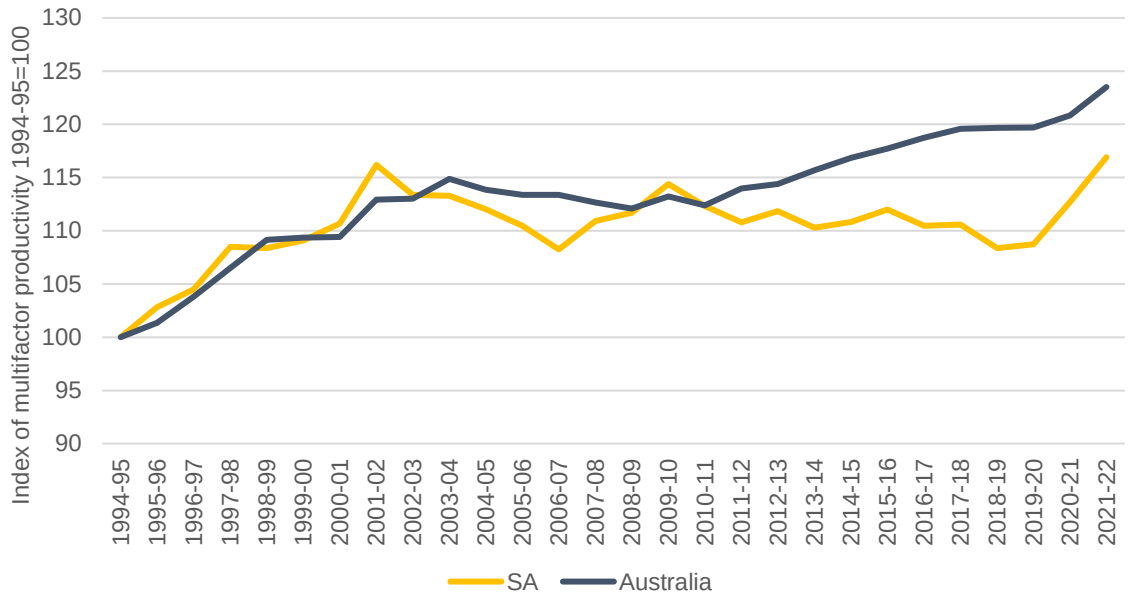
South Australian productivity has not grown at all in net terms over the past two decades.

Multifactor productivity – the amount or quality of output that can be produced from a given quantity of labour and capital is the only sustainable source of long-run economic growth. Unfortunately, South Australian multi-factor productivity growth has been weak, with no net growth over the past twenty years (see Figure 6).

This weak productivity performance has been the main factor behind South Australia's growth in economic output falling well behind the national average in the 2010s. Poor multifactor productivity performance is by no means inevitable – very solid growth was achieved through the 1990s – and it likely reflects a range of structural barriers that are holding South Australia back.[9]

[9] For a more in-depth discussion of productivity and its drivers see Chang, P., C. Findlay and S Whetton (2023), 'Demystifying Productivity', South Australian Productivity Commission Research Discussion Paper No. 4, available at: https://www.sapc.sa.gov.au/research-program/research-discussion-papers/Research-discussion-paper-no.4-Demystifying-Productivity.pdf

Figure 6: South Australia's productivity has not improved in net terms over the last 20 years
Multifactor productivity, South Australia and Australia, 1994-95 = 100



Australian Bureau of Statistics (2022, 2021) National Accounts (ABS Cat. No. 5204, Table 1 and, for the States and Territories, ABS Cat.No.5220.0, Tables 2-10)

Finding 3: South Australia's productivity growth has been poor over the past two decades, and this is an important factor in the weak economic growth over the same period.

To delve into the causes of the decline in MFP growth, we need to examine the performance of the key factors influencing MFP, i.e., technological progress and efficiency change. This question has been well covered in international research but less so in Australia.

Internationally technological progress has been the main driver of productivity growth over the long term, and South Australia will not see sustained growth in productivity and incomes unless we can grow through technology and innovation.

In the US over the past 70 years technological progress contributed around half of overall output growth and three quarters of productivity growth.[10] More broadly, across the OECD (not including Australia) it is estimated that technological progress increased at an average rate of 1.5 percent over a 15-year period (1990 – 2004), while efficiency declined at an average rate of 0.6 per cent. The net effect resulted in MFP growth of 0.9 per cent over this period.[11]

One recent Australian study[12] found that for South Australia, technological progress had stalled from early this century, and inefficiency had plagued the economy for almost the last two decades. South Australia's economic performance has declined because the state has fallen further behind in technological terms. Its failure to apply effectively even the technology already available has slowed its growth.

[10] Jones, C.I. (2022), 'The Past and Future of Economic Growth: A semi-endogenous perspective', *Annual Review of Economics*, 14:125–52
[11] Barcenilla-Visús, S., J.M. Gómez-Sancho, C. López-Pueyo, M.J. Mancebón and J. Sanaú (2013), 'Technical change, efficiency change and institutions: Empirical evidence for a sample of OECD countries', *Economic Record*, *89*(285), pp.207-227
[12] Fox, J. K., (2022), Productivity Inequality: Potential for levelling up by industry and state, A presentation prepared for the CAER-Productivity Commission Workshop on Prospects for a Post-pandemic Productivity Boom, Centre for Applied Economic Research, UNSW Business School, 11 November

Doing a better job of keeping pace with the global growth in technology would significantly increase average incomes in South Australia

If, over the last two decades, South Australia's innovation system had kept pace with the long-run average global growth of technology and knowledge and delivered MFP growth of 1 percentage point per year (rather than the actual performance of no growth in MFP) GSP per person could have grown 1 percentage point faster per year over the last two decades (2000-01 to 2019-20).

If this had happened, South Australia's GSP per person would be comparable to that of New South Wales's GSP per person in 2020, that is, about $13,500 higher than SA's actual level in 2020.

Wages broadly track economic output per person and productivity, so if South Australia *had* been able to achieve this sustained growth in productivity, then wages could also be expected to match those seen in New South Wales. For the average South Australian full-time worker, this would mean earning $8,000 more per year than they actually did in 2020.

Finding 4: If South Australia's rate of innovation had been at the long-run US average over the past two decades, our output per person today would have been in line with New South Wales.

1.3 South Australia's business sector

Knowledge and technology are turned into economically valuable innovation and growth primarily in the firm, and innovation policy should be focused on increasing the extent of business innovation.

However, since most firms are small and targeted at specific local market niches, innovation policy is unlikely to be of much use to them.

Firms generally engage in two types of innovation: incremental and transformative. They undertake incremental innovation to improve existing product lines, processes, or business models. They undertake transformative innovation to create new products, processes, or business models to capture markets from other firms, or create new markets. [13]

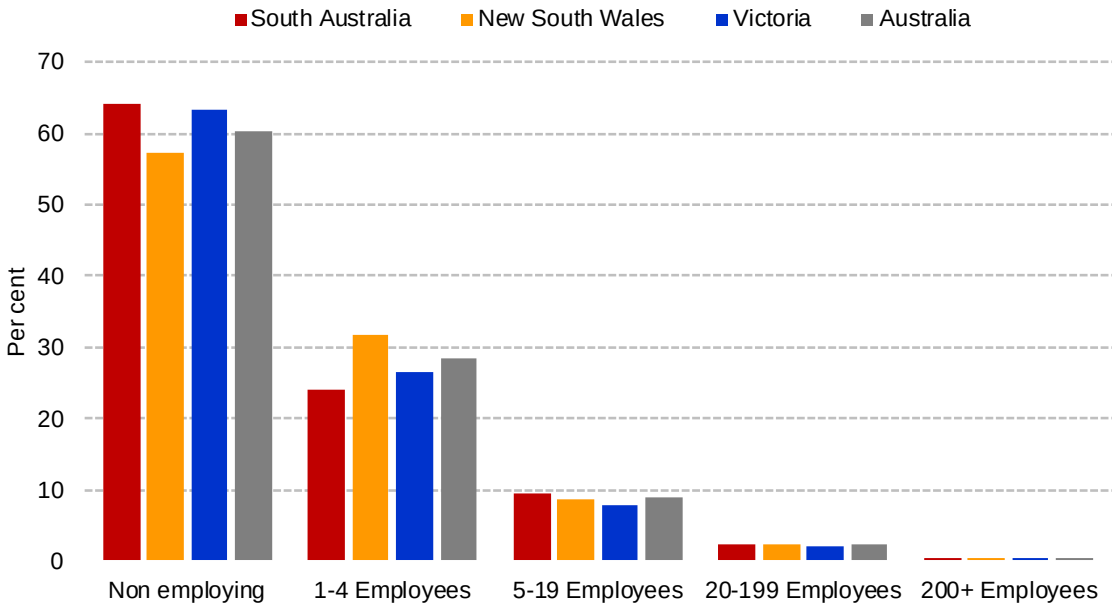
Studies have found that the types of innovation undertaken by firms affects their rate of growth, which in turn affect the rate of economic growth and the number of net jobs created.[14]

South Australian businesses are generally very small…

For a majority of firms, transformative innovation is not relevant. They are sole traders or small firms with a clear market niche. Or they are firms addressing a specific emerging need, such as a new café setting up in a suburban area to cater to the higher rates of people working from home. Indeed, 64 per cent of South Australian businesses were non-employing businesses (e.g. sole traders) and a further 24 per cent employed one to four people (see Figure 7).

[13] Bessant, J. and Tidd, J. (2021), Managing Innovation, Seventh Edition, Wiley; Akcigit, U. and Kerr, W., (2018), "Growth through Heterogeneous Innovations", Journal of Political Economy, 126 (4), pp. 1374-1443; and Kerr, R. W. (2015), "Innovation and Business Growth." In Designing the Future: Economic, Societal and Political Dimensions of Innovation, edited by Austrian Council for Research and Training Development, 137–156. Vienna, Austria: Echomedia Buchverlag.
[14]Kerr, R. W. (2015), "Innovation and Business Growth." In Designing the Future: Economic, Societal and Political Dimensions of Innovation, edited by Austrian Council for Research and Training Development, 137–156. Vienna, Austria: Echomedia Buchverlag.; Akcigit, U. and Kerr, W., (2018), "Growth through Heterogeneous Innovations", Journal of Political Economy, 126 (4), pp. 1374-1443.; Henrickson, L., Taylor, D., Ang, L., Cao, K., Nguyen, T., and Soriano, F., (2018), The Impact of Persistent Innovation on Business Growth, Research Paper 2, Department of Industry, Innovation and Science, Canberra; and Majeed, O., Balaguer, A., Hansell, D., Hendrickson, L., Latcham, A., and Satherley, T., (2018), What Drives High Growth? Characteristics of Australian Firms, Research Paper 1, Department of Industry, Innovation and Science, Canberra.

Figure 7: South Australia's business sector is dominated by sole traders and very small firms
Businesses by Employment Size, 30 June 2022, Proportion of total businesses



Source: ABS (2022), Counts of Australian Businesses, including Entries and Exits, accessed 20 February 2023.

Nor is this small scale by and large a temporary phenomenon. Bakhtiari (2019), using BLADE data for the period 2002–2015, finds that:

- about 76 per cent of firms in Australia survive in the first three years, and about 39 per cent of firms survive during the first ten years;
- the majority of surviving firms hardly grow from age one to three;
- more than half of the surviving firms are still non-employers by age 3;
- less than 10 percent of firms from new to age 3 experience fast growth; and
- 'transformative' entrants make up a small share of the total.

This means that for most firms, innovation policy will not be relevant to their business's prospects. Assistance is more likely to be needed around business skills, legislative compliance, HR issues etc. The Commission notes that at the time of writing the South Australian Government is developing a small business strategy after an extensive consultation process. Such a strategy is likely to be a better approach to structuring support to the majority of small firms that are not innovation intensive.[15]

A small proportion of firms are 'high-growth' firms and they account for a disproportionate share of net jobs growth and of innovation. These firms should be the target (and objective) of policies aimed at driving economic outcomes from innovation.

The potential drivers of transformative innovation are not all new entrants, or all small firms, but rather those firms with the potential to become high-growth firms.[16] High growth firms are not a large share of firms, recent research has found that 14 per cent of all firms in Australia were high-growth firms in 2014, down from 18 per cent in 2005. But they have a disproportionate impact on the strength of the economy, accounting for 46 per cent of net jobs growth in Australia over the period.

[15] https://business.sa.gov.au/news/shaping-the-small-business-strategy
[16] Defined as firms with average annualised growth rates in turnover and/or employment of more than 20 per cent, sustained for at least a three-year period, OECD/Eurostat (2018), Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition, The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris/Eurostat, Luxembourg

Compared to the average firm, high-growth firms are typically younger; more likely to engage in innovation; and pay higher wages.[17] Therefore increasing the number of high-growth firms in an economy will increase wages and improve employment prospects as well as pushing up GSP growth.

Finding 5: Most net jobs growth, and most job creating innovation in Australia occurs in high-growth firms.

This means that enabling high-growth firms, and firms that have the potential to be high-growth firms, needs to be at the centre of any policy focused on using business innovation to increase economic competitiveness and growth.

Finding 6: Policy aimed at stimulating economic growth through encouraging business innovation should be targeted at enabling current and potential high-growth firms.

Most high-growth firms did not remain in the high-growth phase for a long period of time with more than half of the high-growth firms in the study period exiting their high-growth phase within 4 years, and only 11 to 14 per cent of high-growth firms remaining in their high-growth phase after 7 years. However even after their high-growth phase has ended, firms that have been high-growth firms continue to have higher growth rates than the average (see Table 1).

Table 1: Median annual turnover growth by firm age, high-growth firms and all firms

	Turnover growth (per cent)	
Firm age	**High Growth firms**	**All firms**
4 years	55.2	6.6
5 years	12.5	2.9
6 years	6.1	–2.2
7 years	2.1	0.0
8 years	1.5	–3.0
9 years	1.1	–1.6
10 years	0.9	–1.6
11 years	2.3	–1.9

Source: Majeed et al. (2021)

This pattern of growth is similar to international findings.[18]

Unfortunately, South Australian firms are much less likely to be high-growth. This is true across industry sectors and so is driven by South Australian business dynamism

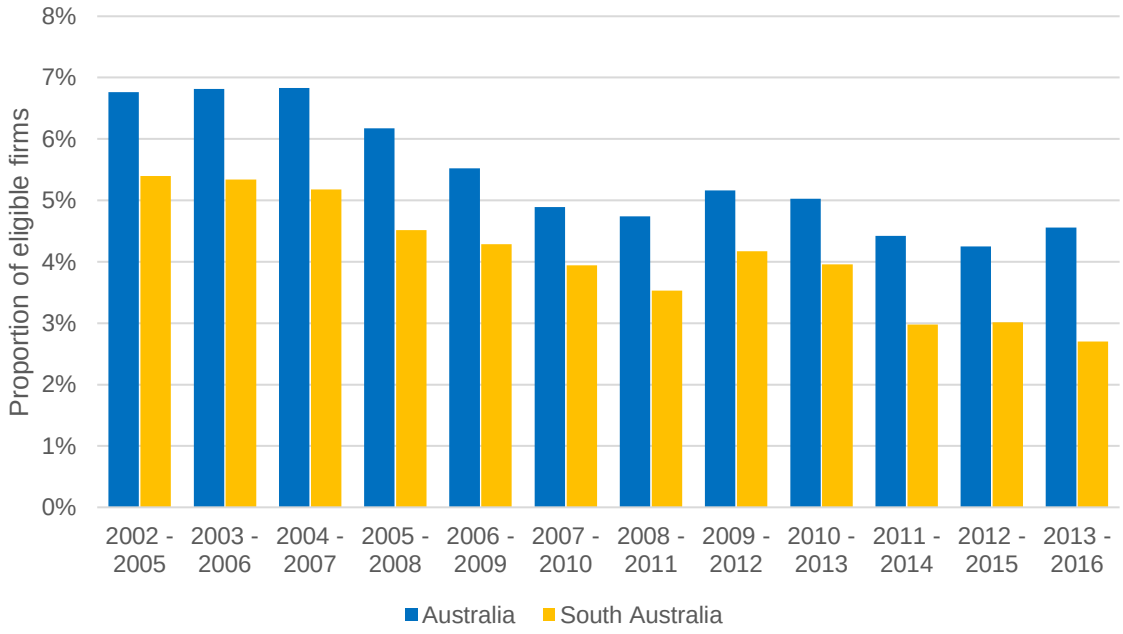
Analysis of the BLADE dataset by DIIS (unfortunately now somewhat dated but still in our judgement relevant) shows that South Australian firms are significantly less likely to be high-growth firms than the national average, and this underperformance was consistent from 2002 to 2016 (Figure 8). The other data on relative business performance, incomes growth, and productivity in

[17] Majeed, O., Balaguer, A., Hansell, D., Hendrickson, L., Latcham, A., and Satherley, T., (2021), What Drives High Growth? Characteristics of Australian Firms, Economic Record, 97 (318), p.350-364; Majeed, O., Balaguer, A., Hansell, D., Hendrickson, L., Latcham, A., and Satherley, T., (2018), What Drives High Growth? Characteristics of Australian Firms, Research Paper 1, Department of Industry, Innovation and Science, Canberra.
[18] Moreno, F., and A. Coad (2015), 'High-growth firms: Stylized facts and conflicting results', *Advances in Entrepreneurship, Firm Emergence and Growth*, 17, 187-230; Brown, R., S. Mawson and C. Mason (2017), 'Myth-busting and entrepreneurship policy: the case of high growth firms', *Entrepreneurship & Regional Development*, 29 (5-6), 414-443; Satterthwaite, S. and R. Hamilton (2017), 'High-growth firms in New Zealand: Superstars or shooting stars?', *International Small Business Journal*, 35(3), pp. 244-261; Coad, A., J.R. Holm, J. Krafft and F. Quatraro (2018), 'Firm age and performance', *Journal of Evolutionary Economics*, 28 (1), pp. 1-11.

South Australia suggests that this relative underperformance in high-growth firms remains the case today.

As was the case for Australia as a whole, the proportion of high-growth firms has been declining, with the rate of decline being slightly higher than the national average. By 2013-16, around 2.7 per cent of South Australian firms were high-growth compared to a national average of 5.5 per cent.

Figure 8: Significantly fewer South Australian firms are high-growth than the national average
Proportion of firms which are 'high-growth' by year, Australia and South Australia

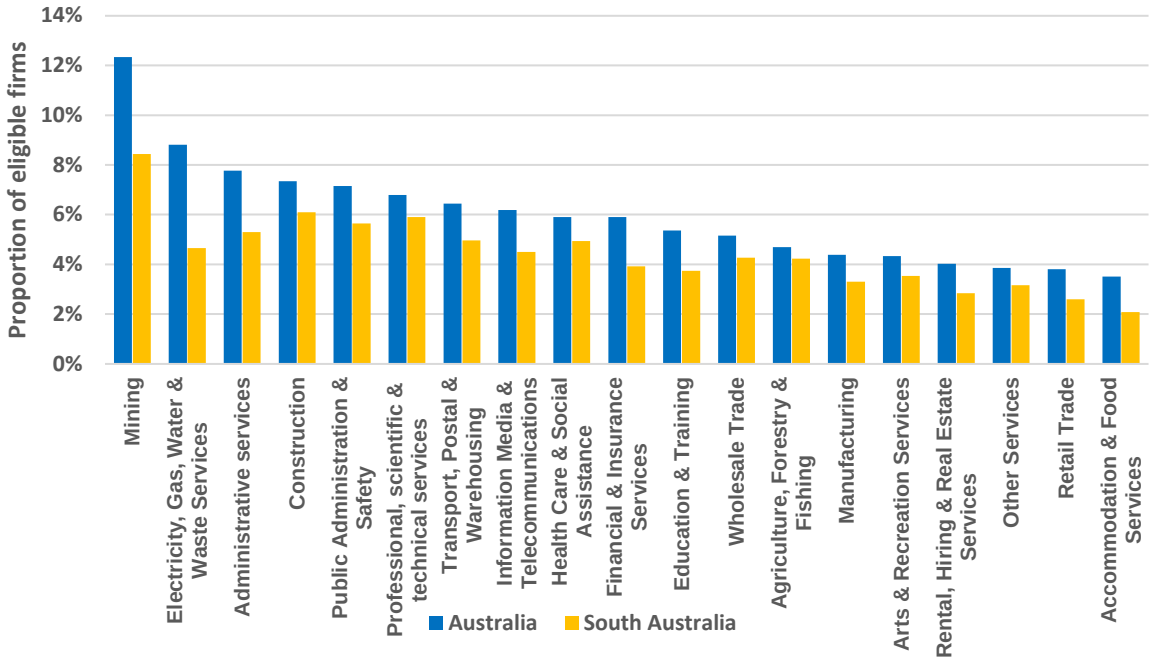


Source: B Dobson-Keeffe, SA Department for Innovation and Skills, unpublished data

Finding 7: South Australian businesses are less than half as likely to be 'high-growth firms' than the national average.

This underperformance relative to the national average does not (at least primarily) reflect differences in industry structure, with South Australian firms being less likely to be high-growth in each of the 19 included industry sectors (see Figure 9).

Figure 9: The low share of high-growth firms in SA occurs in every industry sector
Proportion of firms which are 'high-growth' by industry, sorted in descending order of Australian share, Australia and South Australia



Source: B Dobson-Keeffe, SA Department for Innovation and Skills, unpublished data

The relative underperformance in high-growth firm share was greatest in 'Electricity, gas, water and waste services' where less than half as many South Australian firms were high-growth compared to the national average. 'Mining', 'Administrative and support services', and 'Financial services' also had significant under performance relative to the national average.

Finding 8: South Australia's low rate of high-growth firms is not primarily a result of the state's industry structure, but is evident in every industry sector.

And are less dynamic that those in other states, with lower rates of business entry and exit.

Business entry and exit rates provide insight into the levels of entrepreneurship, business dynamism and competition within an economy (Bakhtiari, 2019; Shambaugh et al., 2018). For example, a high rate of business entry may suggest strong entrepreneurship and a conducive environment to starting new businesses, which can lead to job creation and innovation. High business exit rates can indicate that the market is competitive with less-competitive businesses exiting to make room for new and more innovative and efficient businesses.

South Australia had lower overall business entry and exit rates than New South Wales, Victoria and Australia in 2021-22 (see Table 2). The lower entry and exit rates were particularly prominent among non-employing and micro businesses. The difference between entry and exit rates across all businesses was also smaller in South Australia (5.5 per cent) than in Australia (7.0 percent), indicating a lower level of net business formation. Together these results are suggestive of a lower level of entrepreneurial dynamism within South Australia.

This is not to dismiss the achievements of the many entrepreneurial and innovative firms in South Australia. There are a number of firms doing world class innovative things here and creating high quality jobs and wealth. But even to reach the national average, we would need to have nearly twice as many high-growth firms as we do, and it is this shortfall in the number of high-growth entrepreneurial firms that means that on average our business sector is less dynamic that those in other states.

Finding 9: South Australia's business sector is much less dynamic than the national average. This reduces the scope for business innovation amongst the current SA business community compared with businesses in the eastern States.

Table 2: Business entry and exit rates by employment size, 2021-2022, entries and exits as proportion of businesses at the start of the year

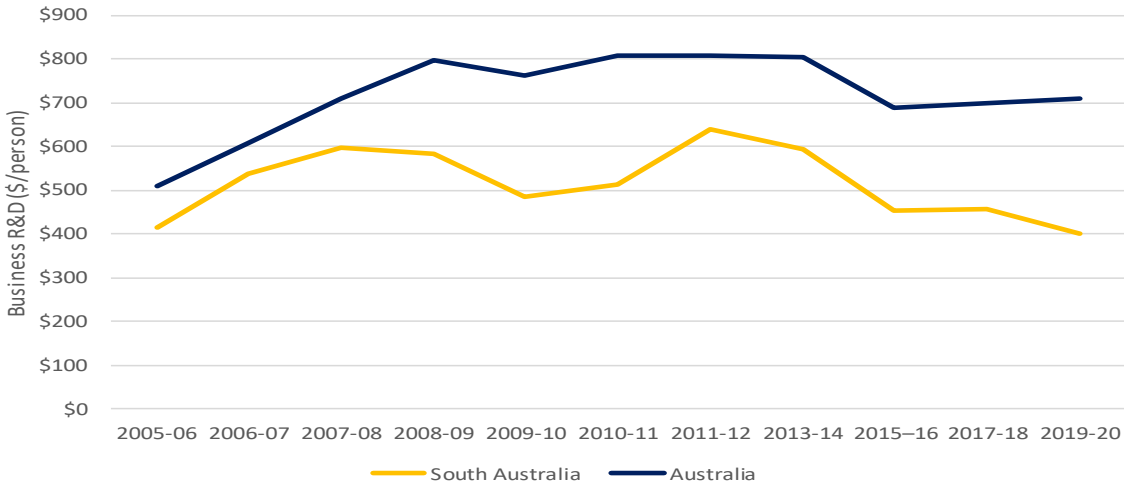
	Non employing	1-4 Employees	5-19 Employees	20-199 Employees	200+ Employees	Total
	Business entry rates					
South Australia	20.4	13.7	4.1	2.6	4.0	16.8
New South Wales	23.7	14.8	4.0	2.2	2.8	18.5
Victoria	31.6	14.9	4.2	3.2	3.5	23.8
Australia	25.1	15.2	4.1	2.7	3.0	19.7
	Business exit rates					
South Australia	14.2	7.6	4.4	2.8	1.3	11.3
New South Wales	16.9	9.1	4.7	3.4	2.4	12.9
Victoria	16.1	8.7	5.0	3.0	4.6	12.7
Australia	16.2	8.9	4.9	3.2	2.4	12.7

Source: ABS (2022), Counts of Australian Businesses, including Entries and Exits, accessed 20 February 2023

South Australian firms also invest much less in the drivers of innovation, including Research and Development (R&D)

Figure 6 shows that business spending on R&D per person has fallen slightly in South Australia over the last 15 years, whereas national average spending is higher although below its level in the early 2010s (figure 10).

Figure 10: South Australian business invests less in Research & Development and the gap is widening Expenditure by business on R&D, $ per person (2021 values)



Source:

Source: ABS 81040 Research and Experimental Development, Businesses.

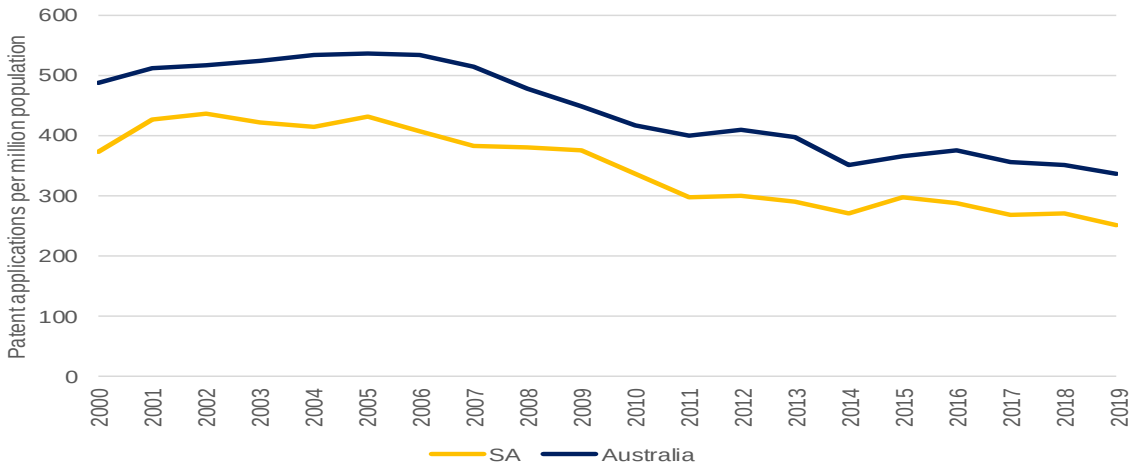
Analysis undertaken for the Commission by the ABS as part of the 2021 Inquiry into Research and Development suggested that the underperformance on Research and Development (R&D) is heavily influenced by the relatively older average firm age, and the smaller average size of South Australian businesses.

And South Australian firms are less likely to patent

Patents are often used to measure the success of R&D efforts. They are designed to incentivise innovation. However, in practice, not all patents have led to innovations because it is dependent on

other factors, such as access to financial capital, practical application, regulations, potential markets, etc. Nonetheless, a larger pool of patents would increase the likelihood that a patent could lead to an innovation. Conversely rates of patenting vary between sectors reflecting different approaches to the protection of IP. Patent applications in South Australia have been consistently lower than the national average, suggesting innovation output in the state is below average (Figure 11).

Figure 11: South Australian firms consistently file fewer patents
Patent applications per million persons, SA and Australia



Source: IP Australia.
Note: Data for 2020 and 2021 not included as there is a structural break in the series.

Finding 10: South Australian firms invest less than the national average in R&D and this gap has been widening. They are also less likely to patent innovations.

South Australian firm tend to be 'inward looking' in their innovation, with a particularly low likelihood to draw on universities as a source of ideas.

Data on the innovation activities of South Australian firms collected by the ABS as part of their business surveys[19] paints an interesting picture of the South Australian innovation ecosystem. The overall propensity to undertake any form of innovation in SA firms is similar to that in other states, of the order of 50 percent. Like other states, that effort is dominated by attention to process innovation, rather than creation of new products or services. Innovation is mainly targeted at the local market.

Skills identified as required for innovation are mainly those related to management rather than technology. Hardly any of the innovation is transformative (most only new to the firm, not even to the South Australian industry).

Key sources of ideas are internal including customers.The contribution of competitors scores higher than that of external research providers.

However, SA firms are also outliers in several respects. They:

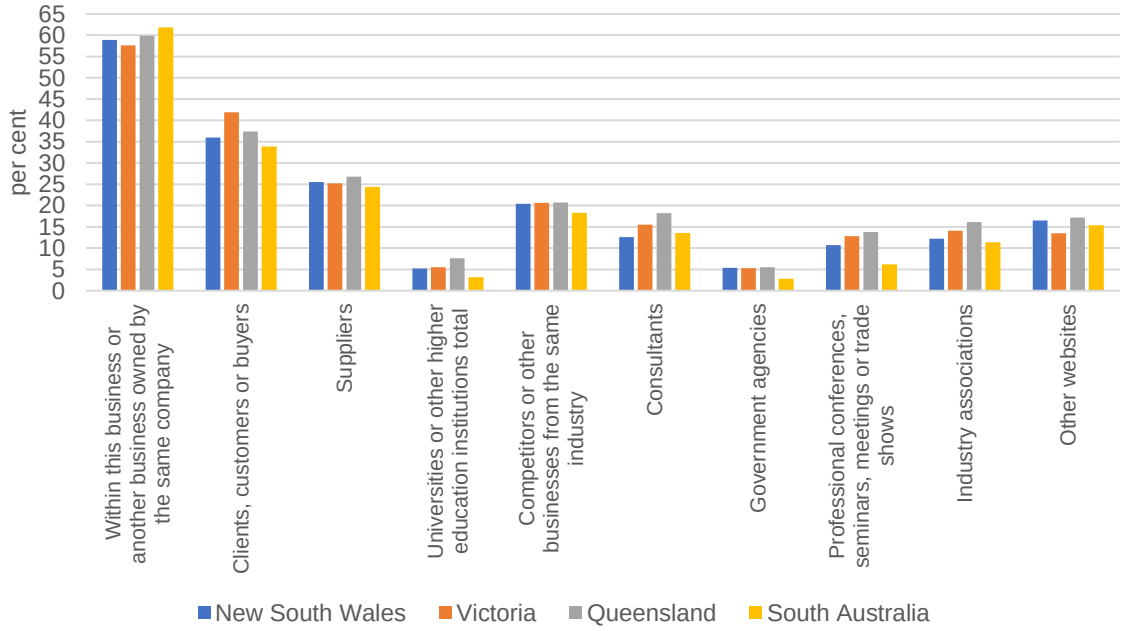
- make relatively small use of government support
- are less likely to seek additional funds for innovation
- use a narrower source of funds for innovation
- look more likely to focus on one project at a time and have less activity in the innovation pipeline

[19] Australian Bureau of Statistics (ABS) (2022) 'Characteristics of Australian Business, 2020-21'

- put more weight on lack of access to skills and on ‘uncertain demand’ as barriers to innovation
- make far less use of universities as a source of ideas;
- tend to source innovation ideas from within their own business or business group, and are much less likely to drawn on external sources of innovation ideas; and
- undertake far less joint R&D with collaborators and focus more on sharing facilities or undertaking joint marketing.

South Australian firms source ideas from inward oriented sources – within the business group or from clients or suppliers. External sources are relatively less important, including consultants, government agencies, industry associations etc. (see Figure 12).

Figure 12: South Australian firms are much more inward looking in their sources of ideas for innovation
Sources of ideas for innovation, innovation active firms, per cent of total



Source: ABS (2022), Characteristics of Australian Business, 2020-21

Universities score (extraordinarily) low for all states as a source of ideas, but this share is even lower in SA. Only 3 per cent of South Australian innovation active firms identified universities as a source of ideas for innovation.

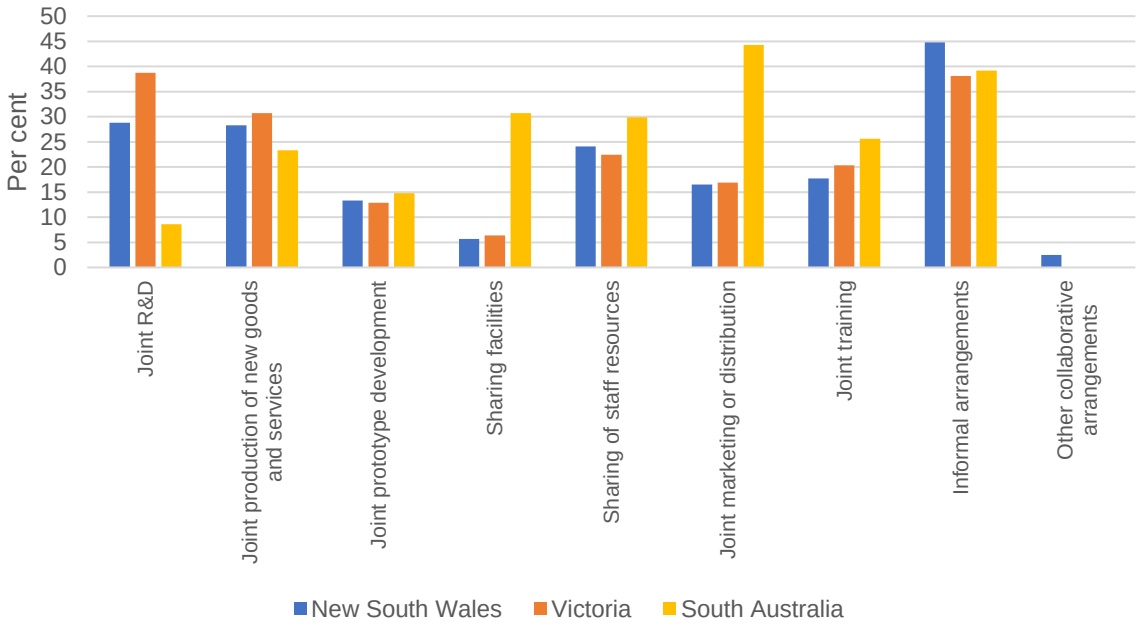
Even more concerning, when Universities *are* used, passive engagement such as access to journals and publications, and academic conferences are reported to be more important than other, more direct, engagement with the university. Only one per cent of innovation active South Australian firms report having drawn on joint research with a university. As only 50 per cent of South Australian firms are innovation active, this means that only one firm in two hundred collaborates with universities on innovation.

Finding 11: South Australian businesses are very inward looking in their innovation, with significantly fewer South Australian innovation active firms drawing on universities as a source of ideas for innovation compared to businesses interstate.

Innovative South Australian firms are much less likely to undertake joint R&D than their peers interstate.

SA is also an outlier with respect to the types of collaborative arrangements (see Figure 13). SA firms are much more likely to be involved in sharing facilities or in joint market arrangements. They are much less likely, by a factor of 3 to 5, to be involved in joint R&D.

Figure 13: Innovative firms in SA have a very different pattern of collaboration, with joint R&D significantly less common
Types of collaborative arrangements around innovation, innovation active firms, per cent of total



Source: ABS (2022), Characteristics of Australian Business, 2020-21

Finding 12: South Australia's business sector is not in a position to be the main driver of innovation or of the research business connection at this stage.

1.4 South Australia's research workforce

An economy's ability to innovate depends, in part, on the resource effort devoted to carrying out innovation-related activity. These resources primarily comprise spending on research and development (R&D) and the local labour force.[20] The ability of the local labour market to contribute to innovation depends not only on the number of people employed to carry out R&D activity, but also the quality of human capital in terms of the knowledge and skills held by workers. For example, an analysis of innovation activity across Australian industries found that the share of persons with a degree or post-graduate degree was around a third higher for high-innovation industries compared to medium- or low-innovation industries, notwithstanding some considerable variation within the high-innovation industries themselves.[21]

In addition to obtaining high levels of formal education and training, having sufficient skills within specialised knowledge areas also contributes to innovation capacity. For example, the development of new goods, technologies and services generally requires skills in relation to science, engineering,

[20] Stern, S., Porter, M., and Furman, J, 2000, *The Determinants of National Innovative Capacity*, NBER Working Paper Series, Working Paper 7876.
[21] Toner, P, 2011, *Workforce Skills and Innovation: An Overview of Major Themes in the Literature*, OECD Directorate for Science, Technology and Industry (STI), Centre for Educational Research and Innovation (CERI).

technology and design.[22] Attracting more people to study science, technology, engineering and mathematics (STEM) has become a central pillar of many OECD innovation strategies given the fundamental role these fields play in generating new knowledge.[23]

This means that the number of people in a region with innovation relevant skills, and particularly the number of people in innovation jobs, can act as both an indicator of the level of current innovation activity in the region, and as a measure of the region's capacity innovate.

The relative share of employees with innovation skills working in an industry, or the relative share of national employees working in an innovation occupation in the state can highlight areas of strength and weakness in the state's innovation system.

But skills are not just an indicator of current success, they also determine the extent to which a firm (and in aggregate and industry) can draw innovation from other contexts into their firms, and develop novel innovation internally.

Educational Attainment – PhDs and Masters

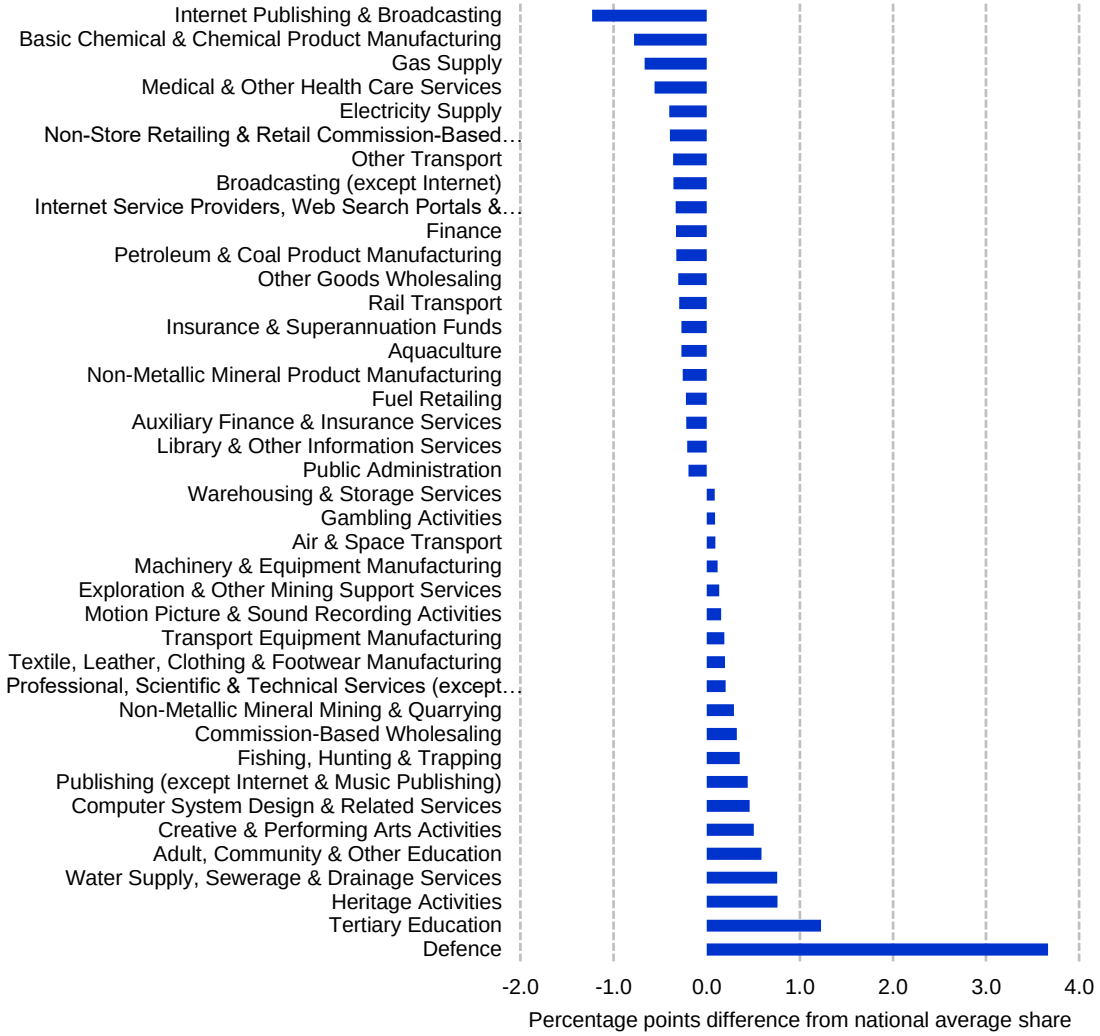
South Australia employs a share of PhDs in its workforce in line with the national average. The defence sector is particularly likely to employ PhD qualified people relative to its peers interstate.

South Australian workers are just as likely to have a PhD as workers for Australia as a whole with 1.3 per cent of employed people in South Australia having a doctoral degree as their highest level of educational attainment (see Figure 14).

There are some notable differences in the propensity for workers to have a doctoral degree between South Australia and Australia as a whole among certain industry sectors. In 2021, the share of workers with a PhD in the South Australian defence industry was 3.7 percentage points above the national average. Tertiary education, heritage activities, and water supply, sewerage and drainage services (0.8 percentage points) were other areas of relative over-representation.

[22] Organisation for Economic Co-operation and Development (OECD), 2011, *Skills for Innovation and Research*, OECD Publishing. <http://dx.doi.org/10.1787/9789264097490-en>
[23] Organisation for Economic Co-operation and Development (OECD), 2016, *OECD Science, Technology and Innovation Outlook 2016*, OECD Publishing, Paris. <http://dx.doi.org/10.1787/sti_in_outlook-2016-en>

Figure 14: Defence sector employees in South Australia are much more likely to have a PhD than the national average, and workers in IT and chemicals are much less likely
Largest Over- and Under-representation of People with a Doctoral Degree by Industry Sector, Difference in share of total industry employment, South Australia relative to Australia – 2021



Source: ABS (2021), 2021 Census - counting persons, place of usual residence, [Census TableBuilder], accessed 15 February 2023

But employment of people with a Masters degree is a different story. The share of the SA workforce with a Masters degree is well below the national average, and this is true for almost all industry sectors.

While overall an equal proportion of workers in South Australia had a doctoral degree compared to the national average in 2021, a different story applies for master's degree recipients: a much lower share of workers in South Australia had a master's degree compared to the national workforce (5.8 per cent versus 7.6 per cent). The higher national figure largely reflects that workers with a master's degree comprise a relatively larger proportion of the workforce in both New South Wales (9.1 per cent) and Victoria (8.8 per cent), see Figure 15.

Figure 15: South Australia has fewer employees with Master's degrees than the national average, with the gap being particularly large in IT and finance
Largest Over- and Under-representation of People with a Master's Degree by Industry Sector, Difference in share of total industry employment, South Australia relative to Australia – 2021

Source: ABS (2021), 2021 Census - counting persons, place of usual residence, [Census TableBuilder], accessed 15 February 2023

Differences in industrial structure between the states would in part explain South Australia's relatively lower share of workers with a master's degree. NSW and Victoria have above average shares of employment in sectors where master's degrees are most common including 'finance', 'professional, scientific and technical services', and 'computer system design and related services'.

However, differences in industry structure do not fully account for the lower degree of workers with a master's degree observed for South Australia. The state had a lower share of workers with a master's degree across almost all industry subdivisions.

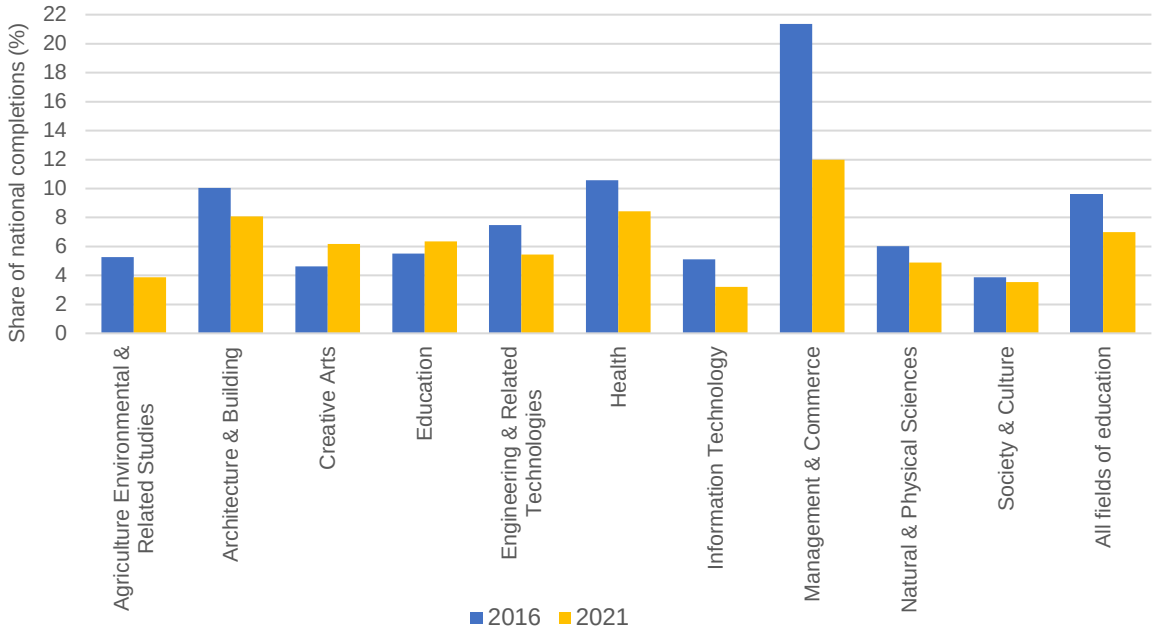
Finding 13: South Australian workers are less likely than average to have a post-graduate qualification, largely due to very low levels of South Australian workers with Master's degrees.

Gaps in post-graduate employment aren't due to a lack of South Australians completing postgraduate degrees.

Supply factors within the state do not appear to explain the disproportionately low levels of South Australian workers with postgraduate qualifications. Total postgraduate completions for domestic students at South Australian universities have been at or above our population share for some time (see Figure 16).

Finding 14: The lower share of employees with postgraduate qualifications is not because fewer South Australians undertake postgraduate qualifications, instead it appears to be a lack of local employment opportunities.

Figure 16: Postgraduate completions in South Australia match their national share, but are low in agriculture, IT, engineering and science
Postgraduate completions by broad field of education, 2016 and 2021, share of national total



Source: Australian Government Department of Education (2022) Award Course Completion Pivot table, available at https://www.education.gov.au/higher-education-statistics/student-data/selected-higher-education-statistics-2021-student-data*, accessed 5 May 2023*

There are however significant differences by field of education with significantly fewer South Australians (both in 2016 and in 2021) completing postgraduate degrees in Information Technology; Agriculture Environmental and Related Studies; Society and Culture; Engineering and Related Technologies; and Natural and Physical Sciences.

Finding 15: South Australian universities produce significantly fewer postgraduates in Information Technology; Agriculture Environmental and Related Studies; Society and Culture; Engineering and Related Technologies; and Natural and Physical Sciences than the national average.

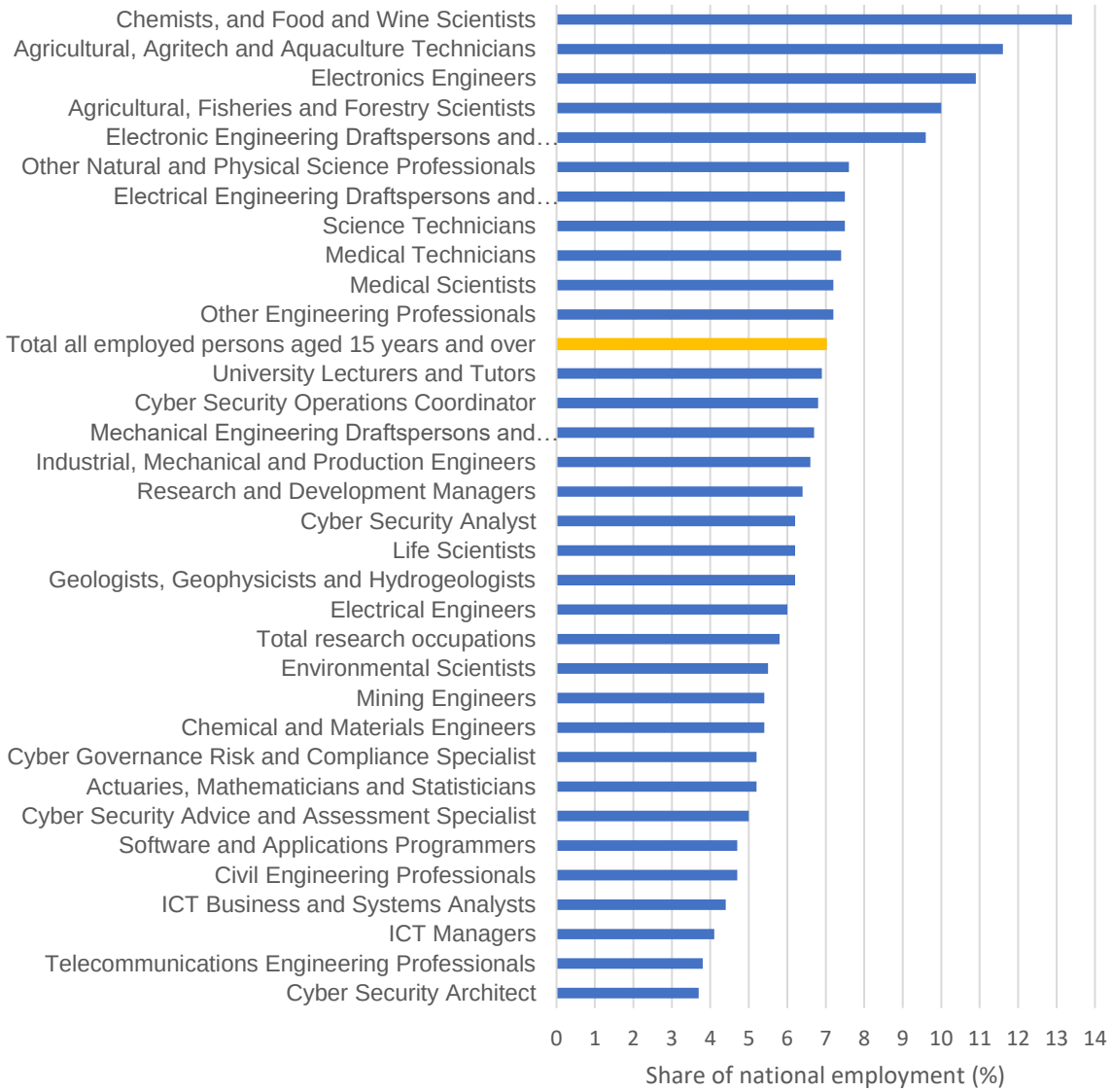
Innovation Occupations

Another way to look at the employment data is to focus on people employed in specific 'innovation' occupations rather than the qualification levels they hold.

Significantly fewer South Australians are employed in 'innovation' jobs. If our share of innovation jobs was in line with the national average, 7,000 more South Australians would be employed in an innovation job today.

Figure 17 shows South Australia's share of the national workforce for the key innovation occupations. The state was home to 5.8 per cent of the science and innovation workforce in 2021, which was well below the state's share of all employed persons (7.0 per cent). As a result the capacity of the state to produce and implement new ideas, and to capture existing ideas and technology from the rest of the world, is diminished.

Figure 17: South Australia has a disproportionately low share of people employed in innovation occupations
Key innovation occupations, SA share of national employment, 2021



Source: ABS (2021), 2021 Census - counting persons, place of usual residence, [Census TableBuilder], accessed 15 February 2023

Finding 16: South Australia has significantly fewer people employed in innovation jobs than the national average, indicating a lower level of innovation compared to other states, and a lower capacity to generate and implement innovations.

When measured against their relative shares of the total national workforce, the research workforce tended to be over-represented in New South Wales (33 per cent), Victoria (28 per cent), and the Australian Capital Territory (3.5 per cent), and under-represented in South Australia (5.8 per cent) and Tasmania (1.4 per cent).

Not only does South Australia lag well behind its population share for innovation jobs in the 2021 data, there is also no evidence of overall improvement. It is not possible to do a perfect comparison across Censuses[24] but based on the available data South Australia's share of national innovation jobs has actually declined slightly from 6.0 per cent of the national total in 2016 to 5.8 per cent in 2021.

South Australia's deficit in the innovation workforce is relatively substantial. If we were even able to reach the national average, there would be 7,000 more South Australians employed as scientists, computer programmers, and engineers today.

If we were to achieve the concentration of workers in innovation occupations seen in NSW or Victoria there would be 10,000 more South Australians employed in these occupations.

South Australia's workforce data confirms the state has innovation strengths in wine, agribusiness and defence. But it also highlights weaknesses in our innovation capacity in ICT (including cybersecurity), civil engineering and mathematics.

South Australia has innovation workforce strengths in the areas of agriculture, food, agribusiness, and electronics, with employment shares well above the state's population share.

On the other hand, the occupational profile reveals some areas where South Australia has a notable gap in workforce capacity. In particular, information and communications technology (ICT), software programming cyber security, civil engineers, and telecommunications engineers are poorly represented within South Australia's workforce.

Finding 17: South Australia has a strong workforce in key innovation occupations linked to the wine sector, agribusiness and defence, suggesting that those sectors are competitive nationally in innovation. But the state has significantly fewer people employed in innovation jobs in key occupations such as cyber security, software programming, and civil engineering suggesting important gaps in innovation capacity.

Access to global entrepreneurial talent

International students provide an underutilised pool of potential entrepreneurial ideas and skills for South Australia. As a state we should be doing all we can to support them in commercialising their ideas here in South Australia. The recent introduction of the Business Innovation and Investment (Provisional) visa (subclass 188), Entrepreneur stream (188E visa) as a state nominated visa class means that there is now a visa available with a pathway to permanent residency (if the conditions are met) that is tailored for entrepreneurs, rather than high-net worth, experienced, business people. However, we have heard that processing delays, and a limited number of positions available to South Australia, have significantly reduced the scope for this visa to be used to retain international students and attract inward migrants with plans to develop start-ups in areas of state government priority. Barriers to international students securing skilled worker visas with a pathway to employment also reduces the potential for migration to support South Australian innovation.

[24] The publicly available 2016 Census data does not report at the 6-digit occupation level which means the cyber security occupations cannot be disaggregated from the broader occupation group of 'Database and Systems Administrators, and ICT Security Specialists' but as these cyber security occupations were only 1.5 per cent of national innovation jobs in 2021 it will not make a material difference to the comparison.

Finding 18: Difficulties in accessing visas with a pathway to permanent residence for entrepreneurs, and current international students, mean that migration is not fulfilling its potential role in supporting innovation in SA.

Recommendation 1: The South Australian Government should work with the Commonwealth Government to maintain a specific entrepreneurial pathway in the skilled migration system as part of the response to the 2023 Review of the Migration System, particularly for international students, and to improve pathways for international students more generally.

1.5 This inquiry

The data set out in this chapter has painted a long-term picture of a state stuck in a low growth trajectory, falling behind the eastern states in economic output and in wages.

As well as being low growth, the South Australian economy shows little evidence of being internationally competitive outside of commodities. Exports are almost all in commodities and basic metals. High value-added, complex, goods and services exports have actually fallen by over $1 billion in real terms over the decade.

Productivity is the most important long-run driver of economic growth, but South Australia's productivity performance has been weak. The data shows that South Australia has fallen further behind the global 'technology frontier'. It is this failure to effectively apply the technology already available that has led to the significant slowdown in growth over the last decade. The available evidence suggests that this is because of consistently low levels of innovation and dynamism in South Australian businesses.

We know from international experience that a strong culture of research and innovation in business, and deep connections between regional research institutions such as universities[25] and the local business sector is critical to keeping pace with the global frontier of technology.

This inquiry is focused on that latter driver of business innovation. It aims to support the South Australian Government by undertaking a thorough examination of how research is turned into increased competitiveness for our state, including:

- the importance of research and knowledge diffusion for economic competitiveness;
- the effectiveness of current links between research institutions (including universities) and business, and of government programs supporting research and innovation; and
- what the State Government can do (including in collaboration with others) to help bridge the gap between the generation of knowledge and those who could put it to use.

The right policy settings in this area can make a significant contribution to addressing the productivity growth and income gaps with the rest of Australia, increasing the complexity and diversity of the state's economy, and reducing the risks of excess dependence on our agricultural and mining sectors for our international competitiveness.

The goal is to significantly increase the number of South Australians who are employed in high-wage jobs, and in jobs which are more secure because they are innovating with the global economy rather than at the mercy of international economic trends.

[25] In addition to its research universities, South Australia also has a number of substantial public research institutions such as SAHMRI. In most cases through the report the use of the word universities should be taken to also encompass the public research institutes.

Chapter 2 examines the potential drivers of innovation in South Australia, including the state's business community, exiting innovation policies, the state's universities, and its innovation workforce. It also outlines the international evidence on how to optimise university-business links around innovation.

Chapter 3 then outlines our conclusions of the set of policy interventions that appear to be best placed to improving the link between the state's research institutions, and researchers, and business to foster a culture of world-class business innovation in the state.

2. How to improve the connection between universities and the broader South Australian economy

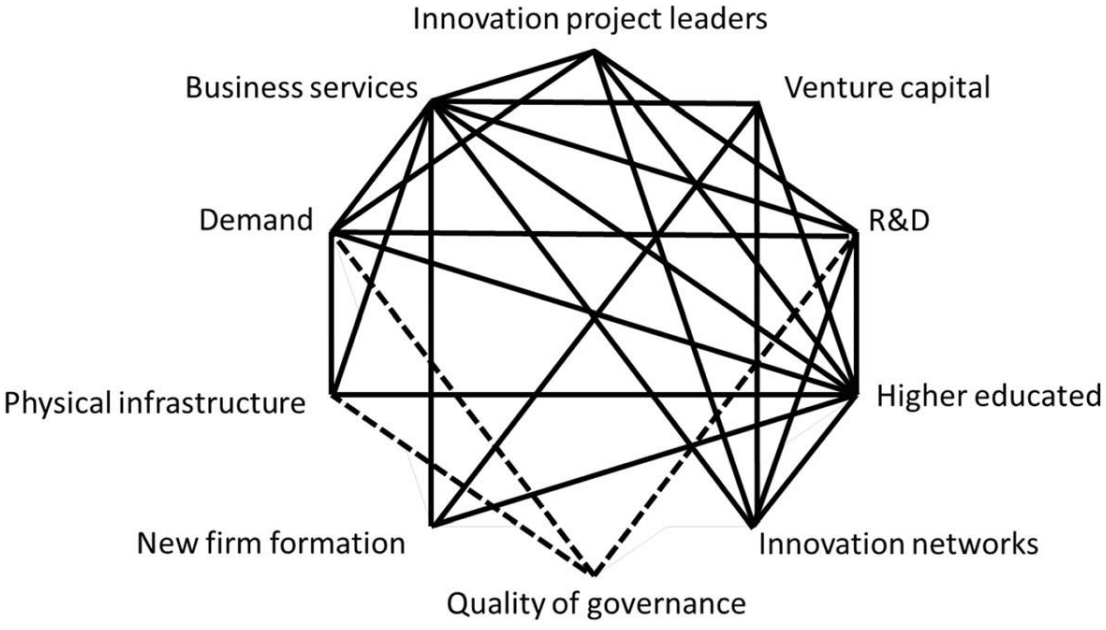
> … though universities do best when they have strong international partnerships, these are greatly strengthened in terms of institutional support when they bring manifest benefit at home. Research can lead to positive community outcomes and supporting jobs. It is possible to increase educational opportunities across university degrees or international study opportunities and it is local impact that is more noted and is most crucial. … it is as important as ever for universities to be both local and global and for the global to benefit the local.[26]

Firms undertake innovation within the broader local society and economy, and a range of local factors determine how effectively they are able to innovate.

The extent and effectiveness of business innovation is determined by a range of broader influences such as access the skilled labour needed to implement innovation; the degree of competition within local industry, and access to external markets; and the quality and extent of connections to local research institutions to knowledge and inventions.

Innovation within firms does not take place in a vacuum. The extent to which a firm can successfully innovate is significantly influenced by internal factors such as its financial resources, the level of competition in its industry sector, and the quality of its management and workforce. However, the potential to innovate is also affected by the range of external factors such as access to business services, the scale and quality of the local innovation workforce, local leadership and governance, access to finance, the amount of relevant research taking place in local institutions, and how easy it is for firms to connect to that research and knowledge (see Figure 18).

Figure 18: Elements of the innovation ecosystem



Source: Stam and Van de Ven (2021)[27]

Truly successful innovative regions require all the elements supporting business innovation to be working effectively and interactively. But this also means that business innovation performance can

[26] Byrne, E. and Clarke, C. (2020), *The University Challenge: Changing universities in a changing world*, Pearson International Content, e-book, p. 101
[27] Stam, E. and A van de Ven (2021), 'Entrepreneurial ecosystem elements', *Small Business Economics*, 56: 809-832

be improved through initiatives targeting other drivers of local innovation; business innovation policy does not have to be exclusively focused on firms.

Looking at the South Australian innovation system, some elements appear to be in good shape. Quality of governance and physical infrastructure are good, and business services are readily available (both in SA and from providers located interstate). Most of the feedback we have received is that venture capital funding is readily available to South Australian start-ups and scale-ups with a clear market opportunity, although a number of stakeholders identified gaps in the availability of seed funding.

The Commission's assessment is that there are currently gaps in some other key elements of South Australia's innovation ecosystem, including a lack of innovation leadership, less developed innovation networks (particularly between research institutions and business), and below average rates of R&D and new firm formation.

Finding 19: South Australia has gaps in its innovation system around innovation leadership, innovation networks, R&D and new firm formation.

Finding 20: Based on the evidence, the South Australian economy is materially less innovative than the national average. This is a significant structural economic weakness.

2.1 Government innovation policy

2.1.1 South Australian innovation investment

At least as far back as the Multi-Function Polis in 1987 South Australian governments have sought to lift the level of innovation and productivity in the state; to what unfortunately appears to be limited effect given the trends we observe in productivity.

Turning to current policy efforts, the lead South Australian Government agency on innovation policy is the Department for Innovation, Industry and Science (DIIS). It is responsible for managing the delivery of the EXCITE strategy (focused on research) and the FIXE strategy (focused on entrepreneurialism). The Chief Scientist of SA and the SA Chief Entrepreneur are both located within DIIS and form part of its policy development system.

The industry, innovation and science component of the Department's budget includes total expenditure of $37.6 million in 2022-23, including grants and subsidies of $11.8 million. Adjusted for population, this is lower than innovation expenditure in NSW and significantly lower than the innovation expenditure in Victoria.

For 2022-23 the NSW budget allocates $252.4 million for the Future Economy fund, matching NSW's level of per capita expenditure would give South Australia an innovation budget of $56.3 million, one and a half times the current budget. Victoria has allocated $473.2 million to 'Industry, Innovation, Medical Research and Small Business' in 2022-23; on a pro-rata basis matching this expenditure would give South Australia an innovation budget of $130.0 million three and a half times the current budget allocation. Each of these states also has significant investment in infrastructure relevant to their innovation performance.

Other innovation support policies are located within Primary Industries and Resources SA, the Department for Trade and Industry and SA Health.

South Australian Government innovation programs are spread too thin making them on average under-resourced and harder for businesses to identify the best program for their needs.

The supports currently offered by the South Australian Government can be broadly characterised as having significant breadth, but as a consequence many of the individual interventions (and indeed individual objectives) have relatively limited resources allocated to them. This also makes the innovation support system harder to navigate for businesses or researchers seeking the most appropriate programs and supports.

Finding 21: South Australia has a large number of innovation programs, but most are small and have limited funding. This makes them harder for business to navigate, and reduces their impact.

South Australian Government innovation funding encompasses two large research institutes, the SA Health and Medical Research Institute (SAHMRI) which receives operational funding from SA Health as well as competing for Australia Government grants schemes and commercial income, and the South Australian Research and Development Institute (SARDI) which receives operational funding from PIRSA as well as competing for industry research corporation funding. In addition, the South Australian Government funds a range of innovation grant and support programs. Those examined by the Commission as part of this inquiry include:

Australian Institute of Machine Learning (AIML) – DIIS

AIML was established as a research centre jointly funded by the South Australian Government, an initial industry partner (Lockheed Martin) and the University of Adelaide. This centre directly supports research and development projects with South Australian businesses and government and aims to attract international businesses that result in improved productivity and efficiency and new products and services based on artificial intelligence.

The program aims to deliver an innovative model for effective and sustainable research collaboration between universities, industry (including the defence industry), South Australian SMEs and government.

South Australian Government funding for AIML was allocated across four programs:

- Artificial Intelligence Skills Development
- Defence Industry Engagement
- Government Efficiency Engagement
- SME Engagement and Global R&D

Brandon BioCatalyst, South Australian Government contribution – DIIS

Brandon BioCatalyst is a life science investment collaboration with over $800 million under management. It brings together over 50 medical research institutes and hospitals in Australia and New Zealand with major Australian superannuation funds, the Australian and New Zealand governments, as well as Australian state and territory governments, into a research and investment collaboration. The program has had seven South Australian investments. The South Australian Government funding is provided through Stream 3 of the Research and Innovation Fund (RIF) and enables SA based projects to be eligible for investment from the fund**.**

External Innovation and Translation Intermediary (MTP Connect) – DIIS

The program, established as a budget measure in 2022/23, provides direct financial support to MTP Connect to undertake the role of external innovation and translation intermediary for the Adelaide BioMed City (ABMC) precinct. The program is funded for 3 years and is designed to drive research,

innovation, and translation amongst members of ABMC and more broadly across South Australia's health and medical industry sector, through the provision of strategic intermediary functions.

GigCity – DIIS

The program, established in 2016/17 and currently funded until 2023/24, aims to support small, yet potentially high-growth, firms by making available high-speed (1 to 10 gigabits per second) and high-quality broadband services through a telecommunications network that connects the state's major education and innovation precincts. The program currently provides broadband services to businesses and organisations in 23 designated innovation districts throughout the metropolitan area and in some regional centres, such as Mount Gambier.

Global Expansion Program (GEP) - DTI

The Global Expansion Program (GEP) aims to increase the number of South Australian companies exporting higher value export products and services and pursuing high-growth through persistent and sustainable exporting strategies. The GEP provides up to $50,000 per company, to support high-growth, export-ready, South Australian businesses to build their export capability and capacity and become the state's next global leaders. 50 businesses have participated in the program to date, with 30 businesses securing $50,000 grants.

Go2Gov – DIIS

The program, which has now closed to new applications, drew on the Economic and Business Growth Fund (EBGF) and allowed government agencies to fund trials of, or pilot programs for, start-up or early-stage business solutions developed by SA businesses. Eligibility for the program was confined to business solutions that directly addressed a challenge or problem identified by the funding agency. The program was divided into two pathways: matched and unmatched projects.

Go2Gov was intended to support start-ups and early-stage businesses with scalable potential by giving them the opportunity to sell innovative products and services to government. Successfully delivering a product or service to a reference customer is often a critical prerequisite for the growth of early-stage businesses. Go2Gov, by making it possible for local start-ups and early-stage businesses to secure a government contract, can help businesses to build a track record of success and attract additional investors.

Industry Doctoral Training Centre Program – DIIS

The EXCITE Industry Doctoral Training Centres (IDTCs) is an initiative, drawing on funding from the Research and Innovation Fund, to facilitate collaboration between industry and the university sector to deliver greater levels of innovation in SA. It is also intended to strengthen the state's STEMM and R&D workforce. The IDTC program consists of two pilots: an IDTC stream covering the broad field of biomanufacturing and a parallel stream focused on developing the industrial application of quantum technologies. Both streams will accept up to a maximum of 15 enrolments, with each student to receive a stipend of $35,000 per annum over four years. The South Australian Government will contribute $15,000 to each stipend, with the remainder, to be split evenly, coming from the program's university and industry partners.

The IDTC model, particularly its industry partnership component, is based on an initiative developed and implemented by the UK's Engineering and Physical Sciences Research Council (EPSRC).

Manufacturing Growth Accelerator (MGA) – DIIS

The South Australian Government has provided funding to establish and deliver a Manufacturing Growth Accelerator (MGA) to be located in Flinders University's Factory of the Future facility at the Tonsley Innovation District.

Established in 2022 and drawing from the Manufacturing Innovation Grant Program**,** the MGA is funded for 5 years until August 2027. The accelerator research projects will be undertaken by Flinders University researchers in collaboration with South Australian SMEs and key industry partners and will support SMEs to develop and strengthen the necessary capabilities to secure customer contracts and participate in global supply chains in the defence sector and other sectors such as, but not limited to, medical devices, energy, circular economy, and construction.

The MGA is designed to fund activities including; innovative applications of advanced joining technologies including welding and adhesives; innovative applications of advanced additive manufacturing technologies; innovative applications of advanced materials such as lightweight metals, polymers and composites; worker centric digital technologies for safety, productivity and quality; human-machine learning to support growth of advanced manufacturing; and skill formation in support of digital transformation, amongst others.

Medical Device Partnering Program (MDPP) – DIIS

The South Australian Government has provided financial support to the Medical Device Partnering Program (MDPP) which supports the development of new, high-tech medical devices through facilitating collaboration between researchers, industry, end - users and government, and undertaking rapid research projects that demonstrate proof of concept and de-risk ideas.

Based within the Medical Device Research Institute at Flinders University and commencing in 2018 with a current expiry of June 2024, the program is intended to provide support to start-ups such as research and experimental development and other activities that support the development of innovative medical and assistive technologies with an identified clinical need, sound technical solution and viable market opportunity. Broadly, the MDPP is intended to be a product incubator for new technology ideas and concepts, providing outcomes and filling the pipeline for business incubators.

National Collaborative Research Infrastructure Strategy (NCRIS) co-investment – DIIS

The National Collaborative Research Infrastructure Strategy (NCRIS) is a Commonwealth initiative that manages Australia's national research infrastructure (NRI) and funds advanced equipment, data, and expertise to embrace new technologies and develop high value-added products and services for the global marketplace.

As part of a state budget allocation, the South Australian Government has co-invested with a number of research organisations including the three universities and SAHMRI in 11 NCRIS facilities located in South Australia. NCRIS funding is considered against Australian Government priorities, including at least one of the nine priority areas in the 2016 Roadmap and at least one of the priority investments in the 2018 Investment Plan. The facilities support multiple innovation sectors including agriculture, food and wine, health and medical, defence and space, advanced manufacturing, environment and energy. The users of these facilities and their research outputs come from academia, industry and State Government agencies.

Research and Innovation Fund (RIF) – DIIS

The Research and Innovation Fund (RIF) was established in 2019 as the consolidation of a number of other funds including the Research Commercialisation and Start-up Fund (RCSF) and is currently funded until 2027. The program attempts to address the lack of investable early-stage companies in South Australia with a grant program to help translate innovative ideas into investable companies and to build a pipeline of quality deal flow for later stage investors.

The program operates under the RIF Investment principles, and effectively has three streams of funding across the innovation system spectrum. This includes funding for research to start-up

businesses via seed start-up funding which aims to generate significant benefits such as revenue growth, export income, local employment or other social benefits to South Australia.

South Australian Cooperative Research Centre Assistance Program – DIIS

The South Australian Cooperative Research Centre (CRC) Assistance Program provides South Australian Government support to South Australian participants in the Commonwealth Government CRC Program, which supports industry-led research collaboration aimed at solving industry-identified problems and improving the competitiveness, productivity, and sustainability of Australian industries.

DIIS currently provides funding to ten CRCs that are either headquartered or have a significant node in South Australia (5 headquarters and 5 nodes). In 2021/2022, SA was successful in three CRCs led bids with a total value of $633 million over 10 years. The program receives its funding from Stream 1 of the RIF.

SA Innovation Challenge – Augmenting Ability – DIIS

The program, approved in January 2020, is an element of the broader EXCITE innovation strategy, with the primary aim of supporting the development of new technologies and products. These are intended to provide solutions to 'challenges' identified by South Australian Government agencies. In addition, the program seeks to produce in-kind investment from applicants and contribute to the creation of new jobs in the advanced manufacturing, R&D and hi-tech sectors.

The program is designed to attract interest from both the South Australian public research sector and local industry sectors, including start-ups. The program is agnostic about whether applicant businesses are locally, nationally or foreign owned, but businesses are expected to demonstrate a capacity to deliver their proposals using local supply chains and in partnership with South Australian businesses and institutions.

South Australian Venture Capital Fund (SAVCF) – DIIS

The South Australian Venture Capital Fund (SAVCF) was established in 2017/18 to support local businesses with high-growth potential to secure funding to enable their growth into national and global markets and strengthen the competitiveness of local entrepreneurs to attract private co-investment. Additionally, it is expected to earn a commercial rate of return for investors (including the South Australian Government) commensurate with industry standards for early-stage venture capital funds.

The SAVCF is currently managed by Artesian venture partners and is structured as a co-investment fund requiring eligible companies to match at least 50 per cent investment from other sources. While the SAVCF does not have any restrictions on sectors or industries there are certain exclusions related to property development, finance, insurance and construction (other than technologies within these industries). It also requires that eligible companies have at least 50 per cent of its assets and 50 per cent of staff located in South Australia for a 12 month period from the initial investment date. As of December 2022, the SAVCF has invested in 10 companies and supported 440 jobs in the investee companies.

Startup Hub – DIIS

Located in the Lot Fourteen innovation precinct, the Startup Hub was established in 2019 as an incubator targeted at scale-up firms. A key objective of the Startup Hub is to provide a central, co-located space for entrepreneurs, startups and scaling businesses to access customers, networks, mentors, experts and investors. Stone & Chalk provides a full-service model of innovation services to startups, scaleups, corporations and governments. This includes the provision of structured programs and facilitation of access to customers, capital, talent, expertise, community and insights.

Tenants pay an access fee for the facilities broadly in line with those charged by co-working spaces, that varies depending on the amount of office space needed, and whether it is fixed or 'hot desked'. The incubation services are fully funded through DIIS's contract with Stone and Chalk.

UniSA Future Industries Accelerator Testlab – DIIS

The Future Industries Institute (FII), Testlab was established at UniSA in 2016 as an innovative model for effective and sustainable research collaboration between universities and business. The South Australian Government provided financial support over a three year period at the 2016/17 State Budget to support industry engagement activities at the FII. These include utilising academic expertise and research infrastructure to address pertinent industry challenges, build research and development capacity in business and develop entrepreneurial capacity in universities. A key aspect of this model is to enable co-creation, co-location and sharing of resources between business and the university.

Between 2016/17 and 2018/19, the programs funded mobility grants for researchers from industry to be placed in FII and vice versa; industry partner access to FII research infrastructure; and a R&D voucher program and a further funding for a program manager. This program ended in January 2023.

University of Adelaide CNRS exchange – DIIS

The CNRS exchange program is a provided through the RIF stream 1 with co-investment from the University of Adelaide and industry partners. It is aimed at covering the costs of visiting researchers that will enable the University of Adelaide to build research and industry collaboration projects and reciprocal research exchanges with the French National Centre for Scientific Research (CNRS) and industry partners.

A key aim of the grant is to establish collaboration that may lead to the creation of new CNRS International Research Projects (IRPs) or International Research Laboratories (IRLs). The program is funded for four years (September 2022 - August 2026). The program focus areas include, CO2 catalysis, hydrogen, space and earth observation, and an IRL Crossing (CNRS' first international research laboratory in Australia).

University of Adelaide Future Industry Making Fellowships Scheme (FIMFS) – DIIS

The South Australian Government provides financial support for the Future Industry Making Fellowships Scheme (FIMFS) with additional funding from the University of Adelaide that will cover the costs of recruiting a minimum of two globally leading research talent (fellows) relevant to existing and emerging South Australia industry to build local capacity and capability. A specific requirement of the grant is for the fellows having a track record of working with industry and will continue to work closely with industry.

A lump sum grant was provided to the University of Adelaide to recruit two fellows at the Institute for Machine Learning and the Institute for Photonics and Advanced Sensing. The funding for the FIMFS commenced in June 2022 and will end in October 2029 and is expected to contribute to attracting top research talent to South Australia that will lead to high quality industry-research collaboration and engagement.

Wine Export Recovery and Expansion Program - DTI

The Wine Export Recovery and Expansion Program was developed to improve market diversification for South Australian wine exporters following the effective closure of the China market due to tariffs along with other negative impacts, such as COVID-19, the 2019 bushfires, the global

shipping crisis and the 2021 grape vintage oversupply.[28] The program caters to large, medium, and small wine exporters through different initiatives.

In order to better understand the relative effort going into different aspects of research and innovation policy, the Commission has mapped the programs supported by the South Australian Government aimed at supporting business innovation against the framework developed by the OECD in their review of university-industry collaboration, see Figure 20.[29]

Amongst the range of programs implemented, a small number of types of support were very common:

- Financial support for universities to host industry researchers;
- Funding of infrastructure and intermediaries for collaboration
- Networking support to build industry/research linkages
- Outreach activities to raise awareness of research sector/ industry opportunities; and
- Subsidies/grants for industry R&D and innovation

Despite the wide range of programs implemented, and a policy focus on business innovation for the past 40 or so years, neither productivity nor business innovation has caught up to the rest of the country. The persistent weakness of business innovation in South Australia suggests that the current set of policies as a whole, including innovation precincts, have not been effective in achieving their objectives.

Finding 22 South Australian innovation programs in aggregate show no evidence to date that they have achieved their objectives.

The plethora of funding streams and the extent to which they nest within one another creates the potential for double counting of resources allocated to supporting innovation in South Australia. Initial calculations suggest that across the programs operated by DIIS, DTI and PIRSA to support business innovation (including the operating grant for SAHMRI and SARDI, and the HMRF funding allocated to SAHMRI, but excluding spending on Lot 14) there is of the order of $29.9 million currently being allocated by the South Australian Government in grants to innovation programs and research institutes. These policies could usefully be consolidated both to make it easier for SA businesses to identify support available, and also to free up resources for higher priority activities.

In considering where to potentially redirect funds from, any existing programs that deliver similar support to Commonwealth Government programs (such as many of the direct grants to business for export facilitation or innovation investment), operational funding (rather than outcome based, or competitive, funding) for independent research institutes, and programs where the spend is very small all warrant a thorough examination to ensure they are productive for the state and are delivering value for money.

Recommendation 2: The South Australian Government should consolidate its existing broad portfolio of innovation grant and support programs (including export grants) into a much smaller number of more focused programs, using half of the current funding allocation. Funding freed up by this process can be redirected towards the university reform and growth fund (see Recommendation 10).

[28] The effective closure of the China market represented over 40 per cent of all South Australian wine exports ($800m annually).
[29] OECD (2019) 'Science-Industry Knowledge Exchange: A Mapping of Policy Instruments and their Applications', OECD Science Technology and Industry Policy Papers', Number 66

Figure 19: Mapping of South Australian Government programs on innovation to the OECD framework

Program or program element	Subsidies/grants for industry R&D and innovation	Vouchers/grants for firms to purchase R&D services from universities	Tax incentives for firms purchasing research from universities	Financial support to firms to recruit PhDs and post-docs	Performance based funding systems for university linkages with industry	Public private partnerships creating joint research laboratories	Financial support for universities to host industry researchers	Funding of infrastructure and intermediaries for collaboration	Grants for IP applications from universities	Financial support to academic spin-offs	Public procurement of university research	Reform of IP regulations regarding publicly funded research	Reform of regulation relating to spin-offs from academics and students	Sabbaticals and mobility schemes to support researchers working in industry	Career rewards for researchers engaging in knowledge transfer to industry	Open access and open data provisions for publicly funded research	Collaborative industry/ research sector road-mapping and foresight exercises	Training programs on knowledge collaborations	Guidelines, standards and codes of conduct for industry/ research [illegible]	Networking support to build industry/research linkages	Outreach activities to raise awareness of research sector/ industry opportunities
Wine Export Recovery and Expansion Program																					
Global Expansion Program																					
Brandon Biocatalyst								X	X	X										X	
Australian Institute of Machine Learning (AIML)	X	X				X	X							X						X	X
SA Cooperative Research Centre Program	X					X	X	X											X	X	X
AMREx - Flinders University and University of Strathclyde							X														
GigCity								X													
Go2Gov	X									X											
Industry Doctoral Training Centres						X	X								X			X		X	X
Innovation Challenge	X							X													
External Innovation and Translation Intermediary							X	X									X	X		X	
Manufacturing Growth Accelerator							X													X	

Program or program element	Subsidies/grants for industry R&D and innovation	Vouchers/grants for firms to purchase R&D services from universities	Tax incentives for firms purchasing research from universities	Financial support to firms to recruit PhDs and post-docs	Performance based funding systems for university linkages with industry	Public private partnerships creating joint research laboratories	Financial support for universities to host industry researchers	Funding of infrastructure and intermediaries for collaboration	Grants for IP applications from universities	Financial support to academic spin-offs	Public procurement of university research	Reform of IP regulations regarding publicly funded research	Reform of regulation relating to spin-offs from academics and students	Sabbaticals and mobility schemes to support researchers working in industry	Career rewards for researchers engaging in knowledge transfer to industry	Open access and open data provisions for publicly funded research	Collaborative industry/ research sector road-mapping and foresight exercises	Training programs on knowledge collaborations	Guidelines, standards and codes of conduct for industry/ research [illegible]	Networking support to build industry/research linkages	Outreach activities to raise awareness of research sector/ industry opportunities
Medical Device Partnering Program							X													X	
The National Collaborative Research Infrastructure Strategy						X	X	X													
SA Venture Capital Fund										X											
Start-up Hub																		X		X	X
UniSA Future Industries Accelerator	X	X					X	X												X	X
University of Adelaide CNRS Research Exchange							X							X						X	
University of Adelaide Future Industry Making Fellows Program							X							X						X	
Lot Fourteen								X										X		X	X
South Australian Health and Medical Research Institute (SAHMRI)					X		X	X		X										X	X
South Australian Agricultural Research and Development Institute (SARDI)						X	X	X					X							X	X

Recommendation 3: Any new funding allocated to independent research institutes by the South Australian Government should be managed through the University Reform and Growth Fund to deliver economically and socially significant outcomes for the state.

South Australian Government assertion of rights to Intellectual Property (IP) arising from work funded through grants impedes commercialisation without any meaningful benefit to the government.

Consultations with universities and entrepreneurs on barriers to commercialisation of university generated IP have identified a potential blocking role of South Australian Government research grant agreement terms and conditions. Although it is by no means universal, stakeholders have identified several cases where grant agreements issued by the South Australian Government asserted the right to IP arising from the funded activity. This has made commercialisation of IP built on this initial South Australian Government funding much more difficult as potential investors or licensees require clear ownership by the university of any IP being commercialised. As the South Australian Government role in innovation is not revenue generation, but broader economic and industrial benefits for the state, we see no rationale for the use of such clauses.

Finding 23: South Australian Government assertion of rights to IP in current or past research grant agreements is a barrier to the efficient commercialisation of research.

Recommendation 4: All South Australian Government research grant program agreements should assign IP to the research institution being funded.

Similarly, where any historic research grant agreements have asserted South Australian Government ownership of IP, commercialisation outcomes could be usefully enhanced if the State Government were to make a policy decision that IP would better vest in the research organisation, and set up a straightforward system for research institutions to request the transfer of IP rights.[30]

Recommendation 5: Where previous South Australian Government funding schemes for universities have seen IP in the project vest with the government, that IP should be automatically assigned back to the university on request and free of charge to facilitate commercialisation. (Except in the case where a technology was being developed on behalf of the and for use by the South Australian Government).

2.1.2 Australian Government innovation investment

The Australian Government invests in innovation by providing funding to support R&D activities by government departments, and national research organisations and programs. The Government is also committed to providing funding for two new initiatives to support innovation: the National Reconstruction Fund; and the University Research Commercialisation Action Plan.

[30] An exception to this is the seed breeding collaboration between SARDI, the University of Adelaide where the joint ownership model and focus on collaboration through a commercialised entity is delivering good outcomes.

Funding to support R&D managed by government departments and research bodies

The Australian Government provided $12.1 billion of funding for R&D in 2022–23, up from $10.2 billion in 2019-20.[31] The Department of Industry, Science, Energy and Resources (DISER) was the largest recipient of R&D funding. DISER programs support basic research, business research and development, commercialisation and translation of research, access to early-stage finance, and collaboration between industry and the research sector. Table 3 presents the Australian Government's investment in R&D by portfolio for the period 2019-20 to 2022-23.

Table 3: Australian Government investment in R&D by government portfolio ($m, current prices)

Portfolio	2019-20	2020-21	2021-22*	2022-23**
Agriculture, Water and Environment	412.68	379.53	461.54	496.44
Attorney General's	3.95	3.76	4.22	5.24
Climate Change, Energy, Environment and Water	485.31	551.55	767.88	696.61
Defence	456.60	557.45	633.97	645.97
Education	3,087.83	4,163.79	3,307.84	3,486.20
Foreign Affairs and Trade	167.34	96.70	100.65	105.05
Health and Aged Care	1,421.83	1,648.17	1,628.37	1,679.67
Home Affairs	-	-	0.75	11.11
Industry, Science and Resources	4,123.94	4,383.42	4,723.73	4,914.30
Infrastructure, Transport, Regional Development, Communications, Arts	15.73	20.98	59.13	25.42
Prime Minister and Cabinet	4.82	1.50	1.50	2.00
Social Services	47.19	39.60	53.41	54.92
Treasury	1.83	1.86	1.90	1.94
Veterans' Affairs	7.42	7.34	6.67	7.46
Total	**10,236.46**	**11,855.66**	**11,751.56**	**12,132.32**

Source: Australian Government. Department of Industry, Science, Energy and Resources 2022-23 Science, Research and Innovation (SRI) Budget Tables.
** Estimated result.*
*** Budget estimate.*

[31] This funding does not include $1 billion in other science, technology, research and innovation-related programs and activities.

Funding to support R&D of national research organisations and programs

The Australian Government also provided $9 billion of funding support to Australia's national research organisations, such as the CSIRO and the Australian Nuclear Science and Technology Organisation (ANSTO), in 2022-23. Additionally, the Australian Government provides $3.2 billion through the Research and Development Tax Incentive to facilitate business R&D activity. Table 4 presents the Australian Government's R&D funding for significant programs and institutions for the period 2019-20 to 2022-23.

Table 4: Australian Government investment in national research organisations and programs valued at over $100 million in 2022-23 ($m, current prices)

Program/activity	2019-20	2020-21	2021-22*	2022-23**
R&D Tax Incentives – Refundable	2,134.00	2,188.00	2,400.00	2,542.00
Research Training Program	1,036.63	1,054.98	1,069.18	1,092.77
CSIRO	837.87	960.54	949.04	991.13
Research Support Program	902.06	1,918.30	930.66	951.19
NHMRC Research Grants	901.45	891.26	830.21	898.34
ARC – National Competitive Grants Program	762.54	716.49	803.70	831.59
Medical Research Future Fund (MRFF)	375.52	597.94	455.00	650.00
R&D Tax Incentives – Non-Refundable	460.00	470.00	580.00	620.00
Defence, Science and Technology (DST) Group	377.71	441.73	493.21	472.70
Australian Renewable Energy Agency (ARENA)	231.37	227.54	422.01	312.63
National Collaborative Research Infrastructure Strategy (NCRIS)	179.91	256.35	273.57	286.04
Australian Nuclear Science and Technology Organisation (ANSTO)	257.82	260.51	262.80	264.43
National Institutes Program – ANU Component	205.45	209.67	211.97	216.64
Cooperative Research Centres Programme	130.81	234.17	187.34	199.37
Defence Innovation Hub	64.59	97.90	99.86	121.67
Grains Research and Development Corporation	72.54	64.78	90.39	105.47
Australian Centre for International Agricultural Research (ACIAR)	107.99	96.70	100.55	102.10

Source: Australian Government. Department of Industry, Science, Energy and Resources 2022-23 Science, Research and Innovation (SRI) Budget Tables.
** Estimated result.*
*** Budget estimate.*

The key institutions and programs are briefly described below:

- **CSIRO** – The CSIRO is Australia's leading research institution. Two of the CSIRO's business objectives are to (i) deliver impact through innovation (implemented in part through the Main Sequence CSIRO Innovation Fund, and the commercialisation services and program streams); and (ii) build collaborative networks (implemented in part through the operation of innovation hubs, precincts and ecosystems and the delivery of the strategic partnerships program).

- **Australian Research Council (ARC)** – ARC grants support fundamental and applied research and research training. They are competitively awarded to individuals, research teams and large-scale centres through two broad arms – Discovery and Linkage schemes. ARC Linkage schemes, through vehicles, such as ARC Centres of Excellence, Industrial Transformation Research Program and the Linkage, Infrastructure, Equipment and Facilities grants, aim to encourage and extend cooperative approaches to research and improve research outcomes by strengthening links within the innovation system.
- **National Health and Medical Research Council NHMRC)** – NHMRC supports effective research translation, including commercialisation, and fosters frontier medical research. The NHMRC strategic and leveraging grants stream supports research that responds to national needs and priorities with schemes such as centres for excellence and the independent research institute infrastructure support scheme.
- **Medical Research Future Fund (MRFF)** – The MRFF is designed to provide a stable and consistent source of funding for health and medical research focussed on national health priorities, such as supporting effective research translation, including commercialisation, and helping to advance frontier medical research. The fund fosters research for medical discoveries as well as early biomedical and medical technology product development by supporting access to researchers, capability, and infrastructure (such as research facilities, equipment, systems, services) and through partnerships with industry.
- **National Collaborative Research Infrastructure Strategy (NCRIS)** – NCRIS supports priority large scale collaborative research infrastructure, which is available for use by researchers from universities, public research institutes, and business. Research infrastructure in the form of 11 NCRIS facilities is located within SA's Universities. These facilities include the; Australian Nanofabrication Facility, Australian Plant Phenomics Facility, Bio platforms Australia, Microscopy Australia; and the National Imaging Facility.
- **Cooperative Research Centres (CRC)** – The CRC program provides grant funding to support industry-led collaborative research partnerships working on industry-identified problems supporting science, research, and commercialisation; and enable growth and productivity for globally competitive industries. The CRC Program supports industry, research, and the community in two ways: (i) CRC Grants – which support medium to long term industry-led collaborative research for up to 10 years; and (ii) CRC Project Grants which support short term industry-led collaborations for up to a maximum of three years. There are currently 5 CRCs headquartered in SA with 5 other CRC nodes.

Funding to support the National Reconstruction Fund

The Australian Government has committed $15 billion to establish the National Reconstruction Fund (NRF). The NRF will provide finance to projects in seven priority areas to leverage Australia's natural and competitive strengths: renewables and low emissions technologies; medical science; transport; value-add in the agriculture, forestry and fisheries sectors; value-add in resources; defence capability; and enabling capabilities.

The NRF will provide a range of finance options including: loans, equity investment, and guarantees. The investment vehicle is intended to encourage private sector investment in

strategic priority areas by ensuring financing is available to allow SMEs to commercialise projects that would otherwise struggle to secure sufficient capital on sustainable terms.

At present, the Australian Government has allocated $8 billion from the NRF's, with a total endowment of $15 billion, to the following strategic priority areas:

- up to $3 billion for renewables and low emissions technologies;
- $1.5 billion for medical manufacturing;
- $1 billion for value-adding in resources;
- $1 billion for critical technologies;
- $1 billion for advanced manufacturing; and
- $500 million for value-adding in agriculture, forestry, fisheries, food, and fibre.

The Government is in the process of establishing the National Reconstruction Corporation (NRC) to manage the NRF. The NRC will be independent of the Australian Government. Its activities will be overseen by its governing board (appointed by the responsible ministers). The NRC will have the authority, anchored in its enabling legislation, to manage its portfolio of investments as it sees fit. Once fully operational, the NRC will take responsibility for managing a total asset base of $15 billion, which the corporation must invest in ways that "support, diversify and transform Australia's economy to secure future prosperity and drive sustainable economic growth".

As the NRC's enabling legislation[32] makes clear, the corporation will act as an independent financier and will operate commercially to generate a positive rate of return on its investments, subject to its investment mandate and the declared areas of economic priority. The NRC will begin operating with an initial endowment of $5 billion, with the remaining $10 billion to be credited to the corporation's special account before 2 July 2029. The funds can be credited in instalments and at times to be determined, in writing, by the ministers.

Critical Technologies

The NRC will make available $1 billion in finance to eligible businesses engaged in the development and commercialisation of critical technologies.

The Australian Government is yet to release detailed policy guidance on the ways in which the NRC's investment mandate, including the seven priority areas for investment, will contribute to, and be integrated into, a wider policy of support for the development of critical technology capability in Australia.

That said, the available guidance material on the NRF suggests that the Australian Government might not depart substantially from the list of critical technologies identified in the current *Action Plan for Critical Technologies* (the Action Plan), at least for the purposes of setting the NRC's investment priorities.

The Action Plan was released under the previous government in November 2021 and includes, but is not limited to, a large range of emerging technologies grouped under seven overarching categories, such as advanced materials and manufacturing; artificial intelligence, computing, and communications; quantum, including quantum computing and post-quantum cryptography; and biotechnology, gene technology and vaccines. The Action Plan contains an open-ended list of critical technologies, which is subject to change in response to shifts in Australia's national interest, and develops a 'response framework' to

[32] The NRC will be established pursuant to the Corporations Act 2001 and will be subject to the Public Governance, Performance and Accountability Act 2014.

guide the government's use of various policy levers, including regulatory action and direct investment, to promote and protect Australia's critical technology capability.

The response framework at the core of the Action Plan, which has not been rescinded by the current government, is divided into four categories. These are defined by two principal criteria: their centrality to Australia's assessed national interest and the costs of the actions required to implement them. The latter range from relatively low-cost actions that contribute to greater resilience, such as government support programs for industry, to high-cost actions associated with directly regulating certain types of economic activity or diverting resources away from areas of private sector investment.

Funding to support the University Research Commercialisation Action Plan

The Action Plan, announced in February 2022, provides funding of $2.276 billion over 11 years intended to improve Australia's research commercialisation outcomes. The Action Plan includes: Australia's Economic Accelerator; introduction of a National Industry PhD Program; expanding CSIRO's Main Sequence Ventures; and establishment of the Trailblazer Universities Program.

The package of initiatives announced builds on the strategic priorities of the NRF, ensuring Government research investment is directed to sectors which have the potential for scale and positive economic outcomes.

The Action Plan includes funding to establish the National Industry PhD Program to support the addition of 1,800 Industry PhDs to the workforce over 10 years. The National Industry PhD program will support PhD candidates to undertake industry focused research projects to increase the knowledge and skills for translating university research into commercialisation outcomes. The Program consists of two streams:

- **Industry Linked PhD stream**: For outstanding PhD candidates to undertake research projects co-designed by university and industry, with opportunities to gain experience in industry and participate in a 12-week training program.
- **Industry Researcher PhD stream**: For highly capable industry professionals who are supported by their employers to undertake PhD projects in partnership with a university while retaining employment.

Finding 24: Australian Government programs deliver substantial financial support to business innovation, and this support will become even more significant once the national reconstruction fund begins disbursing resources.

2.2 The role of research institutions in business innovation

Universities are potentially instrumental in supporting South Australia's transition towards a sustainable and productive economic future. By engaging with businesses, particularly Small and Medium Enterprises (SMEs), universities can stimulate innovation, cultivate a dynamic workforce with future-ready skills, and promote regional economic growth. Academic start-ups and scale-ups significantly contribute to this process by generating new opportunities, enhancing regional competitiveness, and enabling knowledge transfer between academia and industry.

Fostering collaborations between universities and businesses can result in joint research and development initiatives addressing the green energy transition's requirements. Potential outcomes include new technologies, products, or services contributing to a low-carbon economy, such as renewable energy systems, energy-efficient materials, and circular

economy solutions. Through collaboration, universities offer expertise and resources, while SMEs contribute practical industry knowledge and market insights. This cooperative approach can yield innovative solutions that promote economic growth and align with the state's sustainability objectives. Universities can also help rectify the skills and education mismatch by closely collaborating with businesses to identify current and future skill demands. This information can guide the creation of tailored education and training programs better aligned with industry needs, ensuring graduates are well-prepared to join the workforce and contribute to South Australia's green transition. Additionally, universities can facilitate internship and placement opportunities with South Australian SMEs, granting students valuable work experience and further solidifying the relationship between academia and industry.

Academic start-ups and scale-ups are crucial in this process, as they bridge the gap between universities and the business world. By commercialising academic research and innovations, these start-ups can develop new products, services, and technologies that propel the green transition and augment South Australia's economic complexity and productivity. Furthermore, academic start-ups can attract investment, both domestically and internationally, strengthening the state's reputation as a green innovation hub and securing its status as a stable and secure global partner. Additionally, academic start-ups and scale-ups often catalyse job creation and economic growth, especially in emerging sectors such as renewable energy, green manufacturing, and sustainable agriculture. As these companies expand, they can generate new employment opportunities, attract skilled workers to the region, and stimulate local supply chain development.

The concentration of research talent in research institutions including the universities, is a key asset for the state, with these skills being essential for the development of innovations and their translation into new contexts. However, the effectiveness with which universities connect to their local economy determines whether their research talent can deliver on its potential.

The degree of match between university research effort and parts of the local business community with the capacity necessary to draw in knowledge and inventions and turn them into economically valuable innovations is an important influence on whether universities can fulfil their potential role in the local economy.

Different approaches to management of IP; allocation of time to applied, business-focused research; and factors taken into account when considering academic staff for promotions can all affect the impact of universities on local business innovation.

Equally, universities that are in a region with an innovation-active business community are more likely to find potential partners with sufficient absorptive capacity and have a greater economic impact as a result.

Talent is the key to university business collaboration and to innovation more generally

People, and their ability to transmit tacit knowledge, are the source of research spillovers generally, and the impact of research institutions in particular. This means that any set of policies aimed at strengthening the research-business relationship around innovation needs to be primarily focused on talent: how it can be grown, how it can be fostered, how it can be attracted and how it can be retained.

Some of this is the traditional movement of graduates and post-graduates out into businesses. But less traditional movements can be incredibly effective, e.g. academics temporarily working in firms and industry researchers working in universities. It is important that university human resources (HR) and intellectual property (IP) policies facilitate this.

> *To get more successful at research commercialisation, Australia needs to go beyond what we call 'bench-to-bookshelf' science.*
>
> *We need to take the next steps after doing great research at the lab bench and publishing it in top global journals.*
>
> *To do that, we need to train a much bigger community of 'bench-to-boardroom' scientists.*
>
> *Scientists who can take exciting lab bench discoveries into startups, industry partnerships and to venture capital investors.*[33]

Finding 25: Innovation at its heart is about talented people, and talented people need to be the focus of future South Australian Government innovation policy.

Proximity between universities and potential business partners is important, but in this context proximity does not mean co-location, but rather being conveniently located, being in the same labour market, holding similar values and understandings, and facing similar incentives.

There is good evidence that proximity is an important factor in enabling university business links. Despite the increasing use of digital technologies to meet collaborators and colleagues across the world, there are still strong geographic patterns to the locations of industry and to university business collaborations.

But importantly, proximity here does not mean being located in the same building or even the same city block. Instead, because spillovers between university research and innovative businesses, and indeed between innovative firms using the same or similar technologies, develop from interactions of talented people, the geography of spillovers largely reflects local commuting patterns.[34] Empirical studies find that distance only becomes a barrier to collaboration when the university and the business are no longer within a common commuting area, typically limited to around 25 to 30 km apart. Some of this is the direct impact from staff moving between employers and taking knowledge and innovation with them. And some of the impact is the spillovers arising from joint research and development which allow more effective communication of how the innovation works in practice (also called tacit knowledge transmission) as part of the collaboration.

Finding 26: Geographical proximity is important to university-business links around innovation, but in this context geographical proximity means being conveniently

[33] Professor Mark Hutchinson, President, Science and Technology Australia, National Press Club Address, March 2022, transcript available at: https://scienceandtechnologyaustralia.org.au/mark-hutchinson-npc-address/
[34] Matray, A. (2021), 'The local innovation spillovers of listed firms', *Journal of Financial* Economics, 141, pp. 395-412; National Institute of Economic and Social Research (2021), From Ideas to Growth: Understanding the drivers of innovation and productivity across firms, regions and industries in the UK, BEIS Research Paper 2021/041, Department for Business, Energy, and Industrial Strategy; Atta-Owusu, K., R. Dahl Fitjar and A. Rodríguez-Pose (2020) 'What Drives University-Industry Collaboration: Research excellence or firm collaboration strategy?', CEPR Discussion Paper DP14565; Delorme, D. (2023) 'The Role of Proximity in the Design of Innovation Intermediaries' Business Models', *Technological Forecasting and Social Change*, 188; Bertoletti, A. and G. Johnes (2021), 'Efficiency in University-Industry Collaboration: an analysis of UK higher education institutions', *Scientometrics*, 126, pp. 7679-7714; OECD (2019) 'Science-Industry Knowledge Exchange: A Mapping of Policy Instruments and their Applications', OECD Science Technology and Industry Policy Papers', Number 66

located, not co-location. Similarity of values, norms and technological understanding is more important than geographic proximity in enabling successful business industry collaborations.

There are a small number of limited cases where closer proximity is justified. Access by business to research infrastructure located in universities (such as Flinders University's 'Factory of the Future') is a case where (temporary) co-location to facilitate joint research between a firm and an industry partner using the facility and associated laboratory space can create significant economic value. This also requires an organisational openness to this type of model of collaboration.

Similarly in health and medical research, research institutions will typically need to locate relatively close to the hospital in which their clinician researchers are working as the clinicians need to be able to move between clinical work and research work through the day.

This suggests that narrowly defined innovation districts are unlikely to provide any material additional value making them a low priority for future State Government investment where budgets are constrained. This is particularly so in a city like Adelaide where, with a commercial property vacancy rate of 16.1 per cent[35] at the time of writing, there is a significant stock of vacant space available within walking distance of the CBD campuses of the three universities available to potential research and industry tenants. State Government resources should instead be focused on investments that help build productive connections between university researchers and businesses located in their city, particularly investments in people.

Finding 27: Given budget constraints, investment in buildings (including precincts) should be a low priority for future State Government innovation spending.

Provision of common use infrastructure located in universities where it is delivered in a way that allows temporary location of industry researchers on-site whilst they are using the facility can be extremely valuable in building deep university business connections around innovation.

Broader government policies aimed at increasing the quality of life of their citizens through better healthcare, better education, a better protected environment and improved local amenity will also be important (but entirely outside the scope of this report) as they help attract and retain talented people.

Delorme (2023) goes further and suggests that proximity in the context of university business links should be thought of as having five dimensions:

- Geographical proximity;
- Cognitive proximity – similarity of knowledge bases;
- Social proximity – personal connections between academics and those working in business, allowing trust to develop;
- Institutional proximity – similarity of workplace norms and values; and
- Organisational proximity – similar regulations and incentives across the organisations.[36]

[35] https://www.propertycouncil.com.au/media-releases/record-office-supply-drives-flight-to-quality, data is for the six months to January 2023.
[36] Delorme, D. (2023) 'The Role of Proximity in the Design of Innovation Intermediaries' Business Models', *Technological Forecasting and Social Change*, 188, p. 2-3

Again, this suggests a very different set of policy priorities than a model of proximity that focuses on co-location. Efforts should be targeted at better aligning incentives and norms across organisations, facilitating interpersonal connections, and identifying researchers and industry contacts with similar knowledge bases, including common focuses on specific underpinning technologies.

The role of universities in driving innovation is not purely a STEM story.

Most of our economy is services, and whilst there are a number of STEM based enabling technologies that are likely to be important for services, much of the innovation they need will draw on social sciences and humanities. Most significant channels for these collaborations are likely to be the output of graduates and post-graduates. But commercialisation activities should not ignore non-STEM academics as an important source of ideas.

And as a partially corollary of this, the important skills for commercialisation are not just technical but also entrepreneurial. Building entrepreneurial education and experiences into the post-graduate (and possibly undergraduate) curriculum across university faculties and making such education available to those academics who are interested, is likely to be an important enabler of university business collaboration.

Finding 28: Successful commercialisation of research does not only depend on great science or engineering; it also needs a range of non-STEM skills.

Incentives and structures need to be aligned to objectives

The OECD, in reviewing university business collaborations[37], concludes that successful programs designed to support technology transfer entail a combination of different financial instruments and soft instruments. The programs also require a regulatory framework that enables researchers to engage in such activities and provides them with incentives.

The OECD found a major challenge to be that only a small proportion of technology transfer projects leads to substantial economic impact in terms of income and jobs. The challenge is to scale-up the most promising projects, including to international markets, rather than just increasing the total number of spin-offs and patents generated.

Fragmentation of innovation ecosystems was consistently identified as a barrier to successful collaboration. The fragmentation can lead to overlapping activities, an unclear presentation of the sector for industry engagement and a misallocation of research and education potential. The analysis points to a profusion of initiatives, instruments, regulations, mechanisms, and institutions lacking direction and coherence.

Cooperation between business and researchers is widespread but focuses on smaller projects and applied R&D. The overlap of university and public research institute research activities can create inefficiencies. Contribution to knowledge transfer has been lower in emerging areas (technology or markets) and has concentrated on established links and industry structures. Related to this is that there are few incentives (such as innovation vouchers) to encourage firms to reach out to PRIs for the first time. Businesses that have participated in research collaboration either on thematic research programs or on a project basis have observed that these arrangements often suffer from mismatches generated by

[37] OECD (2019) 'Science-Industry Knowledge Exchange: A Mapping of Policy Instruments and their Applications', OECD Science Technology and Industry Policy Papers', Number 66, pp. 75-108

high-level abstraction of agenda-setting processes and the more concrete aims and interests of businesses.[38]

Finding 29: Alignment of incentives between researchers and businesses is an important element of facilitating effective connections for innovation.

Use of intermediaries between universities and business is almost universal, but there is very substantial variations in the types of intermediaries used

All advanced innovation ecosystems have one or more sets of intermediaries between research institutions and potential end-users of research, but these can take a number of forms and have a range of focuses. Research undertaken by the OECD[39] identifies a wide range of models used in its member economies, all of which can be broadly categorised base on their delivery of one or more of the following types on intermediation:

Knowledge manager

- Research production (undertaking primary research (new discovery) and/or secondary research (translating research undertaken elsewhere into the local context);
- Research dissemination and advocacy (communicating the results of research, though mechanisms such as websites, newsletters, forums and practice guidelines);

Linkage agent

- Relationships and network building (undertaking events, presentations and facilitating networking and collaboration agreements);

Capacity builder

- Individual skills and capacity building (delivered through workshops, training courses, seminars and public lecture series);
- Organisational and system development and capacity building (organisational development programs, leadership development programs, coaching, mentoring);

Transversal

- Research use and intervention support (through meeting plans, guidelines for interventions, implementation coaching and mentoring, funding proposals of intervention support)
- Evaluation, scale-up and sustainability (monitoring plans, evaluation of outcomes and impacts, feasibility studies).

In the South Australian context models of university business intermediation are likely to need to be located within research centres or institutes at universities

Given the specific limitations identified in South Australia's level of business R&D and innovation, and the engagement between researchers and business, intermediation functions targeted at research production, and organisation and system development and

[38] OECD (2019) 'Science-Industry Knowledge Exchange: A Mapping of Policy Instruments and their Applications', OECD Science Technology and Industry Policy Papers', Number 66, *Plewa, C., T. Darney, A. Meerman and V. Galán-Muros (2017), 'The State of Australian University-Business Cooperation (The Business Perspective)'*
[39] Torres, J. M. and M. Steponavičius (2022), 'More than just a go-between: the role of intermediaries in knowledge mobilisation', OECD Education Working Paper No. 285

capacity building are likely to be most immediately useful. Many of the other intermediation approaches are structured to build on a base of engaged business users of innovation.

For South Australia, given its business sector, intermediation functions targeted at research production, and organisation and system development and capacity building are likely to be most immediately useful. Potentially relevant models include the Fraunhofer Gesellschaft, the UK Catapult network internationally, and AIML and the Factory of the Future in South Australia (the first three of which are described in Boxes 1 through 3). Many of the other intermediation approaches are structured to build on a base of engaged business users of innovation.

Finding 30: Intermediation between research and business in South Australia will be more successful if it is undertaken through jointly designed and implemented research projects.

Box 1: Fraunhofer Gesellschaft – Germany

What has worked well?

The Fraunhofer has unwavering focus on applied research. Fraunhofer activities are designed to support its core mission and business model. That is, to ensure that its research has practical application by bridging the gap between academic research and industry needs, and to scale up commercial innovations.

The Fraunhofer has developed strategy, internal capability (e.g., infrastructure and human capital), and collaborative networks with external partners (e.g., industry, other research institutes and universities) over the years to help achieve its mission. This approach has resulted in numerous innovations, such as the development of the MP3 audio compression format, white-emitting diode LED, and the airbag.

The Fraunhofer has strong collaboration with industry, governments, and universities. The Fraunhofer's funding model incentivises the organisation to foster close collaboration with industry, federal and state governments, and universities. For instance, as about two-thirds of Fraunhofer's income is derived from private and publicly funded research contracts with industry, this funding arrangement incentivises Fraunhofer researchers to search for opportunities with industry to apply and/or commercialise their research results. For instance, almost 75 per cent of contracting partners are small and medium-sized enterprises (SMEs). Most of these SMEs are in the manufacturing sector, which includes R&D-intensive fields, such as transport, machinery/mechanical engineering, chemistry, and pharmaceuticals.[40] Comin et al. (2018) finds that a one percent increase in the scope of contracts with the Fraunhofer leads to an increase in the growth rate of a partner firm's turnover by 1:3 percentage points.

Additionally, as about one-third of the Fraunhofer's income comes from the federal and state governments in the form of base funding, this funding arrangement also encourages the Fraunhofer to foster close collaboration with governments, and support government innovation policies. [41] In this regard, the Fraunhofer also has strong links with universities to leverage academic expertise and cutting-edge research. It has Intellectual Property Right (IPR) agreements with around 180 universities in Germany.

[40] Frietsch, R., Neuhäusler, P. Jäger, A., and Schubert, T, (2022), A microeconomic perspective on the impact of the Fraunhofer-Gesellschaft, https://www.fraunhofer.de/content/dam/zv/de/forschung/leistungsangebot/Report-Microdata-2022.pdf
[41] Fraunhofer, (2021), Fraunhofer Annual Report 2021, https://www.fraunhofer.de/s/ePaper/Annual-Report/2021/index.html#0
https://www.research-in-germany.org/en/research-landscape/research-institutions/fraunhofer-gesellschaft.html

The Fraunhofer has expertise across a broad range of disciplines and industries. Due to large scale of the organisation in terms of budget and workforce, the Fraunhofer has built up expertise across a wide range of industries and disciplines, including materials and components, production, microelectronics, energy and environment, health and life sciences, and information and communication technologies. This broad expertise enables the Fraunhofer institutes to support innovation across various sectors, making it a valuable partner for industry. The interdisciplinary approach of the Fraunhofer institutes also fosters cross-fertilisation of ideas, leading to breakthroughs that might not have been possible within a single domain of research.

What has not worked as well?

The Fraunhofer faces challenges in managing a large portfolio IPRs. The Fraunhofer currently holds around 30,000 active patents and around 700 active trademarks. It registers around 60 trademarks per year. Navigating IPR issues can be time-consuming and complex, potentially delaying the development and commercialisation of innovative technologies. Managing the IPR process more efficiently and effectively could help the Fraunhofer expedite the technology transfer process.

The Fraunhofer has limited international presence. While it has several international affiliated partners (mainly in Europe) and project cooperation and strategic partnerships, it does not have an extensive international presence relative to its size and stature. This could hinder the Fraunhofer's ability to support global innovation, particularly in the rapidly evolving global technology landscape. Expanding the Fraunhofer's global reach could help it develop a more diverse perspective on innovation, enabling it to better support its partners and address the challenges faced by various industries worldwide.

The Fraunhofer business model tends to support industries that already exist (e.g., automobile, engineering, machinery, electric power, chemical, and pharmaceutical)**, rather than new industries** (e.g., biotechnology, financial technology, etc.) because of higher costs and risks associated with these industries. Some argued that this could be related to the German's innovation system which tends to build on established structures rather than creating new ones. "The resulting pattern of innovation is one that is more likely to generate improvements of existing products of existing firms and sectors than to give rise to new ones."[42]

Adapting the Fraunhofer model elsewhere

A study by the US National Research Council[43] notes that the Fraunhofer model may not be adaptable to the US because other essential elements of the German innovation system are not present to the same degree as in the US (and hence elsewhere). For instance, these elements include: (i) stable government funding for commercially relevant research; (ii) a high share of SMEs and family businesses (also known as the Mittelstand) in the economy; the "dual system" of vocational education and training; and the country's preference for cooperative arrangements over competition. These elements reflect the cultural and institutional aspects of German society, which cannot be easily replicated.

The study also notes that the Fraunhofer's approach is less likely to foster transformative innovations, compared to the US. It does, however, show that a high cost, high wage country, like Germany, can compete effectively in international markets in established industries, through the systematic and continuous application of knowledge.

[42] Streeck, W., (1995), German Capitalism: Does it Exist? Can it Survive? In Colin Crouch and Wolfgang Streeck, eds. Modern Capitalism or Modern Capitalisms? London: Francis Pinter, p. 14
[43] National Research Council (NRC), 2013, 21st Century Manufacturing: The Role of the Manufacturing Extension Partnership Program, Washington, DC, The National Academies Press. http://nap.nationalacademies.org/18448

Box 2: Catapult Network – United Kingdom

What has worked well?

The Catapult Network has focused on building local innovation capacity. Catapult activities are designed to give research practical application by bridging the gap between academic research and industry needs, and to scale up commercial innovations. Through various reviews, stakeholders have made clear that Catapults play an important role in helping to bridge the valley of death. Catapults provide support to companies possessing mid- to high- Technology Readiness Levels (TRLs) to: access equipment and skills; help shape policy and regulation for innovative companies; guide applicants on private and public funding, and establish unique collaborations. Catapults provide support to SMEs and start-ups, with advice and toolkits including products, processes, workforce development, investment, and routes to export.

The Catapult network has focused on collaboration with industry, governments, and universities. Catapults' relationships with universities vary across the network appropriate to their specific sector or technology. Some have deep ties with specific universities, such as the Compound Semiconductor Applications Catapult with Cardiff University. This is closest to the Fraunhofer model, where every institute is attached to at least one university. Other Catapults are still developing links with universities as their organisations mature.

As part of its Academic Engagement Plan, the Offshore Renewable Energy Catapult have created Research Hubs, designed to align Catapult facilities with UK academic expertise and to support the needs of the offshore renewables industry. The hubs also have 40 PhD students.

Businesses either pay to work with Catapults or work on joint projects with public funding. Typically, smaller companies are more dependent on winning public funding and larger companies pay to work directly with Catapults. Large companies and SMEs have both noted the value of skilled Catapult staff and facilities and highlighted the importance of Catapult guidance on public and private funding options.[44]

What has not worked as well?

The Catapults face challenges in encouraging industry R&D. The Catapults are part of a national network of research assets. Strategies for the growth of this network and for encouraging private sector investment in the assets and R&D are outlined in the UK's R&D Roadmap. The R&D Roadmap has been found to have insufficient detail of the UK Government's objectives or its plans for achieving them. A UK Parliamentary report on Catapults found that there does not appear to be a clear list of priority technologies for the UK, or a firm plan to expand the Catapult Network into sectors where the UK has strengths and the potential for economic gains. The report recommended that the UK Government needs to have firm criteria for identifying key technologies and deciding on expansions of the Catapult Network, and these processes must be responsive to future challenges.[45] The resulting pattern of innovation has been one of generating improvements of existing products of existing firms and sectors than to giving rise to new ones.

The Catapults are only one of the necessary components for a successful innovation system and regional development. Catapults are one of several bodies that can contribute to regional development; a recent review found that better coordination is needed at local levels, with a need for "improving the decision-making and local influence" to "align the priorities with those areas.[46] In

[44] UK Government, Department for Business, Energy and Industrial Strategy, Catapult Network Review: How the UK's Catapults can strengthen research and development capacity. BEIS Research Paper Number 2021/013, April 2021.
[45] UK Parliament, House of Lords Select Committee on Science and Technology, *Catapults: bridging the gap between research and industry*, 2nd Report of Session 2019-2021, HL Paper 221.3 February 2021.
[46] UK Parliament, House of Lords Select Committee on Science and Technology, *Catapults: bridging the gap between research and industry*, 2nd Report of Session 2019-2021, HL Paper 221.3 February 2021.

addition, governments should not rely on single or small groups of research assets to drive innovation outcomes but should also encourage systemic and broad-based behaviours of collaboration and investment in R&D.

The Catapults can improve governance arrangements and performance and evaluation processes. Stakeholders have frequently highlighted the seemingly endless reviews of Catapults and that the operations of the centres have not been allowed to establish due to constant changes. As such the 2021 review recommended that 5-yearly evaluation cycles be implemented. As part of recent reviews, performance measures and monitoring indicators have been implemented that relate more to outcomes of the centres, rather than activity-based measures.

Adapting the Catapult model elsewhere

The impact of Catapult centres varies, with the longest established having the greatest impact as measured by private investment and business partners – suggesting there are benefits to giving them time to establish themselves in the relevant sectors. Long term commitments to innovation initiatives are common shortcomings in the Australian context.

The Catapult funding and governance model may not be able to be easily replicated in another environment. Catapults are not-for-profit centres, independent from their clients, with corporate oversight from Innovate UK (part of UKRI, a non-departmental public body). In various country studies, the OECD has found several challenges for different types of models. Participation of businesses has been found helpful in articulation of demand of research, however academic research may be geared toward questions that will have long-term horizons, and so the extent to which business will be involved is unclear. Independence in research tasks is also important and involvement of business may compromise this aspect of the applied research institutes. Further, raising business investment in a small regional economy, with few large businesses, will be a challenge.

Regardless of the model chosen, an applied research institute would still operate in the same state, national and international environment as that currently, in terms of competition for labour and research funding (grants in particular), brand recognition and quality service provision to clients, market presence and ease of access for businesses and the establishment of integrated networks for more effective collaboration.

The Catapult model may not be adaptable to South Australia as essential elements of the UK innovation system are not present to the same degree in SA. For instance, these elements include: the full range of universities, research centres and researchers at a national level from which Catapults can draw upon when they establish and operate; the full scope of national funding programs for which such centres would be eligible can only be provided in small proportions at a regional level; and the scale of business and innovation by businesses occurring is naturally smaller at a regional level.

Box 3: Australian Institute of Machine Learning (AIML) – South Australia

AIML is Australia's first university-based institute dedicated to research in machine learning. AIML was established in early 2018, via co-investment from the South Australian Government and the University of Adelaide, and funding from an industry partner, Lockheed Martin.[47] AIML was built on the core of a strong existing research group, the Australian Centre for Visual Technologies (ACVT). The ACVT started with 5 people in 2007 and had grown to over 80 people by 2018.[48]

[47] AIML (2021), 'Annual report 2021'
[48] AIML (2018), 'Annual report 2018'

Since its inception in 2018, AIML has doubled in size and now has more than 170 members. Its members include academics, researchers, engineers, professional staff and around 70 PhD and masters degree students.

To help establish AIML, the South Australian Government provided an initial investment of $7.1 million in December 2017.[49] A further $1.0 million in South Australian Government support was granted to AIML in June 2022. In addition to the South Australian Government and University of Adelaide co-investment, AIML is funded by grant and research contracts.

What has worked well?

The South Australian Government's funding approach for AIML has been mutually beneficial. In return for the South Australian Government providing an initial $7.1 million in funding, AIML agreed to directly support South Australian businesses and government to develop new products and services based on AI. This was primarily achieved through the allocation of thousands of research hours to collaborative projects across four main areas:

- *South Australian Government* – to identify projects for adoption of Al into Government processes to improve productivity, efficiency, and service delivery to South Australian citizens.
- *South Australian SMEs* – to integrate and adopt machine learning and Al in those SMEs, to drive transformational productivity growth that will improve their local and global competitiveness.
- *Global research and development* – to seek out international partners to collaborate on Al related R&D projects. These projects result in an increased international profile for the AIML, attracting global investment.
- *Defence industry* – to support the AIML's collaborative research partnerships with defence industry partners to address the priority needs of Australia's defence industry and contribute to our industrial capabilities.

Due to the substantial amount of research hours subsidised by the South Australian Government funding, the initial cost barrier to investigate the potential benefits of machine learning and artificial intelligence to their organisations was significantly reduced for South Australian Government departments, SMEs and defence organisations. This created low-risk opportunities to explore how these technologies could drive transformation and productivity growth in their organisations.

AIML has quickly established itself as a leader in its area of expertise. Despite only being established five years ago, AIML is already the largest university-based research group in machine learning in Australia, is ranked in the top three global research organisations for computer vision, and number one in Australasia.[50] AIML members produced approximately 100 publications in 2021, contributing notables advances in fundamental machine learning research.[51]

Machine learning underpins the business models of the world's largest corporations and has the potential to deliver significant social, economic, and environmental benefits. By quickly establishing its expertise in this area, AIML is well positioned to take advantage of the continued growth and increasing importance of machine learning in the short- to medium-term future.

AIML has been able to attract, develop and retain high-quality researchers. Through training and employing South Australia's best talent, AIML is developing an ecosystem of machine learning experts.

AIML's charter is centred around developing research excellence, with high industry engagement. AIML has enjoyed disproportionate success at top conferences when compared to similar computer science institutes of much larger size.

AIML has been successful at securing financial support via grant and research contracts. In addition to the funding from the South Australian Government and the University of Adelaide, AIML

[49] AIML (2018), 'Annual report 2018'
[50] AIML (2021), 'AIML Capability Brochure 2021'
[51] AIML (2021), 'Annual report 2021'

has secured $54.8 million from grant and research contracts from 2017 to 2022. The most significant of these contracts being $20 million from the Australian Government to fund AIML's Centre for Augmented Reasoning, which opened in November 2021.

What has not worked as well?

AIML face challenges in developing contracts with South Australian businesses. While AIML has secured grant and research contracts with many different private companies and organisations, many of those contracts have been with overseas or multi-national organisations such as Amazon, Lockheed Martin, RMIT and MITRE, rather than businesses headquartered in South Australia.

This is due to several factors. The small average size of South Australian firms with almost all employing fewer than 20 full-time equivalent (FTE) staff constrains their capacity to absorb transformative innovation. Secondly, of those South Australian SMEs that are of sufficient size, many are not in industries that could benefit from incorporating machine learning and AI into their businesses. Finally, even when AIML was able to identify an SME that could benefit from their machine learning and AI services, the SMEs often did not have the clean data sets needed by the machine learning and AI algorithms.

General awareness of the potential benefits of machine learning and AI remains low across South Australian SMEs and government departments. While overall awareness levels of machine learning and AI amongst South Australian Government departments and SMEs has improved over time, much more work needs to be done in this area.

When it was first established, AIML hosted various events to promote community education and engagement with AI and machine learning, including research showcases, weekly AIML research forums, guest research presentations, a psychology and AI/machine learning ideation workshop and a PHD recruitment event. However, AIML's awareness and engagement activities have tapered off in recent years.

Adapting the AIML model elsewhere

For an AIML-like model to be successfully adopted in other areas of the South Australian economy, a few factors would need to be considered. Firstly, any potential areas would need to have a significant South Australian university research base to ensure that there was a critical mass of researchers. Ideally those researchers would be engaging with locally based SMEs, rather than mainly multi-national and interstate organisations. This would ensure that the field chosen would have the local activity required to support it.

The absence of a strong local industry base should not be the sole reason to exclude an area from adopting the AIML model, but it does create a risk that students in that area will either remain in academia or move interstate or overseas once their studies have been completed, making the retention of talent more difficult.

South Australia's narrow industry base does present a limiting factor in terms of suitable areas of the economy that the AIML model could be adopted in. However, one way in which this could be alleviated, at least in part, is by looking at technologies that could be applied across several industries, rather than focusing on a model centred around a specific industry.

Another issue to be considered is the length of the funding blocks. AIML's initial funding period was for five years. However, funding has since been extended until 2023, with discussions ongoing regarding further funding beyond that date. If the AIML model were to be adopted elsewhere, longer funding blocks should be considered as they allow universities to focus on growing their organisation, rather than on getting their funding renewed.

2.3 South Australian research institutions

2.3.1 South Australia's universities

South Australia's three research universities – Flinders University, the University of Adelaide, and the University of South Australia – are the state's most significant research institutions. Between them they host 66,383 undergraduate students, 25,620 post-graduate students and employ 3,930 academic staff (see Table 5). South Australia also has a substantial private university, Torrens University, but as that is primarily focused on teaching it has not been included in this analysis.[52]

The University of South Australia has the highest student numbers, but the University of Adelaide has substantially higher total revenue and research revenue than the other two institutions.

As well as representing a future (and in some cases current) asset for the state, students can be an important link between universities and the business community particularly where the course involves an industry placement. All three universities have put significant effort into designing and implementing models of student placements.

Each of the three universities, and many of the business stakeholders consulted through this inquiry, have been able to give us examples of students (particularly post-graduate students) not only contributing to the firm though their placement, but also linking the firm back into researchers at the university enabling knowledge transfer and innovation support. Many on-going research collaborations between SA firms and universities had their start in hosting a student placement.

Finding 31: Student placements play an important role in establishing and strengthening university-business connections.

South Australian universities are heavily reliant on student revenue for their financial sustainability, and the current Australian research funding model reduces the extent to which they can invest in long-term research capabilities.

It is also clear from the data that the financial scale and economic sustainability of South Australian universities is driven by student income. Research accounts for only 14 per cent to 25 per cent of the income of South Australian's universities (see Table 5).

Feedback from university stakeholders also indicates that Commonwealth funding allocated for research support and overheads is lower than the costs incurred in undertaking the research, and so Commonwealth grant funded research needs to be cross subsidised from international student revenues. This has a significant impact on the extent to which universities can invest in long term research capabilities, and on the types of contract research staff are given (which are largely based on the life of the grant). This in turn creates barriers to workforce development and maintenance of corporate knowledge and relationships with industry partners.

[52] In addition to its research universities, South Australia also has several substantial public research institutions. Some of these such as SAHMRI are South Australian specific, some are local nodes of national bodies. In most cases through the report the use of the word universities should be taken to also encompass these public research institutes.

Table 5: Key characteristics of South Australian Research Universities, as at 2021

	Flinders University	University of Adelaide	University of South Australia
Undergraduate students			
Domestic	14,219	16,327	26,234
International	1,349	4,801	3,453
Post-Graduate students			
Domestic	6,131	5,094	4,955
International	3,171	4,263	2,006
Academic staff			
Research and teaching (FTE)	412	734	491
Research only (FTE)	396	675	477
Teaching only (FTE)	242	168	335
Total academic staff (FTE)	**1,050**	**1,577**	**1,303**
Professional staff (FTE)	**1,167**	**1,927**	**1,535**
Research income ($'million)	**81.4**	**298.5**	**94.4**
Total revenue ($'million)	**552.4**	**1,146.6**	**677.3**

Source: Department of Education, Selected higher education statistics, Flinders University 2021 annual report, University of Adelaide 2021 annual report, University of South Australia 2021 annual report.

Finding 32: The revenue of South Australia's universities, and therefore the incentives that they face, is largely driven by student income.

Other research institutions

In addition to the three universities South Australia also hosts several state-based institutions, the largest of which are the South Australian Health and Medical Research Institute and SARDI, and local nodes of the two major national research institutions, The Defence Science and Technology Group and the CSIRO.

The **South Australian Health and Medical Research Institute** (SAHMRI), was established in 2009 as an independent Medical Research Institute, incorporated as a company limited by guarantee jointly owned by the South Australian Government and the three research universities. SAHMRI's founding objectives were to reverse the decline in the state's health and medical research performance and to enhance collaborations between existing researchers and research teams.

The **South Australian Research and Development Institute** (SARDI) is the state's single largest public research institution, delivering 'science outcomes for public good'. As the principal research arm of the Department of Primary Industries and Regions South Australia (PIRSA) SARDI undertakes applied research and development aimed at supporting South Australia's primary industries and food and wine sectors.

The **Defence Science and Technology Group** (DSTG), is the Australian Government's lead agency responsible for applying science and technology to safeguard Australia's national interests. DSTG has a significant R&D presence in SA. Its largest Australian operation is located at Edinburgh in Adelaide, and is home to more than 1,200 scientists, engineers, IT specialists and support staff undertaking military research in areas such as: surveillance systems, autonomous systems, electronic warfare, information systems, propulsion and energy, weapons effects, human science and operations analysis[53]. It also

[53] Defence SA, Defence Science and Technology, (Web Page, undated) <https://defencesa.com/projects/research-and-development/>

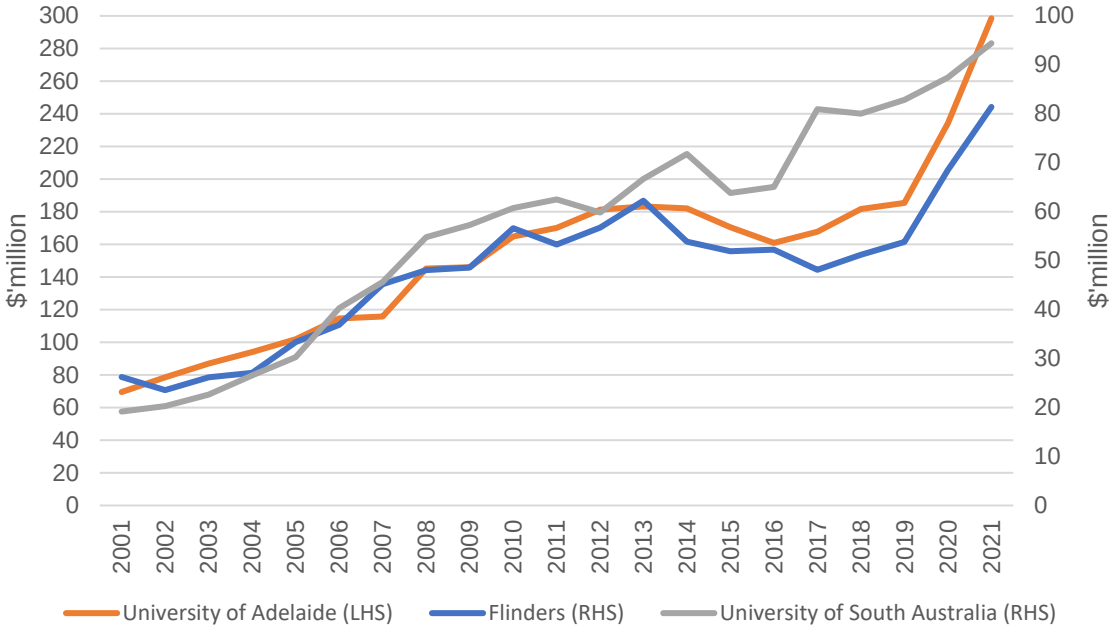
has a policy for R&D collaboration with partners and industry through the Research Collaboration Security Framework.

The **CSIRO** is the Australian Government's primary scientific research agency with 5,672 people employed across 53 sites throughout Australia and globally. The scale of CSIRO's South Australian operations are smaller than DSTG's, with three of its total of 53 sites located in South Australia.

2.3.2 Research performance

Total research income for each of the South Australian universities has grown strongly over the past decade. In the case of Flinders University and the University of Adelaide that has been largely through very strong growth since 2019, in the case of the University of South Australia the growth rate has been more consistent over the decade (Figure 20).

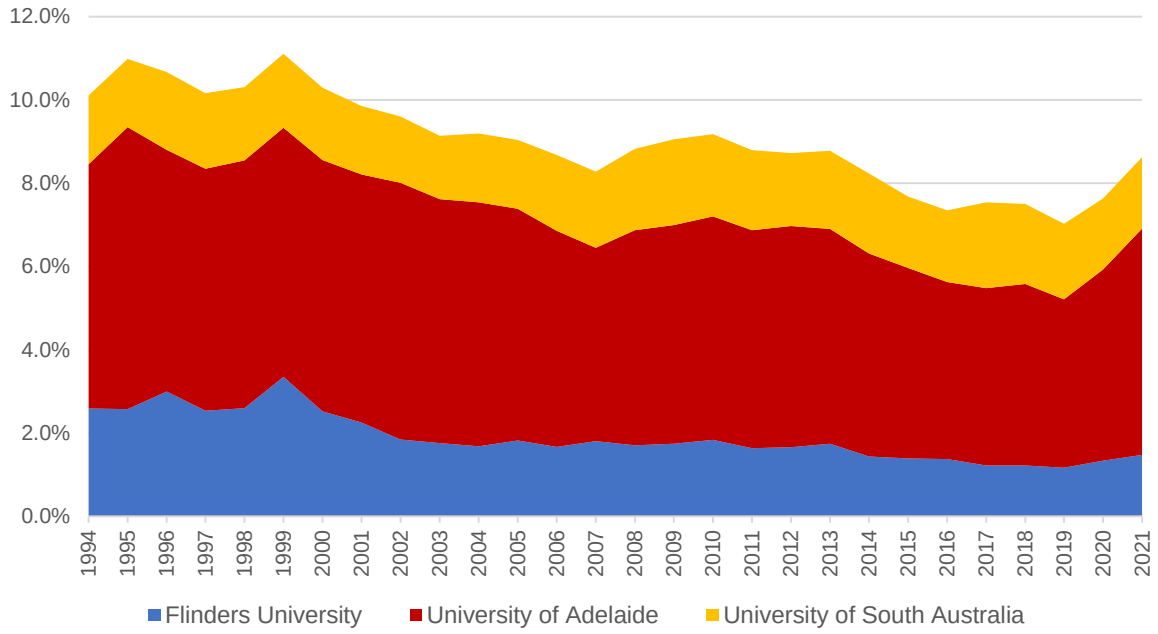
Figure 20: The value research income for South Australian research universities has grown strongly over the past two years
Total research income, $million nominal



Source: Australian Government Department of Education (2022), 'Higher Education Research and Development Income time series (1994-2021)'

As a share of total national university research grants the recent performance is not quite as strong. In the 1990s and 2000s South Australian universities had a disproportionately high share of national research grant income, peaking at 11.1 per cent in 1999. However, this fell back, such that by 2019 the state's share was 7.0 per cent, in line with its share of the population (see Figure 21). The sharp uptick in nominal funding over the last two years has meant that South Australia again enjoys a higher share of national grants than would be expected given its population, having secured 8.6 per cent of the national total in 2021.

Figure 21: South Australian universities share of national research income has fallen significantly over the past three decades, although it has bounced back over the last two years
Total research income, South Australian research universities, share of national total (per cent)



Source: Australian Government Department of Education (2022), 'Higher Education Research and Development Income time series (1994-2021)'

South Australian universities have performed well in securing research funding over the past two years, partially reversing a long-term decline in share of national funding. The national cooperative research program, and funding from rural research and development corporations are areas of strength.

South Australia has strengths in the cooperative research centres (CRC) program (a scheme that funds large-scale, long-term collaborations between a consortium of universities and a number of businesses and government agencies), and in category 1 - other (particularly funding from the rural research and development corporations, the bodies that allocate funding collected from compulsory industry levies on the agricultural sector to fund industry relevant research), see Figure 22.

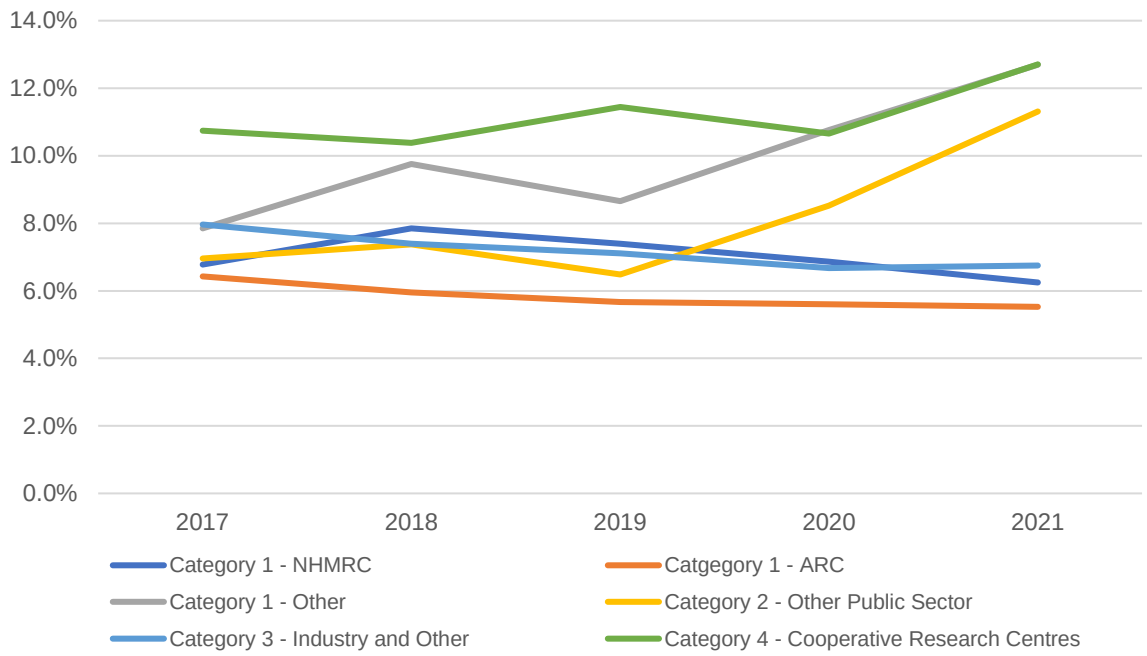
Finding 33: South Australian universities have performed well in securing research funding over the past two years, partially reversing a long-term decline in share of national funding. The national cooperative research program, and funding from rural research and development corporations are areas of strength.

The universities' performance has been much less strong in funding from the two main national research funding bodies, the National Health and Medical Research Council (NHMRC) and the Australian Research Council (ARC).

South Australia's share of national NHMRC funding (the traditional peer reviewed medical research funding scheme) continues to decline. From a high of almost 11 per cent of the national total in 1994, SA's share dropped to 7.4 per cent in 2009 and to 6.3 per cent in 2021, below the state's population share.

Similar trends can be observed in ARC research grant funding (the main peer reviewed research funding scheme for non-medical research) data, with SA having fallen from 6.4 per cent of national funding in 2017 to 5.5 per cent in 2021.

Figure 22: South Australia has strengths in CRC funding and grants from rural research and development corporations (Cat 1 – other)
Research income by funding stream, South Australian research universities, share of national total (per cent)



Source: Australian Government Department of Education (2022), 'Higher Education Research and Development Income time series (1994-2021)'

South Australian universities perform poorly in schemes targeted at the highest performing researchers, securing only two of the 80 Laureate Fellowships awarded over the last five years.

Perhaps of greatest concern, South Australia appears to be performing particularly poorly in schemes targeted at the highest performing researchers and in schemes targeted at developing and supporting early career researchers.

The Laureate Fellowship scheme is the Commonwealth funding specifically targeted at supporting Australian universities to attract and retain world-class researchers. Since its establishment in 2009 South Australian universities have only secured 8 of the 225 Laureate Fellowships awarded, 3.6 per cent of the total. And the relative performance appears to have worsened. In the last five years South Australia only secured two of the 80 Laureate Fellowships awarded (2.5 per cent of the national total).

South Australian institutions have also significantly underperformed in schemes supporting early career researchers. This creates potential barriers to sustaining areas of local excellence, and in providing opportunities for early career researchers to remain in the state and contribute to it.

Analysis by the Office of Chief Scientist SA (OCSSA) has identified that grant schemes targeted at supporting the development of early career researchers have some of the smallest South Australian funding shares. For example, South Australian researchers only

received 3 per cent of NHMRC Investigator grants in 2021. This relative weakness in funding for early career researchers has the potential to restrict the pipeline of talented young researchers in South Australia, potentially worsening the funding gap still further.

Finding 34: South Australian universities have underperformed in grants targeted at the highest performing researchers, and those supporting early career researchers.

Research strengths

There are a number of areas of significant research strength across South Australia's universities. Analysis of field weighted relative citation rates by OCSSA have identified the following disaggregated STEMM fields of research[54] in which South Australian research output quality is collectively ranked towards the top of the OECD:

- Applied mathematics;
- Artificial intelligence;
- Astronomical and space sciences;
- Atomic, molecular and optical physics;
- Chemical engineering;
- Classical physics;
- Computer vision and multimedia computation;
- Condensed matter physics;
- Data management and data science;
- Electronics, sensors and digital hardware;
- Environmental biotechnology;
- Fluid mechanics and thermal engineering;
- Human-centred computing;
- Industrial biotechnology;
- Medical biotechnology;
- Macromolecular and materials chemistry;
- Materials engineering;
- Mechanical engineering;
- Nanotechnology;
- Nuclear and plasma physics;
- Particle and high energy physics; and
- Quantum physics.

Many of these fields of research are relevant to the capabilities that the South Australian economy will need to fully take advantage of the emerging opportunities in areas the South Australian Government is focusing on such as defence, particularly the AUKUS submarine build, and in the green energy transition and in the potential for more sustainable manufacturing that might emerge from it.

Finding 35: South Australia has a number of areas of current world class research strength. And a number of these strengths map well to key economic priorities for the state such as the green energy transition, and the defence sector.

[54] As the OCSSA analysis was restricted to fields of research within science, technology, engineering, mathematics and medicine areas of local strength in the humanities, social sciences, business, law and creative arts are not included in this list.

2.3.3 University industry collaboration

Business survey data and bibliometric analysis suggest that collaborations between South Australia businesses and the state's universities are low by international standards.

As noted in chapter 1, South Australian businesses are very inward looking in terms of sourcing ideas for innovation, with only 3 per cent of South Australian innovation active firms (and only 1.5 per cent of all firms) reporting that they used universities as a source of ideas for innovation, and only 1 per cent reporting having collaborated with a university on innovation.

Bibliometric analysis undertaken by the Office of the Chief Scientist SA (OCSSA) indicates that the majority of South Australian STEMM fields are ranked in the bottom half of the OCED for research-business collaboration (based on the inclusion of industry co-authors on research publications). Australia is also ranked relatively low in the OECD for research-business collaborations in most STEMM fields and in global surveys of R&D performance such as the 2022 Global Innovation Index.

A major challenge identified by OCSSA in their analysis is improving technology diffusion into businesses in manner which allows them to compete with those who move quickly to adopt a new technology ahead of the market.

Stakeholder feedback to the Commission through this inquiry reported that it can be very difficult identifying the appropriate contact at universities, that university engagement is often skewed towards large firms, and that reaching IP agreements are extremely time consuming and bureaucratic.

Another significant barrier for industry research engagement identified by OCSSA is the lack of awareness of existing research facilities by local businesses. For example, OCSSA consultations on NCRIS facilities suggest that a large majority of South Australian businesses were not aware of the existence of common use research facilities relevant to their industry sector. Instead, a number of the NCRIS facilities appear to have been used largely by academic researchers.

Commercialisation rates in South Australian universities are low.

As there are only three research universities in South Australia it is not possible to publish aggregate data on the number of spin-outs created to commercialise university IP without potentially disclosing commercially sensitive data.

However, the average annual number of spin-outs created over the time frames for which data was provided by the universities (which covered a different number of years in each case) were below the state's population share based on the national spin-outs reported by universities which participated in the Survey of Commercialisation Outcomes from Public Research in 2021[55], below the state's population share. The share of licenses of University developed IP to industry was lower, with the average number of licenses across the three universities over the reported years less than half the state's population share based on the

[55] Knowledge Commercialisation Australasia (2022), Summary of results from 2021 Survey of Commercialisation Outcomes from Public Research, available at: https://techtransfer.org.au/metrics-data/ The survey included responses from 49 universities and public research institutes, and so is likely to somewhat understate the national total.

national total for licenses in 2021 reported in the Survey of Commercialisation Outcomes from Public Research.

Stakeholder feedback to the inquiry, both from academics who had sought to commercialise university IP and from industry partners (within firms and within the venture capital/finance sector) was that South Australian universities were still regarded as very bureaucratic and legalistic in their approach to potential commercialisation of IP, and that it was not unknown for it to take over a year for an agreement to be finalised.

Finding 36: Rates of commercialisation of university IP at South Australian universities lag the national average.

CRC funding and contract research revenue paints a more positive picture.

Industry funded research income for the three universities paints a more positive picture, with the three universities significantly outperforming South Australia's population share in securing funding through the CRC program, and performing roughly in line with the state's population share in securing contract research funding reported under 'Category 3 - Industry and other' in the national data. This may suggest that South Australian universities are much better at securing collaborations with large firms, which are more likely to be headquartered interstate or overseas, rather than with South Australian small and medium sized firms.

A number of stakeholders also noted in consultations that over the past five to ten years each of the local universities had made significant progress in making contract research engagements less bureaucratic and easier for industry partners, and that the universities had become more flexible about ownership of IP generated through contract research.

2.3.4 Make the university element of university/business connections the focus for South Australian Government innovation policy

The available data on the current scale of innovation activity in South Australian firms, and the below average share of high-growth firms in the state's private sector (see section 1.3) and the low share of innovation workers in the state outside of wine, agribusiness and defence (see section 1.4) leads the Commission to conclude that at this point in time the business sector is not the best place on which to focus state government policy effort. South Australia also lacks large national firms headquartered here which in many jurisdictions act as the main driver of the local innovation system.

Nor does the lack of evidence of outcomes from the past forty years of innovation policies suggest that leadership on developing university business connections should come from within South Australian Government agencies.

Universities have several potential advantages that suggest they are a useful place for South Australian Government innovation policy to focus on at this time, including a large number of innovation workers employed directly in the sector, a small number of organisations that would need to be influenced making the process more efficient, and a number of concentrations of world-class research capability that can be built on. As organisations established through South Australian legislation, and because of their receipt of substantial funding from South Australian taxpayers, there is also a legitimate role for the South Australian Government to engage with the universities around their South Australian economic and social impacts.

Finding 37: Of all the mainland states, given its characteristics and structure, our universities are more important to the South Australian innovation system, meaning that South Australian Government innovation policy should, for the next few years at least, be focused on developing the university side of the university industry connection.

Recommendation 6: South Australia's research universities should be the current focus of South Australian Government innovation policy as they currently represent the greatest concentration of world-class innovation capability in the state.

During consultations on the Commission's draft report stakeholder feedback was split on the Commission's proposed focus of policy on the university elements of the university-business connection. Some stakeholders strongly supported this focus, and the emphasis on better supporting and resourcing the universities' connections to the South Australian economy and society. Other stakeholders advocated for either a matching set of policies on the industry side of the relationship, or for the emphasis to be on business supports. We have considered the range of feedback carefully in finalising this inquiry. The Commission's judgement is that at this time, given our circumstances and historical innovation policy efforts, that the focus of South Australian Government innovation policy should be on the universities for the following reasons:

1) Putting the current focus of South Australian Government policy on the universities does not mean that businesses seeking to innovate would be left without support. There are well funded and diverse supports available for innovation in the firm funded by the Australian Government.
2) It is not possible to focus on both university and business elements of their connection, so if the South Australian Government were to focus on business support that would mean not focusing on universities.
3) Our recommendation to focus the South Australian Government's efforts on the university is not suggesting that industry elements of the connection should *never* be the focus. Instead, our judgment is that *at this point in time* there are not enough innovative entrepreneurial firms in SA for the industry side of the relationship to be its main driver. It is our expectation that the initial focus on universities would create 'market making' to help develop the absorptive capacity of SA firms, creating more effective partners for universities in the future.
4) South Australian Government innovation policies have had a firm level focus for the last forty years, and – despite individual successes – progress has not been sufficient overall to revitalise the South Australian economy's innovation capability. This leads us to the conclusion that a new approach is needed.

Recommendation 7**:** In two years' time, once the recommended sets of activities working on developing the university side of the university business connection have had enough time to begin to be implemented, the South Australian Productivity Commission should be asked to review barriers at the business side of the connection and identify potential complementary policy options.

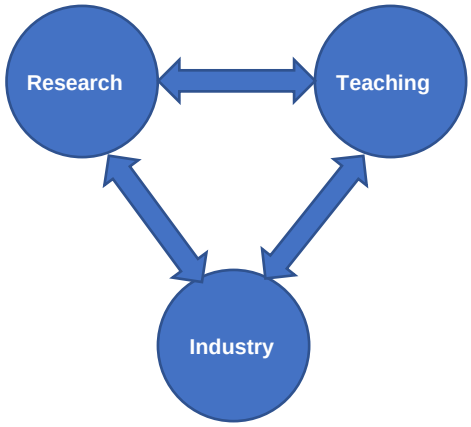
2.4 Entrepreneurial universities: The third mission for universities

2.4.1 The shift towards a new mission

Historically, universities have had two primary responsibilities: teaching and research. Teaching provides students with the knowledge and skills necessary for personal and professional growth, while research involves creating and disseminating knowledge through cutting-edge discoveries and new technology development. These missions have been at the core of higher education, but the rapidly changing world has led to a re-evaluation of universities' roles in society.

In recent years, a third mission for universities in developed economies has emerged, focusing on delivering broader social, economic, and environmental impact beyond their traditional roles in education and research and in particular local impact. This changed focus reflects a growing awareness that higher education institutions should better align with contemporary society's needs and contribute to innovative and sustainable solutions to national and global challenges.[56] And this change in the view of what a high-quality university means need not come at the expense of traditional measures of excellence. As the review of the Scottish technology ecosystem notes that:

> *The best universities view industrial collaboration in general, and start-up facilitation in particular, as equally important to their other missions of teaching and research. They understand that it is difficult to be genuinely world-class in teaching and research without being world-class in industrial liaison and entrepreneurial support. With any of these missing the others are diminished.*



[57]

Universities that have significantly re-oriented their focus towards the third mission are sometimes referred to as “entrepreneurial universities”. A confluence of factors has led to the pivot towards entrepreneurship in higher education, such as:

- Globalisation.
- The rise of the knowledge economy.
- Reduced government funding for universities, resulting in funding gaps.

[56] OECD (2019) ‘Science-Industry Knowledge Exchange: A Mapping of Policy Instruments and their Applications’, OECD Science Technology and Industry Policy Papers, Number 66; Compagnuccia, L. and F. Spigarellib (2020), ‘The Third Mission of the university: A systematic literature review on potentials and constraints’, *Technological Forecasting and Social Change*, 161, December 2020

[57] Logan, M. (2021) ‘Scottish Technology Ecosystem Review’, An independent review commissioned by the Scottish Government, p. 29

- Increased demand from industry in accessing university research to help solve their innovation problems.
- Increased recognition from governments that universities can play a major role in fostering innovation by transferring knowledge and technology to industry.
- Changes in the regulatory and legal frameworks to support entrepreneurial activities by universities. [58]

Finding 38: Increasingly universities and local governments are shifting their focus to expect universities to become entrepreneurial universities delivering on a Third Mission of localised social, economic, and environmental impacts in addition to their traditional roles of teaching and research.

The third mission comprises various activities aimed at promoting social and economic development and fostering environmental sustainability. Key elements of the third mission include knowledge transfer out of universities to businesses and community groups who can put it to productive use, technology commercialisation, entrepreneurship, and community engagement. The purpose of these activities is to ensure that universities not only generate knowledge but also actively contribute to societal improvement through the application of that knowledge.

Knowledge transfer plays a critical role in the third mission of universities, enabling the exchange of ideas, expertise, and skills between academic institutions and external stakeholders. This transfer can occur through various channels, including collaborative research projects with industry partners, sharing best practices among academic institutions, and offering professional development programs for practitioners across different fields. Knowledge transfer ensures that universities' generated knowledge is effectively communicated and utilised in broader society, supporting the growth of knowledge-based economies and fostering innovation.

Technology commercialisation is another essential component of the third mission, as universities increasingly aim to transform their research discoveries into market-ready products and services. For instance, some universities have introduced courses or events on various themes of entrepreneurship to spread the entrepreneurial culture among faculty and students; introduced initiatives, such as business plan competitions and technology transfer services, to promote entrepreneurial activities among academic researchers; established university incubators to stimulate and support technology transfer processes; and established venture funds and other support, such as technology transfer offices (TTO) staffed by retired entrepreneurs, to facilitate the transfer of knowledge and technology from university to industry. By bringing their innovations to market, universities can contribute to economic growth and job creation while generating additional revenue to support their research and educational activities.

There are a variety of ways that universities can facilitate the transfer of technology to industry. Essentially, they can be classified into two categories:

i. Codified transfer mechanisms, which are legal instruments that protect codified knowledge. These include patents and licensing.

[58] OECD (2019) 'Science-Industry Knowledge Exchange: A Mapping of Policy Instruments and their Applications', OECD Science Technology and Industry Policy Papers, Number 66; Audretscha, D. and M. Belitski (2022), 'A strategic alignment framework for the entrepreneurial University', *Industry and Innovation*, 29(2), pp. 285–309; Logan, M. (2021) 'Scottish Technology Ecosystem Review', An independent review commissioned by the Scottish Government

ii. Tacit transfer mechanisms, which are ways to transfer uncodified knowledge assets possessed by the researcher. These include the creation of start-up and spin-off, participation in research projects, and consulting activities.

Community engagement is a vital aspect of the third mission's social impact, emphasising the need for universities to respond to their local communities' needs and actively contribute to addressing social and environmental challenges. This engagement may involve partnering with community organisations to develop and implement targeted initiatives, offering educational outreach programs for underserved populations, or conducting research aimed at addressing specific community concerns. Through these efforts, universities can help strengthen social cohesion and promote more inclusive and sustainable forms of development.

2.4.2 Examples of entrepreneurial universities

The transition from research university to entrepreneurial university originated in the US in the late 19th century. Stanford University and the Massachusetts Institute of Technology (MIT) are examples of universities that first expand their traditional missions of teaching and research to include more applied research with commercial relevance into their programs. They also started to transfer knowledge and providing support to industry.

Stanford is a pioneer of the role of an entrepreneurial university in an agricultural region on the US west coast. It collaborated with industry to support industrial development in the region, which also helped raised its own technical level. Since then, Stanford has exceled in teaching, research, and entrepreneurial activities. According to Stanford's Entrepreneurship Network website, it states that "Stanford's entrepreneurial ecosystem is rich and diverse, with deep ties to Silicon Valley and regions around the world. The university's entrepreneurial activity is decentralized, flourishing through the work of students, faculty, and staff engaged in events and initiatives for the Stanford community." Stanford consistently ranks in the top 10 universities in the world.[59]

Conversely, MIT is a pioneer of the entrepreneurial university in a declining industrial region on the US east coast. It helped introduce new technology to firms in the region. Since then, MIT has increased its entrepreneurial activities. For instance, the Martin Trust Center for MIT Entrepreneurship offers more than 60 courses on a variety of topics. MIT follows a team-based approach focusing on problem solving, with close connection with companies. In the 2000s, MIT alumni started about 12,000 new firms. The success of MIT's entrepreneurial activities is a combination of factors, including cutting-edge research, supportive entrepreneurial infrastructure, a strong network, and an unwavering commitment to entrepreneurship programs. MIT consistently ranks in the top 10 universities in the world.[60]

Other examples of notable entrepreneurial universities, include Imperial College, London, the University of Twente, Technical University of Munich, Chalmers University of Technology, and Linkoping University.

[59] Etzkowitz, H., Germain-Alamartine, E., Keel, J., Kumar, C., Smith, K., and Albats, E., (2019), 'Entrepreneurial university dynamics: Structured ambivalence, relative deprivation and institution-formation in the Stanford innovation system', *Technological Forecasting and Social Change*, 141, pp. 159-171.and https://sen.stanford.edu/

[60] Sperrer, M., Muller, C., and Soos, J., (2016), The Concept of the Entrepreneurial University Applied to Universities of Technology in Austria: Already Reality or a Vision of the Future?, Technology Innovation Management Review, 6(10), pp. 37-44.

The University of Utah shows that a small regional university can transform its role in its local innovation system and generation of start-ups.

With a much smaller funding base than Stanford and MIT, the University of Utah has one of the highest rates of firm-formation in universities in the US. Utah's main missions are to encourage start-ups, educating students, and performing research. The university has also created the structure and incentives to encourage academics to commercialise their research. Furthermore, junior academics are encouraged to be entrepreneurial because it is part of the academic reward structure.[61]

The rate of start-up formation at the University of Utah increased from an average of 3 per year from 1970 to 2005, to an average of 15 per year from 2006 to 2021

The University of Utah is a public institution of higher education founded in 1850. The University of Utah offers more than 100 undergraduate and 90 graduate degree programs through its 18 colleges and schools. It has a total enrolment of 34,464 students – 25,826 undergraduate and 8,638 graduate students (as at autumn 2021). The University is ranked 105th according to the 2022-23 edition of Best Colleges in America.[62]

The University launched its first tech start-up in 1970. The number of start-ups created averaged 3 per year between 1970 and 2005. However, this figure increased sharply after 2005 – 15 start-ups were created per year between 2006 and 2021.[63] The rapid rate of growth propelled the University of Utah to be ranked equal first with MIT by the Association of University Technology Managers (AUTM) for the number of start-ups created in 2008-09, with 23 start-ups. In 2009-10, the University of Utah overtook MIT and was ranked first – with 19 start-ups. The University of Utah has consistently ranked in the top 5 over the years by the AUTM.[64] Furthermore, the University of Utah was ranked first in 2017 on commercialising technology innovations by the Milken Institute's 2017 ranking of Best Universities for Technology Transfer, compared to its ranking of 14 in the 2006 inaugural report. More recently, the University of Utah was ranked second among large research universities for innovation impact.[65]

In 2020-21, the University of Utah had 203 invention disclosures, 304 inventors, 31 licenses executed, 126 patents filed, and 14 start-ups.[66] Additionally, a recent study found that one of every 61 US venture capital-backed companies in Utah becomes a unicorn, compared to 1 out of 72 in California and 1 out of 101 nationally in the US.[67]

Changes to national and state legislative frameworks around technology commercialisation by universities were an important enabler of change.

When some US federal research agencies allowed universities to patent and license results from federally funded research in the early 1960s, some research universities established internal technology transfer offices to facilitate this process. The University of Utah was one of the early movers in establishing an internal Technology Commercialisation Office (TCO) in

[61] Etzkowitz, H., Germain-Alamartine, E., Keel, J., Kumar, C., Smith, K., and Albats, E., (2019), 'Entrepreneurial university dynamics: Structured ambivalence, relative deprivation and institution-formation in the Stanford innovation system', *Technological Forecasting and Social Change*, 141, pp. 159-171.
[62] https://www.usnews.com/best-colleges/university-of-utah-3675
[63] TVC Annual Report 2018, and Pivot Centre Annual reports, 2019, 2020, 2021, the University of Utah.
[64] https://utahutes.com/sports/2016/6/10/library-u-of-u-111110-html.aspx
[65] https://www.bushcenter.org/publications/the-innovation-impact-of-u-s-universities
[66] https://pivotcenter.utah.edu/news-events/annual-reports/
[67] https://www.linkedin.com/posts/ilyavcandpe_stanford-stanfordgsb-venturecapital-activity-6983788030985711616-a2a5/?utm_source=share&utm_medium=member_desktop

1967 to facilitate technology transfer.[68] The TCO manages all of the University of Utah's intellectual property, negotiates technology licenses, and provides an array of programs to support researchers on campus who want to commercialise their inventions.

Further legislative changes, such as the introduction of the Bayh-Dole Act in 1980 further liberalised the technology transfer process nationally. This legislative reform allowed universities in the US to own and manage intellectual property from federally sponsored research, with royalties shared between the university and inventors, and created a uniform intellectual property management policy for the federal agencies that fund research.

But active engagement by the state government to work with the university to develop less bureaucratic systems for technology transfer, to fund more academics, and to fund start-up incubation was even more important.

In addition, Utah introduced policies and reforms that created a supportive environment to attract capital investment and encourage entrepreneurship and innovation, such as the 10-Point Economic Plan for Revitalisation launched in 2005 which included the Utah state government actively engaging with the university to remove regulatory barriers to commercialisation, to reduce the level of red-tape within the university and adopt a more collaborative approach when working with entrepreneurs, and substantial increases in funding to endow new academic chairs and fund a 'centres of excellence' program to incubate more start-ups.

The University of Utah invested in substantial infrastructure to support its focus on commercialisation of research

To keep pace with the growth of invention disclosures, licenses, patents, and start-ups and the evolving needs in the marketplace, the University of Utah established the Technology Venture Development Office (TVD) to coordinate all commercialisation efforts across campus; provide progressive development grants and support services to help researchers develop a commercially viable product; and attract partners for commercial-sponsored research and investment. The University of Utah also created a senior-level position of Vice President for Technology Venture Development to lead the TVD, and oversee TCO and other entrepreneurship and innovation centres at the university.[69]

The University of Utah also changed the name of TCO to the Centre for Technology & Venture Commercialisation (TVC) in 2013 to capture its dual mission in commercialising inventions through partnerships with existing companies and creating new ventures.[70]

Furthermore, in 2020, the University of Utah established the Partners for Innovation, Ventures, Outreach & Technology (PIVOT) Center, a centralized office to drive the university's expanding efforts for economic engagement for the greater Utah community. The Center builds on the work by the TVC and acts as a hub to foster partnerships between industry, university and government entities. It is also responsible for all aspects of invention management, patent prosecution, licensing, start-up formation and support, equity management and early-stage funding.[71]

[68] https://gardner.utah.edu/Documents/uebr/UEBR2010/UEBR2010no4.pdf
[69] https://archive.unews.utah.edu/news_releases/u-of-u-creates-position-of-vice-president-for-technology-venture-development/
[70] https://www.deseret.com/2013/6/6/20520767/university-of-utah-s-technology-commercialization-office-changes-name
[71] https://attheu.utah.edu/announcements/u-establishes-partners-for-innovation-ventures-outreach-technology-pivot-center/

Finding 39: The University of Utah shows that local governments and universities working with a common purpose of delivering the third mission of the university can transform the impact of the university on its local economy.

Drawing in the university's entrepreneurial and business education was an important support for potential entrepreneurs

Additionally, the University of Utah draws on the rich knowledge, resources, and business support services from the University's David Eccles School of Business, which is ranked among the top 10 schools for entrepreneurship in the US by the US News & World Report. The Business School also houses the Lassonde Entrepreneur Institute (which helps students launch start-ups and raise money), the Lassonde Studios (which provides housing, entrepreneurial workspace, and laboratory for students to test ideas and build prototypes), as well as other business-related institutes and centres.

The Business School also offers a range of programs, including start-up support, workshops, business model competitions, networking events, scholarships, and innovation programs. In 2020, it introduced the first-of-a-kind Master of Business Creation (MBC). This is a professional degree program for founders to develop their business ideas and scale their business. They have access to leading scholars, mentors, experienced entrepreneurs, and other university resources.

In addition, the University of Utah has created the structure and incentives to encourage academics to commercialise their research. Junior academics are encouraged to be entrepreneurial because it is part of the academic reward structure.[72]

University of Utah leadership has consistently focused on delivering its third mission

Establishing the appropriate infrastructure would not be possible without a clear direction, and strong leadership and commitment from senior management of the University, starting with its president. For instance, during Michael Young's tenure as President of the university (2004-2011), one of his top priorities was to integrate commercialisation with the University's core educational and research missions.[73] Successive presidents built on these efforts. Now, developing and transferring new knowledge and technology is one of four main strategic goals of the University of Utah.

The current University President, Taylor Randall, underscored that innovation is one of his three priorities, with initiatives aimed at creating innovation districts and labs and refreshing the university's research and commercialisation leadership strategy.

Randall's plan focuses on boosting research, speeding the transfer of technology to the marketplace and facilitating partnerships between stakeholders. This plan will require a substantial increase in research funding than the record amount of $686 million for 2022. He wants the University of Utah to secure and sustain $1 billion of research funding annually within seven years.

[72] Etzkowitz, H., Germain-Alamartine, E., Keel, J., Kumar, C., Smith, K., and Albats, E., (2019), 'Entrepreneurial university dynamics: Structured ambivalence, relative deprivation and institution-formation in the Stanford innovation system', *Technological Forecasting and Social Change*, 141, pp. 159-171.
[73] https://archive.unews.utah.edu/news_releases/u-of-u-creates-position-of-vice-president-for-technology-venture-development/

Randall said that "I call this picking up our 'clock speed' by increasing the velocity of our engagement to speed up transfer," He also plans to invest $100 million in innovation programs that increase the translation of basic research into commercially useful output.

2.4.3 Pathways to becoming an entrepreneurial university

Studies have examined the various processes that a university goes through to become an entrepreneurial university. For instance, Etzkowitz discussed the four stages in this transformation process, the university:

- identifies its ability to establish priorities and formulate an appropriate strategy;
- acquires financial resources from various sources;
- begins to play an active role in commercialising the viable research results; and
- engages with stakeholders to participate in the development of the innovation environment.[74]

Another pathway proposed in the literature involves the interactions of these five internal factors:

- structures (entrepreneurial infrastructures, e.g., TTOs, incubators, tech parks, business portals);
- strategies (institutional goals, formal incentive structures);
- systems (communication networks and linkages between structures and faculties);
- leadership (qualification and orientation of key leaders, administrators, board of directors, department heads, and researchers involved in the third mission); and
- culture (institutional, departmental and individual attitudes, and norms within the third mission).[75]

Some studies have also found that a majority of academics do not embrace the engagement of entrepreneurial activities within the university because it may distract them from their teaching and research activities; create conflicts of interests (academic values and culture and monetary benefits); and increase corporate disclosure requirements that may restrict the flow of ideas within academia.

2.4.4 Aligning University Reward Systems and Career Opportunities with the Third Mission[76]

Traditional university reward and career development systems are based around the 'two mission' model of universities. Fully implementing the third mission's focus on societal impact, technology transfer, and economic development is likely to require adjustments to better align university reward systems and career opportunities. These could include:

[74] Etzkowitz, H., (2013), Anatomy of the entrepreneurial university. Social Science Information, 52(3), pp. 486–511

[75] Compagnuccia, L. and F. Spigarellib (2020), 'The Third Mission of the university: A systematic literature review on potentials and constraints', *Technological Forecasting and Social Change*, 161, December 2020

[76] This discussion draws on Wright, M., Mosey, S., & Noke, H. (2012). Academic entrepreneurship and economic competitiveness: rethinking the role of the entrepreneur. Economics of Innovation and New Technology, 21(5-6), 429-444; Siegel, D. S., & Wright, M. (2015). Academic entrepreneurship: time for a rethink?. British journal of management, 26(4), 582-595; Wright, M. (2014). Academic entrepreneurship, technology transfer and society: where next?. The journal of technology transfer, 39, 322-334; Link, A. N., Siegel, D. S., & Wright, M. (Eds.). (2019). The Chicago handbook of university technology transfer and academic entrepreneurship. University of Chicago Press; and Grimaldi, R., Kenney, M., Siegel, D. S., & Wright, M. (2011). 30 years after Bayh–Dole: Reassessing academic entrepreneurship. Research policy, 40(8), 1045-1057.

Revised promotion and tenure criteria: Universities could revise promotion and tenure criteria to emphasize faculty contributions to the third mission, including technology transfer, industry collaboration, entrepreneurial endeavours, and public engagement, in addition to traditional research and teaching achievements.

There are two common challenges to expanding promotion and tenure criteria to better reflect the third mission. The first is that academic careers, particularly for the best academics, are in an international context. Whilst incentives at the university level can be shifted to move away from being solely focused on research output, international career opportunities are often still based on the old narrower criteria. The second common problem is that funding for research is often short-term making it difficult for universities to employ researchers on longer-term contracts.

Providing training and professional development opportunities: Offering relevant training and professional development opportunities in technology commercialisation, in building collaborations with industry including the ability to understand industry needs, and in public engagement can encourage faculty engagement with the third mission.

This approach works better when there are sufficient incentives for academics to make use of such training and development opportunities. One way to achieve this is by making impact assessment and applied knowledge a compulsory component of PhD grants and specific grants for established faculty fellows. However, over time, if the overall funding structure becomes increasingly shaped towards a competitive market where university and business relationships are crucial, the interest of academics may shift towards funding research that has societal impacts. An intermediate approach to address this issue is to require internal research proposals to demonstrate interest from businesses before being approved for funding.

Developing alternative career pathways: Universities might develop alternative career pathways for faculty members excelling in the third mission, such as joint appointments with industry partners, providing additional career growth opportunities.

It is indeed important to create opportunities for full professorships that take into account a researcher's impact on society and knowledge transfer. While many universities have incentives for engagement in these areas, it seems that higher positions at Utrecht University may not be directly linked to this movement. This may make it difficult to attract talented researchers who are interested in making a meaningful impact on society. One potential solution to this challenge could be to develop new pathways for advancement that recognize and reward impact and knowledge transfer. This could involve creating new professorship tracks or modifying existing ones to include criteria that prioritize impact and engagement. Additionally, it may be beneficial to provide more resources and support to the organizing institutes that focus on impact activities, making them more attractive to talented researchers. Overall, the key is to ensure that the culture of the university supports and values impact and engagement, and that there are clear and meaningful pathways for advancement for those who prioritize these areas. By doing so, Utrecht University can attract and retain talented researchers who are committed to making a positive impact on society through their work.

Offering financial incentives and support: Financial incentives like seed funding for start-ups, grants for applied research projects, or bonuses for successful technology commercialisation can motivate faculty members, and the schools in which they are located, to engage in and support third mission activities.

Applied research has traditionally been wholly externally funded. Nevertheless, some universities have implemented seed funding structures from internal sources, with a particular focus on supporting interdisciplinary research. This approach has been observed to be successful and should be considered by university administrators when evaluating funding strategies for applied research.

It is crucial that universities are committed to knowledge transfer, and that management of intellectual property is as efficient and 'light-touch' as possible, as well as ensuring academics are incentivised to remain engaged through the commercialisation process. Additionally, staff should be supported in facilitating technology transfer (whether in establishing a start-up or supporting the adoption of IP licensed from the university) through access to incubation facilities, access to university labs, and the possibility of fractional time appointments in industry partners.

Fostering a supportive institutional culture: University leadership should actively promote the importance of the third mission and cultivate a supportive institutional culture by communicating the university's commitment to societal impact, technology transfer, and economic development and highlighting faculty successes in these areas.

In implementing this strategy, several factors must be considered. Firstly, it is important to incorporate impact as a key element in the overall strategy of the university, as well as at the faculty and school levels. This can be achieved by ensuring that impact is integrated into the design of Masters and accreditation programs, and by effectively communicating the importance of impact to staff responsible for such education and research profiles. Overall, a comprehensive and coordinated approach to promoting and measuring impact can help to ensure that the university is effectively engaging with the wider community and delivering research outcomes that have a meaningful impact on society.

Box 4: The Utrecht University Model: Good Practice in Recognition and Rewards

Utrecht University has adopted Open Science as one of its five core principles, striving to enhance and expedite science and scholarship and their societal impact by valuing teamwork over individualism and fostering an open academic culture that supports accountability, reproducibility, integrity, transparency, sharing, and public engagement. To uphold this commitment, the university has devised a Recognition and Rewards vision that acknowledges and rewards teamwork while assessing quality, impact, sharing, and openness to the world. This document serves as the initial step towards a novel system of Recognition and Rewards, comprising three crucial building blocks.

The first building block, Utrecht University's ambition for recognition and rewards, evaluates employees based on their contributions in accordance with Open Science principles and the National Program Recognition and Rewards proposals. This new system will guide recruitment & selection, socialisation, training & development, staffing, performance appraisal, and employee promotion procedures.

The second building block, the TRIPLE model, encompasses six components detailing the three output domains at Utrecht University (research, professional performance, and education), their impact on science and society, and the leadership fostering an environment conducive to their growth. The TRIPLE model highlights team spirit as the default approach in academia and necessitates effective leadership that establishes a safe, open, constructive, diverse, and inclusive academic atmosphere.

The third building block consists of guiding principles—transparency, fairness, inclusiveness, excellence, and adaptability—that facilitate the novel system of Recognition and Rewards. These

principles supply the framework for implementing the Recognition and Rewards system, ensuring fairness and justice for all employees.

2.5 Barriers to South Australian universities completing the transition to entrepreneurial universities

The barriers to research industry collaboration at the university side don't exist because universities are not aware of the benefits of industry collaboration, nor do they reflect poor implementation by universities. Instead, the focus of university activity on teaching and on peer-reviewed research are a response to the incentives they have been given, and the resources available to them.

If, as a state, we want universities to sharpen their focus on local industry engagement we will need to change the incentives the universities, their researchers, and their students, face.

Recommendation 8: The South Australian Government should work with the state's universities to facilitate, and to help resource, their journey to becoming entrepreneurial universities focused on delivering economic and social impacts as well as high quality education and research.

Consultations with stakeholders have identified a number of barriers to the state's universities fulfilling their potential as entrepreneurial universities at the heart of the state's innovation.

2.5.1 Commercialisation of university IP

Contract research seems to be working well in South Australian universities as model for supporting business innovation.

The contract research model of transferring academic knowledge into industry partners appears to have significantly improved over the past five to ten years, and now appears to be functioning relatively well.

Stakeholders with longer experience of dealing with university commercialisation generally expressed the view that progress had been made, particularly in the speed with which contract research can be agreed, the use of standardised contracts, and the willingness of universities to be flexible around management of IP arising from contract research.

But university approaches to spin-outs and licenses of IP are regarded as excessively bureaucratic, and very slow.

However, management of the licensing of IP, or spinning businesses out from South Australian universities, is regarded by stakeholders who have navigated the process as extremely bureaucratic and legalistic. The Commission has heard a number of cases where securing university sign-off on the commercialisation of university IP took well over a year.

Barriers to the commercialisation of university IP have been consistently raised with the Commissioners by stakeholders as one of the areas where the existing performance of South Australian universities is furthest from the ideals of an entrepreneurial university. This feedback has been received from senior academics who had been involved in trying to

commercialise ideas developed by their teams, and from entrepreneurs who had been involved in spinning-out or licensing university developed technology to meet a business need.

Many stakeholders contrasted their experience with South Australian universities' management of spin-outs with the approach taken by Stamford University, where a standard form agreement is used in most cases, and commercialisation agreements are typically finalised within 24 hours.

Finding 40: South Australian universities' processes around commercialising IP, whether through spin-outs or licencing, are regarded as very slow and excessively bureaucratic, and well below world's best practice.

Successful commercialisation of research through a start-up requires significant on-going involvement from the inventor(s)

A significant share of start-ups have at least once founder who is a university staff member, or a current university student. The average is around 15 per cent across the OECD and around 23 per cent of start-ups in high tech fields such as biotechnology[77]

But university staff need the right incentives to participate, as start-ups will typically only work if the key inventors retain a substantial involvement in their commercialisation (e.g. acting as CTO), but equally useful to have key inventors willing to step back and let the CE role be undertaken by a manager.

Student led start-ups are very important for volume, although they are less likely to involve genuinely disruptive technology than research led start-ups, but are generally much less of a policy focus and receive much less support.

Compared to other OECD countries, Australia has a below average rate of researcher founded start-ups, a broadly average level of start-ups with at least one PhD as a founder, and an above average rate of student founded start-ups.[78]

However, South Australian academics consulted by the Commission who had spun research out of their university reported a lack of support from the university, particularly around difficulties with having the commercialisation activity recognised in the workload model or being supported to spend part of their time with the start-up. This was seen as exacerbating the negative impact of the highly bureaucratic approach to IP noted previously.

The relatively high equity shares South Australian universities require when spinning out IP risk diluting the incentive for on-going participation by inventors

Standard practice across all three South Australian universities is for the university to take a substantial equity stake in spin-outs and start-ups that involve IP developed at the university (with IP held in many cases centrally and at the school/faculty level). This means that once equity is granted to early stage and VC investors, and to employees of the start-up the inventors can end up with very low equity shares. This reduces the incentive for the original inventors to devote time to making the start-up a success. And commercialisation professionals consulted through this inquiry indicate that low inventor equity makes them much less willing to invest in a start-up or scale up; partly as it gives the university

[77] OECD (2019) 'Science-Industry Knowledge Exchange: A Mapping of Policy Instruments and their Applications', OECD Science Technology and Industry Policy Papers', Number 66, pp. 50-54
[78] OECD (2019), p. 53

substantial influence, and partly as in their experience inventors with very low equity will not engage sufficiently in the scale-up process.

A number of international reviews, including the OECD's study into university-industry collaboration, and the Scottish technology ecosystem review, have highlighted concerns from venture capital investors that high University equity stakes dilute the incentives of inventors to work on the commercialisation of their technology, reducing the chance of successful spin-outs, and making venture capital funds less likely to invest. [79]

Some leading commercially focused universities internationally have adopted policies which involve much smaller shares of IP accruing to the university – Stanford typically takes 10 per cent and MIT 5 per cent. Stanford and Imperial College London each vary the required equity stake based on the level of pre-incubation and follow-on support provided by the university.[80]

Adopting a similar position in South Australia could increase the number of start-ups created and increase their chance of scaling-up and securing venture capital funding and is unlikely to lead to a significant loss in revenue. Where incubation support, or seed funding, have been provided by the university it could take a higher equity share, depending on the nature and extent of support provided. (For example, the Y-Combinator incubator in the US, probably the best known private sector start-up incubator, takes a 7 per cent equity share in participants in exchange for incubation services and a US$125,000 seed investment.[81])

It is not possible to identify the revenue received by the three South Australian universities from start-ups in their public accounts. However total revenues for 'royalties, trademarks and licences' of suggest that commercialisation of IP is a very small share of university income (see Table 6). In 2021 total IP income was 0.3 per cent of total income for the three universities.

Table 6: Total revenue for royalties, trademarks and licences by university, $'millions.

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Flinders University	0.6	0.5	1.0	3.0	1.3	0.7	0.6	0.8	0.8	0.2
University of Adelaide	3.9	4.8	4.9	4.7	3.9	7.9	6.0	4.6	4.8	6.7
University of South Australia	0.4	0.3	0.3	0.2	0.5	0.4	0.4	0.5	0.5	0.5
Total	5.0	5.7	6.3	7.9	5.7	9.0	7.1	5.9	6.1	7.4

Source: annual reports of Flinders University, University of Adelaide, University of South Australia.

Finding 41: South Australian universities' default equity shares appear to be too high, and adopting a lower standard share could increase rates of scale-up and VC funding for start-ups with university researchers as founders.

2.5.2 Providing academics with recognition for engagement

Human resources policies in universities, including allocation of time between functions, and the factors considered in applications for promotion are driven by the overall priorities of the university. The OECD in its review of university industry collaboration notes that there are

[79] OECD (2019) 'Science-Industry Knowledge Exchange: A Mapping of Policy Instruments and their Applications', OECD Science Technology and Industry Policy Papers', Number 66, Logan, M. (2021) 'Scottish Technology Ecosystem Review', An independent review commissioned by the Scottish Government.
[80] Logan (2020), p. 33-34
[81] Y-Combinator (undated): https://www.ycombinator.com/deal/, accessed 06 March 2023.

widespread issues across its member economies with academic career paths limiting the incentives for industry collaboration and commercialisation of research. This includes:

- limited or negative incentives for researchers to engage and support knowledge transfer activities, as research evaluations focus on peer-reviewed publications.
- lack of incentives for academics to invest time in the intermediate stages (such as validation and readiness) of start-ups commercialising their research due to high university equity shares (see 3.1 above); and
- time allocated to collaboration by academics with industry is insufficient as universities grant insufficient work time. Additionally, academics perceive that university-business collaboration conflicts with their teaching and research responsibilities.

A number of academics consulted by the Commission reported that whilst university policies such as promotion criteria, were notionally supportive of engagement this was in practice given little weight with promotions determined by publications track record and teaching performance. Concerns were also raised that workload allocation models were not flexible around effort put into engagement, with the allowance for engagement typically part of a broader administrative activities category that was usually fully occupied by meeting university reporting requirements.

The University of South Australia has recently taken steps to try and address the promotions related barriers to academic engagement with industry, by allowing academics to nominate whether they want to be assessed on their research quality or the community engagement in setting performance indicators for them. This seems an excellent approach as it allows academics to focus on what they individually do best. An academic who is exceptional at 'pure' research but struggles with industry engagement can nominate research quality measures and a researcher spending time engaging with industry can get recognition for that (and avoid being penalised for the lower research output) by nominating engagement-based performance measures.

Finding 42: The University of South Australia's has implemented an interesting academic employment model which allows academics to choose between research quality and engagement performance indicators.

Recognition of engagement, both through workload allocation processes and through promotion necessarily requires careful management by universities to ensure that across academic areas there is a balanced portfolio of research activity, teaching activity and industry engagement.

However, to truly incentivise industry engagement around research, workload models will also need to be set so that industry engagement (at least by some researchers, perhaps through a 'portfolio' approach at the school level) is supported through adequate allocation of time away from teaching and peer reviewed research.

Finding 43: For academic incentives to truly shift towards giving industry and social engagement equal weight, workload models within universities would also need to be amended so that industry engagement can be sufficiently resourced.

2.5.3 Build and reward entrepreneurial skills across university students

The importance of embedding entrepreneurial education within universities, and teaching it in a way that brings together students (particularly post-graduate students) across different

faculties, is one of the most important sets of recommendations of the review of the Scottish technology ecosystem. The review considers that delivering entrepreneurial education to post-graduate (and possibly undergraduate) students across universities regardless of their faculty, and teaching these students in joint classes to build links between students with different skill sets, is the intervention most likely to build a self-sustaining start-up ecosystem in Scotland. This increase in education would need to be supported through increased availability of incubation services and other early forms of support. The rationale for this focus is that higher levels of start-up formation (and successful scale-up) will require a wider range of research students and academics with entrepreneurial skills, and will need more extensive collaboration between students of 'technical' disciplines and students of business, and social science disciplines.

Good practice in university activities to support entrepreneurialism identified by the Scottish Technology Ecosystem Review[82] include:

- Entrepreneurial education is widely offered by the university, at a number of levels and in a number of formats from full semester courses to short courses;
- Entrepreneurialism education is delivered in a cross-disciplinary way with business and technical students taught together;
- Students perceive that the university values entrepreneurialism;
- Students are encouraged to explore start-up ideas, and are given access to facilities and supports to help them do so;
- Universities are adequately resourced to support their students in entrepreneurialism;
- Computer science [and ICT more broadly] students are taught tech start-up leadership skills as part of their degree; and
- Incubation space (and, potentially, seed investment funding) are available to high-potential student founded start-ups.

To their credit, each of South Australia's three research universities have significantly expanded the extent of their entrepreneurial education and entrepreneurial opportunities over the past decade or so. There are indications that these changes have led South Australia's universities to be amongst the best in the country at entrepreneurial education.

However, it is our judgement that universities need to do even more on entrepreneurial education of students and staff if the three universities are to realise their potential as drivers of the state's innovation. In particular they need to find a way to take the high-quality existing teaching practice around entrepreneurship (and entrepreneurship competitions currently run on a relatively small scale) and make them much more extensive.

Finding 44: Entrepreneurship education and entrepreneurial opportunities should be routinely provided to postgraduate students. Similar courses should be offered as options to undergraduates across all faculties.

[82] Logan, M. (2021) 'Scottish Technology Ecosystem Review', An independent review commissioned by the Scottish Government

3. Making Universities the Engine of our Transition to a Dynamic, Complex Economy

> … universities have a choice between being 'engines of equality', through strong local community engagement and promoting the public benefit and common good, or 'engines of inequality',14 keeping the poorer people out and standing aloof from their community. The choice should be obvious and we believe that the course of public engagement is the path for the future role of universities.[83]

Given the relatively low level of private sector R&D, the extent to which most firms are focussing on incremental, inward-looking innovation, and the predominance of very small firms in the state (see Chapters 1 and 2) our conclusion is that South Australia will need to initially look to our universities to drive productivity enhancing innovation. This does not mean that no policy support should be provided on the business side of the research business connection (for example the applied research institutes discussed in section 3.2 would as part of their role directly provide services to industry partners). Nor does it mean that universities should have the *permanent* role of driving the relationship between research and business. But our analysis of the current drivers of research and innovation in South Australia suggests that universities are the right place to start for now.

Our vision of a transformed, innovative and entrepreneurial South Australian economy, where our people are capturing the opportunities arising from the green energy transition and the substantial expansion of the defence sector requires a much deeper connection between South Australia's universities and their local economy.

This increased connectivity will require all of the state's universities to continue their journey to becoming entrepreneurial universities, that value their economic and social impacts on the state just as much as they value their excellent teaching and high-quality, internationally connected, research. And which are resourced to deliver on all three missions of a modern university.

The Commission's current inquiry in early 2023 is being undertaken against the backdrop of South Australian Government facilitated discussions about a potential merger between the University of Adelaide and the University of South Australia.

The potential implications of a university merger were not included in the Commission's terms of reference for this inquiry and so the Commission is unable to form a view on the relative merits of a merger.

However, we would note that a merger, if designed and implemented competently with a clear focus on changing the way in which the new university engages with the SA economy and society, could create a catalyst for the needed broader cultural change in the merged institution making our suggested reforms more likely to succeed. The merger could also potentially create cost savings, for example, through removing duplications of assets enabling more efficient use of facilities. If any such savings were used to fund applied, industry focused, research in the spirit of our reforms then the potential for the universities to drive improvement in the state's economy would be further enhanced.

[83] Byrne, E. and Clarke, C. (2020), *The University Challenge: Changing universities in a changing world*, Pearson International Content, e-book, p. 117

Even if a merger does not proceed, by focusing stakeholders on the greater economic role the universities could play in the South Australian economy and society, the process has served a useful purpose.

Finding 45: In the South Australian context, the Government's focus on pursuing the benefits that may arise from a potential university merger is sound economic policy and the process of doing so has the potential to play an important role in transforming South Australia into a high innovation, high wage, state.

Proposed reforms by the South Australian Government

We propose the South Australian Government implement two broad reforms to help support South Australia's universities to fully realise their potential as entrepreneurial universities, and to become drivers of the state's business innovation and economic transformation. The key reforms proposed are:

- Make impact on and engagement with the South Australian economy one of the central statutory objectives of our universities by seeking amendments to each of the university Acts;
- Establish a novel University Reform and Growth Fund that would help universities with the costs of implementing the reforms needed to transform them into entrepreneurial universities consistent with the above formal statutory objectives, ensure incentives are better aligned to universities undertaking their 'third mission', and help establish a new model of using world-class South Australian research to build local industry capabilities around critical technologies.
- Our recommendations align with a potential merger that acts as a catalyst for change and which unlocks synergies to be redeployed into helping a potential new university deliver on its third mission to the South Australian economy.

In any situation where reform is being contemplated it is important to weigh up the potential costs and risks of reform with the gravity of the problem being addressed and the expected benefit should the reform succeed.

In undertaking this inquiry, the Commission has not just focused on whether there is a problem that could be usefully addressed. It has also carefully weighed up whether potential intervention is likely to deliver benefits that outweigh its financial costs and potential risks.

Undertaking the proposed interventions is not without risk. Universities operate in a complex national and international market for students and talented academics, and if implemented in the wrong way shifting them to a greater focus on their third mission could prove counterproductive.

Finding 46: In the Commission's assessment, the potential economic dividends from higher incomes and better jobs for South Australians mean that supporting universities to undertake reforms to deepen the connections between the local universities and the South Australian economy is justified.

There are several potential risks from the reforms proposed here. First, engaging with the University Reform and Growth Fund processes could distract university administrations from delivering their three missions. Second, if the reforms are not properly resourced then resources could be diverted from teaching or research. Third if the reforms are not effectively negotiated with the universities, or if their implementation is not appropriately monitored using well designed measures, then the reforms could be ineffectual.

Our proposed intervention includes a number of features aimed at sensibly managing these risks:

- The interventions will be occurring in the context of a commonly agreed unified purpose for the universities, enshrined in each of their Acts.
- The resourcing for the novel University Reform and Growth Fund will be allocated over a ten-year timeframe, and the reforms incentivised will be aligned with the available financial resources.
- The flexible nature of the University Reform and Growth Fund will mean that only reforms where the relevant university and the South Australian Government see value will proceed.
- And the proposed governance and monitoring arrangements will ensure selection of activities is supported by rigorous analysis, and that implementation and impacts are monitored over time, minimising the chance that the reforms are ineffectual.

3.1 Make impact and engagement one of the central statutory objectives of our universities

South Australian universities receive considerable investment from South Australian taxpayers. It is therefore entirely proper that as part of their broader social license to operate the South Australian community should be able to expect our universities to deliver economic and social impacts for their home state. It is this context that informs the Commission's recommendation that a focus on delivering the third mission of universities for the benefit of the South Australian people be prescribed in each of the university Acts.

Finding 47: Delivering economic and social impacts on their local communities is an important part of the South Australian universities' social license.

Internationally, discussions about the role of universities are increasingly referencing a tripartite focus on teaching, research and engagement as part of their social license.

Internationally, discussions of the role of universities and other research institutions have increasingly emphasised engagement with industry and with social problems, often as part of a broader discussion around the 'social licence' for the university to enjoy its typically privileged status in the local innovation system. For example, in the OECD review of university industry collaboration[84] most participating countries referred to the third mission of research institutions, namely engagement with other sectors such as firms and the issues of society and economy (after research and education). The OECD notes that many European nations are explicitly building capabilities within their research institutions to address society's challenges, to orientate resources to radical and globally leading innovation and to facilitate knowledge transfer in paths that are not well established yet have significant economic potential.

This is not yet, at least formally, the case in South Australia. The state's public universities are incorporated under state legislation, with each institution established by its own enabling Act. The enabling statutes provide for the creation, continuation and administration of each university and set out key governance arrangements, including the composition and responsibilities of the universities' governing councils. In addition, the enabling statutes specify that the universities are not instrumentalities of the Crown and that each institution,

[84] OECD (2019) 'Science-Industry Knowledge Exchange: A Mapping of Policy Instruments and their Applications', OECD Science Technology and Industry Policy Papers', Number 66

as a body corporate, is invested with full juristic capacity and possesses unfettered discretion to conduct its affairs as it deems fit (subject to all applicable law, including that they are subject to the *Freedom of Information Act 1991* (SA) and the *Public Finance and Audit Act 1987 (SA)*).

Existing statements of objects and purpose for South Australian universities emphasise the traditional dual teaching and research role of the institutions.

Flinders University – current legislation

Flinders University's enabling Act prescribes a detailed set of functions:

> The functions of the University include, within the limits of its resources—
>
> (a) the provision of educational facilities at university standards for persons who being eligible to enrol seek the benefits of such facilities; and
>
> (b) the establishment of such facilities as the University thinks desirable for providing courses of study, whether within the University or elsewhere, for evening students, giving instruction to and the examination of external students, and providing courses of study or instruction at such levels of attainment as the Council thinks appropriate to meet the special requirements of industry, commerce or any other section of the community; and
>
> (c) generally, the dissemination of knowledge and the promotion of scholarship.[85]

The Act provides the university's council with the power to "approve the mission and strategic direction of the university…"[86]

Flinders University – current strategic plan

Flinders University places the dual aims of industry engagement and research impact at the core of its current strategic statement, *Making a Difference: The Agenda 25* (Agenda 25). The university's strategic plan makes clear that investments to increase research intensity, including successful translation, will be guided by a careful assessment of those areas that have the potential for significant impact, both social and economic.

> Flinders will proactively engage with business, industry, government and non-government organisations to deliver outcomes that promote economic development and change lives for the better. We will maximise our ability to translate research into innovations for industry and society.[87]

Agenda 25 also asserts the university's commitment to enhancing the translatability of its research by seeking opportunities to collaborate with "high-quality partners" in both academia and industry. In common with the University of Adelaide and the University of South Australia, Flinders University's strategic plan emphasises the importance of commercialising intellectual property as a precondition for the development of innovations that are relevant to, and become catalysts for, economic growth.

In addition, Agenda 25 highlights the interconnectedness of engaged research and high-quality teaching. The strategic plan, building on the intersections between industry

[85] *Flinders University Act 1966* (SA), s 4.
[86] *Flinders University Act 1966* (SA), s 5.
[87] Flinders University of South Australia, *Making a Difference: The 2025 Agenda, 7.*

engagement and research translatability, commits the university to ensuring that "research-based students will be equipped at the highest level in their disciplines. They will be provided with opportunities to gain experience in business, industry, government and community sectors".[88]

University of Adelaide – current legislation

The university's statutory object is defined at a relatively abstract level:

> The object of the University is the advancement of learning and knowledge, including the provision of university education.[89]

The enabling Act does not add any additional detail to, or provide further clarification of, the university's objects or functions, but endows the governing council with the power to approve the university's strategic direction and mission.[90]

University of Adelaide – current strategic plan

The University of Adelaide's strategic plan, *Future Making*, emphasises the interdependence of research excellence and research impact as drivers of economic growth and social wellbeing. The university's strategic plan, which seeks to position the institution as an engaged participant in society, rather than a passive commentator on it, is founded on a strategy that aims to harness and harmonise five interconnected 'pillars of excellence':

- Connected to the Global World of Ideas;
- A Magnet for Talent;
- Research that Shapes the Future;
- A 21st Century Education for a Growing Community of Learners; and
- The Beating Heart of Adelaide.

A central commitment outlined in the university's strategic plan, based on the five pillars of excellence, is a focus on investing in research areas, such as agrifood and wine, in which the institution currently has expertise and can achieve sufficient scale to make a difference to the state. According to *Future Making*, this emphasis will also necessitate, and be partly founded on, enhanced industry partnerships.

As part of its commitment to increasing research investment and industry engagement, the university has developed a strategy, dubbed FAME (Foci and Magnets for Excellence), that revolves around four areas of significant opportunity:

- Sustainability – of our energy and environment;
- Agrifood and wine – ensuring economic value-add and food security;
- Health and society – integrating health with Indigenous and societal wellbeing;
- Digi+ – breakthrough technologies for new industries and sovereign capability.[91]

The university plans to utilise its scale in these fields to attract world-class researchers and increase its impact. In addition, the strategic plan commits the university to aligning its areas of research strength, organised on the basis of the FAME framework, with the needs of industry by applying a set of industry engagement priorities (IEPs). These include:

- Defence, cyber and space;

[88] Flinders University of South Australia, *Making a Difference: The 2025 Agenda*., 7.
[89] *University of Adelaide Act 1971* (SA), s 3.
[90] *University of Adelaide Act 1971* (SA), s 9(1)(b)
[91] University of Adelaide, *Future Making: Strategic Plan Update 2022-2023,* 8.

- Energy, mining and resources;
- Health and medical industries;
- Creativity and culture;
- Agrifood and wine.[92]

Each 'cluster' has an industry advisory board and business development capability, with the overarching aim of translating research into areas of societal benefit.

University of South Australia – current legislation

The University of South Australia's enabling legislation requires the university to pursue a comprehensive, and interconnected, set of primary functions:

> (1) The functions of the University are as follows:
>
> (a) to preserve, extend and disseminate knowledge through teaching, research, scholarship, consultancy or any other means; and
>
> (b) to provide tertiary education in such disciplines and areas of study as the University thinks appropriate to meet the needs of industry, commerce, the professions or any other section of the community; and
>
> (c) to provide such tertiary education programmes as the University thinks appropriate to meet the needs of the Aboriginal people; and
>
> (d) to provide such tertiary education programmes as the University thinks appropriate to meet the needs of groups within the community that the University considers have suffered disadvantages in education; and
>
> (e) to provide educational programmes for the benefit of the wider community or programmes for the enhancement of the diverse cultural life of the community, as the University thinks fit; and
>
> (f) to foster and further an active corporate life within the University; and
>
> (g) to perform any functions that are ancillary or incidental to the functions referred to in the preceding paragraphs.
>
> (2) The University must strive for excellence in teaching and research and for attainment of the highest standards in education.[93]

In common with the enabling legislation of the other public universities, the University of South Australia's enabling Act provides that the university council has the power to approve the university's strategic direction and mission, subject to the statutory functions outlined in section 5 of the *University of South Australia Act 1990* (SA).

University of South Australia – current strategic plan

The University of South Australia's current strategic plan, *Enterprise 25*, provides fewer details on the university's approach to, and the initiatives associated with, industry engagement and impact when compared, for example, with the University of Adelaide's *Future Making* plan. The strategic plan does, however, highlight the centrality of industry-focused research to the university's central mission, and reiterates that the university's

[92] University of Adelaide, *Future Making: Strategic Plan Update 2022-2023*., 8
[93] *University of South Australia Act 1999* (SA), s 5.

research and teaching programs are intended "to solve the challenges of industry and society".[94]

The university's strategic plan makes clear that research and teaching must be informed by partnerships with industry, with the aim of achieving effective translation:

> Through our industry-informed curriculum and flexibility of delivery we will further expand our international student population; delivering the best in globally relevant education on campus, online and offshore. Our research themes bring together thought leaders across disciplines to address significant challenges facing society. By taking an industry sector approach, and building partners into large-scale research activities and precincts, we prioritise the translation of knowledge into impact.[95]

Strongly associated with this foundational approach to research and teaching is the ambition that, by 2025, at least 15% of the university's operating income will be derived from research activities, with 60% of that income to come from linkages with a range of industry partners. In addition, the university is committed to growing "the scale and focus of our research by building capacity in areas that we have demonstrated excellence and shown potential for growth."[96]

The university is also committed, as a central plank of its *Enterprise 25* strategy, to ensuring that its precincts are directly connected to, or even co-located with, industry partners. This is intended to aid in linking research, teaching and enterprise activities:

> We will encourage partners, businesses and industry groups to locate on our campuses and we will cluster research and like academic communities in physical and virtual precincts that bring together learning, research and enterprise. We will make connections to form solutions and shape our research and knowledge for the benefit of end users.[97]

The strategic plan makes clear that industry engagement and impact are central to the university's interdisciplinary approach to teaching and research, and that partnering with industry will be the primary 'vehicle' for curriculum development and the identification of research strengths.

It is our judgement that whilst each of the university strategic plans currently contains language consistent to a shift towards an entrepreneurial university focused on delivering all three missions of a modern university, having all three missions acknowledged in each of the university acts would be an important signal to university councils and to the broader community of the value placed on impacts from universities.

Recommendation 9: The South Australian Government should propose amendments to the enabling Act of each of the universities to explicitly prioritise a commitment to economic and social impact as one of the objects and functions of each of the universities.

3.2 Establish a University Reform and Growth Fund

We recommend that the State Government provide resources to support South Australia's universities on their journey to becoming entrepreneurial universities. To reduce uncertainty in year-to-year support, and to maintain a clear focus on the objectives of any such funding,

[94] University of South Australia, *Enterprise 25: Our Strategic Plan, 2018-2025*, 4
[95] University of South Australia, *Enterprise 25: Our Strategic Plan, 2018-2025*, 5.
[96] University of South Australia, *Enterprise 25: Our Strategic Plan, 2018-2025*, 6.
[97] University of South Australia, *Enterprise 25: Our Strategic Plan, 2018-2025*, 12.

we recommend that support be delivered through the novel instrument of a specifically established University Reform and Growth Fund.

This fund would provide the resources for South Australian Government interventions supporting South Australian universities on their journey to becoming entrepreneurial universities, including:

- Incentivising and rewarding university reform (which could include university merger costs) by helping to offset the costs of reforms to university structures, policies and practices; and
- supporting the establishment of a new model for building business university connections in critical technology areas.

Funding reallocated from existing South Australian Government innovation programs would be directed through the University Reform and Growth Fund. Should it choose to do so the South Australian Government could allocate additional resource for innovation through the fund.

Recommendation 10: The South Australian Government should establish a University Reform and Growth Fund to incentivise and directly support economically significant reforms in South Australian universities, which could include merger reform.

3.2.1 Management of the University Reform and Growth Fund

Decisions on the release of resources from the fund should sit with Cabinet.

Advice to Cabinet on proposals from the universities should be prepared by a body specifically tasked with undertaking that assessment, with access to a combination of economics skills to assess the potential impact of any proposed reform, policy skills relevant to the operation of universities, and advanced legal and negotiation skills to ensure balanced and sound proposals.

The assessment body should be supported in its work by an expert group of three academic scientists with extensive experience in building industry links and commercialising research out of universities.

Two potential options for the assessment body would be to:

a) establish a small specific attached agency for this purpose with dedicated resources, or
b) to assign the task of preparing advice to Cabinet to the South Australian Productivity Commission, with a small increase in resources to fund staff with university specific policy expertise to be seconded in DIIS.

Recommendation 11: Decisions on release of reform funds should sit with the South Australian Cabinet. Cabinet should be supported in this by a body specifically tasked with providing independent advice on whether the proposed reforms are potentially economically significant and address one or more of the existing barriers to economic impact from the university.

Stakeholders have told the Commission that frequent changes in government policy settings (both at the State and Commonwealth level) make it more difficult for industry and

universities to structure investments around current policy. Innovation is a long-term activity with benefits taking five or ten (or even more) years to be realised. This makes long-term commitments to funding from governments extremely valuable in giving investors and research institutions the confidence to begin collaborations around innovation knowing that support will be available to see the project through.

Finding 48: Stability in government innovation programs facilitates investments in innovation by universities and industry by reducing uncertainty.

Recommendation 12: The University Reform and Growth Fund should represent a ten-year commitment from the South Australian Government to give universities and industry confidence to build innovation investments around it.

3.2.2 Incentivising reforms in universities

The barriers to research industry collaboration at the university side don't exist because universities are not aware of the benefits of industry collaboration, nor do they reflect poor implementation by universities. Instead, the focus of university activity on teaching and on peer-reviewed research are an entirely reasonable response to the incentives they have been given by current funding systems and the available resources.

There is also limited scope for the South Australian Government to direct universities as they are not instrumentalities of the Crown, and so if, as a state, we want universities to sharpen their focus on industry engagement we will need to change the incentives the universities, their researchers, and their students, face.

Implementing these suggested reforms would not be costless for the universities, and whilst in our judgement they would deliver benefits for the universities, the lion's share of the benefits will flow to the state more broadly. This means that it is reasonable for the universities to be provided with financial support to facilitate the reforms being requested, as otherwise reform would risk diminishing performance in the research or teaching missions of the universities. Providing funding so that universities can reform without diminishing their capabilities in research or teaching is an important focus of the University Reform and Growth Fund.

> We must never diminish either our investments or our resolute focus on discovery research.
>
> Even as we scale up investment in applying and commercialising more of our great work.
>
> For without discoveries, we have nothing to apply, translate or commercialise.[98]

A potential model for shifting these incentives is the national competition policy introduced by the Keating government in 1993. This was set up to facilitate a number of competition-enhancing national reforms that required changes at the state government level. As most of the potential benefits of the reforms would flow to the national economy the reform process included a set of payments to the states if they implemented the reforms These were administered from within the Australian Competition and Consumer Commission.

Whilst this type of approach has proven very successful in Federal financial relations, we understand that its application to government university relationships is novel.

[98] Professor Mark Hutchinson, President, Science and Technology Australia, National Press Club Address, March 2022, transcript available at: https://scienceandtechnologyaustralia.org.au/mark-hutchinson-npc-address/

Each of the individual universities has their own strengths and weaknesses in terms of moving towards the third mission for universities. And individual universities will also have internal constraints and priorities that will influence which reforms they are willing to consider at a given point of time. Therefore, it is not possible to identify *a-priori* what the priority reforms should be in any given year. Instead, this will necessarily be a matter for negotiation between the university in question and the body tasked with preparing advice to Cabinet on the disbursement of the fund. This also broadly reflects the approach taken through the National Competition Policy in the 1990s where state governments would negotiate around which reforms they were prepared to enact.

We do, however, have several matters of broad principle which our analysis of other funding schemes suggest will increase the reform fund's prospects for success.

Funding should be explicitly tied to the implementation of the reforms, and only be disbursed in a given year if the agreed progress towards implementing the reforms to the way in which the universities contribute to the South Australian economy and society has been met.

Administration of the fund should be as seamless as possible.

The specific purposes of the funding could be broadly aligned with activities that will help support the universities in playing their role in the innovation ecosystem. This could include co-investment to support universities in completing their transition to entrepreneurial universities, for example by addressing the barriers identified in Section 2.5.aligned to the economic priorities of the state.

Recommendation 13: One of the objectives of the University Reform and Growth Fund should be to enable South Australian universities to continue their journey to being entrepreneurial universities by providing financial support for reforms.

3.2.3 Critical Technology Applied Research Institutes: a new model for joint research and knowledge sharing with industry

South Australia needs a new model for translating research from universities to industry

Meeting the challenge of translating the knowledge generated in our universities into economic opportunities for the state will require research bodies that are focused on taking knowledge out of the universities into industry, and which are resourced to perform this role.

Allocations from the University Reform and Growth Fund would also be used to establish Critical Technology Applied Research Institutes (CTARIs) located within universities. The proposed model is based around applied researchers specifically employed to co-design and deliver research with industry to address industry problems using critical technologies. This would involve material State Government investment and leverage contributions from the Australian Government, other grant schemes, industry partners and the universities.

Organisations such as this can deliver significant benefits for relatively modest investments. For example, the Australian Research Council Centre of Excellence for Nanoscale BioPhotonics headquartered in Adelaide was established with an initial Australian Government investment of $23 million. This has been used to leverage further investment from industry, State Governments and philanthropy. And, over the past seven years, the centre has created 16 startups with a combined market capitalisation and market value of

$519 million, and has impacts across industry sectors from IVF to meat quality to pain management[99].

The proposed model is based around applied researchers specifically employed to co-design and deliver research with industry to address industry problems using critical technologies.

International evidence suggests that the most effective approach to achieving the 'proximity' between researchers and industry needed for effective translation of knowledge is actually undertaking joint research with industry. The German Fraunhofer Gesellschaft, the UK Catapult Network, and the Canadian network of Technology Access Centres are all successful models of this type of translation service that we have drawn on. Locally AIML, the Factory of the Future at Tonsley, and the ARC Centre of Excellence for Nanoscale BioPhotonics have also informed the design of the proposed approach.

The purposes of the Critical Technology Applied Research Institutes would be to:

1. Build understanding amongst South Australian industry of the potential of the critical technology;
2. Undertake technology driven research and development support for South Australian firms in translating the critical technology into innovation in their firm, including supporting start-ups and scale-ups; and
3. Providing South Australian employment opportunities for talented early career researchers, where they can not only develop their research skills, but also develop commercial skills and connections.

Recommendation 14: The South Australian Government should, over time, as part of the University Reform and Growth Fund, establish Critical Technology Applied Research Institutes, each of which would be tasked with bridging the gap between university research and industry needs around a specific critical technology, or key societal problem. Our expectation is that these would be progressively established over the ten years.
.

Key principles for the selection and operation of each Critical Technology Applied Research Institute are the following:

- **Industrially relevant**: focused on facilitating the application of a technology (or set of technologies) to a well-defined opportunity (which includes resolving societal or industry problems) in which there is potential for significant South Australian business engagement, and which is relevant to the economic priorities of the state.
- **Research strength**: Be related to area of research activity in SA which can be shown to be world class, which has significant depth in its strength, and which is extended as part of the operations, including at the leadership level.
- **Engaged**: have a significant industry engagement focus, with a demonstration of the extent of the current pool of potential partners and ways in which that pool will be increased in the long term (including through the application of other principles).
- **Additional**: undertake new business (value creating) driven research and development support for South Australian firms in translating technology into innovation in their firm, including supporting start-ups and scale-ups.

[99] Professor Mark Hutchinson, President, Science and Technology Australia, National Press Club Address, March 2022, transcript available at: https://scienceandtechnologyaustralia.org.au/mark-hutchinson-npc-address/ and https://cnbplegacy.org.au/

- **Builds the South Australian Innovation Workforce**: employs early career researchers, where they can not only develop their research skills, but also develop commercial skills, translation skills and relationships, including support mechanisms for student interactions with business, including placements at all levels.
- **Fosters non-academic skills**: Staff are engaged with specialist training and support to assist researchers in fulfilling principles of engagement and additionality.
- **Consistency of funding**: access to secure, long-term on-going government funding, without the expectation to become entirely self-funding.
- **Evaluation and review culture**: Funding reviewed on every 5 years (within interim milestone reporting) based on evidence of the impacts, according to the agreed performance indicators and their trajectory.
- **Accessible**: provide industry with access to research infrastructure to facilitate joint research projects and discovery.
- **Clear ownership**: be connected to one university, but with an ownership and management structure specific to the task, and operated in a manner which captures opportunities associated with university research funding from Australian Government sources.

Recommendation 15: Each Critical Technology Applied Research Institute would have a mandate to undertake industry focused applied research in collaboration with industry partners in its technology area, with this joint research being the main way it acts as an intermediary.

In general, competitive allocation of resources is more likely to identify the best value for money opportunity for funding than a ‘top down’ selection process. It also creates the potential for innovative variations to be proposed that still meet the overall objectives of the CTARIs. A competitive selection process where universities and independent research institutes would be able to submit bids for potential CTARIs to be located within their institution. Assessment of these bids would be undertaken through the processes established for the University Reform and Growth Fund.

Recommendation 16: Selection of the Critical Technology Applied Research Institutes should be through a competitive process, with decisions made using the structures developed for the University Reform and Growth Fund.

Resourcing of the CTARIs

In order for the CTARIs to have a meaningful impact on South Australian research and industry capabilities they will each need substantial and sustained investment from the state government.

The uncertainty created by a research system largely funded by short-term grants has been identified by a number of stakeholders as significantly reducing the effectiveness of research in Australian universities, particularly through necessarily creating a risk averse culture within universities regarding their investment in research staff and other research capabilities.

As one of the purposes of the proposed CTARI is to build long-term capabilities and relationships, the funding allocation needs to be for at least ten years allowing capabilities and careers to be invested in. In order to ensure value for money there should be a review at

the fifth year of funding to test the outputs being delivered by the CTARI (and annual reporting to ensure funds are being disbursed appropriately).

Funding of each CTARI should include South Australian Government support for the employment of eight to ten post-doctoral researchers. These post-doctoral researchers would be employed to engage with industry around potential applications of the critical technology, including through undertaking joint research and development with industry partners. This should provide 8,000 to 10,000 hours of industry support per annum.

Other funding, that is consistent with the objectives of the CTARI, could be requested as part of the bidding process and would vary based on the specific needs of the critical technology or the industry sectors targeted for engagement. Examples of the types of activities for which a CTARI could potentially be funded could include a business development manager, world-class academics whose research was relevant to the technology's application in South Australia, seed funding to support start-ups and scale-ups with links to the CTARI or common use infrastructure such as 'maker-spaces' or supercomputers. It is expected that CTARIs would leverage considerable additional funding from competitive grants, industry partners and potentially internal university funds.

It is our recommendation that the proposed resources be allocated to any CTARIs selected, and that any budget constraints lead to a smaller number of CTARIs being funded rather than less money being allocated to each CTARI.

Recommendation 17: Any Critical Technology Applied Research Institutes established should be funded for a minimum ten-year period. It would be better to fund fewer properly rather than spread the available resources too thin.

Appendices

Appendix 1: Notice of Inquiry and Terms of Reference

SOUTH AUSTRALIAN PRODUCTIVITY COMMISSION INQUIRY: TURNING RESEARCH INTO ECONOMIC COMPETITIVENESS FOR SOUTH AUSTRALIA

I, Peter Malinauskas, Premier, hereby request that the South Australian Productivity Commission (the Commission) undertake an inquiry into Turning Research into Economic Competitiveness for South Australia.

Background

South Australia's economy has been strong coming out of COVID, with solid economic growth over the last two years. Unemployment at 4.0 per cent (as at October 2022) is at a low that was last seen in South Australia in the mid-seventies.

However, this strong recent performance has not fixed the long-term structural economic challenges facing Australia. Strong increases in national incomes have not flowed through the income of Australians. A lack of complexity and diversity in the Australian and South Australian economy, holding back wages and productivity growth and leaving us vulnerable to a changing international environment.

We face a generational economic question, and that can only have generational solutions. Solutions that rest on a more skilled population, working in a diverse and growing knowledge rich economy and being rewarded with fair wages. This is why my Government is committed to raising the potential of the state's economy through:

- introducing expanded, world class early-childhood education;
- increasing the quality of education in schools; and
- reforming the University sector to help it to recover from the impacts of Covid, and to enable them to be the engine room of the state's economy.

There is much to be gained if we get this right, with significant opportunities in:

- supporting the global transition to net zero through green minerals produced using South Australia's abundant renewable energy resources;
- increased defence spending linked to the geopolitical context; and
- the opportunity to capture a share of the international trade in green hydrogen.

One of the causes of our low complexity, low diversity economy is the consistently low levels of innovation and dynamism in South Australian businesses. This inquiry will support my Government's work in beginning to build the future that we all seek by undertaking a forensic examination in ***how research is turned into increased competitiveness*** for our state, including:

- the importance of research and knowledge diffusion for economic competitiveness;
- the effectiveness of current links between research institutions (including universities) and business, and of government programs supporting research and innovation; and
- what the State Government can do (including in collaboration with others) to help bridge the gap between the generation of knowledge and those who could put it to use.

Terms of reference

The Commission is asked to consider and report on:

1. The importance of research and knowledge transfer as a potential driver of economic competitiveness in South Australia, and the key enablers of successfully embedding knowledge in the economy to create economic value.
2. Undertake a stocktake of current South Australian Government activities aimed at supporting or stimulating research, business innovation, and associated economic development including their cost, and any existing evidence of outcomes.
3. The nature and current performance of business-research institution collaboration in South Australia, benchmarked against that of other states.
4. Good practice models for government to enable, and make more productive, the process of turning research into economic competitiveness, including:
    a. options to deal with the barriers researchers face in engaging with businesses and other innovation users;
    b. ways of resolving the impediments to businesses engaging with research institutions around innovation in all of its forms; and
    c. cost effective state government support for the translation of research into economic competitiveness.

Inquiry process

The Commission will seek input from relevant experts (including from within the SA Government) and draw on prior work conducted in this field. In particular, the Commission will engage closely with the Department for Industry, Innovation and Science as the lead agency within the SA Government for science and innovation policy.

As a first stage the Commission will carefully review the evidence collected as part of its previous inquiries into Research and Development and into Health and Medical research to ensure that any work in this inquiry is not duplicative.

The Commission will consult with relevant public and private sector organisations in SA and other Australian jurisdictions, Universities and other research institutions active in SA, industry, professional associations and other key stakeholders.

The Commission is to publish a draft report containing recommendations for consultative purposes. A final report is to be provided to me no later than five months from the date of receipt by the Commission of these terms of reference.

Peter Malinauskas
PREMIER

13 / 12 / 2022

Appendix 2: Submissions in response draft report

Appendix of submissions in response to Turning Research into Economic competitiveness for South Australia draft report:

Submissions in response to the draft report	Submission number
Confidential Submission	FR1
Confidential Submission	FR2
Confidential Submission	FR3
KPMG	FR4
SAHMRI (South Australian Health and Medical Research Institute)	FR5
Confidential Submission	FR6
Flinders University	FR7
University of Adelaide	FR8

For more information

W: www.sapc.sa.gov.au
E: sapc@sa.gov.au
P: (08) 8226 7828

30 Wakefield Street
Adelaide SA 5000