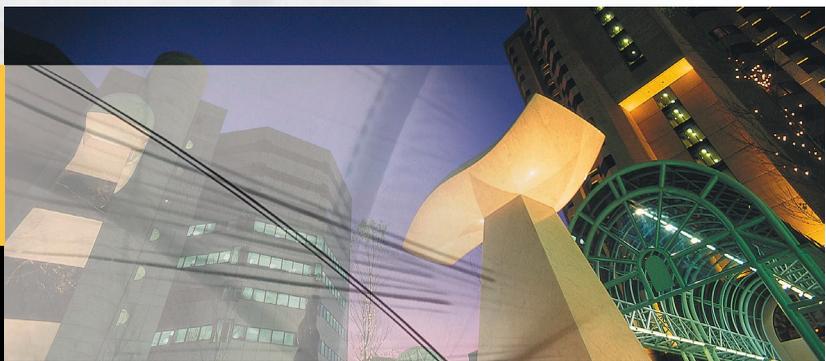


Developing a Bioeconomy *in South Australia*

ADELAIDE

thinkers
in residence



Dr Maire Smith
Thinker in Residence 2004

Developing a Bioeconomy in South Australia

Prepared by
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February 2005

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ISBN 0-9752027-2-3

www.thinkers.sa.gov.au

Maire Smith



Photo courtesy of The Advertiser

Dr Maire Smith has an impressive reputation as the founding Chief Executive Officer of Manchester Innovation Ltd – the commercialisation arm of the University of Manchester.

Manchester has achieved strong commercial success through the establishment of a bioscience incubator facility. It has also attracted substantial venture capital funds to the bioscience industry in the Manchester region.

With many years experience in various commercial roles with major pharmaceutical companies, Dr Smith has a wealth of commercial and product development experience that South Australia can learn from. Dr Smith's background includes oncology, vaccines, immunology, biotechnology, inflammatory diseases and anti-infectives.

Maire has recently been appointed as the Director of Intellectual Property for the United Kingdom's National Health Service.

The following partners were involved in Maire Smith's residency:

Department of the Premier and Cabinet
Bio Innovation SA
Primary Industries and Resources SA

Foreword

Bioscience will play a central role in South Australia's future – creating wealth, jobs and opportunity.

It's the sort of industry I hope we can all embrace, and its success will go a long way towards our meeting the broad economic targets set down in *South Australia's Strategic Plan*.

Dr Maire Smith has made a significant mark on our State. As we've come to expect from our Thinkers, Dr Smith's accomplishments and standing are extremely impressive.

During the first stage of her residency, she was instrumental in setting up Australia's first dedicated bioscience business incubator, to which the State Government has committed \$9 million.

She has outlined South Australia's bioscience capability and potential in areas such as healthcare, food and the environment. Maire has also surveyed the opportunities for these industries to grow and spread internationally through innovation.

Maire has helped further develop our bioscience sector, and to position South Australia as a global market leader. A thriving bioscience sector will be both a reflection of, and a stimulus to, a true culture of innovation in South Australia.

I thank Dr Maire Smith for her contribution to our State, and commend this report to you.

Mike Rann
Premier of South Australia
December 2004

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Summary

This report highlights the importance of biotechnology, both as a means to address many of the global needs relating to healthcare, food and the environment, and as an engine for economic development in those countries that embrace the new technologies.

“Within ten years biotechnology will be at the centre of the nation’s health and well being”, (Biotech 2004, Burrill and Company).

A 10-year vision for Science, Technology and Innovation in South Australia (STI¹⁰), released by the State Government in April 2004, recognises that innovation is essential to shaping a strong and vibrant future within the global economy. This brings the challenge of attracting adequate resources, both human and financial, to develop and then market the opportunities in a global market.

South Australia already has a developing biotech cluster, with an estimated 75 small start-up companies in existence, and four listed on the Australian Stock Exchange. Stressing the importance of such a local cluster as a catalyst, this report considers:

- the role of incubation in developing business
- the crucial contribution of universities and research institutions in providing a sustainable pipeline of products
- the need for a strong intellectual property (IP) policy to protect these assets from an early stage.

In addition, access to professional support, physical accommodation and sustained funding are reported as key success factors. The importance of Bio Innovation SA’s role as a driver behind biotech initiatives in the State is highlighted.



Photo courtesy of Primary Industries and Resources SA

This report makes a number of key recommendations as follows:

Recommendation 1

The Waite Partners conclude a scientific and commercial review of the agricultural biology sector, and produce a business plan around focused targets.

Recommendation 2

Recruit an abgio commercial specialist, with experience and vision, to work with The Waite Partners and Bio Innovation SA.

This role will be responsible for providing high-level business and commercial expertise in promoting the capability of SA partners in plant, animal and environmental biotechnology, nationally and globally. A key component will be to facilitate the funding and support required to exploit both emerging (nascent) markets and short-term commercial opportunities.

Recommendation 3

Knowledge transfer providers, working in collaboration with Bio Innovation SA, highlight key research propositions in biomedicine likely to have a commercial impact.

At least one industry collaborator should be selected to partner and add economic value in an identified area. Attention should be given to building a multi-disciplinary network around core bioscience research capability in South Australia.

Recommendation 4

Align all bioscience technology transfer activities in universities, institutes and hospitals.

The pivotal leadership role of Bio Innovation SA is acknowledged and a legal framework should be established so that contributing partners each receive a return of value from outputs.

Recommendation 5

Publish the State Intellectual Property Policy, and view IP practice in South Australia as an asset to business collaboration, whether that IP emanates from a government department, university, institute or hospital.

Recommendation 6

The State creates a proof of concept fund (open to business and research organisations) in the region of \$1 million per annum.

Funding up to a ceiling of \$250 000 can be apportioned to high value projects, identified by Bio Innovation SA. These projects must meet agreed criteria and milestones and be subject to due diligence.

Recommendation 7

Undertake a targeted promotion of the State’s biotech strengths to inform venture capitalists about bioscience.

The long-term potential of the realistic opportunities in South Australia, and the role the State is already playing to attract venture capital investment, should be highlighted.

Recommendation 8

The State supports an incubation strategy based on market-driven sustainable deals – whether licensing deals or spinout company formation.

The commercialisation activity will need to be driven by Bio Innovation SA, in partnership with the relevant stakeholders from the university, hospital or institute concerned.

Recommendation 9

The State supports infrastructure at Thebarton with a dedicated biotechnology incubator.

This incubator will need branding with a name of powerful resonance such as the “Adelaide Biotechnology Quarter”.

Recommendation 10

Promote entrepreneurial programs, such as those available at the Centre for the Development of Entrepreneurs in the University of South Australia, to help train tomorrow’s entrepreneurs.

Recommendation 11

Establish formal networks involving Bio Innovation SA, the three universities and The Waite Partners, to ensure maximum synergy and consistent policy and branding messages for the commercialisation of biotech opportunities.

Recommendation 12

Showcase suitable opportunities seeking finance in major business sites such as London, Singapore, Tokyo, Boston and San Francisco, signposting South Australia’s biotech network to other business centres.

Recommendation 13

The State liaise with the Federal Government to encourage existing public relations campaigns to promote the advantages of agbio to society.

Data supporting the use of agbio for provision of many applications such as nutritious foods, new medicines and even vaccines, should be used.

Recommendation 14

The State develops specific regional incentives to encourage companies – ideally from Asia – to come to South Australia to collaborate with The Waite Partners and the biotech incubator at Thebarton.

Such an undertaking would help to establish South Australia as an innovator in public-private partnerships around designated key focus areas.

2. Definitions

Definitions

Bioscience is a broad term, which should be taken to include biotechnology, lifesciences (including agriculture and environment), medicine, bio-analytical instruments and software.

The biotechnology industry draws on a broad research field, which Bio Innovation SA defines under three categories:

- 1 Core Biotechnology, for the application of products or processes solely from living systems (eg gene technology, cell biology)
- 2 Related Bioscience, as the application of products or processes from living systems combined with outside disciplines (eg medical devices)
- 3 Industry Facilitators, which apply outside disciplines to serve the biotech industry (eg clinical trials, business consultants).

Agbio encompasses companies using biotechnology to modify and enhance the components and characteristics of the food chain.

Biotechnology can be defined in a number of different ways. The most usual definition is now widely accepted as meaning the application of a set of biological techniques, developed through research, for the production of goods and services. The definition is necessarily wide and ranges from applications in winemaking and agbio, to improved healthcare products. Biotechnology, therefore, represents a large group of enabling technologies, involving biological processes or techniques, with diverse applications in industry across a wide range of market areas.



Photo courtesy of Bio Innovation SA

It is a research-intensive emerging industry with application in a wide range of markets.

Industry Clusters are geographic concentrations of competing, complementary and interdependent firms and industries that create wealth in regions through export and share resources, with access to specialised suppliers and networks to facilitate business.

Ten factors critical for cluster development were identified in the UK by Lord Sainsbury's team in 1999. Lord Sainsbury is the UK Parliamentary Under-Secretary of State for Science and Innovation. These factors are:

- strong science base
- entrepreneurial culture
- growing company base
- availability of finance
- supportive policy environment
- business support and companies in related industries
- premises and infrastructure
- ability to attract staff
- effective networks
- skilled workforce.

'Bio Angels' are private investors who provide funds to develop early stage innovations.

Knowledge transfer is typically used in the UK to describe the application of research knowledge available in public and private research organizations to business problems, and implies a two-way communication between industry and academic researchers.

Technology transfer arms are the commercialization groups within research organizations.

The Waite Precinct is a campus of the University of Adelaide which has a specialist research, teaching and commercial focus on plant bioscience, viticulture and land and water management.

The Waite Partners is the cluster of research companies located within The Waite Precinct. The group forms the largest concentration of plant and environmental research activity in the southern hemisphere, with research expenditure exceeding \$100m per year. Key partners include the University of Adelaide, Australian Wine Research Institute, Commonwealth Scientific & Industrial Research Organisation (CSIRO), the SA Research and Development Institute (SARDI) and the Australian Centre for Plant Functional Genomics (ACPGF Pty Ltd).

3. Framework

for analysis

Dr Maire Smith | Developing a Bioeconomy in South Australia

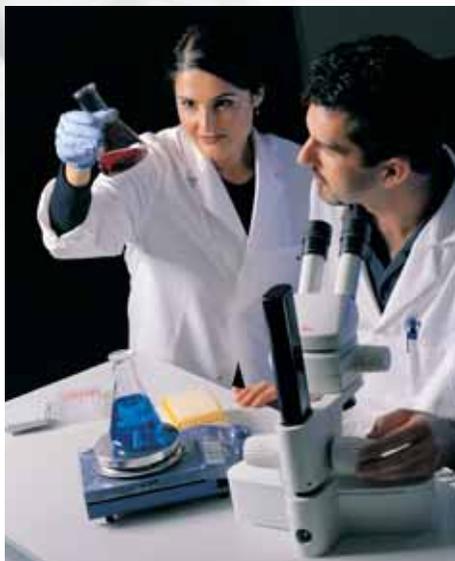


Photo courtesy of Primary Industries and Resources SA

Many observers believe that after information technology, the next major breakthroughs from the knowledge-based economy will be from biotechnology. For instance, Alan Greenspan, Chairman of the Federal Reserve has remarked:

“Some new technologies bring about new goods and services with above-average value added per work hour. The dramatic advances in biotechnology for example, are significantly increasing a broad range of productivity-expanding areas from agriculture to medicine.”

A. Greenspan,
Technology Innovation and the Economy,
Washington DC,
5 April, 2000

In addition to the Federal Reserve and Wall Street, a number of commentators believe that fifteen to eighteen percent of the gross national product of the US will be comprised of healthcare and life science activities over the next two decades.

The key to success will be dependent on developing sustainable strategies to maximise the potential and leverage biotechnology to provide “new” solutions to real problems. However, measured success and the link between outputs (added “economic” value) and inputs (investment money) is not straightforward, given the often long product-cycle times in biotechnology. The full breadth of applications in biotechnology is still in its infancy and access to long-term investment will be needed.

The supply chains for the current major applications (or end products) of biotechnology – healthcare products and agbio – share some of the key elements of research and development. Flexibility in the optimal route to market should be driven by the specific requirements of each case. Routes to market include licensing, partnership with a large company and spin-out company formation.

What are some of the challenges?

Biotechnology offers the opportunity to address many of the global needs relating to healthcare, ageing, food and the environment. South Australia has to identify its key strengths and focus resources where the chances of success are highest.

This brings the challenge of attracting adequate resources, both human and financial, to develop and then market the opportunities, and developing appropriate models.

The scientific and technological revolution is a global reality. South Australia must be able to compete in niche areas of this global marketplace.

3.1. A snap-shot of the biotechnology industry

Biotechnology can be applied across a wide range of market areas. There is a major need in healthcare for more novel and innovative approaches to disease management. There are still no known cures for half of the world’s diseases and some existing cures, such as antibiotics, are becoming less effective due to multiple bacterial resistance. The application of biotechnology promises personalised and preventative medicine, based on genetic predisposition, targeted screening, better diagnosis and innovative drugs. Stem cell research offers the prospect of replacement tissues and organs to treat degenerative disease and injury resulting from examples such as Alzheimer’s and Parkinson’s diseases, burns and spinal injuries.

“In the 1980s scientists identified the gene causing cystic fibrosis; it took nine years. In 1997, scientists located the gene that causes Parkinson’s disease – it only took nine days! Within a decade, gene chips will offer a road map for prevention of illnesses through a lifetime.”

William J. Clinton,
State of the Union Address,
27 January 1998

Some major problems facing healthcare professions in the 21st century are:

- large, unmet clinical needs, especially in chronic and infectious diseases
- an ageing population
- movement to decrease overall healthcare costs.

Innovation in biomedical technology must be aligned with these issues to gain acceptance from the investment community and ultimately, the marketplace. Important advances in genomics, bioinformatics, digital capture technology, miniaturisation and portability in medical devices are leading to new pharmaceutical drugs and device products which will drive the evolution of their respective industries.

In the agbio area, biotechnology has the potential to deliver enhanced food quality and environmental benefits, through agronomically improved crops. Biotechnology is already having an impact on nearly every phase of the crop production cycle; reducing susceptibility to disease and increasing the nutritional value of plants. Food and feed quality may be linked to disease prevention and reduced health risks. Foods with enhanced nutritional qualities, “functional foods”, are likely to become increasingly important as part of lifestyle management and are already viewed as an essential technology for nutritionally poor populations in places such as India and China. Plant genome analysis can lead to these genetic improvements in food. The enhancement of natural resistance to disease or abiotic stress in plants can lead to reduced use of chemical pesticides, fertilisers and

Framework for analysis

water, as well as better adaption to drought and cold (frost). As a result, a more sustainable agricultural practice can be developed with a reduction in soil erosion and a benefit to the environment.

Biotechnology has the potential to improve the non-food use of crops as sources of industrial feedstocks, or new materials such as biodegradable plastics. Plant-based materials can provide both molecular building blocks and more complex molecules for various manufacturing processes, including the pharmaceutical industry and energy.

Modifications under development include alterations to oils, proteins, fibres and new polymers. Biomass will contribute to alternative energy with bio-fuels such as bio-diesel and bio-ethanol. Plant genomics also contributes to conventional improvements through the use of marker-assisted breeding.

Another major application of biotechnology is in bioremediation of polluted air, soil, water and waste, as well as the development of cleaner industrial processes such as those based on the use of biocatalysts.

In addition, new developments are enlarging the potential of biology due to the convergence of technologies. With its requirement for vast databases, collaborative research across many disciplines and precision instrumentation, biotechnology is having a huge impact on informatics (bioinformatics), nanotechnology, biomanufacturing, "biopharming" and electronics amongst others. The extended applications of biotechnology from this

enlarged "bioeconomy" have an impact far beyond just the pharmaceutical, biotechnology and medical devices areas or the healthcare service arena where reductions in overall healthcare costs are a global challenge. This bioeconomy also extends to applications such as the use of sensors to measure patients' symptoms by wireless technology, and "smart clothes" that, for example, enable cardiovascular patients to be monitored remotely.

3.2. Trends in biotechnology

Biotechnology is a global industry, with the US as the largest market. It is a high-risk area (but one promising high economic returns) where a local focus on research strengths with market potential is essential. It requires a specialised, high quality workforce, infrastructure and large research budgets. So why should South Australia want to commit valuable resources to develop such an industry? The answer is simple; the full impact of biotechnology and its tremendous potential for the economy and society has not yet been realised.

Global biotechnology at a glance, 2003

Public company data – Revenues \$m (US)		
Global	US	Asia-Pacific
46 553	35 854	1505

Ernst & Young, *Global Biotechnology Report, 2004*

Many believe that the 21st Century will be an era of biotechnology, and largely replace information technology as an engine for economic development.

"Within ten years biotechnology will be at the centre of the nation's health and wellbeing."

(*Biotech 2004*, Burrill and Company)

Some applications of biotechnology

Healthcare

- better diagnostics
- novel therapeutic drugs
- faster methods of drug discovery
- gene therapy
- improved vaccines

DNA fingerprinting

- improved forensic medicine
- paternity testing

Environmental

- cleaning of hazardous waste without chemical toxicity

Agricultural

- more nutritious/healthy foods
- stress resistant plants (eg drought, salinity)
- plant and animal disease diagnostics
- manufacturing of proteins/vaccines in plants (biopharming)
- reduced pesticide use
- variety improvements in a wide range of crops leading to yield and quality improvements
- enzyme production
- biofuels/biodegradable packaging

Industrial

- lower energy consumption
- cleaner processes with lower production wastes

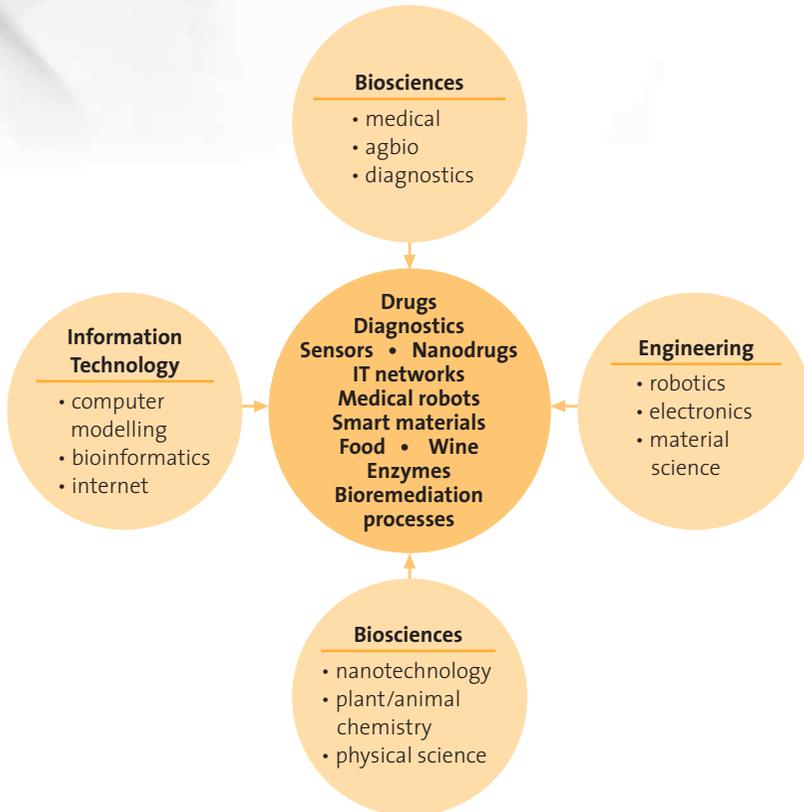
Other countries, such as India and China, are also discovering and investing in the potential of biotechnology, so it may be that a number of discoveries will be made simultaneously. As a result, biotechnology is becoming a very "fluid" industry, with collaborative research and licensing opportunities that often span several countries. A company may begin in one country and eventually be established in another. An example in South Australia is Bresagen, which is based in both the US and Australia in the next stage of product development. The important challenge is to ensure that economic benefit occurs in each part of the development chain.

The biotech industry must leverage the global marketplace to compete, but the underpinnings of success should remain local. It is at the regional level that competitive assets such as a quality scientific workforce and entrepreneurial institutions, supported with capital/finance and good business environment, meet to form the catalyst of a biotech cluster. It is also self-evident that the linkages between people, institutions and industry within a local region drive innovation, productivity and economic benefit.

The challenges for South Australia are how to develop a local cluster based on research strengths, and how to develop global linkages.

Framework for analysis

Biotechnology products from the hub of interdisciplinary science



4. Developing the biotechnology industry in SA

The definition of existing biotechnology in South Australia is very broad, and ranges from applications in winemaking and agbio to improvements in healthcare. This breadth of portfolio is a major strength, as long as a strategic approach is taken to focus on areas where there is likely to be a continuing competitive edge in the global market place.

A point on which all industry experts throughout the world would agree, is that the biotech sector as a whole is still at the beginning of the technology curve, with enormous upside potential. The challenge for South Australia is to think “smart” and identify some of these potential winners from its core strength. In other words, to think locally and be prepared to act globally!

One area in which the State is already a winner is winemaking. Clearly, South Australia already has a highly successful world-class wine industry. The Australian Wine Research Institute, located at The Waite Precinct, is a major provider of research and development in advancing the competitive edge of the Australian wine industry. This contribution has helped to brand Australian wine as a lead player against the more traditional winemakers in Europe. The scientific approach to winemaking, to which South Australia has contributed very heavily, is leading the world’s wine industry in this paradigm shift from the traditional to a scientific, modern approach. South Australia produces (in dollar terms) about 50% of Australia’s wine and 70% of its exports.

4.1. The importance of an industry cluster

There is a developing biotech cluster in South Australia, with an estimated 75 small start-up companies already in existence and four companies listed on the Australian Stock Exchange (Source: Bio Innovation SA). These companies generate over \$100 million revenue for South Australia and employ about 1000 staff. Current projections envisage the creation of 50 new companies and 2500 new jobs over the next decade. This forecast assumes that finance and management will not be limiting factors for company growth.

The key to economic evolution will be to grow the local bio-cluster with sustainable businesses. Sustainability is likely to be achieved from a combination of initiatives, which will include:

- a merger of some of the small “minnow” developing companies, to generate sufficient critical mass for funding by venture capital to generate mature companies
- encouraging an already well-established high-tech company as an anchor tenant for the cluster
- encouraging some small companies and research institutes to act as licensing vehicles; to offer their pipelines as licensing opportunities for a royalty fee, rather than attempt to follow as a stock market IPO-type exit.

Developing the biotechnology industry in SA

These entrepreneurial initiatives will need to be strongly supported by the Bio Innovation SA network.

- encouraging the use of biotech techniques (eg flavour enhancement) to non-biotech industries such as food and pie manufacture.

4.2. The role of universities and research institutes in developing the bioeconomy

The State has a strong science base, supported by the three South Australian universities and a number of medical and agricultural research institutes and hospitals.

Each university has a group dedicated to developing and commercialising intellectual property arising from its research and development (R&D). These include Flinders Technologies Pty Ltd (Flinders University), Adelaide Research and Innovation (The University of Adelaide) and ITEK Pty Ltd (University of South Australia). Based on Commonwealth data, total South Australian university income from royalties, licenses, contract research and consultancies totalled \$46 million in 2002.

The Waite Precinct based around The Waite Campus of the University of Adelaide is a world-renowned research and education cluster for plant bioscience, viticulture, wine and environmental services. The Waite Precinct has an annual research income of \$140 million.

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) had a budget of \$41 million in 2001 in South Australia.

One example of a flagship program is the Preventative Health Program. This is a national initiative with headquarters in Adelaide.

The South Australian Research and Development Institute (SARDI) is the State Government's single largest research organisation, employing 450 staff and investing over \$45 million each year in agricultural, aquatic, environmental and biodiversity sciences. Up to 70% of SARDI's funding is derived from external competitive grants and commercialisation receipts.

The Frome Road and North Adelaide regions are home to a number of internationally recognised hospitals and clinical research institutes, including the Royal Adelaide Hospital, the Women's and Children's Hospital and the Institute of Medical and Veterinary Sciences. Together these organisations employ 600 medical scientists and technicians, win research funding in excess of \$60 million per year and generate revenue from commercial exploitation of R&D outcomes.

The Queen Elizabeth Hospital, incorporating the Basil Hetzel Institute, works with the University of Adelaide and the University of South Australia and services northwestern Adelaide and regional South Australia. Similarly, the Flinders Medical Centre brings together researchers across the biomedical and clinical sciences from the Flinders Medical Centre, Flinders University and the Repatriation General Hospital, servicing the southern regions of Adelaide.



Photo courtesy of Bio Innovation SA

Vision for the future

A 10-year vision for Science, Technology and Innovation in South Australia (STI¹⁰) recognises that research and education communities must work in partnership with business and industry. The Vision also sets a public sector R&D performance index to secure Commonwealth revenue 25% above per capita share within 10 years. It embraces the target of basing either the headquarters or a major node of at least 40% of all cooperative research centres (CRCs), major National Research Facilities and Centres of Excellence, in South Australia.

Basic research observations

Competition for research funds requires greater targeting of a research agenda, with a focus on key projects.

A strategic review is underway at The Waite Precinct, with a view to providing more business focus to the following areas:

- natural resources management
- cereals
- viticulture
- educational products.

In the biomedical area, the Florey Precinct is a co-location of a number of organisations, including:

- Adelaide Microarray Facility
- Adelaide Microscopy
- Adelaide Research and Innovation
- Centre for Pharmaceutical Research
- Child Health Research Institute
- CSIRO Health Sciences and Nutrition
- Hanson Institute
- Institute for Medical and Veterinary Science
- Nidor Pty Ltd
- PharmaQest Pty Ltd
- Raustech Pty Ltd
- Royal Adelaide Hospital
- University of Adelaide
- University of South Australia
- Women's and Children's Hospital.

A number of research strengths are represented:

- reproductive medicine
- molecular biosciences
- cancer and immunology
- tissue engineering of bone and cartilage
- pharmacology
- SA natural history and taxonomy
- CSIRO – disease prevention and nutrition
- phase I clinical trial centre.

It is recommended that a technology review be undertaken to identify the most promising medical technologies for business innovation and that some priorities are created in a few targeted areas.

Developing the biotechnology industry in SA

The technology transfer operations in the university, hospital and research institute areas are currently under review. Initiatives include input of experienced management from Bio Innovation SA and a possible review of a pan-university technology transfer agreement.

Universities and research institutes are increasingly realising that managing the balance between basic research and applied research is very important if they are to have an economic impact.

These organisations are targeting talent to specific research themes and are becoming more mindful of the importance of stimulating inter-disciplinary research and encouraging collaboration between different departments. Such collaboration, often at a national scale, is increasingly seen as a prerequisite for qualifying for grant funding.

More than ever before, universities, hospitals and research institutes are under pressure from communities, industry and faculty to translate their discoveries into commercialised products. Part of this process can be accelerated by encouraging collaboration between the knowledge economy and industry. Partnerships with industry should be actively expanded around key areas of strength, such as agbio and the most promising biomedical research areas.

There has already been some movement towards greater collaboration between public and private sector research activity, with a common focus on commercial outcomes with incentives, such as the Australian Plant Functional Genomics Centre. However, to be internationally competitive it is essential

that South Australia creates more public/private partnerships as translational vehicles as a route to market, using the State's research capabilities and private companies' development capability.

4.3. Intellectual Property (IP)

Intellectual Property (IP) underpins many investment decisions made in biotechnology. For the biotech industry to make a major contribution to economic growth, the patent system must be both useable and strong enough to support industry's needs. In summary:

- IP is the vehicle by which technology transfer happens, so a strong patent policy is vital
- it is recognised that government employees and university employees generate large volumes of IP. In both instances, the IP is owned by the employer
- to encourage the commercialisation of IP from the public and university sectors, transparent guidelines should be made available to staff, setting out their respective responsibilities and advantages
- a number of employees will be collaborating between both sectors to ensure that the potential of IP in this category is realised, the IP policy should also incorporate joint ownership and development. This will necessitate the development of suitable legal framework documents
- to incentivise staff to be innovative, attention must be given to including a reward-sharing component in the policy. This will encourage staff to think as entrepreneurs and to contribute to the innovation economy

- the strength of Australian patents must be maintained in a global context and this may require federal lobbying, as appropriate.

It is understood that the IP policy for State employees is under development.

4.4. The role of incubation in developing business

Australia's first dedicated bioscience incubator is to be built in South Australia with \$9 million State Government funding. The 3000 square metre purpose-built facility will be situated at the Thebarton Bioscience Precinct. The facility will have specialised laboratory and office accommodation for lease to early stage biotechnology companies with growth potential.

Discussion is ongoing about the need for an incubator dedicated to agbio at The Waite Precinct. The strategic review of The Waite Precinct is likely to conclude that in order to create a dynamic commercial interface with research, significant infrastructure will be required to facilitate commercial research collaboration and new agbio spinouts. As a short-term solution, some existing space will be used for incubation and, in addition, the attraction of a multinational anchor tenant to work with Waite researchers will be given top priority.

The entrepreneurial leadership role provided by Bio Innovation SA is essential to this incubation, to maximise the likelihood of success in commercialising bioscience opportunities.



Photo courtesy of Primary Industries and Resources SA

The ingredients for maximising success

The opportunity – universities and research institutes that can provide a pipeline of products. The intellectual assets must be protected and a strong intellectual property policy is essential at the early stage.

The environment – a local skills base, professional support for commercial ventures, the provision of finance, patent lawyers, accountants and other professional services and accommodation.

Long-term stability – physical accommodation, more finance, deal flow and customers for the fledgling industry.

One of the major contributors to growth in the evolving South Australian bioeconomy is Bio Innovation SA, which provides an entrepreneurial capability to assist company formation and mentoring skills – and now the addition of an incubator to the team's armamentarium should assist the bridge-building between pure academia and the marketplace.

Developing the biotechnology industry in SA

The incubator

- nurtures the entrepreneur
- shifts the culture from academic to entrepreneur
- 'hands-on' management support
- focus for networking
- builds the 'SA' brand
- provides dedicated facilities and support services
- maximises chances of commercial success

The route to market

Requirements

- basic research funding
- adequate tech transfer mechanisms
- physical/personnel/funding infrastructure incubator and grow on space

Results

- products and licensing opportunities
- economic benefit in local environment
- products in local/national/international marketplaces

The major challenge for South Australia is growing sustainable businesses and creating an economy that builds on its strengths in emerging technologies. An incubator needs to be an integral part of the local, national and international biotech continuum.

4.5. Sources of finance for biotech exploitation in SA

A 10-year Vision for Science, Technology and Innovation in South Australia (STI¹⁰) was released by the State Government in April 2004. It recognises that innovation is essential in shaping a strong and vibrant future within the global economy. This goes some way towards defining the performance targets.

There is general agreement that there is research of high quality in South Australia, especially in a number of key areas. Concern has been expressed that in 2003–04, South Australia received only a minimal increase in National Health and Medical Research Council grants⁷. Factors that may have contributed to South Australia's relative under-performance, compared to say, Queensland and Victoria, may be the following:

- in South Australia state funding supplements federal funding to a lesser degree than some other states.

⁷ South Australia received a 2% increase in funding compared to 2002–03. NSW received a 4% increase, Victoria 4% and Queensland 6%. Source: NHMRC Grants Books 1995 – 2001, Focus publication 2002, RMIS 2003.

- South Australia's teaching hospitals have experienced some financial stress and may have been unable to maintain research spending levels.

The high quality of research at the Hanson Institute has been noted. It is understood that they have also received significant research funding from external sources such as the National Institutes of Health in Maryland, US.

Funding is of primary importance to biotechnology companies because of the high level of R&D costs and the long lead times before products are commercialised. The key determinants for obtaining funding are:

- inherent risks of the project
- quality of the business proposition
- experience of the management team
- value of the intellectual property.

A number of government-funded initiatives exist and these are managed by Bio Innovation SA. They include:

- an Intellectual Property Fund ('IP Fund') to meet the costs of filing Australian provisional patent applications. There is also a provision within the Fund which allows Bio Innovation SA to pay for a PCT application (that is, a Patent Cooperation Treaty which covers 90 countries) where the need for finance and the potential for commercialisation in the foreseeable future can be demonstrated. Scientists falling under the Department of Human Services jurisdiction, who can demonstrate that they cannot source funds for provisional patents from elsewhere, can



Photo courtesy of Primary Industries and Resources SA

apply to the IP Fund to pay the costs for filing an Australian provisional patent application

- AIB Labs (Adelaide Integrated Bioscience Laboratories) grants provide technical staff salaries, aimed at improving access to major research equipment/core technologies and help develop the AIB Labs service facilities
- Business Development Initiative funding – up to \$30,000 in support for emerging/start-up companies, on a project-by-project basis, to assist with vital tasks to achieve commercial proof of concept for products/technologies. Payments are made on a case-by-case basis, upon application, and average \$15,000

Developing the biotechnology industry in SA

- Bio-Arc fund up to \$25,000 contribution as an industry partner in an Australian Research Council (ARC) Linkage Project grant. The first round of applications was due on 7 April 2004 and four applications were received (three of which were submitted to the ARC in May). Notification of success (or otherwise) from the ARC will be received by the companies in November 2004, for projects starting in January 2005. The objective of the scheme is to enable collaborative projects between SA biotech companies and researchers at SA universities in further developing cutting-edge biotechnology with significant commercial potential.

In addition, Bio Innovation SA provides matching funding for the Federal Government's Biotechnology Innovation Fund (BIF). Bio Innovation SA provides up to 25% (\$125,000 maximum) towards project costs, conditional on BIF approval. Australian Stock Exchange-listed companies can apply for up to \$20,000. Bio Innovation SA has provided \$1.1 million in matching funding to date.

By providing a total of approximately \$1.6 million in funding to SA companies (pre-seed funding plus BioCatalyst), Bio Innovation SA has leveraged approximately \$3.5 million in additional private and/or federal funding into the State.

There is a rudimentary Bio Angel investor network in Adelaide, which has made one investment in biotechnology. One of the long-term challenges for the State is to encourage more venture capital investment. A State initiative with a \$10 million cornerstone

investment is currently in the tendering phase, with the aim of attracting independent venture capital funds.

Gaps in current sources of finance

Overall, there are insufficient funds to pay for applied research when a project has been established, the business objective identified and a mentoring program is in place. This is a major gap that could be met by proof of concept funding, which allocates up to say, \$250,000 per project.

The real gap in early stage funding for biotechnology companies is in the space between creation of the originating technology/IP and reaching a development stage, which is able to attract 'angel' or other external funding before the venture capital funding or industry partner comes in. Venture capitalists worldwide are increasingly unwilling to devote the time to very early stage ventures until the risk has been minimised by attainment of milestones and perhaps, a prototype has been developed.

Any venture capital industry is primarily interested in investing for a defined period, during which measurable progress in the development process is expected. In the past, the major overall outputs from Australia's medical research community have been medical diagnostics and biological targets, rather than lead molecules; much of this is too early for venture capital funding. One of the challenges, which again a strategically managed incubator can assist with, is to correct the imbalance in investment. In 2000, according to the Australian Bureau of Statistics,

Funding routes for commercialisation

	Researcher	Mentor (Bio Innovation SA)	Angel	Proof of Concept Fund	VC Fund	Industry
Research focus on technology						
Patent strategy						
Market evaluation						
Need to produce prototype or reach milestones			?			
Need to access further finance						

only 5% of the country's venture capital investment was targeted to biotechnology. If a properly managed incubator shows that it is implementing strategies to convert intellectual property from targets to actual focussed products, this should help catalyse the venture capitalists into action and may even encourage the formation of a venture capital fund dedicated to the biotech industry.

The South Australian biotech industry needs to map a clear exit route for the venture capitalists to enable them to encash their investments. The development of more highly focussed and highly publicised partnerships

between public and private institutions and with major companies will help to make the eventual biotech start-ups more attractive to the venture capital industry. These multi-disciplinary collaborations towards common goals are key and should provide a potent mix for success sought by the venture capital industry.

5. The strategic challenges for developing a biotechnology cluster in SA

Dr Maire Smith | Developing a Bioeconomy in South Australia

There is plenty of evidence to show that the key to economic growth is to accelerate the innovation lifecycle – from business conception, to formation and then growth into a marketable transaction.

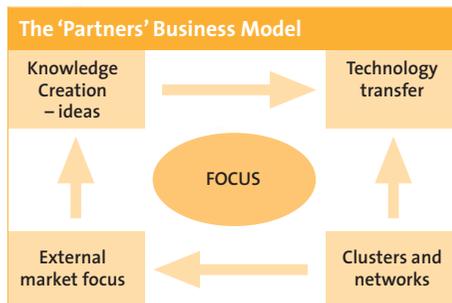
Any economic growth is likely to be built upon a set of strategic commitments. 'Churn' is necessary as a driver of innovation, as a magnet for increased outputs from R&D and a generator of jobs and wealth.

South Australia has an objective to build a biotechnology cluster, based on long-term incremental growth, in identified strategic areas of local strength.

The State is in direct competition with other areas round the world which are also competing for export markets. It is essential therefore that economic growth is built upon a set of common strategic commitments which drive innovation across the entire value chain.

All partners – universities, institutes, hospitals and entrepreneurs – have a role to play in the value generation process. To make a significant impact, all levels of contributions to the value chain must be in the strategy and part of the vision.

It is essential that local strengths harmonise and that partners cooperate rather than compete. Innovation is not just about technology; it is about people and involves an active interaction among individuals, institutions and organisations. It has to be an inclusionary process, utilising South Australia's strengths and looking towards an external market focus.



A continuum of many partners adding value 'en route' to market

Critical factors impacting the growth of SA's bioeconomy

A number of critical factors will impact the growth of South Australia's economy. These have been well summarised within *South Australia's Strategic Plan* (March 2004) and include the following:

- competitive business climate – maintain Adelaide's rating as the least-costly place to do business in Australia (KPMG Competitive Alternatives Study)
- investment – match or exceed Australia's ratio of business investment as a percentage of the economy within 10 years
- interstate migration – reduce to zero by 2008, with a positive inflow by 2009
- total population – increase SA's population to two million by 2050
- treble exports – income to be trebled to \$25 billion by 2013. Two sectoral goals are food and wine
- students – double number of overseas students in 10 years
- commercialisation of research – significantly increase patent applications within five years

- investment in science, research and innovation – approach the OECD average within 10 years.

These selected targets from *South Australia's Strategic Plan* are generally supportive for encouraging economic growth. With limited resources it is important to make South Australia a technology and innovation State,

building on existing foundations. South Australia should become an area that people will want to come to as an attractive location for high value-added businesses and jobs – a 'State of Opportunity'.

A table of factors which may be critical for impacting the full economic potential of biotechnology is presented below:

Factors critical for realising the full economic value of biotechnology

- | | |
|---|---|
| 1 State and federal investment | <ul style="list-style-type: none"> • both state and federal funding are necessary • competition for investment requires targeting of the research agenda • infrastructure support should be maintained with a mentoring program • increase South Australia's population to expand the workforce |
| 2 Other investment | <ul style="list-style-type: none"> • address gaps in financing model with a proof of concept fund • encourage other investors with tax breaks, eg Bio Angels • expand venture capital initiatives eg with Singapore |
| 3 Building the local critical mass | <ul style="list-style-type: none"> • build one vision for technology commercialisation • develop one tech transfer network for biotechnology • build an innovation alliance around knowledge transfer and business • build entrepreneurial leadership – Bio Innovation SA, entrepreneurs and business mentors • expand enterprise education and link to local business • create a website for 'budding' entrepreneurs |
| 4 Business environment | <ul style="list-style-type: none"> • initiatives to encourage companies to move to South Australia • market the positive 'quality of life' issues in South Australia • use overseas trade representatives to market SA biotech • build more bridges with Asia |
| 5 Public awareness policy | <ul style="list-style-type: none"> • communicate factual information on the value of biotechnology • develop a policy on GM Food |
| 6 Impact on other industries | <ul style="list-style-type: none"> • biotechnology is a platform of converging technologies and needs bridges with other industries, such as IT and electronics |
| 7 Building exports | <ul style="list-style-type: none"> • build on traditional exports – grains, wine and aquaculture • be prepared to collaborate with overseas companies and define the new export areas for biotech |

6. Recommendations

Recommendations

6.1. Research vision

The maxim 'think locally but be prepared to act globally' is pivotal to gaining maximum potential from South Australia's knowledge base. This will result in the long-term generation of economic wealth and increased job opportunities within the State.

Competition for research money requires the creation of a unified research vision. It is no longer acceptable to work in all areas of biotech. Broadly, South Australia's bioscience research falls into two target areas: agbio and biomedicine.

6.1.1. Agbio

The Waite Precinct has a major focus on Agbio. Food and wine remain the State's largest export earners at \$3 billion a year, and South Australia has an opportunity to continue to contribute and expand in this major sector.

Aquaculture is a major growth area for exports to the 'high end' markets of South East Asia, Japan and parts of Europe.

There are a number of short-term and long-term objectives where biotechnology may have input. Short-term initiatives might include partnering with a large company to share a research base to accelerate product development. Long-term objectives might include early initiatives such as 'biopharming' for production of proteins for medical use, or use of plant extracts as medicinal drugs.



Photo courtesy of Primary Industries and Resources SA

Recommendation 1

The Waite Partners conclude a scientific and commercial review of the agricultural biology sector, and produce a business plan around focused targets.

Recommendation 2

Recruit an agbio commercial specialist, with experience and vision, to work with The Waite Partners and Bio Innovation SA.

This role will be responsible for providing high-level business and commercial expertise in promoting the capability of SA partners in plant, animal and environmental biotechnology, nationally and globally. A key component will be to facilitate the funding and support required to exploit both emerging (nascent) markets and short-term commercial opportunities.

6.1.2. Biomedicine

South Australia has a long history of quality research in the biomedical arena from its various institutes and universities. According to Bio Innovation SA, key research areas include:

- reproductive medicine
- molecular bioscience/proteomics
- cancer research
- tissue engineering of bone and cartilage
- CSIRO – disease prevention programs
- a clinical trial centre.

From the commercial perspective, South Australia is in a position to create opportunities from biomedicine, selecting the underlying research strengths where there is scope to differentiate resulting products in the global market place. R&D is the lifeblood of biotechnology and it is expensive. One factor for a successful biotechnology industry is to build interdependence between academia and industry. This has been achieved with some success in America and Europe. The same opportunity should be taken in South Australia.

In addition, biotechnology is increasingly a meeting place for converging technologies such as bioinformatics, electronics, engineering and materials science. This multi-disciplinary network should be encouraged to seek appropriate opportunities in South Australia.

Recommendation 3

Knowledge transfer providers, working in collaboration with Bio Innovation SA, highlight key research propositions in biomedicine likely to have a commercial impact.

At least one industry collaborator should be selected to partner and add economic value in an identified area. Attention should be given to building a multi-disciplinary network around core bioscience research capability in South Australia.

6.2. Technology transfer in South Australia

Bio Innovation SA plays a pivotal role in helping to facilitate technology transfer between the various knowledge transfer partners, universities and institutes. However, there could be synergistic gains, with reduction of overall costs, if there was more alignment of these activities. It is recognised that technology transfer is a stressful and expensive process. But the concept of embracing the perspective of aiming for mutually beneficial outcomes, by having a more closely aligned technology transfer system in South Australia, should lead to enhanced business activity.

Recommendation 4

Align all bioscience technology transfer activities in universities, institutes and hospitals.

The pivotal leadership role of Bio Innovation SA is acknowledged and a legal framework should be established so that contributing partners each receive a return of value from outputs.

Recommendations

6.3. Intellectual Property policy

Intellectual Property (IP) underpins many investment decisions made in biotechnology. The existence of appropriate patents or patent applications can be the *sine qua non* for an investment. The patent system must therefore be strong enough to support industry's needs. There is an increasing interdependence between universities and industry to supply new products for industry's needs. IP is the vehicle by which technology transfer happens, so a good patent system is vital. The involvement of academic laboratories underlies the importance of IP protection at reasonable cost.

A patent strategy for the State is under development and individual institutions also have their own IP policies. There needs to be general convergence of principles between these policies, although it has to be accepted that there may be good reasons for flexibility in some exploitation arrangements. For example, the form of grant of rights to a business may be a non-exclusive license, exclusive license or an assignment, depending on the specific case.

Recommendation 5

Publish the State Intellectual Property Policy, and view IP practice in South Australia as an asset to business collaboration, whether that IP emanates from a government department, university, institute or hospital.



Photo courtesy of the Australian Barley Board

6.4. Filling the funding gap

There are a number of state and federal funds to assist commercial exploitation. There is still a funding gap for biotechnology companies in the space between creation of the originating technology/intellectual property and reaching a development stage (against agreed milestones) that will attract 'lower risk' venture and/or development capital backing from whatever source.

Funding for the creation of the originating technology/intellectual property is primarily funded with grant money and early stage initiatives. However, this funding is insufficient in most cases to demonstrate very early proof of concept. There is some Bio Angel money but this is sketchy at best and needs supplementing.

Recommendation 6

The State creates a proof of concept fund (open to business and research organisations) in the region of \$1 million per annum.

Funding up to a ceiling of \$250 000 can be apportioned to high value projects, identified by Bio Innovation SA. These projects must meet agreed criteria and milestones and be subject to due diligence.

Recommendation 7

Undertake a targeted promotion of the State's biotech strengths to inform venture capitalists about bioscience.

The long-term potential of the realistic opportunities in South Australia, and the role the State is already playing to attract venture capital investment, should be highlighted.

6.5. Overcoming the hurdles to commercialisation

The primary driver of commercialisation must be the market. The likely market potential of a new piece of technology will be the best route to follow for effective commercialisation. Some of the products suggested by excellent scientific research will find that the potential market is too small to sustain the development of even a small company. Technology of this kind may be made a practicable proposition for company formation by bundling together several pieces of related technology. Alternatively, a licensing deal with an outside company may be the preferred route.

The challenge for South Australia is to develop these opportunities with input from mentors such as Bio Innovation SA.

Recommendation 8

The State supports an incubation strategy based on market-driven sustainable deals – whether licensing deals or spinout company formation.

The commercialisation activity will need to be driven by Bio Innovation SA, in partnership with the relevant stakeholders from the university, hospital or institute concerned.

Recommendation 9

The State supports infrastructure at Thebarton with a dedicated biotechnology incubator.

This incubator will need branding with a name of powerful resonance such as the "Adelaide Biotechnology Quarter".

Recommendations

6.6. Encourage an entrepreneurial culture

A vibrant research environment needs entrepreneurs to manage the small companies. Success and value generation require a focus on achievable projects, and Bio Innovation SA spearheads the entrepreneurial activity in biotechnology where a young business cluster is developing. There is, however, a need to develop the general entrepreneurial flair in the community. For example, perceptions amongst university staff about the role of technology commercialisation and its impact on economic development has a mixed reception. University staff, by necessity, have to balance a basic research agenda with teaching programs, student numbers and balancing the books. To succeed in the biotechnology market, universities, hospitals and institutes will have to embrace both interdisciplinary relationships and a greater dialogue with industry. Developing competency in these areas will require knowledge of several fields of science, combined with business and legal skills. To achieve these aligned objectives on innovation, it is recommended that entrepreneurial teaching programs for scientists are encouraged.

Recommendation 10

Promote entrepreneurial programs, such as those available at the Centre for the Development of Entrepreneurs in the University of South Australia, to help train tomorrow's entrepreneurs.



6.7. Continue to build the networks

Innovation is dependent on people and the interaction between people. Barriers have to be overcome so that self-interest is aligned with a common goal.

Bio Innovation SA has established formal working groups involving all universities and The Waite Precinct to ensure synergy in the purchase and use of major research equipment. Known as the AIB Labs project, it has increased the rate of collaborative funding bids for major research equipment.

It is proposed to extend this model to other areas to ensure South Australia's capability is comprehensively identified and widely promoted, to increase collaboration between industry and academic researchers.

The networking process is taking off in South Australia, and it will also be strengthened in venues such as The Waite Precinct.

There is room for further networking on a global scale, possibly via the diplomatic service, in major business centres of the world.



Photo courtesy of Primary Industries and Resources SA

Key opportunities from South Australia seeking finance could be showcased via this diplomatic network.

Recommendation 11

Establish formal networks involving Bio Innovation SA, the three universities and The Waite Partners, to ensure maximum synergy and consistent policy and branding messages for the commercialisation of biotech opportunities.

Recommendation 12

Showcase suitable opportunities seeking finance in major business sites such as London, Singapore, Tokyo, Boston and San Francisco, signposting South Australia's biotech network to other business centres.

6.8. Public relations campaign

Worldwide, the common perception of biotechnology is mixed with some fear and many high expectations. The major challenge for public education is probably the use of GM crops in the agbio area. It is essential that South Australia continues to work on this message in concert with the Federal Government. Bio Innovation SA is fronting this for the State with Biotechnology Australia.

Bio Innovation SA is the State's representative on two Commonwealth/State committees, with a coordinating role in national bioscience policies/programs and marketing respectively.

At a national level, Biotechnology Australia is the body responsible for the development of PR campaigns, particularly to inform the community of issues relating to genetically modified organisms. Bio Innovation SA regards this as a national issue, which does not require duplication at state levels.

Recommendation 13

The State liaise with the Federal Government to encourage existing public relations campaigns to promote the advantages of agbio to society.

Data supporting the use of agbio for provision of many applications such as nutritious foods, new medicines and even vaccines, should be used.

Recommendations

6.9. Retention of workforce and attracting outside companies

South Australia's Strategic Plan highlights the need to increase the population to two million by 2050. The need to retain graduates and attract new graduates is important for growing the developing bioeconomy. The skills required will not focus solely on researchers – business, legal, marketing and management skills are just as important for overall success. In addition, new companies, especially from Asia, should be encouraged to come here. This can be achieved with various initiatives such as using the incubator or The Waite Precinct to place an anchor tenant, building university-industry partnerships and global initiatives around a common research focus. These mechanisms will help to change mindsets, improve leadership, create role models and identify the characteristics for development of critical mass. Such initiatives will assist the positioning and branding of the region – first for local support and second for the economic attraction of a wider audience and market opportunities.

Recommendation 14

The State develops specific regional incentives to encourage companies – ideally from Asia – to come to South Australia to collaborate with The Waite Partners and the biotech incubator at Thebarton.

Such an undertaking would help to establish South Australia as an innovator in public-private partnerships around designated key focus areas.

Acknowledgements

Acknowledgements

It is a great pleasure for me to acknowledge the contributions of the following who made my task so much easier:

Premier Mike Rann

Hon Trish White

Tamsin Jones

The Thinkers in Residence Team, particularly Ann Clancy, Joanna Hughes and Gabrielle Overton

The Bio Innovation SA team, particularly Jurgen Michaelis, Ann Nelson, Martin Miller, Michelle Fraser and Nicole Brackenridge

The Waite Partnership, particularly Jim Hallion, Rob Lewis, Don Ploughman and Wayne Powell

The University of Adelaide, particularly James McWha and Janet Dibb Smith

Tim Flannery, Chair of the Premier's Science and Research Council

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