More and more Australian businesses, government agencies and universities are turning ideas into jobs and income for all Australians. By encouraging skilled and motivated Australians to take on the challenges of creating and developing new ideas, we better secure our nation’s future prosperity.

Government investment in science and technology is a necessary investment in our economic and social prosperity. The Australian Government demonstrated the importance of this in 2001 with the five-year $3 billion Backing Australia’s Ability strategy, the largest single investment in Australian innovation at the time. This was followed in May 2004 with the announcement of the $5.3 billion Backing Australia’s Ability – Building Our Future through Science and Innovation package, which builds on Backing Australia’s Ability and establishes an unprecedented $8.3 billion, 10-year commitment.

This report demonstrates how government, industry and the research sector are making great advances in science and innovation and producing economic and social benefits. By working in partnership through Backing Australia’s Ability, these sectors are strengthening Australia’s ability to generate ideas and undertake research, accelerating the commercial application of ideas, and developing and retaining Australian skills.

Research and development spending is increasing across these sectors, with research spending by universities increasing by 22.9% between 2000 and 2002, while investment by business in university research rose by 27.8%.

The Australian Government’s Innovation Report 2004-05 celebrates many great achievements in science and innovation. It shows that innovation is thriving in our universities, government agencies and industries, including many examples of successful collaboration internationally and at home. Increasingly, highly skilled Australians are working together to help us solve and understand issues in areas such as health, the environment and national security. Their ideas, knowledge and skills are the building blocks of economic and social progress.

The Hon John Howard MP
Prime Minister
PRIME MINISTER’S FOREWORD I

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<td>Australian Antarctic Division</td>
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<td>ABARE</td>
<td>Australian Bureau of Agricultural and Resource Economics</td>
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<td>ABRS</td>
<td>Australian Biological Resources Study</td>
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<tr>
<td>ABS</td>
<td>Australian Bureau of Statistics</td>
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<td>ACIS</td>
<td>Automotive Competitiveness and Investment Scheme</td>
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<td>ACPFPG</td>
<td>Australian Centre for Plant Functional Genomics</td>
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<td>AGSF</td>
<td>Australian Government Space Forum</td>
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<td>AIATSIS</td>
<td>Australian Institute of Aboriginal and Torres Strait Islander Studies</td>
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<td>AIC</td>
<td>Australian Institute of Criminology</td>
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<td>AIFS</td>
<td>Australian Institute of Family Studies</td>
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<td>AIMS</td>
<td>Australian Institute of Marine Science</td>
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<tr>
<td>ANP</td>
<td>Advanced Networks Programme</td>
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<td>ANSTO</td>
<td>Australian Nuclear Science and Technology Organisation</td>
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<td>APA</td>
<td>Australian Postgraduate Awards</td>
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<tr>
<td>ARC</td>
<td>Australian Research Council</td>
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<td>ART</td>
<td>Assisted Reproductive Technology</td>
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<td>ASCC</td>
<td>Australian Stem Cell Centre</td>
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<tr>
<td>BA</td>
<td>Biotechnology Australia</td>
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<tr>
<td>BERD</td>
<td>Business expenditure on research and development</td>
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<td>BIF</td>
<td>Biotechnology Innovation Fund</td>
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<tr>
<td>BITS</td>
<td>Building on IT Strengths</td>
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<td>BMP</td>
<td>Best management practices</td>
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<td>BMRC</td>
<td>Bureau of Meteorology Research Centre</td>
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<td>BRS</td>
<td>Bureau of Rural Sciences</td>
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<td>BTRE</td>
<td>Bureau of Transport and Regional Economics</td>
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<tr>
<td>COMET</td>
<td>Commercialising Emerging Technologies</td>
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<td>CRC</td>
<td>Cooperative Research Centre</td>
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<td>CRDC</td>
<td>Cotton R&amp;D Corporation</td>
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<td>CSIRO</td>
<td>Commonwealth Scientific and Industrial Research Organisation</td>
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<tr>
<td>CSTACI</td>
<td>Commonwealth, State and Territory Advisory Council on Innovation</td>
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<td>DEST</td>
<td>Department of Education, Science and Training</td>
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<tr>
<td>DITR</td>
<td>Department of Industry, Tourism and Resources</td>
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<tr>
<td>DSTO</td>
<td>Defence Science Technology Organisation</td>
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<tr>
<td>EBA</td>
<td>Enrolment benchmark adjustment</td>
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<td>EU</td>
<td>European Union</td>
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<td>FMS</td>
<td>Federal Magistrate Service</td>
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<td>FIG</td>
<td>Food Innovation Grants</td>
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<td>GDP</td>
<td>Gross domestic product</td>
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<td>GGAP</td>
<td>Greenhouse Gas Abatement Programme</td>
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<tr>
<td>GOVERD</td>
<td>Government expenditure on R&amp;D</td>
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<tr>
<td>Abbreviation</td>
<td>Description</td>
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<tr>
<td>HECS</td>
<td>Higher Education Contribution Scheme</td>
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<tr>
<td>HELP</td>
<td>Higher Education Loan Programme</td>
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<tr>
<td>HERD</td>
<td>Higher education expenditure on R&amp;D</td>
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<td>IAP</td>
<td>Innovation Access Programme</td>
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<td>ICT</td>
<td>Information and communications technology</td>
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<td>IGS</td>
<td>Institutional Grants Scheme</td>
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<td>IIF</td>
<td>Innovation Investment Fund</td>
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<td>IP</td>
<td>Intellectual property</td>
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<tr>
<td>IPRIA</td>
<td>Intellectual Property Research Institute of Australia</td>
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<tr>
<td>IPRS</td>
<td>International Postgraduate Research Scholarships</td>
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<td>IR&amp;D Board</td>
<td>Industry Research and Development Board</td>
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<td>ISL</td>
<td>Information Sciences Laboratory</td>
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<tr>
<td>ISL</td>
<td>International Science Linkages</td>
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<td>IT</td>
<td>Information technology</td>
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<td>ITOL</td>
<td>Information Technology Online Programme</td>
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<td>LWA</td>
<td>Land and Water Australia</td>
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<td>MFP</td>
<td>Multi-factor productivity</td>
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<td>MHRI</td>
<td>Mental Health Research Institute</td>
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<td>MODL</td>
<td>Migration Occupations in Demand List</td>
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<tr>
<td>NBS</td>
<td>National Biotechnology Strategy</td>
</tr>
<tr>
<td>NCRIS</td>
<td>National Collaborative Research Infrastructure Strategy</td>
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<tr>
<td>NCW</td>
<td>Network centric warfare</td>
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<tr>
<td>NFIS</td>
<td>National Food Industry Strategy</td>
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<tr>
<td>NHMRC</td>
<td>National Health and Medical Research Council</td>
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<tr>
<td>NIAS</td>
<td>National Innovation Awareness Strategy</td>
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<td>NICTA</td>
<td>National Information and Communications Technology Australia</td>
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<td>NIDP</td>
<td>New Industries Development Programme</td>
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<tr>
<td>NII</td>
<td>National Information Infrastructure</td>
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<tr>
<td>NMI</td>
<td>National Measurement Institute</td>
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<tr>
<td>NSF</td>
<td>National Science Foundation, USA</td>
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<td>NYSF</td>
<td>National Youth Science Forum</td>
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<tr>
<td>OECD</td>
<td>Organisation for Economic Cooperation and Development</td>
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<td>P1</td>
<td>Pharmaceuticals Partnerships Programme</td>
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<td>PBS</td>
<td>Pharmaceutical Benefits Scheme</td>
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<td>PCP</td>
<td>Pilot Commercialisation Projects</td>
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<td>PDF</td>
<td>Pooled Development Funds</td>
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<td>PELS</td>
<td>Postgraduate Education Loans Scheme</td>
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<td>PFRAs</td>
<td>Publicly-funded research agencies</td>
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<td>PIIP</td>
<td>Pharmaceutical Industry Investment Programme</td>
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<td>PSL</td>
<td>Platforms Sciences Laboratory</td>
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<td>R&amp;D</td>
<td>Research and development</td>
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<td>RDCs</td>
<td>Rural R&amp;D Corporations</td>
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<td>REEF</td>
<td>Renewable Energy Equity Fund</td>
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<td>RIBG</td>
<td>Research Infrastructure Block Grant</td>
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<td>RRR</td>
<td>Replacement nuclear research reactor</td>
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<td>RTS</td>
<td>Research Training Scheme</td>
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<td>Abbreviation</td>
<td>Description</td>
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<tr>
<td>S&amp;T</td>
<td>Science and technology</td>
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<tr>
<td>SARS</td>
<td>Severe acute respiratory syndrome</td>
</tr>
<tr>
<td>SET</td>
<td>Science, engineering and technology</td>
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<tr>
<td>SII</td>
<td>Systemic Infrastructure Initiative</td>
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<tr>
<td>SSL</td>
<td>Systems Sciences Laboratory</td>
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<td>TCF (SIP) Scheme</td>
<td>Textile, Clothing and Footwear Strategic Investment Programme Scheme</td>
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<td>UK</td>
<td>United Kingdom</td>
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<tr>
<td>US</td>
<td>United States</td>
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<tr>
<td>VC</td>
<td>Venture capital</td>
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<td>VCLP</td>
<td>Venture Capital Limited Partnerships</td>
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<tr>
<td>WestVAMP</td>
<td>West Cliff Ventilation Air Methane Project</td>
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<tr>
<td>WHO</td>
<td>World Health Organisation</td>
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EXECUTIVE SUMMARY

The 2004-05 Innovation Report focuses on Australian Government agencies and initiatives in science and innovation in Australia, and includes the progress in implementing the Australian Government’s major innovation statement, Backing Australia’s Ability. In May 2004, the Australian Government announced additional support for science and innovation through Backing Australia’s Ability – Building Our Future through Science and Innovation increasing funding to an unprecedented $8.3 billion over the 10 years to 2011. This brings total Government funding for science and innovation to $52 billion over 10 years.

This is the fourth Innovation Report released since the announcement of Backing Australia’s Ability in 2001. It focuses on strengthening our ability to undertake research, accelerating the commercial application of ideas, developing and retaining Australian skills, National Research Priorities, key institutions relating to science and innovation, and informing the future. This year’s report has shifted to more quantitative output reporting for the Government’s programmes and initiatives, reflecting that the effects of Backing Australia’s Ability are now starting to become apparent.

This Innovation Report includes the second Innovation Scorecard, which benchmarks Australia against other OECD countries, and reports on agencies’ implementation of the National Research Priorities.

Strengthening our Ability to Undertake Research

Research is the key source of knowledge and ideas. It is these ideas that are a major force in increasing productivity and economic growth. Australia’s government research and development (R&D) expenditure is relatively high by international standards. It amounted to 0.33% of gross domestic product (GDP) in 2002-03, compared with 0.25% for both the OECD and the European Union.

Numerous government agencies are reporting progress in achieving long-term strategic research, often in areas of public good where investment by the private sector is low. The Australian Nuclear Science and Technology Organisation (ANSTO) is constructing a replacement nuclear research reactor, which will place the agency in the top three nuclear research centres in the world. CSIRO received $12.1 million from active licences, options and assignment agreements. Revenue from the private sector totalled $108.8 million.

During 2002-03, business expenditure on R&D was nearly $6 billion, an increase of 3.6% over 2001-02 levels. Australia’s business R&D is relatively low compared to the OECD average and most industrialised OECD countries. Government initiatives to encourage business R&D include a 175% (Premium) Tax Concession for additional labour-related R&D expenditure, in addition to the existing 125% R&D Tax Concession. As at 30 June 2004, 4,981 companies had registered for the R&D Tax Concession. This is a 7.4% increase on the previous year. 745 firms registered for the 175% Premium Tax Concession, which is a 30.7% increase on the previous year. Rural R&D Corporations investment in rural innovation was $454 million in 2002-03, with a similar figure expected in 2003-04.

Australia’s higher education expenditure on R&D in 2002 was $3.4 billion, representing an increase of 22.9% over 2000. Funding of R&D in the higher education sector from business rose by 27.8% to $174 million in the same period. In 2004 the National Competitive Grants Programme funded 875 Discovery Projects, 532 new collaborative research projects and awards worth $119.9 million over five years. Funding for Research Infrastructure Block Grants rose from $136.7 million in 2003 to $160 million in 2004.
Accelerating the Commercial Application of Ideas

Translating ideas into marketable products, processes and services is a key aspect of the Australian innovation system. *Backing Australia’s Ability - Building Our Future through Science and Innovation* has an emphasis on commercialisation programmes.

A new programme, Commercial Ready, was launched in October 2004. It is designed to stimulate greater innovation and productivity growth in the private sector, providing around $200 million a year in competitive grants to small and medium-sized businesses.

Government support for bringing research to the investment ready stage is an important aspect of helping individuals, small companies and researchers in universities. The successful Commercialising Emerging Technologies (COMET) has been extended by $100 million under *Backing Australia’s Ability - Building Our Future through Science and Innovation*. Companies supported by COMET in 2003-04 have achieved significant commercialisation outcomes. These include capital raisings of $95 million, 130 strategic alliances, licenses or agreements and 30 instances of manufacturing commencements or product/service launches.

To help increase the take-up of leading edge technologies and best practice processes by Australian firms the Innovation Access Programme – Industry provided $10.9 million to 40 projects in 2003-04. The Information Technology Online Programme has allocated almost $12 million to 110 projects to encourage the adoption of commercial uses of the internet. Eleven successful first round applicants were offered $87 million in grants to undertake almost $290 million in additional pharmaceuticals R&D, under the Pharmaceuticals Partnerships Programme.

At October 2004 there were 69 Cooperative Research Centres (CRCs) operating, employing more than 3,700 full-time equivalent research staff and supporting more than 2,400 postgraduate students. The centres have undertaken nearly 5,400 research contracts for industry and other end-users, earning $419 million.

Developing and Retaining Australian Skills

A strong skills base is important because it provides us with the ability to grasp and create new opportunities from technological developments and innovation. The Australian Government invests in human capital at every level, including schools and the higher education system.

The 2003 Review of Teaching and Teacher Education stated that science, technology and mathematics education must be given high priority. Data available from 1976 show a decline in participation in physics, chemistry and biology subjects in Year 12. This is partly offset by increasing participation in other sciences such as psychology. *Backing Australia’s Ability - Building Our Future through Science and Innovation* addresses this trend by providing $38.8 million over seven years for the Boosting Innovation, Science, Technology and Mathematics Teaching Initiative.

At a high school level, Australian students continue to perform well in the International Science and Mathematics Olympiads. In 2004, Australia ranked highly, with 12 of the 13 competitors awarded medals, including three gold. While in Australian universities the number of science and engineering graduates rose rapidly as a percentage of total graduates over the last few years. In 2003 the Australian Government paid $193 million to institutions on behalf of 39,810 students who had elected to take out a Postgraduate Education Loans Scheme (PELS) loan for their tuition fees.

The Australian Government has extended funding for additional targeted university places in *Backing Australia’s Ability - Building Our Future through Science and Innovation*. Additional funding of $199.5 million to 2011 will extend the 2000 additional targeted university places announced in 2002. About 5,470 places will have been created by 2005 as students continue in their courses.
National Research Priorities

The four National Research Priorities announced by the Prime Minister in 2002 are:

- An Environmentally Sustainable Australia;
- Promoting and Maintaining Good Health;
- Frontier Technologies for Building and Transforming Australian Industries; and
- Safeguarding Australia.

Each of these priorities is accompanied by a set of goals. During 2003, the priority goals were enhanced to strengthen the contribution of social sciences and humanities research. All Australian Government research and research funding bodies have established plans showing how the priorities are to be implemented in their activities. Agencies have commenced reporting on their progress with the implementation of the priorities, and this Report presents vignettes indicating the wide variety of ways that agencies have embraced the National Research Priorities initiative.

Moving Forward with Confidence

The Australian Government has undertaken a detailed programme to assess and evaluate Australia’s research and innovation system. The reviews include: Mapping Australian Science and Innovation, an Evaluation of Knowledge and Innovation Reforms, the National Research Infrastructure Taskforce and the Review of Closer Collaboration between Universities and Major Publicly-Funded Research Agencies.

Recommendations were made on issues such as collaboration and linkages, research infrastructure, research quality assessment and university research funding. Backing Australia’s Ability - Building Our Future through Science and Innovation has responded to many of these recommendations.

The $542 million National Collaborative Infrastructure Strategy will strengthen the coordination of the Australian Government’s investment in research infrastructure. It will provide researchers with access to major infrastructure, link infrastructure funding more directly to Australia’s National Research Priorities and foster greater research collaboration.

The government is providing $2.8 million to address the issues of quality and accessibility through developing two frameworks: a Research Quality Framework and a Research Accessibility Framework.
Science and innovation, so vital for maintaining a country’s economic growth, includes research, development, the accumulation of knowledge, commercialisation and the use of technology. Science and innovation provide the tools to manage risk, solve complex problems and adapt to change. Governments around the world are aware of the critical and positive impact that science and innovation have on future economic growth, competitiveness, human welfare and the environment.

Innovation is a process fed by ideas and basic knowledge, as well as skills, funding, management and business know-how. Information and knowledge-flow in innovation is vital. Interaction and links between business, government, research agencies, non-government organisations and universities play a crucial role in creating a successful national innovation system.

Innovation is not only the province of new or high-tech industries, but is also essential to the future of many of Australia’s traditional sectors such as agriculture, manufacturing and mining. It helps us understand and solve issues in areas such as health, the environment and national security.

Government Support for Science and Innovation

The Australian Government recognises that investment in science and innovation is an investment in Australia’s economic and social prosperity. In 2001 the government announced Backing Australia’s Ability - An Innovation Action Plan for the Future, which provided an investment of $3 billion over five years for a wide range of programmes designed to promote research, commercialisation and skills.

Backing Australia’s Ability – Building Our Future through Science and Innovation

Backing Australia’s Ability – Building Our Future through Science and Innovation was announced by the Prime Minister in May 2004. This $5.3 billion science and innovation package increased the government’s 10-year investment in Backing Australia’s Ability to $8.3 billion, and total government funding for science and innovation to $52 billion over 10 years.

The Government’s Backing Australia’s Ability investment focuses on three key elements in the innovation process:

- strengthening Australia’s ability to generate ideas and undertake research;
- accelerating the commercial application of ideas; and
- developing and retaining Australian skills.

The new package began in 2004-05, with most funding starting in 2006-07. Measures will be delivered by the five portfolios:

- Education, Science and Training;
- Industry, Tourism and Resources;
- Communications, Information Technology and the Arts;
- Agriculture, Fisheries and Forestry; and
- Health and Ageing.
A key feature of *Backing Australia’s Ability – Building Our Future through Science and Innovation* is increased emphasis on collaboration between businesses, universities and publicly-funded research organisations. Extra attention will also be given to achieving the National Research Priorities.

*Backing Australia’s Ability – Building Our Future through Science and Innovation* continues significant funding increases for ideas through competitive research grants, major and systemic research infrastructure, extended funding for the Information and Communications Technology (ICT) Centre of Excellence and support for international collaboration.

Support for accelerating the commercial application of research is provided through initiatives such as the $1 billion Commercial Ready Programme to support industry innovation activities, an enhanced Commercialising Emerging Technologies Programme, a refocusing of the Cooperative Research Centres Programme to provide clearer commercial paths for ideas and technology developed in the public sector, and more funding for the Building on IT Strengths Incubator Programme and the Australian Stem Cell Centre (previously the National Stem Cell Centre).

Encouraging positive attitudes towards science and innovation is also an important aspect of the package. New funding of $38.8 million will go to develop an innovative teaching culture in science, mathematics and technology in schools. The Questacon – Smart Moves programme will also be expanded.

Other new measures include:

- the CSIRO National Flagships Initiative to develop large-scale collaborative research partnerships ($305 million);
- funding for overhead infrastructure costs for independent medical research institutes ($200 million over seven years);
- funding to coordinate and focus counter-terrorism research ($7.2 million);
- establishing quality and accessibility frameworks for publicly-funded research ($2.8 million over the next two years); and
- extending Regional Protection Funding ($12.4 million) to help regional universities maintain and build their capacity to carry out research which is of benefit to regional Australia.

This is an unprecedented long-term funding commitment from the government. It ensures businesses, researchers, universities and other organisations are in the position to make long-term commitments.


While it is too early to accurately assess the impact of *Backing Australia’s Ability* indications are positive. Recent figures released by the Australian Bureau of Statistics (ABS) reveal a 20% increase in business R&D spending from 2000-01 to 2002-03. Research spending by universities for 2002 increased by 22.9% from the year 2000, while investment by business in university research rose by 27.8%.

**National Research Priorities**

*Backing Australia’s Ability* flagged the need to emphasise research in areas in which Australia enjoys or wants to build a competitive advantage.

Following extensive consultation the Prime Minister announced the National Research Priorities in December 2002. Enhancements were announced by the Minister for Education, Science and Training in November 2003 following further consultations with the social sciences and humanities research communities.

The purpose of the National Research Priorities is to:

- focus investment on research in key areas that can deliver significant economic, social and environmental benefits to Australia;
build on our national research strengths while seeking new opportunities in emerging areas; and
provide a catalyst for the formation of teams and networks of researchers across many disciplines in Australia and internationally.

The National Research Priorities are:

- An Environmentally Sustainable Australia;
- Promoting and Maintaining Good Health;
- Frontier Technologies for Building and Transforming Australian Industries; and
- Safeguarding Australia.

The priorities are aspirational in nature and intended to be recognised by all Australians as areas of endeavour that will help to deliver the kind of future we want.

Following the announcement of the National Research Priorities the Prime Minister wrote to State and Territory Premiers and Chief Ministers outlining the priority areas and seeking their support.

All Australian Government research and research funding bodies that can contribute to a National Research Priority are reporting on implementation through this year’s Innovation Report, which provides for the first time a whole-of-government picture of activity under the four priorities and their associated goals.

The Government’s Innovation Report

This report, and its predecessors, is designed to keep the community informed on the Australian Government’s science and innovation activities. This is the fourth report released since the beginning of the Backing Australia’s Ability initiative.

The 2001-02 Innovation Report provided a picture of Australia’s innovation landscape. This included previous achievements and actions, and how the government was building on these actions and future plans.

The 2002-03 Innovation Report illustrated how government, industry and the research sector were working together to improve and build on Australia’s achievements in innovation. It also included the first Australian Innovation Scorecard – a biennial series measuring innovation.

The 2003-04 Innovation Report highlighted the many examples of collaboration between the different facets of Australia’s innovation system. It provided an update on the Government’s programmes and initiatives and included an outline on how the future of Australia’s innovation system was being planned.

This year the effects of Backing Australia’s Ability have started to show, and the 2004-05 Innovation Report is reflecting this by shifting to more quantitative output reporting for the government’s programmes and initiatives. The report includes the second Innovation Scorecard which benchmarks Australia against other OECD countries. It also reports on implementation of the National Research Priorities.
The Australian Innovation Scorecard 2004 is the second in a biennial series measuring innovation. It is designed to provide a snapshot of Australia’s innovation performance, in particular relative to other OECD economies. The first Scorecard appeared in the 2002-03 Innovation Report Backing Australia’s Ability – Real Results Real Jobs.

A working definition of innovation is that it is the process whereby ideas are transformed through economic activity into sustainable value-creating outcomes, the emphasis being on the process of converting ideas into economic outcomes.

**The Indicators**

There are many different indicators that could be used to benchmark Australia’s innovation performance. The indicators used in the 2004 Scorecard stay as close as possible to those in the 2002 Scorecard. They were chosen to reflect the flow of the innovation process and to allow benchmarking against other OECD countries. The 15 indicators are grouped into six categories:

- **knowledge creation** – the ability to generate new ideas and technologies;
- **human resources** – the capacity of the labour force to transform these ideas and technologies into tangible economic outcomes;
- **finance** – the pool of funds available to commercialise ideas and technologies;
- **knowledge diffusion** – the capacity to transfer new ideas and technologies throughout the economy;
- **international collaboration** – the international linkages of Australia’s innovation system; and
- **market outcomes** – economic return on the investment in innovation.

When using this Scorecard, it should be kept in mind that an increase in any one of the various indicators may not necessarily be a better outcome for the economy. This is true especially for input type indicators such as those in the knowledge creation and human resources categories, as it is difficult to prove a direct relationship between increased expenditure and subsequent increases in innovation output. Nor is it necessarily the case that being higher on any or all of the indicators relative to OECD countries is a goal in itself. Innovation policy and outcomes need to have regard to particular country circumstances, including comparative advantages, economic and institutional performance and other policy goals and objectives.

The Scorecard is not designed to be prescriptive, but to provide an overview of Australian trends in key innovation indicators and to compare these to trends in OECD countries.

Due to constraints on the availability of internationally comparable data used in the Scorecard, many of the indicators use 2001 or, occasionally, earlier data. All data are at least one year advanced from that used in the previous Scorecard, with the exception of expenditure on innovation as a share of total sales in manufacturing, where updated data were not available. This means that the effects of the Backing Australia’s Ability initiatives are not yet apparent. Indeed, it will take some years for the effects to be felt in some of the indicators, particularly those in the market outcomes category.
### Australian Innovation Scorecard 2004

<table>
<thead>
<tr>
<th>Category</th>
<th>Headline indicator</th>
<th>2004 rank*</th>
<th>2002 rank</th>
<th>Leader</th>
<th>Australia</th>
<th>OECD leader</th>
<th>OECD average</th>
<th>Relative to OECD</th>
<th>Available data</th>
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<tr>
<td><strong>Knowledge creation</strong></td>
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<tr>
<td>R&amp;D expenditure in government and high education sectors as % GDP</td>
<td>6 7 Iceland 0.78% 1.26% 0.68% Above 2002</td>
<td>6 7 Iceland 0.78% 1.26% 0.68% Above 2002</td>
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<tr>
<td>Scientific and technical articles per million population</td>
<td>8 8 Switzerland 1,188 articles 2,070 articles 719 articles # Above 2003</td>
<td>8 8 Switzerland 1,188 articles 2,070 articles 719 articles # Above 2003</td>
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<td>Number of US patents per million population</td>
<td>18 18 United States 53 patents 340 patents 152 patents # Below 2003</td>
<td>18 18 United States 53 patents 340 patents 152 patents # Below 2003</td>
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<td>Business sector R&amp;D expenditure (BERD) as % GDP</td>
<td>19 19 Sweden 0.79% 3.32% 1.54% Below 2002</td>
<td>19 19 Sweden 0.79% 3.32% 1.54% Below 2002</td>
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<td><strong>Human resources</strong></td>
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<td>Percentage of workforce with tertiary education</td>
<td>6 5 United States 20.0% 29.0% 15.4% ^ Above 2002</td>
<td>6 5 United States 20.0% 29.0% 15.4% ^ Above 2002</td>
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<td>Number of science graduates per 10,000 persons in labour force *</td>
<td>6 6 Republic of Korea 33 graduates 48 graduates 23 graduates ^ Above 2001</td>
<td>6 6 Republic of Korea 33 graduates 48 graduates 23 graduates ^ Above 2001</td>
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<td>Researchers per 10,000 labour force</td>
<td>8 7 Finland 72 researchers 147 researchers 61 researchers Above 2002</td>
<td>8 7 Finland 72 researchers 147 researchers 61 researchers Above 2002</td>
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<td><strong>Finance</strong></td>
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<td>Investment in venture capital as % GDP</td>
<td>7 18 Sweden 0.20% 0.39% 0.20% # Equal 2001</td>
<td>7 18 Sweden 0.20% 0.39% 0.20% # Equal 2001</td>
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<td><strong>Knowledge diffusion</strong></td>
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<td>Investment in ICT as % of business sector gross fixed capital formation *</td>
<td>6 39 United States 20.5% 28.0% 21.6% Below 2001</td>
<td>6 39 United States 20.5% 28.0% 21.6% Below 2001</td>
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<tr>
<td>Internet users per 1,000 population</td>
<td>6 10 Iceland 601 users 659 users 443 users # Above 2003</td>
<td>6 10 Iceland 601 users 659 users 443 users # Above 2003</td>
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<td>Investment in new equipment - investment in machinery &amp; equipment as a % of GDP</td>
<td>10 12 Slovak Republic 8.7% 15.8% 7.3% Above 2002</td>
<td>10 12 Slovak Republic 8.7% 15.8% 7.3% Above 2002</td>
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<td><strong>Collaboration</strong></td>
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<tr>
<td>Share of foreign affiliates in manufacturing R&amp;D *</td>
<td>4 3 Hungary 45.0% 78.5% 19.1% # Above 2001</td>
<td>4 3 Hungary 45.0% 78.5% 19.1% # Above 2001</td>
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<tr>
<td>Breadth of international science and engineering collaboration †</td>
<td>12 8 United States 106 countries 186 countries 90 countries # Above 2001</td>
<td>12 8 United States 106 countries 186 countries 90 countries # Above 2001</td>
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<td><strong>Market outcomes</strong></td>
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<tr>
<td>Average annual growth in multi-factor productivity between 1997 and 2001 *</td>
<td>4 4 Ireland 1.8% 3.7% 0.8% # Above 2001</td>
<td>4 4 Ireland 1.8% 3.7% 0.8% # Above 2001</td>
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<tr>
<td>Expenditure on innovation as share of total sales in manufacturing % ‡</td>
<td>N/A 16 Sweden 1.9% 7.0% 3.3% # N/A 1996-97</td>
<td>N/A 16 Sweden 1.9% 7.0% 3.3% # N/A 1996-97</td>
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</tbody>
</table>

Sources: ABS Catalogue 1350.0, 8109.0, 8111.0 and 8112.0 (2002, 2004), OECD STI Scoreboard 2003, US Patent and Trademark Office 2003, World Competitiveness Yearbook 2004, OECD Main Science & Technology Indicators, Number 1 2004, OECD Science, Technology and Industry Outlook 2002, OECD Education at a Glance 2004, OECD Activity of Foreign Affiliates (AFA) Database 2004, OECD Education Database 2004, OECD Venture Capital Database 2004, OECD Economic Outlook 73, NSF Science and Engineering Indicators 2004, Thompson ISI 2004. Baseline years - 1996 to 2003. Number of OECD countries 30. # Indicates ITR calculation of weighted OECD average. ^ Indicates that the average is a country average rather than a weighted average. @ Averages for multi-factor productivity growth should be interpreted cautiously as unexplained productivity improvement may be driven by different factors across economies. † This indicator was not included in the 2002 Scorecard. The 2002 rank given here is using 1999 data. ‡ Last Australian manufacturing innovation survey 1996-97. * Australia's current ranking is from a field of 27 - 30 OECD countries with the exception of: Investment in venture capital as a percentage of GDP (25), Investment in ICT as a percentage of business sector gross fixed capital formation (18), Share of foreign affiliates in manufacturing R&D (19), Growth in multi-factor productivity between 1997 and 2001 (17), and Expenditure on innovation as a share of total sales in manufacturing (19) - number in parentheses represents the number of OECD countries. A “top ten” performance is considered to be within the top third of available OECD countries.
Highlights

Compared to outcomes in the 2002 Scorecard, Australia’s outcomes have improved on most indicators, with investment in venture capital (VC), scientific and technical articles and internet usage all increasing significantly.

Compared to OECD countries, Australia’s strengths are in government and higher education expenditure on R&D, a highly educated workforce, widespread use of the internet, a high proportion of foreign affiliates in manufacturing R&D, and a high level of multi-factor productivity (MFP) growth.

Australia’s measures are comparatively lower in the areas of patenting levels in the US, business expenditure on R&D and the breadth of international science and engineering collaboration (see table on previous page).

Summary of Australia’s Innovation Performance relative to the 2002 Scorecard

The change in Australia’s performance between the 2002 and 2004 Scorecards as a percentage of the 2002 values is shown in Figure 1. It shows Australia’s performance against only 13 indicators because there have been some changes made between the 2002 and 2004 Scorecards. Two indicators appear in the 2002 Scorecard that do not appear in 2004 due to a lack of data. These are science graduates in the labour force aged 25-34 and the number of international and domestic strategic alliances between firms. These indicators have been replaced by science graduates in the labour force (with no age restrictions) and the breadth of science and engineering collaboration. It is anticipated that these new indicators will continue to be available in the future and so will be able to be used for comparison in future Scorecards.

Figure 1: Change in Australian values between 2002 and 2004 Scorecards as a percentage of the 2002 values


* Innovation as a % of total sales has not been updated from the 2002 Scorecard due to a lack of new data.
### Table 1: Comparison of Australia’s performance in the 2002 and 2004 Scorecards

<table>
<thead>
<tr>
<th>Indicator</th>
<th>2002 Scorecard</th>
<th>2004 Scorecard</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(year of data)</td>
<td>(year of data)</td>
</tr>
<tr>
<td>R&amp;D expenditure in government and higher education sectors as a percentage of GDP</td>
<td>0.76% (2000-01)</td>
<td>0.78% (2002-03)</td>
</tr>
<tr>
<td>Scientific and technical articles per million population</td>
<td>803 articles (1999)</td>
<td>1,188 articles (2003)</td>
</tr>
<tr>
<td>Business sector R&amp;D expenditure as a percentage of GDP</td>
<td>0.72% (2000-01)</td>
<td>0.79% (2002-03)</td>
</tr>
<tr>
<td>Percentage of workforce with tertiary education</td>
<td>18.0% (1999)</td>
<td>20.0% (2002)</td>
</tr>
<tr>
<td>Researchers per 10,000 labour force</td>
<td>67 researchers (1999)</td>
<td>72 researchers (2002)</td>
</tr>
<tr>
<td>Investment in venture capital as a percentage of GDP</td>
<td>0.12% (2000)</td>
<td>0.20% (2001)</td>
</tr>
<tr>
<td>Investment in ICT as a percentage of business sector gross fixed capital formation</td>
<td>22.5% (2000)</td>
<td>20.5% (2001)</td>
</tr>
<tr>
<td>Internet users per 1,000 population</td>
<td>465 users (2001)</td>
<td>601 users (2003)</td>
</tr>
<tr>
<td>Investment in machinery and equipment as a percentage of GDP</td>
<td>8.7% (1998)</td>
<td>8.7% (2002)</td>
</tr>
<tr>
<td>Share of foreign affiliates in manufacturing R&amp;D</td>
<td>45.0% (1999)</td>
<td>45.0% (1999)</td>
</tr>
<tr>
<td>Average annual growth in MFP</td>
<td>1.5% (1995-1999)</td>
<td>1.8% (1997-2001)</td>
</tr>
<tr>
<td>Expenditure on innovation as a percentage of total sales in manufacturing</td>
<td>1.9% (1998-97)</td>
<td>N/A</td>
</tr>
</tbody>
</table>

In terms of a comparison between Australia’s performance in the 2002 and 2004 Scorecards, Figure 1 and Table 1 show that the best performances were in:

- investment in venture capital (from 0.12% of GDP to 0.20% of GDP);
- scientific and technical articles (from 803 articles per million population to 1,188 articles per million population); and
- internet usage (from 465 users per thousand population to 601 users per thousand population).

Australia only decreased its performance in two indicators between the two Scorecards:

- investment in ICT (from 22.5% of business sector gross fixed capital formation to 20.5% of gross fixed capital formation); and
- the number of US patents (from 54 patents per million population to 53 patents per million population).
Summary of Australia’s Innovation Performance Relative to OECD Countries

The Australian Innovation Scorecard 2004 shows that Australia performed above the OECD average in ten of the headline indicators. Australia also ranked amongst the top 10 OECD countries in 11 headline indicators.

An overall picture of Australia’s innovation performance is shown in Figure 2. This compares Australia’s performance across the 15 indicators with the OECD average. However, as mentioned earlier, it should be noted that the final indicator, innovation as a percentage of total sales, although included, has not been updated since the 2002 Scorecard due to a lack of new data.

As shown in Figure 2, Australia is performing at 50% or more above the OECD average in three indicators. These indicators, scientific and technical articles per capita, foreign affiliates in manufacturing R&D and multi-factor productivity growth for 1997 to 2001, show that Australia has an environment that is attractive to foreign investment and encourages global collaboration.

Figure 2: Australia’s innovation performance in the 2004 Scorecard compared to the OECD average


* Innovation as a % of total sales has not been updated from the 2002 Scorecard due to a lack of new data.

Other areas where Australia is strong are in the percentage of the labour force that has a tertiary education, the number of science and engineering graduates in the labour force and internet usage. These indicators show that Australia’s labour force is highly skilled and able to participate in the innovation process.

However, Australia’s business expenditure on R&D and levels of patenting in the United States are substantially below the OECD average. In addition, Australia is below the OECD average for investment in ICT as a percentage of business sector gross fixed capital formation, although this is less than 10% below the OECD average.

Figure 3 shows Australia’s performance compared to the OECD average for the 2002 and 2004 Scorecards in the set of 12 indicators that are common to both Scorecards. Australia performed above the average for the eight indicators out of the common set in the 2004 Scorecard, which is one more than in the 2002 Scorecard. Australia’s performance against the average has increased between the 2002 and 2004 Scorecards in eight indicators (scientific and technical articles, business expenditure on R&D, tertiary education, researchers in the labour force, investment in venture capital, investment in new equipment, foreign affiliates in manufacturing R&D and MFP growth) and decreased in one (public expenditure on R&D).
In terms of ranking within the OECD, Australia has improved its relative position in four indicators, remained in the same position in four and decreased in five, although the improvements were of a greater magnitude than the decreases. It is important to note when comparing international rankings that they can be volatile due to differences in measurement across countries.

Australia increased its position within the OECD in:
- public expenditure on R&D (one place);
- investment in new equipment (two places);
- internet users (four places); and
- investment in venture capital (11 places).

Australia has decreased its position within the OECD in:
- tertiary education (one place);
- researchers in the labour force (one place);
- foreign affiliates in manufacturing R&D (one place);
- scientific and technical articles (one place); and
- international science and engineering collaboration (four places).

Figure 4 compares Australia with the OECD leader’s performance for each indicator. This shows that Australia is well placed compared to the leader for internet usage and investment in ICT, but is significantly behind the OECD leader for patenting in the US and business expenditure on R&D.
Figure 4: Australia’s innovation performance compared to the OECD leader, 2004 Scorecard*


* For ease of presentation, leader performance is shown to three times the OECD average. Leader performance in foreign affiliates in manufacturing R&D and MFP growth are 4.1 and 4.7 times the OECD average respectively.

** Innovation as a % of total sales has not been updated from the 2002 Scorecard due to a lack of new data.

Summary of Australia’s Innovation Performance Against Each Category

Knowledge creation

Australia performed well in the level of expenditure on R&D in the higher education and government sectors, with expenditure of 0.78% of GDP in the 2004 Scorecard, compared to 0.76% in the 2002 Scorecard. Figure 5 shows that Australia ranked equal sixth with Germany, and was significantly above the OECD average.

Figure 5: Public expenditure on R&D as percentage of GDP compared to the OECD average

Source: OECD, ABS. Data from 2002 or latest available year.
The number of scientific and technical articles per million population is a measure of the nation’s ability to generate new knowledge, and provides an indication of the potential for the development of innovative products, services and technologies. In the 2004 Scorecard, Australia registered 1,188 articles per million population, compared to 803 articles in the 2002 Scorecard. Figure 6 shows that Australia ranked ninth in the OECD, and significantly - about 60% - above the OECD average.

Figure 6: Number of scientific and technical articles per million population compared to the OECD average

![Image](https://example.com/image.png)

Source: Thompson ISI. Data from 2003.

Patents per million population provide an indication of the intention of researchers to develop their knowledge into new products. As an indicator, there are limitations, as many patents are never developed into products. Nonetheless, it is one of the few measures of intent to commercialise available, and one that is used extensively internationally, particularly patents registered in the US. Because the US is the largest market in the world, registering a patent there tends to indicate that the invention is capable of competing with the world’s best.

A further limitation of this indicator is that many foreign companies register patents in the US, but many US companies do not register their patents anywhere else, and so this indicator does not give the same indication of international competitiveness of US inventions as it does for other countries. The US and Japan also exhibit a high propensity to patent, thereby distorting the average, with the result that 25 of the 30 member countries are below the OECD average.

Australia registered 53 patents per million population in the 2004 Scorecard, a slight decrease from the 2002 Scorecard level of 54 patents per million population. Figure 7 shows that Australia ranks 18th in the OECD for US patent registration, and significantly below the average.
The level of business expenditure on R&D (BERD) is a measure of the private sector’s contribution to developing new knowledge and refining existing technologies for commercial outcomes. Australia had an expenditure of 0.79% of GDP in the 2004 Scorecard, an increase from 2002 where the expenditure recorded was 0.72% of GDP. Figure 8 shows that Australia’s performance in this area is significantly below the OECD average, ranking 19th (equal to the Czech Republic) relative to other OECD countries. Australia’s position relative to the OECD average has improved slightly since the 2002 Scorecard, from 54% below the average to 49% below. Note the addition of Luxembourg in the 2004 Scorecard which was not present in the set of countries available for the 2002 Scorecard.

Source: OECD. Data from 2002 or latest available year.

Figure 8: BERD as a percentage of GDP compared to the OECD average


Figure 7: Number of US patents per million population compared to the OECD average
**Human resources**

The proportion of the workforce with a tertiary education is an indicator of the comparative skill level of a nation’s workforce, and provides an indication of the labour force’s ability to utilise new ideas and technologies. In the 2004 Scorecard, 20.0% of the Australian workforce had a tertiary education, compared to 18.0% in the 2002 Scorecard. Figure 9 shows that Australia performs strongly in the area, ranking sixth in the OECD and significantly above the average.

**Figure 9: Percentage of the workforce with a tertiary education compared to the OECD average**

![Percentage of workforce with tertiary education](image)

Source: OECD. Data from 2002.

The number of researchers in the labour force is an indicator of the economy’s ability to generate and apply new knowledge, and to participate in a knowledge driven global economy. In the 2004 Scorecard, Australia registered 72 researchers for every 10,000 people in the labour force, compared to 67 researchers in the 2002 Scorecard. Figure 10 shows that Australia ranks eighth in the OECD and is slightly above the average.

**Figure 10: Number of researchers per 10,000 persons in labour force compared to the OECD average**

![Number of researchers per 10,000 persons](image)

Source: OECD. Data from 2002 or latest available year.
The 2004 Scorecard does not include the 2002 indicator on the number of science graduates aged 25-34, instead it has been replaced with a broader indicator that does not specify age. For this new indicator in the 2004 Scorecard, Australia has 33 graduates for every 10,000 people in the labour force. It is possible to create equivalent data for this indicator as if it had appeared in the 2002 Scorecard, showing Australia had 32 graduates for every 10,000 people in the labour force. The data used in this instance was 1999 or latest available year. Figure 11 shows the number of science graduates per 10,000 persons in the labour force.

Australia performs well on the number of science and engineering graduates flowing into the workforce and its sixth ranking is above the OECD average. This suggests that Australia is well positioned to take advantage of graduates’ ability to adapt and use emerging technologies in a knowledge driven global economy.

Figure 11: Number of science graduates per 10,000 persons in labour force compared to the OECD average

Source: OECD. Data from 2001 or latest available year.

Finance

The size of the venture capital market indicates the availability of investment capital to finance new businesses which offer the prospects of above average returns for investors. This indicator examines the investment in early stages and expansion venture capital as a percentage of GDP. It does not include management buyouts (another common use of venture capital) as this is less directly related to the innovation process. Figure 12 shows that Australia is ranked seventh, and was equal to the OECD average.

The level of venture capital investment as a percentage of GDP in Australia increased from 0.12% in the 2002 Scorecard (a low base) to be equal to the OECD average of 0.20% in the 2004 Scorecard. However, the volatility of the venture capital market needs to be considered when analysing this data. Worldwide, there was a spike in venture capital investment in 2000, the year reported in the last Scorecard associated with the technology boom, with Iceland, the United States, Canada and the United Kingdom among those most affected. In 2001, when the technology bubble burst in the US, the amount invested in venture capital in these countries returned to close to their 1999 values. The effects of the end of the technology boom had not been felt in Australia by the end of 2001, and this has contributed to its improvement in OECD rank.
Knowledge diffusion

The use of information and communications technologies (ICT) is recognised as a significant driver of economic growth and productivity improvements. In the 2004 Scorecard, Australia’s level of investment in ICT as a percentage of gross fixed capital formation is 20.5%, a decrease from the 2002 Scorecard level of 22.5%. Figure 13 shows that Australia is ranked sixth, and slightly below the OECD average in investment in ICT as a percentage of business gross fixed capital formation.

This indicator has undergone some change since the 2002 Scorecard, with 18 OECD countries having data available for the 2004 Scorecard. In the 2002 Scorecard, data for only nine countries (Australia, Canada, Finland, France, Germany, Italy, Japan, the UK and the US) were available, and hence no OECD average was calculated.

Figure 13: Investment in ICT as a percentage of business sector gross fixed capital formation compared to the OECD average

Source: OECD. Data from 2001 or latest available year.
Another measure of knowledge diffusion capability is the number of internet users in the population. In the 2004 Scorecard, Australia has 601 internet users per 1,000 population, an increase over the 2002 Scorecard where Australia had 465 internet users per 1,000 population. Figure 14 shows that Australia performs strongly in this area, ranking sixth, and significantly above the OECD average.

**Figure 14: Internet users per 1,000 people compared to the OECD average**

![Percentage difference from the OECD average](image)


The level of investment in new equipment provides an indication of the vitality of the economy. Companies that purchase new machines and equipment also diffuse new technologies and processes. In the 2004 Scorecard, Australia’s level of investment in new equipment was 8.7% of GDP, the same as in the 2002 Scorecard. Figure 15 shows that Australia is ranked 10th, and above the OECD average.

**Figure 15: Investment in new equipment as a percentage of GDP compared to the OECD average**

![Percentage difference from the OECD average](image)

Source: OECD. Data from 2002.
International collaboration

The R&D expenditure of foreign owned companies in the Australian manufacturing sector, as a proportion of total manufacturing R&D, indicates the attractiveness of Australia as a location for manufacturing R&D. Australia’s data for this indicator has not changed between the 2002 and 2004 Scorecards, remaining at 45.0%. Figure 16 shows that Australia is strong in this area, ranking fourth and significantly above the OECD average.

Figure 16: Share of foreign affiliates in manufacturing R&D compared to the OECD average

A 2002 Scorecard indicator not appearing in the 2004 Scorecard is the number of strategic alliances between firms. This is excluded as the 2002 Scorecard data were of a one-off nature. This indicator has been replaced with one showing the breadth of international science and engineering collaboration. This indicator gives a count of the number of countries each country has jointly authored science and engineering articles with. Although not exclusively collaborations between firms, it does include this type of collaboration.

International science and engineering collaboration is an important element in the innovation process, helping to diffuse technology and make R&D more efficient. In the 2004 Scorecard, Australia collaborated with 106 other countries on science and engineering articles. Using data from 1999 it is possible to construct this indicator as if it had appeared in the 2002 Scorecard, with collaboration with 113 countries. Figure 17 shows that those countries that have the most international science and engineering collaboration partners are on the whole located in North America and Western Europe. Australia is ranked 12th and is slightly above the OECD average.
Innovation is an increasingly important driver of productivity. Australia’s annual average growth in MFP between 1997 and 2001, as reported in the 2004 Scorecard was 1.8%. The average annual growth in MFP reported in the 2002 Scorecard was 1.5% between the years 1995 and 1999. Figure 18 shows that Australia has the fourth highest average annual growth in MFP in the OECD.
Expenditure on innovation as a share of total sales measures the relative commercial importance of innovation to firms. Australian data on this indicator is limited to the last point of collection, 1996–97, and will not be updated until a new innovation survey is released, which is expected to be in February 2005. Because of the lack of updated Australian and other country data, this indicator (shown in Figure 18) remains unchanged from the 2002 Scorecard. The Australian value for the expenditure on innovation as a percentage of total sales in manufacturing therefore remains at its 2002 Scorecard value of 1.9%. Figure 19 shows that Australia was ranked 16th in the OECD, and below the average.

Figure 19: Expenditure on innovation as a share of total sales in manufacturing compared to the OECD average*

[Graph showing percentage difference from the OECD average for various countries.]

Source: OECD. Data from 1996-97 or latest available year.

* Innovation as a % of total sales has not been updated from the 2002 Scorecard due to a lack of new data.

Conclusion

Australia improved its performance between the 2002 and 2004 Scorecards in eight of the 13 common indicators and decreased in two. Areas of particular improvement include investment in venture capital, scientific and technical articles, internet usage and MFP growth. Australia’s performance decreased in patents and investment in ICT.

Compared to the OECD average in the 2004 Scorecard, Australia ranked amongst the top 10 OECD countries in 11 headline indicators, performing above the average in 10 of the 15 indicators and below in four. Australia performed well above the average in foreign affiliates in manufacturing R&D, MFP growth and scientific and technical articles, and well below the average in patents and business expenditure on R&D.

Australia scores well in those indicators relating to a well educated workforce. This is a strong indicator of the economy’s ability to generate and apply new knowledge and technologies. These are important factors for participation in a knowledge-driven global economy.

Overall, the Australian Innovation Scorecard 2004 shows that Australia is well placed with its innovation system but also highlights areas where a case may be made for the need for improved performance.
CHAPTER TWO: INITIATIVES FOR A DYNAMIC NATIONAL INNOVATION SYSTEM

For a country of its size and population Australia is a high performer in science and innovation. With only 0.3% of the world’s population, 1% of the world’s trade and 1% of the world’s GDP, Australian researchers produce 2.88% of the world’s output of research publications.

As the international science and innovation boundaries are continually pushed forward, Australia must focus on promoting and improving local science and innovation efforts while also ensuring that it is positioned to capture the benefits of knowledge flows and technology transfer from larger and more technologically advanced countries. Developing an innovation culture and improving the transfer of knowledge and ideas from researchers to innovators are critical long-term goals for Australia. Performance in these areas can be uneven as the science and innovation system evolves, but the trends over time are increasingly positive. Public policy settings must respond to and support those trends.

The Chief Scientist outlined key themes for a dynamic innovation system in Australia in his November 2000 report titled The Chance to Change. This followed on from the National Innovation Summit and the Innovation Summit Implementation Group Report. The Chief Scientist also placed the innovation system in the context of a strategy focused on national outcomes based on sound investment in science, engineering and technology (see figure below).

Ideas: a nation’s potential for innovation is strongly linked to its research capacity, the generation and utilisation of ideas requires excellent facilities that enable our scientists, engineers and technologists to innovate as well as providing a stimulating and challenging environment for students.

Commercialisation: encourage close networks of companies and publicly funded research providers in order to facilitate the smooth translation of ideas into innovative products and services.

People and culture: an ideas culture needs skills development, commercially viable intellectual property systems, a scientifically aware population and an environment that supports the innovation process.

(The Chief Scientist, The Chance to Change, November 2000, p.25)
Backing Australia's Ability, in alignment with the findings of the Chief Scientist and the Innovation Summit Implementation Group, targets three key themes which are fundamental to a strong national innovation system:

- strengthening our ability to generate ideas and undertake research;
- accelerating the commercial application of ideas; and
- developing and retaining Australian skills.

This chapter focuses on the progress, achievements and outcomes of Australian Government programmes, initiatives and agencies in the three key areas above as follows:

- part one examines initiatives strengthening Australia’s R&D ability;
- part two looks at how the Australian Government is accelerating the commercial application of ideas; and
- part three describes strategies to ensure skills are being developed and retained.
**PART ONE – Strengthening our Ability to Generate Ideas and Undertake Research**

New ideas are essential for Australia to compete and succeed in science and innovation. They can result in new processes, products and outcomes, producing commercial value. Australian researchers are adept at drawing on the world stock of knowledge and research, and Australian firms have proved very successful in adopting and adapting overseas technology. We must however, be more than a fast user of other nations’ technologies to ensure our industries remain competitive in the global marketplace. It is essential for Australia to have the capability to perform cutting-edge research. Research is the key source of knowledge and ideas, and knowledge and ideas have proven to be a major force to increase productivity and economic growth.

Gross expenditure on R&D (GERD) in Australia in 2002-03 was estimated to be $12,250 million at current prices, 17.6% higher than in 2000-01.

Australia’s government R&D expenditure is relatively high by international standards. It amounted to 0.33% of gross domestic product (GDP) in 2002-03, compared with 0.25% for both the OECD as a whole and the EU-15. Over the last two decades, Australia’s government expenditure on R&D (GOVERD) as a percentage of GDP has remained well ahead of the OECD average and the EU-15 average.

**Figure 20: Australia’s GOVERD as a percentage of GDP, in comparison with the OECD and EU-15 averages, 1981 to 2002**

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Highlights in 2003-04 included:

- The National Measurement Institute commenced on 1 July 2004. This new institute provides a national centre for measurement in physics, chemistry, and biology and national leadership of legal metrology. It brings together the CSIRO’s National Measurement Laboratory, the National Standards Commission and the Australian Government Analytical Laboratories.

- The CSIRO received $305 million over seven years additional funding to enable the development of large-scale collaborative research partnerships which reflect the National Research Priorities.

- In 2003, business expenditure on R&D in 2002-03 was nearly $6 billion, which is an increase of 20% over 2000-01 levels.

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1. EU-15 countries include Belgium, Denmark, Germany, Greece, Spain, France, Ireland, Italy, Luxembourg, the Netherlands, Austria, Portugal, Finland, Sweden and the United Kingdom.
The Australian Research Council (ARC) and the National Health and Medical Research Council (NHMRC) are working together to expand cooperation between agencies and to identify opportunities for joint research targeting health and medical research in emerging technologies.

**Government Research Agencies**

Government research agencies are a vital part of Australia’s national innovation system. They undertake activities that contribute to the nation’s wealth and improve health, safety and the quality of life. They focus on long-term strategic research, often in areas of public good, where investment by the private sector is low due to uncertain or insufficient commercial outcomes or unacceptable risk. They also play an important role in training and developing researchers and science-based professionals.

**Figure 21: Australia’s GOVERD as a percentage of GDP – by Commonwealth and State Governments, 1978-79 to 2002-03**

![Figure 21: Australia's GOVERD as a percentage of GDP – by Commonwealth and State Governments, 1978-79 to 2002-03](chart.png)

Source: Estimates provided by the Science and Innovation Analysis Section, DEST.

Australia’s GOVERD decreased by 0.05 percentage points of GDP over the last 24 years, from 0.41% of GDP in 1978-79 to 0.33% of GDP in 2002-03, which reflects the general downward trend of GOVERD in OECD economies over the period (see Figure 20). The decrease is mainly attributable to the fall of R&D expenditure in Commonwealth Government agencies over the period.

In 2003-04 Australian Government funding to major federal research agencies totalled $1.3 billion. In 2004-05 funding for CSIRO, the Australian Nuclear Science and Technology Organisation (ANSTO) and the Australian Institute of Marine Science (AIMS) were at record levels. All institutes had their triennium funding (2004-05 to 2006-07) confirmed in the 2004-05 Budget.

**Australian Antarctic Division**

The Australian Antarctic Division (AAD) of the Department of the Environment and Heritage manages Australian Government activity in Antarctica. The AAD seeks to advance Australia’s Antarctic interests in pursuit of its vision of having “Antarctica valued, protected and understood”. It does this by conducting Antarctic research and other activities aimed at achieving the government’s Antarctic goals, and by administering and maintaining a presence in Australian Antarctic and subantarctic territories. For this purpose the AAD received $87.1 million of Australian Government funding in 2004-05.
Much of the research undertaken is public good research. Scientific data produced by AAD contributes to new generation climate change models, sea level rise estimates, sustainable fisheries, understanding Australia’s biodiversity, space weather and environmental protection.

In 2003 Australia’s Antarctic research programme resulted in 301 publications. The programme supported 74 PhD, six masters and 26 honours students in 52 institutions in 16 different countries. The AAD publishes the *Australian Antarctic Magazine*. Most of Australia’s Antarctic scientific research is conducted under the auspices of major international research programmes coordinated by the Scientific Committee on Antarctic Research and the World Climate Research Programme, the Scientific Committee on Oceans Research and the Scientific Committee of Commission for the Conservation of Antarctic Marine Living Resources.

A recent evaluation strongly endorsed the quality of the overall scientific programme. It recommended moving from discipline-based research to multi-discipline, theme-based research, a recommendation the AAD is implementing.

www.aad.gov.au

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**MAINTAINING A SUSTAINABLE FISHERY AROUND HEARD ISLAND AND MCDONALD ISLANDS**

Scientists from the Australian Antarctic Division and elsewhere used cutting edge technology aboard the Aurora Australis and on Heard Island last summer, in a groundbreaking attempt to assess the diet of land-based predators (penguins, seals and albatrosses).

A satellite tracking system was used to map predators’ feeding patterns, revealing a daily map of where individual seals, penguins and albatrosses hunted. Scientists used this animal track data to position the ship to where they collected samples to find out what food species were available.

DNA analysis of the predators’ faeces collected on the island provided scientists with valuable information about what they were eating relative to what was available. These data provide the basis for the establishment of commercial catch limits. The technique will be further developed more generally to enable comprehensive analyses of predator diets to be made without the need to handle animals.

A seal is weighed as part of dietary studies of predators in the Heard Island and McDonald Islands region

Credit: © Nick Gales, courtesy of the Australian Antarctic Division
Australian Biological Resources Study

The Australian Biological Resources Study (ABRS), a programme within the Department of Environment and Heritage, documents and distributes information about our flora and fauna. It administers grants for research on Australia’s biodiversity and provides awards, including postgraduate scholarships and student travel bursaries, to outstanding students wishing to pursue a PhD in biodiversity research. In 2004–05 ABRS received Australian Government funding of $3.2 million. The programme is a world leader with its internationally recognised publications on taxonomic information, web information and a range of authoritative online databases such as the Australian Plant Name Index and the Australian Faunal Directory.

In 2003–04, ABRS launched the Flora of Australia Online database, awarded 66 grants to 105 applicants and provided funding of $94,434 for postgraduate scholarships. Publications produced include Volume 56A of Flora of Australia, and three publications in the Flora of Australia Supplementary Series. This year a special publication was produced with the Australian National Insect Collection, CSIRO, called Evolution of Behavioural and Ecological Diversity: Australian Acacia Thrips as Model Organisms. The programme works closely with the States and the broader Australian taxonomic community.


FLORA OF AUSTRALIA ONLINE – A WORLD FIRST

Flora of Australia Online, launched by the Parliamentary Secretary to the Minister for Environment and Heritage (1998-2004) the Hon. Dr Sharman Stone, MP, in March 2004, is the world’s first national online interactive taxonomic data resource for flora. This cutting-edge technology makes species level information more accessible to general and scientific audiences.

The data, previously published in the books, Flora of Australia, provides the basic systematic flora data needed for understanding and managing conservation, biological diversity, the environment and biotechnology.

Information is used by farmers, conservationists, local government officers, land care groups, scientists, educators, university and school students, who can now customise data delivery to suit their own needs. Information is available for uses like environmental projects, habitat information for land managers, identification keys for naturalists, or species lists for environmental impact statements and land surveys.

Flora of Australia Online is found at www.deh.gov.au/biodiversity/abrs/online-resources/flora/
Australian Institute of Aboriginal and Torres Strait Islander Studies

The Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS) is a statutory body and independent research organisation promoting knowledge and understanding of past and present Australian Indigenous cultures. It houses the world’s premiere collection of Aboriginal and Torres Strait Islander resources including printed material, sound recordings, films and video and hosts the Aboriginal Studies Press.

AIATSIS is a partner of the Cooperative Research Centre for Aboriginal Health, as well as an associate with the Cooperative Research Centre for Desert Knowledge. It has links with the Office of Indigenous Policy Coordination, Minerals Council of Australia, most Australian universities and many international higher education centres as well domestic stakeholders such as the National Native Title Tribunal.

In 2003-04 the cohort of 10 AIATSIS Research Fellows produced 12 edited volumes, 10 chapters, 47 papers, 38 reports and approximately 60 conference and seminar presentations. The Aboriginal Studies Press published seven titles including Very big Journey and Woven Histories: Dancing Lives. During this period the Institute awarded 40 grants in the fields of anthropology, archaeology, arts, education, governance, health, linguistics and public policy, politics and law. More than 40 research projects were finalised. Eight Indigenous researchers took part in the International Visiting Research Fellowship and Indigenous Research Fellowship Schemes. AIATSIS hosted two seminar series: Health and Society: an Indigenous Context, and Indigenous Autonomy and Regional Development in addition to the AIATSIS Native Title Conference (with 500 delegates) and The Family History Fair.

www.aiatsis.gov.au

Australian Institute of Marine Science

The Australian Institute of Marine Science (AIMS) is Australia’s only research agency entirely focused on marine research. In 2004-05 the Australian Government provided funding of $22.5 million to the Institute.

AIMS brings together some of the world’s best expertise in marine science in three broad areas – marine conservation and biodiversity, coastal processes and marine biotechnology. Research is focused on sustainability and new opportunities through the transfer of knowledge. This research supports marine conservation and industry development across the northern parts of Australia’s Exclusive Economic Zone.

AIMS main laboratory is located at Cape Ferguson, 50km from Townsville. Support bases in Fremantle and Darwin supplement research. Two AIMS vessels, the RV Cape Ferguson and RV Lady Basten, support access to tropical waters off Queensland, the Northern Territory and Western Australia. A fleet of smaller vessels supports fieldwork near-shore and offshore.

AIMS achievements in 2003-04 include:

- The discovery that the temperature threshold for coral mortality is only 0.5-1°C higher than the threshold stress in corals (bleaching), and the fact that the type of zooxanthellae (a highly diverse group of unicellular plants) in a coral can influence its tolerance to increases in water temperature of one to two degrees celsius. Both these discoveries will assist national policy decisions associated with climate change.

- Research which revealed that all the commonly used agricultural chemicals, including less-toxic bio-oils, limit coral growth and settlement of coral larvae.
A causal attribution framework has been developed to assess causal links between terrestrial run-off, inshore water quality and the ecological status of coral reef ecosystems.

Dr J. E. N. (Charlie) Veron was awarded the Darwin Medal (the most prestigious award given by the International Society for Reef Studies) in recognition of his major contributions to coral studies.

AIMS has 150 staff, two-thirds of whom are directly engaged in scientific activity. This capacity is significantly increased through an extensive international network of research collaborations. The institute also contributes to future science capacity through graduate and postgraduate training. For example, 56 postgraduates were supervised by AIMS staff during the past year.

www.aims.gov.au

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BATH-SPONGE AQUACULTURE

Remote Indigenous communities in northern Australia are working with the Australian Institute of Marine Science (AIMS) to explore bath-sponge aquaculture as a new sustainable regionally based industry. Sponge aquaculture is ideally suited to remote locations, because sponges grow well without intensive feeding or upkeep, post-harvest processing is simple, and the final product (dried sponge skeletons) does not need refrigeration and is light and cheap to transport.

Aquaculture may provide a sustainable and reliable production method that avoids the pitfalls of wild fisheries elsewhere. Two species of rapidly growing sponges that occur locally around the Palm Islands in the Great Barrier Reef and off the coast of Arnhem Land in the Northern Territory are being trialled.

A pilot sponge farm has been developed on Palm Island. AIMS has also identified candidate bath sponge species off the coast of Arnhem Land and has established initial sponge growth trials with the sea rangers at the communities of Warrawi and Maningrida. A key feature of these projects is skills and technology transfer to communities from the outset, through employment and training including linkage to the Community Development Employment Programme.
Australian Nuclear Science and Technology Organisation

The Australian Nuclear Science and Technology Organisation (ANSTO) is Australia’s national nuclear organisation. ANSTO is constructing a replacement nuclear research reactor (RRR). When up and running in 2006, the performance of the RRR’s eight leading-edge neutron beam instruments will place ANSTO in the top three comparable nuclear research centres in the world. In 2004-05, ANSTO received Australian Government funding of $153.3 million.

Achievements in 2003-04 include:

- Research on two rare water isotopes which could be the key to accurately tracking the evaporation and precipitation cycles of the world’s major river basins. This research will fill in gaps left by traditional climate forecasting which uses atmospheric and oceanic models based on total water movements.

- Development of a portable gamma radiography camera, called Gamgen. The camera is versatile, robust and reliable. It is used, for example, in power stations and the oil industry to take radiographic images of key components to ensure the safety and efficiency of plant, by finding flaws or cracks.

Other achievements

Forty-nine patents were filed, including for new bioreactor technology for use in biosynthesis of antibiotics and wastewater treatment.

ANSTO was a key organiser of the 15th International Symposium of Radiopharmaceutical Chemistry. The organisation’s global profile in nanotechnology was raised by the successful organisation of the 12th International Workshop on Sol-Gel Science and Technology, with 250 delegates from 35 countries.

Researchers from 37 universities receive access to ANSTO’s facilities through the Australian Institute of Nuclear Science and Engineering (AINSE). AINSE provided support for 239 university projects in areas such as manufacturing, advanced technology, medicine and environmental protection, 41 postgraduate research students, and other activities. 372 articles were published following AINSE supported research.

www.ansto.gov.au
X-rays and neutron scattering technology are being used by scientists to solve the costly problem of shrinkage during thermoplastic manufacture.

A standard method for manufacturing thermoplastics—a common type of polymer—is injection-moulding. The manufacturer creates a mould, injects it with molten polymer, lets it cool, opens the mould and releases the shaped piece of plastic. But sometimes the polymer loses its shape by warping or shrinking.

The Australian Nuclear Science and Technology Organisation (ANSTO) is investigating warping and shrinking in injection-moulding of the polymer polypropylene. ANSTO and its partners in the Cooperative Research Centre for Polymers are modelling what happens during injection-moulding, and then simulate the process using computer software. This may also lead to software to solve similar problems in processing other polymers.

When polypropylene is injected into the mould at enormously high pressure, it squeezes the polymer around and against the mould’s contours – a frictional movement called shearing. The force of this friction – ‘shear’ force – alters the polymer’s molecular state and its crystal structure on cooling, which affects the properties and behaviour of the product.

Using X-ray and neutron-scattering technology, ANSTO is mapping exactly what happens to polypropylene under shear forces and investigating the crystalline structure that results. Small-angle X-rays fired through the polymer produce time-lapse images of exceptional quality and detail of the general sequence of events, while neutrons beamed through the polymer delineate what happens to the chain architecture of individual molecules.
The Bureau of Meteorology Research Centre (BMRC) conducts research for Australia’s national meteorological service, the Bureau of Meteorology. In 2003-04 it received $9.1 million in Australian Government funding. BMRC’s research covers model development, data assimilation, climate dynamics, weather forecasting, climate forecasting, and ocean and marine forecasting. BMRC develops advanced techniques and systems (including regional and global models of the atmosphere and ocean). These become the operational systems which provide the basis for the Bureau’s products and services.

In 2003-04 more than 50 articles by BMRC scientists were published in international journals and books. A further 68 were published as reports or conference papers. BMRC scientists served on national and international working groups and external advisory committees concerned with both scientific and science policy issues. Collaborations included major international scientific experiments such as the Darwin Area Wave Experiment, the Tropical Rainfall Measuring Mission and the Atmospheric Radiation Measurement Programme installation at Darwin. BMRC also worked with CSIRO, the Royal Australian Navy and the Australian Greenhouse Office.

www.bom.gov.au/bmrc

EXCITING DEVELOPMENTS IN SEVERE THUNDERSTORM WARNINGS

The Bureau of Meteorology Research Centre (BMRC) has developed a range of tools that will significantly enhance the Severe Thunderstorm Warning Service for the Australian public over the next two years.

Forecasters use a web-interface to view tailored thunderstorm information from the Bureau’s atmospheric computer model which focuses their attention on areas most at risk from thunderstorms, hours before they even begin to form. When a storm develops, they manipulate 3D radar images with a world-class home-grown software system, overlaid with overseas state-of-the-art radar thunderstorm algorithm output to give them an up-to-the-minute understanding of the structure and threat posed by each cell.

Warnings are created with a revolutionary Bureau-developed thunderstorm forecast preparation system that will provide tailored products in range of formats: text, graphics, and voice.
Commonwealth Scientific & Industrial Research Organisation

The Commonwealth Scientific & Industrial Research Organisation (CSIRO) is Australia’s national science agency. It serves government, industries, businesses and communities across the nation by carrying out research and development in fields of economic, social and environmental importance. CSIRO employs more than 6,500 staff in 21 research divisions located across 58 sites throughout Australia and overseas.

In 2003-04 CSIRO employed 259 postdoctoral fellows, sponsored 235 students and supervised 464 PhD students, 46 master students and 56 honours students. The organisation executed 188 licences and had 148 new patents issued worldwide.

During 2003-04 two announcements were made of particular significance to CSIRO. A total of $305 million over seven years was announced as part of Backing Australia’s Ability - Building Our Future through Science and Innovation to accelerate delivery of the Flagship Program. As part of the 2004 Federal Budget CSIRO’s three year base funding was confirmed with a record $1.7 billion appropriation being provided for the 2004-07 triennium.

Examples of collaborative ventures include:

- Establishment of a strategic research partnership between CSIRO Petroleum, Woodside Energy Ltd, Curtin University of Technology and University of Western Australia (operating as the West Australian Energy Research Alliance) to address technology solutions for oil, gas and other energy projects.
- A joint venture between CSIRO Forestry and Forest Products and New Zealand’s Forest Research to create a single forestry R&D entity in the region.
- A partnership with the Bureau of Meteorology and the Royal Australian Navy in the Australian Government joint oceans research initiative.
- A joint research programme with the University of Tasmania to build the nation's capability in marine environment and resource management.
- A strategic agreement between Benitec Limited, CSIRO, and the Queensland Department of Primary Industries to accelerate Australia’s lead in the global commercialisation of DNA Directed RNA interference, a breakthrough gene silencing technology.

Income in 2003-04 from active licence, options and assignment agreements came to $12.1 million. Running royalties amounted to $10.4 million. Private sector revenue (domestic and international) accounted for 39% of all external income and totalled $108.8 million. Total revenue for 2004-05 will be $903 million of which $576 million represents direct appropriation from the Australian Government.

CSIRO education activities directly involved more than 300,000 students, parents and teachers as well as more than 400,000 through the national weekly television programme Totally Wild. About 220,000 students took part in classes presented by CSIRO education staff at schools through the Lab on Legs programme or in the CSIRO Science Education Centres.

www.csiro.au
SUNBAKING TO MAKE YOUR CAR BODY STRONGER

CSIRO has developed a new process that could lead to the production of aluminium cars and planes that get stronger the longer they are left to bake in the sun.

The new process involves curing or age-hardening aluminium to a point where the curing process can be completed by exposure to sunlight rather than in a furnace.

A team of scientists at CSIRO Manufacturing and Infrastructure Technology in Melbourne found that if the high temperature ageing process used to strengthen aluminium components, such as castings or motor vehicle body panels, is interrupted — and the material is allowed to undergo secondary ageing at ambient temperature — the material becomes 20% tougher.

CSIRO’s patented heat treatment results in higher energy absorption during rupture (by up to 800%) which could translate to improved safety in car collisions.

The dual heat treatment process overcomes the age-old problem for manufacturers of being restricted to either increasing the strength of aluminium products or subsequently reducing their fracture toughness, or vice versa.

CSIRO’s new heat treatment significantly reduces the time of high temperature ageing to about an hour, and uses Australia’s warm climate to complete the process. That process continues, albeit at a slower rate, for the life of the vehicle.

KNOWING WHEN TO FLOWER

CSIRO Plant Industry made a major breakthrough late in 2003 with its discovery of the gene that triggers flowering in cereal crops like wheat and barley.

Although much more work needs to be done before the secrets of plant flowering are fully revealed, the discovery of the WAP1 gene provides researchers with the key to influencing one of the major traits cereal crop breeders have sought to control for thousands of years.

It is now known that WAP1 turns ‘on’ to activate flowering when the cereal plant is at the right stage of development and when environmental conditions are suitable.

This knowledge could be used to help breed cereal plants that flower when needed and experiments are already underway to see if spring wheats can be made to flower even earlier using more active versions of WAP1. WAP1 could also be used to block flowering in grasses that cause allergies and to prevent sugarcane flowering, allowing sugarcane plants to allocate more resources to producing cane.
The Defence Science Technology Organisation (DSTO) is the research arm of the Department of Defence. With an annual budget of approximately $300 million, it provides expert, impartial and innovative application of science and technology to the defence of Australia and its national interests. DSTO has three research laboratories:

- The Platforms Sciences Laboratory (PSL) provides support to existing and future platforms (aircraft, ships and submarines). PSL is headquartered at Fishermans Bend in Melbourne.
- The Systems Sciences Laboratory (SSL) supports the acquisition, operation and integration of electronic systems on major platforms and land forces. SSL is headquartered at Edinburgh near Adelaide.
- The Information Sciences Laboratory (ISL) supports Defence’s exploitation of advances in information technology and communication technologies. ISL is also headquartered at Edinburgh.

In addition to Melbourne and Edinburgh, DSTO maintains research facilities in Sydney, Perth, Canberra, Scottsdale and Innisfail as part of these laboratories. The organisation employs about 2,200 people, the majority of whom are scientists and technical staff.

In 2003-04 DSTO filed 10 provisional patent applications and published nearly 330 scientific reports, as well as a similar number of articles in scientific and technical journals. Licensing of technologies for commercialisation included mine neutralisation devices and frangible surrogate leg technology aimed at reducing injuries from anti-personnel landmines.

DSTO is a member of 10 Cooperative Research Centres including the Integrated Engineering Asset Management and Advanced Composite Structures Cooperative Research Centres. The organisation played a key role in the International Ballistics Symposium and the Australian Joint Strike Fighter Industry and Technology Conference. It marketed 42 commercial opportunities, such as a landmine protection toolkit, and a number of simulation software products.

A recent independent review of DSTO’s external engagement and contribution to Australia’s wealth found that the economic benefit from a small number of selected projects has at least covered the organisation’s cumulative budget costs for the past 13 years, and that a significant economic surplus is the more likely outcome.

www.dsto.defence.gov.au

DSTO has established a virtual reality laboratory known as the Future Operations Centre Analysis Laboratory (FOCAL) to investigate the effectiveness of advanced visualisation technologies in enhancing Australian Defence Force situational awareness, mission planning and decision making.

Credit: Images provided by DSTO
Geoscience Australia

Geoscience Australia is an Australian Government funded programme that enhances the potential for the community to gain economic, social and environmental benefits through geoscientific research and information. In 2004-05 Geoscience Australia received funding of $101.1 million.

Its activities are reflected in the level of global exploration industry investment in Australia, its contributions to resource management and in the information it generates to support regional development and environmental protection. Through its work on maritime boundaries, it helps establish and maintain Australia's sovereignty. The geomagnetic information and advice it provides helps maintain navigation standards for maritime transport and aviation industries, while its geohazards information helps communities better plan for natural and man-made hazards.

Achievements in 2003-04 include:

- A study of the petroleum geology of the Otway Basin, offshore Victoria and South Australia; a new assessment of the petroleum resource potential of the Browse Basin, offshore northwestern Australia; and the release of a new database (Australian Provinces) which captures our current understanding of the geology of all offshore petroleum basins.

- Improved geoscientific understanding of mineral potential and the controls on mineralisation, developed through studies in a number of regions across Australia.

- 210 topographic maps and associated digital data sets and satellite imagery products were completed for civilian and military purposes. These products are fundamental for resource management and regional development.

- A five-year strategic partnership with the Department of Transport and Regional Services to develop models and tools and a programme of data collection to deliver national risk assessments for hazards including earthquake, flood, severe wind (including hail and cyclones), storm surge and bushfire.

www.ga.gov.au

National Measurement Institute

The National Measurement Institute (NMI), part of the Department of Industry, Tourism and Resources, commenced on 1 July 2004. It provides a national centre for measurement in physics, chemistry and biology and national leadership of legal metrology. It brings together the CSIRO's National Measurement Laboratory, the National Standards Commission and the Australian Government Analytical Laboratories.

The NMI provides a more coordinated and efficient approach to supporting manufacturing and service industries. It is responsible for establishing and maintaining national standards of measurement and ensuring conformity, where appropriate, with international standards. Examples of NMI services include specialist chemical and biological measurement in the areas of forensic science, drugs in sport, food safety and the environment and calibration of measuring instruments.

www.measurement.gov.au

The Business Sector

Australian business expenditure on R&D (BERD) is low by OECD standards but is improving, with expenditure as a percentage of GDP growing at a faster rate than the OECD average over the last 20 years. Business expenditure on R&D in 2002-03 was nearly $6 billion, an increase of 20% over 2000-01 levels. This is the highest level ever recorded and is the third successive year of increase. In real terms BERD increased by 1.5% compared with 2001-02. Human resources devoted to R&D grew by 5.9% over 2001-02 to 32,982 person years in 2002-03.
New ideas and R&D are foundations of business growth. They can lead to new processes, products and outcomes with commercial value. The study, *Mapping Australian Science and Innovation*, reported that due to undertaking some form of R&D, 75% of firms reported a moderate to major impact over the past five years, and 95% expected a moderate to major impact on growth over the coming five years. Benefits are often felt outside of the enterprise.

R&D activity is greatest in the manufacturing sector. It contributes 13% of GDP but is responsible for 43% of BERD. The services and construction sector is increasing its share of BERD, currently 47%, but it falls short of its contribution to GDP, which is 77%. In some ways this is not surprising given that the manufacturing sector uses R&D to develop and improve its products and processes. The services sector focuses more on knowledge and skills and their use in business. The services and construction sector includes computer services, which is the industry with the highest R&D level.

Innovative firms strengthen the national innovation system by:

- encouraging innovation in their suppliers;
- bringing in new expertise and technologies;
- engaging with the research and education institutes; and
- generating new business opportunities, and jobs, profits.

Government incentives, such as the Tax Off Set and the 175% Tax Concession, play an important role in encouraging business expenditure on R&D. *Backing Australia’s Ability – Building Our Future through Science and Innovation* will continue to encourage growth in business expenditure on R&D.

**R&D Start**

R&D Start, available to all non-tax exempt Australian companies, provides grants and loans for competitive projects to develop new or improved materials, products, processes and services. In October 2004, R&D Start was replaced by Commercial Ready, an initiative announced in *Backing Australia’s Ability – Building Our Future through Science and Innovation*.

Core Start provided grants of up to 50% of eligible project costs for companies with annual group turnover of less than $50 million. Start Plus provided grants of up to 20% of eligible project costs for companies with an annual group turnover of $50 million or more. Start Premium was an additional repayable loan, which could top up either Core Start or Start Plus. Start Graduate provided grants to companies with a group annual turnover of less than $50 million to engage a graduate on a R&D project undertaken in collaboration with a research institution.

In 2003-04, 255 grant and loan applications were considered and 157 were approved to a value of more than $176 million. Another $5.5 million was approved to extend support for existing projects. An independent review in 2003, based on a comprehensive survey of Start recipients, indicated R&D Start generated significant levels of private and national benefits. The main economic impacts of programme funded R&D were:

- development of a new or better product, service or process;
- development of technology that reduced respondents’ costs;
- increased intellectual property; and
- increased opportunity to engage in new collaborative ventures.

It was estimated that for every dollar invested, the community receives benefits amounting to $4.50 in return.

www.ausindustry.gov.au
START GRANT HELPS PRODUCE IMPROVED ARTIFICIAL KNEE

A doctor used a $2 million grant from the Australian Government’s R&D Start to become Australia’s only producer of artificial knees.

In 1988, Greg Roger formed a partnership with the knee surgeon, Mervyn Cross, and with support from government research centres, universities and private industry began designing a better artificial knee.

Their first artificial knee was implanted in 1992, and is still working well. Of the first 1,000 knee operations, there has been less than a third of the failure rate regularly seen in other artificial knee procedures.

The artificial knee has also been exported to Europe and the United States.

Dr Roger was named as one of six winners of the 2004 Clunies Ross Awards, presented to Australian scientists and engineers who have ‘persisted with their ideas often against the odds to the point that their innovations are making a real difference’.

R&D Tax Concession

The R&D Tax Concession aims to increase the amount of business R&D being conducted in Australia. It has three elements:

- **125% Tax Concession** – deductions of up to 125% of eligible expenditure incurred on R&D activities from assessable income;

- **175% Premium Tax Concession** – higher level deduction for companies that have additional R&D expenditure above the previous three-year average; and

- **Tax Offset** – assists small companies, especially those in tax loss, who can not derive an immediate benefit from the 125% R&D tax concession.

Table 2: Registrants as at 30 June 2004 for 2002-03

<table>
<thead>
<tr>
<th>Registrants as at 30 June 2004</th>
<th>Company numbers</th>
<th>Reported R&amp;D expenditure (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total registrants</td>
<td>4981</td>
<td>5983.7</td>
</tr>
<tr>
<td>R&amp;D Tax Offset</td>
<td>1822</td>
<td>493.6</td>
</tr>
<tr>
<td>175% Premium</td>
<td>598</td>
<td>2395.9</td>
</tr>
<tr>
<td>Tax Offset and 175% Premium</td>
<td>147</td>
<td>61.5</td>
</tr>
</tbody>
</table>

Source: R&D Board Annual Report 2003-04 page 44
An evaluation of the programme in 2003 found the Tax Concession is effective in encouraging additional business investment in R&D. Key findings include:

- the main focus of R&D is on developing new and better products and reducing costs through process improvements;
- on average, firms expect that their R&D is highly novel or develops a platform technology that might spur innovations in other industries or applications;
- about 30% of respondents indicated their R&D built on R&D developments in other industries, and about a third obtained access to R&D by buying the intellectual property; and
- on average, most firms expect that a typical year’s R&D will contribute substantially to sales and profits five years after it is conducted.

*Backing Australia’s Ability – Building Our Future through Science and Innovation* provides an estimated $390 million over five years from 2006-07 to continue the new elements introduced by *Backing Australia’s Ability - An Innovation Action Plan for the Future:* the Tax Offset; the 175% Premium R&D Tax Concession and effective life treatment for R&D plant. This funding is in addition to the tax expenditure on the 125% R&D Tax Concession, which is up to $360 million per year (2006-07 estimate).

www.ausindustry.gov.au

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**LEADING THE WORLD IN LOW-COST PRODUCTION**

What do paint, plastics, paper, toothpaste and cosmetics have in common? Apart from being common household products, they all contain titanium pigment – and if they were produced here in Australia, there’s a 40% chance it came from Millennium Inorganic Chemicals.

Millennium Inorganic Chemicals began operations in 1996, taking over a long-established titanium plant at Australind near Bunbury in south-west Western Australia. Today, there are 450 employees, 50 based overseas, and a very successful Chinese office established in 1999.

As an export-focused company operating in a highly competitive global market, the Australian Government’s R&D Tax Concession scheme helped Millennium Inorganic Chemicals maintain its competitive edge and helped mitigate risk and facilitate research projects that otherwise would not have gone ahead.

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**The Rural R&D Corporations**

Rural R&D Corporations (RDCs) are a unique partnership between industry and government to invest in R&D to advance the interests of industry as well as the wider community.

RDC investment in rural innovation was $454 million in 2002-03. A similar figure is expected in 2003-04, but in future years the recent drought is expected to reduce the flow of industry R&D levies and the associated Australian Government’s matching dollars. Emphasis is on the delivery of R&D outcomes that have a practical application.

Adoption of new technologies delivered by R&D has improved productivity. This was demonstrated in the dairy industry, where the Australian Bureau of Agricultural and Resource Economics found that over the period of 1991-92 to 2001-02, the volume of milk produced per cow has increased by about 25%, while the volume of milk produced per dairy hectare has gone up by 60%. The production per week of farm labour also rose 60% over the same period.
R&D has also contributed to the establishment of new industries. For example, southern blue fin tuna have only been farmed since 1991 and several health and nutrition issues needed to be addressed through R&D to make the enterprise successful. The farm gate value of southern blue fin tuna increased from zero in 1991 to $256 million in 2002-03.

Not only is agricultural R&D expected to deliver obvious economic and environmental benefits, but it is also expected to provide broader, positive social outcomes for the wider community. In the broad area of public benefits, the RDCs have been particularly active in the areas of diet and nutrition and food safety, the former issues being especially relevant because of the increasing incidence of obesity.

For example, Meat and Livestock Australia’s red meat and human nutrition R&D programme explores how protein in the diet may benefit weight management and cardiovascular health and lower the risk of diabetes.

Horticulture Australia has also researched and promoted the benefits of fruit, nuts and vegetables in the diet. Horticulture Australia is also part of a group in Australia and New Zealand that is undertaking a $20-million research project, Vital Vegetables®, to create vegetables with an increased concentration of antioxidants and other health promoting compounds in certain vegetables, to make the body better able to fight cancer.

More information including further case studies is available in the publication Innovating Rural Australia 2003, which is available at www.daff.gov.au

HELPING THE FISHING INDUSTRY UNDERSTAND TASMANIAN ROCK LOBSTER BREEDING HABITS

Satellite tracking, computer models and biological research have helped discover the breeding habits of the Tasmanian rock lobster and are ensuring the fishing industry understands the need to protect breeding stock.

The Fisheries Research and Development Corporation and its partners in the Tasmanian Aquaculture and Fisheries Institute and CSIRO have provided valuable information about where rock lobster larvae go. This information is being used by regulators and the fishing industry to protect against overfishing.

It was wrongly believed that when rock lobster spawned off the coast of Tasmania there was little impact on subsequent local stock because ocean currents carried the young far away.

Scientists, using satellite tracking, computers models and improved understanding of larval biology and recruitment, were able to show that eddies in the ocean systems adjacent to Tasmania could trap larvae for a sufficient time for them to go through their 11 different life stages, and finally swim ashore as young lobsters to start the cycle again where their parents began it.

This convinced fishers that protecting breeding stock wherever they occurred was paramount for a productive fishery. No longer do fishers believe that they are protecting stock just to see the larvae washed away to benefit others.
Green ants, native to northern Australia, are replacing insecticide in the battle against pests in Northern Territory cashew plantations.

They not only reduce costs through reduced chemical use but also promote yields and quality, due to the behaviour of the ants in “cleaning and polishing” the nuts prior to harvest. Young nuts continuously secrete nectar, which is taken away by green ants, leaving clean and shining nuts. Trees protected by insecticide spray develop a black residue on the nuts due to the growth of fungus, leaving a sooty mould and look dull.

Trees protected by transplanted ant colonies produced yields of 861 kilograms an acre each year more cashew nuts than trees protected by insecticides. The ants are proving so effective against the major cashew pests that they could save growers about $1,500 a hectare each year.

Food Centres of Excellence

The Food Centres of Excellence programme is an initiative under the National Food Industry Strategy (NFIS). The programme is delivered by industry-led company NFIS Ltd, with the Australian Government providing $12.4 million over five years to June 2007. The programme will help establish Australia as an international centre of excellence in food industry innovation, leading to greater investment and employment by Australian based food businesses.

Two centres have been established: the National Centre of Excellence in Functional Foods (NFIS contribution $5.5 million over five years) and the Australian Food Safety Centre (NFIS contribution $4.5 million over five years). The centres, now in their second year of operation, are developing links with food businesses to increase commercialisation outcomes, investment and employment.

Each of the centres is a consortium of Australian based R&D organisations. Their partners include the Smart Foods Centre, University of Wollongong; Food Science Australia; CSIRO Health Sciences and Nutrition; Department of Primary Industries, Victoria; and the Tasmanian Institute of Agricultural Science, University of Tasmania. Core members (Australian Food Safety Centre) are: Dairy Australia; Grains Research and Development Corporation; Meat and Livestock Australia; OzFood Net; Rural Industries Research and Development Corporation; Seafood Services Australia; Tasmanian Government Department of Primary Industries, Water and Environment; and Victorian Department of Primary Industry.

www.nceff.com.au

www.foodsafetycentre.com.au

Food Innovation Grants Programme

The Food Innovation Grants (FIG) Programme is an initiative under the National Food Industry Strategy and aims to increase innovation by the food industry. FIG is delivered by NFIS Ltd, with the Australian Government allocating $34.7 million to FIG over the five years to June 2007. The focus of the programme is to gain commercial results from R&D and innovation. Projects funded involve technical R&D to resolve a scientific or technical challenge for the food industry in Australia, with commercial uptake by food businesses. FIG provides competitive, merit-based grants on a dollar-for-dollar funding basis for up to half the eligible project costs to food businesses. In 2003-04, total new projects valued at $30.5 million were funded with FIG committing $10.6 million.
Market outcomes can be seen in the first projects to be completed under the programme. Two of the completed projects have already received customer orders for their new products: Dover Fisheries’ new glass-like, retortable plastic container for abalone and Dorrian Farms’ new mechanised production of dice-and-paste avocado products.

www.nfis.com.au

**AUSTRALIA’S FIRST ANTIOXIDANT ENRICHED ICE CREAM CONTAINING VINLIFE®**

Vinlife®, natural grape skin and seed extracts, manufactured by Tarac Technologies and made from Australian wine grapes, are being commercialised globally as functional food and beverage ingredients with scientifically proven heart health benefits.

Tarac is building on its base as a major manufacturer and supplier of grape alcohol and tartaric acid to become a R&D company with leading edge technologies associated with grape derived bio-actives. To date, the company has invested approximately $5 million on research and business development. As far as the company is aware, Vinlife® is the only grape seed extract that has been clinically proven to have heart health benefits, in food, using controlled human clinical studies. This research culminated in the launch of the Vinlife® brand.

Vinlife® was successfully commercialised in Australia in January 2004 with its incorporation into Wendy’s 99% fat free Chocollo® soft serve ice cream. Wendy’s used Vinlife® to strengthen the marketing proposition of its Heart Foundation endorsed Chocollo® product and has subsequently launched in New Zealand during August 2004. Tarac is now focusing on expediting sales in international markets.

Having obtained the maximum grant amount in the first round of the Food Innovation Grants totalling $1.5 million, Tarac will continue to invest in the research and development of grape bio-actives in collaboration with CSIRO Health Sciences and Nutrition, University of Adelaide and other research providers.

Vinlife® is important in making Wendy’s Heart Foundation endorsed 99% fat free Chocollo® even healthier

Credit: Image supplied by Tarac Technologies
World Class Centres of Excellence – ICT: National ICT Australia

The National Information and Communications Technology Australia (NICTA) Centre of Excellence was established in October 2002 as the ICT cornerstone of Backing Australia’s Ability. Australian Government funding of $129.5 million was allocated for its first five years of operation to 2005-06.

The programme aims to:

- develop world-class ICT research capabilities in existing and emerging fields;
- increase ICT research skills by providing postgraduate training and attracting researchers from overseas;
- exploit for Australia’s benefit the commercial potential of research outputs; and
- be a catalyst for the development of networks and clusters of ICT industry networks.

NICTA completed its first full year of operation in December 2003. At 30 June 2004 NICTA had 192 staff, of which 51 were contributed researchers from the University of NSW and the Australian National University. NICTA had 14 active research programmes and three under development at the Melbourne Laboratory. Up to 108 research students are supported by NICTA through scholarship support and supervision provided by NICTA researchers. It is currently undergoing the rapid growth necessary to achieve world-scale capacity in 2006 when it expects to have more than 260 researchers, 17 research programmes and 100 PhD students.

Under Backing Australia’s Ability – Building Our Future through Science and Innovation, the Australian Government committed an additional $251 million for NICTA’s second phase of operations to 2010-11.

NICTA is becoming a leader in Australia’s ICT research community and is actively involved with Australia’s major public and private research centres and universities, as well as with international counterparts in the US, Europe and Asia.

The organisation will also establish links with small and medium-sized enterprises so they can become familiar with its research activity. Research collaboration includes activities with DSTO, the Smart Internet Cooperative Research Centre on Pervasive Networking and activities with the CSIRO.

NICTA’s research has a strong international focus and its mission is to build a global presence for Australia. International activities include collaborative projects under the first round of the European Union (EU) 6th Framework with Ericsson, Nokia, Siemens and Alcatel, and the second round of the EU 6th Framework, which includes collaborative activities with France Telecom and Juniper, Ericsson, Daimler Benz and UC Berkeley.

www.nicta.com.au

www.dcita.gov.au/ictcoe
Initiatives for a Dynamic National Innovation System

Chapter Two – World Class Centres of Excellence – Biotechnology: Australian Stem Cell Centre

The Biotechnology Centre of Excellence, the Australian Stem Cell Centre (ASCC), is the flagship biotechnology initiative of Backing Australia’s Ability. The ASCC initially received $43.5 million over four years from the Department of Industry, Tourism and Resources and the Australian Research Council. In May 2004 the Australian Government announced it would provide a further $55 million to 2010-11 through Backing Australia’s Ability – Building Our Future through Science and Innovation. The Centre will also receive $5.5 million from the Department of Education, Science and Training’s Major National Research Facility Programme, as well as $11.4 million from the Victorian Government for infrastructure development.

The ASCC has signed a Stakeholder Agreement with Monash University, the University of Adelaide, the University of New South Wales, the University of Queensland, Howard Florey Institute, the Peter MacCallum Cancer Centre, the Victor Chang Cardiac Research Institute and the Murdoch Children’s Research Institute.

It is pursuing national and international commercial collaborations and has a licence agreement with the United States biotechnology company LifeCell Corp to acquire certain enabling rights to tissue matrix technology. ASCC has also announced plans to collaborate with the Melbourne-based company Stem Cell Sciences Ltd to develop and distribute new human embryonic stem cell lines.

www.nscc.edu.au/ascc_home.html
www.biotechnology.gov.au

BOOST FOR AUSTRALIAN RESEARCH COMMUNITY AND ENTERPRISE COMPUTING

The Centre for Advanced Studies, established by computer company IBM in Sydney in April 2003, will provide Australian-based researchers with access to the company’s worldwide research resources, and ensure Australia remains at the forefront of ICT innovation.

One of the first projects under the initiative is collaboration on open source software with the Australian Government’s ICT Centre of Excellence, National ICT Australia, at the University of New South Wales. Seconded university staff, as well as PhD and Honours students, are focusing on increasing the performance of open source software like Linux.

The Centre of Advanced Studies is the first of its kind outside North America. IBM’s 15 existing research relationships and projects in Australia will now come under the Centre programme.

The Centre demonstrates the importance of R&D and how collaboration between government, research communities and industry can create opportunities to enhance innovation and business transformation.

Top: NICTA’s Empirical Software Engineering Program
Bottom: Graph Visualisation in 3D
Credit: Images supplied by NICTA
The Australian Government launched the National Biotechnology Strategy (NBS) in 2000 to provide a framework for capturing the benefits of biotechnology for Australia, while protecting the safety of people and the environment. The government provided $30.5 million in 2000 for NBS activities. This funding supported Biotechnology Australia (BA) initiatives, providing coordination for the Australian Government’s non-regulatory biotechnology policy across five Departments (industry, agriculture, environment, education and science, and health). BA’s key activities are:

- Management of key activities under the NBS, including a Public Awareness Program to provide the public with credible and balanced information about biotechnology issues.
- Collaborative work with States and Territories on biotechnology.
- Secretariat support for the Australian Government Biotechnology Ministerial Council, the Australian Biotechnology Advisory Council (a group of experts who provide independent advice to the Government on biotechnology issues), the Biotechnology Liaison Committee (comprising Australian Government, State and Territory officials) and meetings of BA partner departments.

The 2000 funding also included support for addressing industry issues (i.e. IP management and environmental risk) and the establishment of the $20 million Biotechnology Innovation Fund (BIF). An additional $20 million was announced for BIF in 2001 under the initial Backing Australia’s Ability package.

An evaluation of the effectiveness of the NBS and BA was undertaken in 2003-04.

In May 2004 announcements under Backing Australia’s Ability – Building Our Future through Science and Innovation included on-going funding to the NBS and BA of $20 million until 2007-08. The funding will enable BA to build on the outcomes of the 2003 evaluation through its broad range of activities across BA partners and through its two work units – the Strategy & Coordination Section and the Communication & Public Awareness Section.

Significant achievements in 2003-04 include:

- completing the evaluation of the NBS and BA, with a report to the Biotechnology Ministerial Council;
- securing funding in the 2004 Budget for ongoing activities under the NBS and BA for a further four years;
- a major meeting of Premiers and Ministers at the BIO 2004 Conference in June 2004 which reached agreement on a way forward for all jurisdictions to assist in the development of a more national approach to biotechnology; and
- continued effectiveness of BA’s public awareness program.
The University Sector

Universities play an important role in the innovation system by strengthening and maintaining Australia’s knowledge base and research capabilities, through the development of an effective research and research training system. The Australian Government provides funding for research in the sector and funding to support the research undertaken by the sector.

The Government’s Knowledge and Innovation: A policy statement on research and research training, resulted in major changes to how higher education research was funded. Two major outcomes from the statement were:

- a strengthened Australian Research Council and an invigorated national competitive grants system; and
- performance-based funding for research training and research activity in universities with allocative formulae.

This approach was designed to encourage institutions to be more flexible and responsive in developing a strategic portfolio of research activities and training programmes, and to secure the benefits of the achievements of individual researchers and teams.

Australia’s higher education expenditure on R&D in 2002 was $3.4 billion, representing an increase of 22.9% over the year 2000 expenditure. Funding of R&D in the higher education sector from business rose by 27.8% to $174 million in the same period.
Australia’s higher education R&D expenditure (HERD) represented 0.45% of GDP in 2002, compared to 0.41% for both the OECD as a whole and the EU-15. Australia’s HERD as a percentage of GDP surpassed the averages for the OECD as a whole and the EU-15 in the early 1990s. It has grown by 0.09 percentage points since 1981, compared with an increase of 0.06 percentage points for both the OECD as a whole and the EU-15 over the same period.

The major fields of research by higher education organisations were medical and health sciences ($375 million or 10.9%) and agricultural, veterinary and environmental sciences ($235 million or 6.9%). The proportion of R&D expenditure directed towards pure basic research and strategic basic research has decreased slightly since 2000, with pure basic research down from 30.0% to 28.4% and strategic basic research down from 23.9% to 23.4%. Applied research has increased from 38.5% to 40.6%.

**Funding for Research**

**Australian Research Council**

The Australian Research Council (ARC) advises the Australian Government on investment in national research. Under the National Competitive Grants Programme (NCGP), it supports research and research training through open competition in the sciences, social sciences and humanities. It facilitates collaboration between Australian researchers and industry, government and community organisations, and the international research community.

The ARC received an additional $736.4 million over five years, under *Backing Australia’s Ability – An Innovation Action Plan for the Future*, to double the funding for the NCGP by 2005-06. As part of the 2004 *Backing Australia’s Ability – Building Our Future through Science and Innovation* package the Australian Government announced that it would provide an additional $1,189.2 million to maintain the funding level achieved. This is in addition to the supplementary funding of $275 million for 2006-07 announced in the 2003-04 Budget. In total the ARC received $2,200.6 million under *Backing Australia’s Ability*.

In 2004, the ARC and the NHMRC worked together to encourage and fund research in new and emerging fields of health and medical research. The ARC also established a new Research Networks funding scheme to encourage collaborative approaches to research in inter-disciplinary settings.
A recent evaluation found that the ARC reacts appropriately, effectively and efficiently to developments in government innovation policy, and that it is active in adapting its programmes to match the Australian Government’s overall innovation goals. Another study found that the returns from investment in ARC-funded research are high in absolute terms, while a study focusing on the impact of publications found that ARC-supported research performed strongly.

The National Competitive Grants Programme

The National Competitive Grants Programme (NCGP) supports high-quality research, collaborative links, high-quality research training, and acquisition and access to equipment and facilities. As mentioned above, peak level funding reached under Backing Australia’s Ability will be maintained under Backing Australia’s Ability – Building Our Future through Science and Innovation. Aspects of the NCGP are:

- **Discovery Projects** fund small single projects to clusters of larger projects. There were 3,240 applications for funding commencing in 2004, of which 875 were successful. The average size of Discovery research grants has risen from just under $179,000 in 2001 to almost $272,000 in 2004.

- **Linkage Projects** support collaborative projects between higher education researchers and industry. Across the two rounds of applications for funding commencing in 2004, the ARC is supporting 532 new collaborative research projects and awards worth $119.9 million over five years. This investment will attract $164.0 million in matching contributions from 939 partner organisations. The average size of Linkage research grants is now $225,000.

- **Linkage Infrastructure** supports collaborative development of large-scale research infrastructure by universities and other research organisations. In the 2004 new funding round the ARC received 147 applications for funding, of which 75 were approved. The ARC’s funding commitment to these projects is $28.2 million.

- **Federation Fellowships** have proven successful in attracting world-class expatriate researchers and foreign nationals to Australia. Of the 25 fellowships awarded in 2004, 10 are to expatriate Australians and five are to foreign nationals.

- **Research Centres** include the co-funded Centres of Excellence (the Australian Centre for Plant Functional Genomics, National ICT Australia, and the Australian Stem Cell Centre), ARC Centres of Excellence, ARC Centres, Special Research Centres and Key Centres of Teaching and Research. In 2003 the ARC established eight new ARC Centres of Excellence and nine new ARC Centres in areas of National Research Priority.

In the relatively short time between commencement of research and the provision of the final report required by the ARC, many projects have advanced to the point where commercial activities are being undertaken. For example, development of a prototype monitor to help detect jaundice in newborn infants resulted in a licence agreement with Flinders Medical Centre and Helicon Technology, while research conducted by Professor Stuart Crozier resulted in patents in the field of magnetic resonance imaging.

www.arc.gov.au
Australia's hypersonic scramjet engine will be flight tested in 2005 at speeds that, if applied to aircraft, could radically cut the time of long distance air travel. Sydney to London, for example, would take only a couple of hours.

With Australian Research Council funding of $1.8 million, Professor Allan Paull and his team at the Centre for Hypersonics at The University of Queensland are pushing research boundaries in the area of high-speed travel.

The team will test new concepts expected to lead to greater flexibility in operational engines and work speeds in excess of 3,000 metres a second. Flight testing negotiations with several international agencies are in progress.

Hypersonics is a growing area of research in Australia, attracting investment from international agencies and companies. Australia is a world leader in scramjets, launching the first-ever successful test flight in 2002. NASA has an edge in flight control and scramjet development at the lower Mach numbers (the ratio between the airspeed of an object and the speed of sound), but Australia has the edge at higher Mach speeds.

Australian scientists are reinventing road transport and making driving safer.

The Australian National University and spin-off company Seeing Machines Pty Ltd are using Australian Research Council funding of $280,000 to develop intelligent vehicles. Seeing Machines has won major international contracts with companies like Volvo.

Lane departure and driver fatigue warning, as well as automatic lane-following functions, are already in place in some prototype and test vehicles. A more sophisticated function is the adaptive cruise control, which combines the function of standard cruise control with an inbuilt sensor to determine distance from other vehicles so that, even if the control is set to 100 kph for example, a slower vehicle in front will cause the speed to drop to a safe level.
Funding to Support Research

Research Infrastructure Block Grant Scheme

The primary objective of the Research Infrastructure Block Grant (RIBG) Scheme is to enhance the development and maintenance of research infrastructure in higher education institutions by meeting the project-related infrastructure costs associated with Australian Competitive Grants. The RIBG allocation to institutions is formula-driven with allocations reflecting the relative success of each institution in attracting competitive research funds.

The level of infrastructure support provided through RIBG during 2003 was approximately 20 cents in the competitive research dollar. In calendar year terms, RIBG funding rose from $136.7 million in 2003 to $160.3 million in 2004.

The funding mechanism for RIBG was examined as part of the Evaluation of the Knowledge and Innovation Reforms. Through Backing Australia’s Ability – Building Our Future through Science and Innovation the Australian Government provided an additional $554.5 million to RIBG between 2006-07 and 2010-11 to maintain the Scheme at 20 cents for each dollar of Australian competitive research grant income.


Institutional Grants Scheme

The Institutional Grants Scheme (IGS) maintains and strengthens Australia’s knowledge base and research capabilities by developing an effective higher education research and research training system. Institutions have discretion in the way they spend their IGS allocation.

IGS funding rose from $277.6 million in 2003 to $284.6 million in 2004.


Health and Medical Research

Significant improvements in our quality of life have resulted from health and medical research. This research not only improves health and quality of life, it also contributes to economic growth and prosperity through developing new products, new business enterprises and new jobs. Organisations which perform health and medical research include medical research institutes, universities, hospitals, pharmaceutical companies, biotechnology enterprises, research consortia, government agencies and health interest groups.

Much of the research is funded through Australian Government grants administered by the National Health and Medical Research Council (NHMRC) and the ARC. State governments provide funds to public hospitals and infrastructure, as well as grants to medical research institutes and universities which also support research. Pharmaceutical companies contribute through sponsoring clinical trials and by funding their own R&D programmes.

Australian Government funding for health and medical research has been increased recently. The Australian Government responded to the recommendations in the 1999 review of health and medical research, The Virtuous Cycle: Working Together for Health and Medical Research by doubling the funding provided to the NHMRC for research over the following five years through the injection of $614 million.

In 2002-03 Australia spent $1.8 billion on health R&D, amounting to 0.25% of GDP. Over 50% of the expenditure occurred in the higher education sector.
National Health and Medical Research Council

The National Health and Medical Research Council (NHMRC) is responsible for developing standards, fostering research and training, and considering ethical issues relating to health and medical research. Recent studies state that research outcomes from NHMRC support are achieving high impact, reaching international standards, and publications have a very strong citation performance.

In 2004-05 the Australian Government allocated $427 million to the NHMRC for health and medical research projects.

During 2003-04:

- $169 million was provided to 415 projects (including 27 new investigator grants valued at $8 million and seven Aboriginal and Torres Strait Islander grants worth $4.3 million) and $76 million to 11 Program grants;
- 35 expressions of interest were received for funding for new Aboriginal and Torres Strait Islander research: *A Healthy Start to Life* initiative. The research aims to improve the maternal, infant and childhood health of Aboriginal and Torres Strait Islander people by providing $7 million over five years to better understand how health programmes can be more effective;
- enabling Grants were established to strengthen the research base in areas of strategic importance. The focus of the first round is Special Facilities providing or supplying access to DNA, cell, tissue, organ banks, computer networks, specialised registers and databases. The focus for the second round will be clinical trials resources. Approximately $15 million over five years has been allocated for each round;
- a national consortium was funded to develop a test for severe acute respiratory syndrome (SARS) tailored to Australian requirements; and
- the first Australian licences allowing research using excess Assisted Reproductive Technology (ART) embryos were issued.

The Council awarded 163 scholarships ($9.9 million), including 12 for biomedical and medical post-graduates ($7 million), 62 Research Fellowships ($35.6 million), 10 Practitioner Fellowships ($3.4 million) and 38 Career Development Awards ($15.9 million).

Community consultations were conducted on understanding ethic guidelines, research into xenotransplantation and on the impact of privacy regulation. The Aboriginal and Torres Strait Islander health research forum was also established to coordinate and align all NHMRC activities in this priority area.

Eleven new awards valued at $29 million over five years addressing significant health problems in the Asia-Pacific region were announced in mid 2003. The projects are jointly funded by NHMRC with the United Kingdom based Welcome Trust and the New Zealand’s Health Research Council. This is the first time that the Trust has joined with governments outside of the UK to fund a specific programme. Funding has also been provided for Australian and European scientists to work together.

www.nhmrc.gov.au
Chapter Two – Initiatives for a Dynamic National Innovation System

Major Research Infrastructure

Australia’s capacity for science and innovation is strongly linked to its research infrastructure. To perform excellent research and to be able to innovate, scientists, engineers and technologists need access to world-class infrastructure, both in Australia and overseas, including facilities, equipment and instrumentation, computers and the latest developments in knowledge.

Infrastructure can consist of:

- research facilities and equipment and the buildings that house them;
- libraries and mechanisms for accessing knowledge;
- ICT networks and equipment used for research purposes;
- collections and archives; and
- large complex data sets.

Backing Australia’s Ability – An Innovation Action Plan for the Future was instrumental in helping Australia put in place world-class ICT infrastructure for research. Significant advances have been made in developing an advanced broadband network, distributed high performance computing capacity, accessible data and information repositories, agreed ICT standards and coordinated development of middleware.

One of the Australian Government’s priorities under Backing Australia’s Ability – Building Our Future through Science and Innovation is to fund collaborative research infrastructure proposals. This is in addition to financing research infrastructure in universities and research agencies. This approach builds and advances the approach taken in the first Backing Australia’s Ability announcement.

Researchers from the Mental Health Research Institute (MHRI) in Melbourne are unraveling the mystery of schizophrenia by identifying a number of genes that may cause the disorder.

With National Health and Medical Research Council funding of $553,000, the researchers from the Rebecca L. Cooper Research Laboratories at the Mental Health Research Institute in Melbourne examined tissue from brains obtained post mortem from people with schizophrenia. They identified 69 genes whose levels of expression were changed in the brains of subjects with the disorder.

This research will lead to better treatment for the disorder, which ranks in the top five lifetime disability disorders according to the World Health Organization, with substantial social and economic costs to society.

The team, headed by Associate Professor Brian Dean and including postgraduate students from the University of Melbourne, has been awarded $1 million from the American National Institute of Health to expand its study from 12,000 to more than 25,000 discrete genes.

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National Collaborative Research Infrastructure Strategy

The National Collaborative Research Infrastructure Strategy (NCRIS) was announced under Backing Australia’s Ability – Building Our Future through Science and Innovation. The Strategy will provide $542 million over seven years (2004-05 to 2010-11) to provide researchers with major research facilities and the supporting infrastructure and networks necessary for world-class research.

Amongst its key objectives, NCRIS is aiming to link infrastructure funding more directly to the National Research Priorities, foster greater research collaboration and develop a more strategic approach to Australia’s involvement in international science infrastructure collaborations. NCRIS follows, and builds on, the major programme of investments provided through the Systemic Infrastructure Initiative and the Major National Research Facilities programme.

Development work on NCRIS is currently underway. It is anticipated that formal programme guidelines will be issued in around mid 2005, followed by a process to identify infrastructure priorities and funding proposals. The Government has appointed a high level Advisory Committee, to be chaired by Professor Rory Hume, to advise on the development of NCRIS.

Health and Medical Research – Independent Research Institute Infrastructure Scheme

Backing Australia’s Ability – Building Our Future through Science and Innovation included the provision of $200 million over the next seven years for the overhead infrastructure costs for independent medical research institutes. The funding will assist independent medical research institutes that administer NHMRC funding with overhead infrastructure costs, by providing up to 20 cents for every dollar competitively provided for research by the NHMRC. This funding is consistent with that already provided to universities through the Research Infrastructure Block Grants Scheme (RIBG).

Major National Research Facilities Programme

The Major National Research Facilities (MNRF) Programme increases research opportunities by providing better access to world-class facilities. The programme is designed to retain Australian research expertise, attract overseas researchers and firms to Australia and support commercialisation of results. Under Backing Australia’s Ability the programme received funding of over $150 million over five years to 2005-06. Fifteen specialised world-class facilities are being funded.

Achievements in 2003-04 include:

- ongoing training programmes that support postgraduate students and researchers. For example, the Australian Synchrotron Research Programme Fellowship scheme helped eight people develop their skills overseas;
- launch of the National Neuroscience Facility and the Australian Proteome Analysis Facility;
- overseas and national collaboration. For example the Australian Computational Earth Systems Simulator established a significant number of overseas alliances in their first year, while in June 2004 the Australian Genome Research Facility and the National Human Genome Research Institute in the United States announced they would jointly map the genome sequence of the Tammar wallaby; and
- scientists at the ANU-based project of the Gemini and SKA Facility have linked with a small Australian company to rebuild instruments being designed and built for the Gemini Observatory. The instruments were destroyed in the 2003 Canberra bushfires.

www.dest.gov.au/MNRF/
The National Neuroscience Facility (NNF) recently launched its newest technology platform, the Integrative Neuroscience Facility (INF).

The $4.1 million facility provides comprehensive phenotyping services for behavioural, anatomical, physiological and pharmacological assessments of animal models. The service provides for neurobiological and psychological research and pre-clinical drug testing for industry.

The INF is currently working in collaboration with the major pharmaceutical company Schering AG (Germany), and local Australian biotechnology company Prana Biotechnology Ltd. This work offers hope to patients with degenerative disorders such as Alzheimer’s disease, stroke and Parkinson’s disease.

The INF is one of eight research platforms of the National Neuroscience Facility (NNF), created through the Australian Government’s Major National Research Facilities programme.

www.nnf.com.au

Systemic Infrastructure Initiative

Through the Systemic Infrastructure Initiative (SII), part of Backing Australia’s Ability – An Innovation Action Plan for the Future, the Australian Government is providing $246 million from 2002 to 2006 for infrastructure to support world-class research and research training at Australian universities.

SII funds have been directed to key areas including high-speed communications links and broadband as well as facilitating discovery, access and dissemination of scholarly information.

The $80 million invested by the Australian Government in high-speed communication links and access to broadband has been bolstered by co-investment from universities, CSIRO and State and Territory governments. The outcome has been the development of communications capacity for Australian researchers of a standard that is comparable to the advanced research networks in North America and Europe.

A further $22 million has been provided to support information management and access in Australian universities. This infrastructure will position Australian universities at the forefront of developments in managing the outputs of research in the digital environment.

Philanthropy

Comprehensive surveys on philanthropic activities are carried out very intermittently, therefore obtaining accurate statistical data on the level of philanthropy occurring in Australia is problematic. Philanthropy Australia estimates that there are at least 2,000 trusts and foundations in Australia, which disperse between half a billion and $1 billion a year.

The Government encourages philanthropic activities through mechanisms such as tax incentives.

Prime Minister’s Community Business Partnership

The Prime Minister’s Community Business Partnership is a group of prominent Australians from the community and business sectors that provides advice and promotes a culture of individual and corporate social responsibility. The partnership examines mechanisms for increasing the level of philanthropy, including for innovation in business and industry.

www.partnerships.gov.au

Science and Innovation in Foreign Aid

Australia works with other governments, the United Nations, Australian companies and non-government organisations to design and set-up projects which tackle the causes and consequences of poverty in developing countries. Our aid programmes reach more than 58 million people around the world each year, with most activities taking place in the Asia-Pacific region.

Australian Centre for International Agricultural Research

The Australian Centre for International Agricultural Research (ACIAR) operates as part of Australia’s international development cooperation programme. In 2004-05 the Australian Government allocated the Centre $47.5 million. ACIAR aims to reduce poverty and improve livelihoods through more productive and sustainable agricultural systems in developing countries. It plans, funds and manages collaborative agricultural research and development projects in the areas of crop and livestock sciences, capture and culture fisheries, forestry, land and water resources and postharvest technology. ACIAR is also involved with economic and policy issues associated with sustainable management of farming systems and natural resources. The projects are designed to meet partner country priorities in areas where Australia has special research competence. ACIAR also communicates the results of the research it supports, funds training related to its research programmes and administers Australia’s contribution to the International Agricultural Research Centres.

Activities during 2003-04 included:

- **Knowledge creation** - ACIAR funded 192 bilateral agricultural research projects, all of which delivered new knowledge in Australia and overseas partner countries. ACIAR published and distributed 20 new titles in its scientific series (four monographs, six proceedings, six technical reports and four working papers), and two reports in its impact assessment series. These works included syntheses from past ACIAR-funded projects and programmes of work as well as reviews of subject matter to complement current and future work.

- **Human capacity** - ACIAR’s training programme covers postgraduate fellowships, research management training, short-term cross-discipline training courses for personnel working on ACIAR projects and training courses through the Australian Academy of Technological Sciences and Engineering Crawford Fund. During 2003-04, 50 fellowship holders from 15 countries pursued higher degree studies in Australia. Six graduates received small grants for follow-on research in their home countries. Three outstanding mid-career agricultural scientists participated in a customised six-week career development programme. ACIAR organised a four-week training programme for

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2 www.philanthropy.org.au
20 African agricultural scientists under the African Regional Agriculture and Training Initiative. The group learned from Australian experts on dry land salinity, biodiversity and semi-arid landscape and farming systems management.

- **Knowledge diffusion and awareness** - ACIAR’s website is the major means of disseminating its publications and information. During 2003-04 more than 70 summaries of the outcomes of concluded projects were published on the site, which also includes progress reports of active projects. The ACIAR magazine *Partners in Research for Development* was relaunched with a fresh look. Each issue includes stories on a selection of projects grouped thematically around specific agricultural issues and countries. The former *Postharvest Newsletter* was also relaunched as the electronic news bulletin *Linking Farmers to Markets*.

- **Collaboration** - all ACIAR projects involve collaboration between publicly-funded research institutions in Australia and overseas. About 20% of projects include collaboration with non-government organisations in Australia or abroad and a smaller number include industry organisations and other private partners.

- ACIAR funds public good research. In several cases a new vaccine or test kit for detection of disease has been commercialised by research partners.

In 2004-05 a similar range of activities relevant to National Research Priorities is planned.

www.aciar.gov.au
Australian and Chinese agricultural scientists are working together to overcome soil loss, salinity and acidity through a $1.3 million project that involves crop rotation trials in both countries.

The five-year project involves the University of Adelaide, NSW Agriculture, the Agricultural Production Systems Research Unit within CSIRO Sustainable Ecosystems, and two institutes in Gansu Province, China.

Scientists are investigating tillage and cropping systems to reduce erosion, improve soil fertility and increase economic returns from wheat-based cropping through better utilisation of available resources. The project sites are in eastern Gansu Province and areas around Wagga Wagga in southern NSW and Roseworthy and the southern Yorke Peninsula in SA.

In one component, researchers are looking at ways of including lucerne (a deep-rooted, high water use, perennial forage plant) in farming systems traditionally based on annual crop and pasture plants (shallow-rooted, low water use, short growing season). The issue is water balance in areas with highly variable climates. In Gansu and South Australia, the scientists have just begun using the modelling tool APSIM (Agricultural Production Systems sIMulator), a tool that is useful in integrating climate, soil, crop and pasture information, in their work with farmers, to learn together about managing their farms for increased productivity and sustainability.

Adoption of this new practice is a major change for local grain farmers, with implications for farm enterprise mix (crop versus livestock), choice of crop and pasture rotation sequence, and overall profitability.
PART TWO – Accelerating the Commercial Application of Ideas

Commercialisation is a crucial part of innovation and very important to the research world. It is the process of going from minds to markets and generating economic outcomes. It is therefore an important pathway for the national research effort to deliver tangible and ongoing benefits for society at large, including industry.

Commercialisation involves three key factors:

- demand for ideas and inventions that can be turned into marketable products and services;
- supply of high quality and relevant research that responds to that demand; and
- financial investment in the identification, protection and exploitation of ideas and inventions that have potential value in the marketplace.

When commercialisation works well, these factors work together to help drive ideas to market.

For industry, new ideas and inventions stimulate the business development process. This helps to establish and maintain competitive advantage in anticipating and meeting market needs and opportunities. For researchers, bringing ideas and inventions to market in a timely and effective manner helps realise the relevance and value of that research. It is therefore important for researchers and research institutions to build strong, ongoing connections with industry and investors who can help bring ideas, inventions and innovations to market.

The package, *Backing Australia’s Ability - Building Our Future through Science and Innovation*, increases the emphasis on commercialisation through a range of programmes targeted at supporting businesses and research institutions as they take the results of research and transform them into marketable products, services and processes.

Highlights in 2003-04 included:

- Developments supported under the Renewable Energy Equity Fund include wind generation, a hybrid energy storage system for use in waste collection vehicles, long-life batteries for use in remote and arid areas, biofuels and geothermal energy from hot, dry rocks.
- Companies supported by the Commercialising Emerging Technologies programme in 2003-04 have achieved significant commercialisation outcomes including capital raisings of around $100 million; 237 strategic alliances, licenses or agreements; and 35 instances of manufacturing commencements or product and service launches.
- Continuation of the successful R&D Start program with 157 projects approved to a value of more than $176 million. Another $5.5 million was approved to extend support for existing projects. An independent review of R&D Start showed that the program generated significant private and national benefits. It is estimated that every dollar invested returned $4.50 in community benefits.
- Commercial Ready was launched on 1 October 2004 and replaces R&D Start. Commercial Ready aims to stimulate greater innovation and productivity growth in the private sector, by providing around $200 million a year in competitive grants for small and medium-sized businesses.

Providing Capital for Commercialisation

One of the key factors affecting the successful commercialisation of research outcomes is the availability of early stage investment capital. Often scientific discoveries from our universities and public sector research institutions have commercial potential, but their development is not sufficiently advanced to attract traditional venture capital investment.

The Australian Government aims to improve the commercialisation of technology by Australian firms by increasing access to venture capital through programs such as the Innovation Investment Fund (IIF) program and the Pre-Seed Fund (PSF) program, and by supporting companies to develop their management skills and business planning through the Commercialising Emerging Technologies (COMET) programme.
Australia’s venture capital market has grown significantly over the past 10 years from a small base. According to Australian Bureau of Statistics data as at 30 June 2003, investors had $7.5 billion committed to venture capital investment vehicles, an increase of 9% from $6.9 billion the previous year. The value of early stage investments was 17% of total investments.

**Pooled Development Funds**

The Pooled Development Funds (PDF) programme aims to increase the supply of patient equity capital for small to medium-sized enterprises. By establishing commercially operating private sector investment companies, the programme develops and demonstrates the market potential for providing equity capital to eligible companies.

Companies registered as PDFs receive concessional tax treatment on returns from eligible investments. Since they began in July 1992, PDFs have invested in more than 420 Australian companies. There were 109 registered PDFs at 30 June 2004.


**Venture Capital Limited Partnerships**

Venture Capital Limited Partnerships (VCLP) are designed to encourage non-resident foreign investment into the Australian venture capital market through the establishment of a flow through investment vehicle.

The VCLP initiative extends tax exemptions provided to designated foreign pension funds on profits from the disposal of investments in eligible venture capital businesses. In 2003, tax exemptions were extended to:

- all tax exempt residents from Canada, France, Germany, Japan, the United Kingdom, and the United States
- non-resident venture capital funds established and managed in the countries above; and
- taxable non-residents holding less than 10% of the equity in venture capital limited partnerships. This includes residents of Canada, Finland, France, Germany, Italy, Japan, the Netherlands (excluding the Netherlands Antilles), New Zealand, Norway, Sweden, Taiwan, the United Kingdom and the United States.

As at 30 June 2004, two VCLPs were registered, four VCLPs were conditionally registered and one entity was under the transitional rule. In June 2004 the Australian Government implemented a number of changes and enhancements to the Venture Capital Legislation including:

- allowing the registration of limited partnerships, formed under recently amended Victorian and New South Wales partnership laws, which have separate legal entity;
- allowing investment through holding companies of both consolidated and consolidatable groups, where the group satisfies the eligibility tests;
- allowing investment into companies which are spun-off from larger entities, subject to satisfying integrity rules; and
- removing minor impediments to the operation of the regime.

To access the concessional taxation arrangements, VCLPs must be registered by the Pooled Development Funds Registration Board, which administers the incentive. The Board is serviced by the Department of Industry, Tourism and Resources.

Innovation Investment Fund

The Innovation Investment Fund (IIF) programme is designed to promote the commercialisation of Australian R&D by providing venture capital to small, high-tech companies at the seed, start up or early expansion stages of their development. As at 31 July 2004, the programme had invested $195 million in 66 individual companies. Of this, approximately $100 million was invested in 35 information technology projects and companies.

Three initial public offers took place during 2003-04. The companies involved were:

- Alchemia Ltd – a biotechnology company that specialises in the discovery, development and synthesis of carbohydrate-based molecules for pharmaceutical applications;
- Pharmaxis Ltd – a specialist pharmaceutical company committed to the research, development and commercialisation of human therapeutic products that address chronic respiratory and autoimmune diseases. The company is also developing improved lung function tests; and
- Cogstate Ltd – involved in neuroscience, particularly the development and commercialisation of products for neurodegenerative disorders and conditions.

www.ausindustry.gov.au

THE EVOLUTION NEXUS

A transportable, multi-functional broadcast control room for live to air television broadcasting has been designed by Sydney based broadcast technology innovators, with the assistance from the Innovation Investment Fund.

Manufacturer Evolution Broadcast has developed a product called Evolution Nexus, which uses the most advanced digital and touch screen technology, as well as customised software and control interfaces, to provide more control and flexibility, a more compact production infrastructure and significant savings.

A real industry first - the design embraces a sophisticated mix of ergonomics, serviceability and aesthetics to provide gains in efficiency and mobility. The Nexus, which is available globally, recently won an Australian Design Award® for design innovation. FOXTEL is the company’s first customer.
**Renewable Energy Equity Fund**

The Renewable Energy Equity Fund (REEF) is a specialist renewable energy fund, modelled on the Innovation Investment Fund programme. REEF encourages the development of emerging Australian companies with domestic and global market potential and other incorporated bodies that are commercialising R&D in renewable energy technologies. It also develops fund managers with experience in the renewable energy industry.

The Australian Government has provided $17.7 million to REEF which is matched by private sector funding of $8.8 million, making REEF’s total capital $26.6 million.

Developments supported under REEF include wind generation, a hybrid energy storage system for use in waste collection vehicles, long-life batteries for use in remote areas, biofuels and geothermal energy from hot dry rocks.

www.ausindustry.gov.au


**Research to Investment Ready Stage**

To achieve their commercialisation objectives, including securing the necessary finance to fund development, projects need to establish their technical validity and business case.

There are many great innovations developed by individuals, small Australian companies and researchers in universities and other publicly funded research institutions. Initiatives such as the new Commercial Ready Programme and the Commercialising Emerging Technologies Programme provide support to help these innovations reach their commercial potential by providing companies with the knowledge, resources and links to exploit opportunities. These programmes are designed to help bridge the funding gap that can prevent many fine ideas being transformed into innovations that result in new and better products and services.

**Pre-Seed Fund**

The Pre-Seed Fund was announced as part of the Backing Australia’s Ability initiative in January 2001. The Fund targets commercially promising R&D opportunities at the pre-seed stage within Australian universities, Cooperative Research Centres and government research agencies.

The Pre-Seed Fund assists the commercialisation of public sector R&D activities by further developing the management and entrepreneurial skills of public sector researchers and building links with the finance and business community. It has established licensed venture capital funds managed by expert private sector funds managers in which the Government and private sector investors invest.

The Pre-Seed Fund programme has a total of $104.1 million to support projects or companies formed by universities or government research agencies. The Australian Government is providing $72.7 million of the capital, with the balance provided by private sector investors, universities and public sector research agencies. In November 2002, four venture capital funds became operational following a selection process by the Industry Research and Development Board. To date, $7 million has been invested by the fund managers.

www.ausindustry.gov.au

**Commercialising Emerging Technologies**

Commercialising Emerging Technologies (COMET) is a competitive, merit-based grants programme which supports businesses and individuals commercialise innovative products, processes and services. The programme supports skills development in management, business planning, market research, intellectual property, and developing working prototypes and proven technology.
COMET is delivered through a network of business advisers who are consultants contracted from the private sector. The programme started in 1999 as a $30 million initiative over three years and was extended in *Backing Australia’s Ability* with a further $40 million from 2001 to 2005. The programme has been extended under *Backing Australia’s Ability – Building Our Future through Science and Innovation* with a further $100 million taking it through to 2010-11. Since 1999, there has been capital raisings of $280 million; 848 strategic alliances, licenses or agreements; and 163 instances of manufacturing commencements or product and service launches.

Companies supported by COMET in 2003-04 have achieved significant commercialisation outcomes, including capital raisings of around $95 million, 130 strategic alliances, licenses or agreements and 30 instances of manufacturing commencements or product/service launches.

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**COMET HELPS WITH OIL CLEANING MACHINE**

Mining and industrial machinery, motor vehicles, motor bikes and most other machines use oil for lubrication that must be changed regularly. But what if the life of lubricants could be extended, in some cases indefinitely?

The Portable Centrifugal Oil Cleaning System, developed by Townsville-based company Lubemaster, has the potential to change the way industry practises lubrication and save millions of dollars a year.

The five-year project was supported by a $52,000 Australian Government Commercialising Emerging Technologies (COMET) grant. A COMET business adviser helped the company develop a business and marketing plan, tackle intellectual property issues and commercialise the product.

The system’s unique design uses the proven technology of centrifugal particle removal, together with a vacuum dehydration unit for removal of water. The filtration unit cleans heavy gear oils without any reduction of flow rates through the filter. This had previously been impossible. Other advantages of the new system include the absence of any major drive parts that could wear out. Components are simply washed, re-assembled and re-used.

Using Lubemaster’s oil cleaning unit allows the useful life of oil (non-engine applications) to be extended indefinitely. This has the potential to reduce used oil being disposed of by industry, making it friendly to the environment.
The Biotechnology Innovation Fund (BIF) has helped biotechnology companies demonstrate proof of concept. It also progressed projects from the research stage to early commercialisation.

BIF was part of the National Biotechnology Strategy. It was designed to remove major development constraints associated with a lack of pre-seed, early stage and seed capital. Under Backing Australia’s Ability, BIF received an additional $20 million to 2003-04.

Since the programme began in 2000, approximately $36 million has been allocated to 160 successful applicants. BIF Round 5 was completed in November 2003, with 24 successful applicants receiving funding of $5.6 million. By May 2004, 70 BIF projects had been completed with most successfully commercialising biotechnologies.

In recognition of the strong demand, an additional round of BIF was deemed necessary to merge the end of BIF with the start of the new Commercial Ready programme. Commercial Ready will continue to support proof of concept activities without limiting that support to biotech companies.

www.biotechnology.gov.au
Virtual care is becoming a reality due to a new broadband video link-up system that enables medical specialists to provide long distance care and advise hospital staff in other locations.

The new technology transmits high quality audio, video and vital signs data. This enables a specialist at Nepean Hospital in Sydney’s west to control multiple cameras and interact with emergency staff during life saving procedures in the Blue Mountains District Hospital, Katoomba.

The CSIRO heads the CeNTIE consortium that has developed the Virtual Critical Care unit (ViCCUTM) project with funding provided through the Australian Government’s Advanced Networks Programme.

The ViCCUTM allows 24-hour monitoring of a patient and improves services available to regional areas. It can be used to treat heart attacks, injuries from car accidents, and burns. The telepresence of an obstetrician will soon assist with births.

The most important innovation of the system is that the specialist can now help trauma patients directly and can more effectively communicate with remote hospital staff.

In May 2004 the ViCCUTM system won the Australian Information Industry Association iAIIA award for Implementation - Telecommunications. These awards recognise the best development and deployment of information and communications technology in Australia.

Building on IT Strengths – comprising the Advanced Networks Programme, the BITS Incubator Programme and the Intelligent Island Programme

The $158 million, five-year Building on IT Strengths (BITS) Programme was established by the Australian Government in June 1999. It builds the strength and competitiveness of the Australian information industries sector by increasing the number of new small to medium-sized enterprises in information and communications technology.

The $78 million BITS Incubator Programme aims to improve the rate of commercialisation of ideas and R&D by establishing incubators to increase the success rate of new businesses. Funding provided to incubator managers allows them to assist new companies when they may not be well served by venture capital markets. The program established 10 incubators in all mainland States and Territories.

The $39 million Advanced Networks Programme (ANP) helps develop advanced network infrastructure in Australia that will deliver long-term benefits to the Australian economy. It supports the development, trials and demonstration of advanced communications networks, experimental networks and test beds, and funds two projects providing very high capacity (up to 10 gigabits a second) networks linking Perth, Melbourne, Canberra, Sydney and Brisbane (CeNTIE and GrangeNet). These networks enable research into network technologies and emerging high-speed broadband applications. The third ANP project (m.Net) is an advanced wireless network which enables research into wireless network technologies and applications.
Though the BITS Programme was not originally funded under **Backing Australia’s Ability**, **Backing Australia’s Ability – Building Our Future through Science and Innovation** has extended the funding for the majority of BITS Incubators, through the ICT Incubators Programme ($36 million), and the Advanced Networks Programme ($21 million).

The objective of the $40 million Intelligent Island Programme is to help develop an internationally competitive ICT sector in Tasmania by supporting new projects and building on existing industry, Tasmanian Government initiatives and the research capacity of Tasmania’s education sector.

Intelligent Island covers seven initiatives including a $20 million Centre of Excellence in Health Informatics and Bioinformatics to be established by the University of Tasmania and the Tasmanian Department of Health and Human Services; and the In-tellinc incubator ($8 million).

[http://www.dcita.gov.au/Article/0,,0_1-2_11-4_15153,00.html](http://www.dcita.gov.au/Article/0,,0_1-2_11-4_15153,00.html)

[http://www.dcita.gov.au/Article/0,,0_1-2_11-4_15253,00.html](http://www.dcita.gov.au/Article/0,,0_1-2_11-4_15253,00.html)

**Commercial Ready**

Commercial Ready was launched in October 2004. It aims to stimulate greater innovation and productivity growth in the private sector providing around $200 million a year in competitive grants to small and medium-sized businesses. The grants will assist these enterprises undertake research and development with a high commercial potential, technology diffusion, and proof-of-concept and early-stage commercialisation activities.

Commercial Ready was announced as part of **Backing Australia’s Ability – Building Our Future through Science and Innovation**. It will replace R&D Start Programme, the Biotechnology Innovation Fund and the competitive grants support for technology diffusion from the Innovation Access Programme – Industry.


**Encouraging Companies to Innovate**

Companies innovate through converting ideas and outcomes of R&D to goods and services, or using them to enhance the operation of a business. It can also involve improving the way a firm operates, such as changing marketing distribution, management structures or services.

Innovative activity by firms, particularly R&D, can be high risk. Innovation by firms, however, also provides substantial rewards. The 2002 Australian Industry Group report, *Expenditure and Drivers in Australian Manufacturing*, found that innovative small to medium enterprises were more likely to exhibit increased employment and revenue compared to firms that did not innovate. Additionally, ABS data show that manufacturing firms that are technological innovators have substantially higher sales than firms that are not technological innovators.

The Australian Government recognises the importance of raising the capacity of business to innovate, and through a number of initiatives is encouraging a diverse range of industries to increase their commitment to innovation.
Chapter Two – Initiatives for a Dynamic National Innovation System

International Science Linkages

The International Science Linkages (ISL) programme, announced as part of Backing Australia’s Ability – Building Our Future through Science and Innovation, began in July 2004. It builds on and expands the funding formerly provided through the Innovation Access Programme (IAP) – International Science and Technology (S&T). In 2004-05 the programme has been provided with $9.3 million, with $55.5 million being provided over five years from 2006-07. The ISL supports high-quality collaboration between Australian scientists and international partners on leading edge science and technology.

During 2003-04, funding for collaborative projects under IAP-S&T resulted in 39 scientific publications. As a result of funding through the access to major research facilities component, 105 journal articles are expected to be published, demonstrating the high quality research being performed.

An Allen Consulting Group review of IAP – S&T concluded that:

- programme objectives remain appropriate;
- it has had substantial impact, with an average of five new collaboration partners and four new strategic alliances already resulting from each project funded; and
- the programme is delivered efficiently, relying upon a range of external expertise and relationships for the successful selection of activities and administration of funding.


SAFER DRINKING WATER

An Australian consortium is part of a European Union project, called EU MicroRISK, to assess risks and provide management advice for safe microbiological levels in drinking water systems.

The University of NSW Centre for Water and Waste Technology (School of Civil and Environmental Engineering, UNSW) is leading the quantitative microbial risk assessment component with funding of $377,603 from the competitive grants component of International Science Linkages.

Traditional approaches to providing microbiological safe drinking water are proving inadequate to deal with new viruses and disinfectant-resistant pathogens such as Cryptosporidium and Norovirus. A more proactive approach is needed to guarantee the microbiological safety of drinking water, as promoted in the 2004 Australian and World Health Organization drinking water guidelines. Results from the project will be incorporated into national and international drinking water guidelines and lead to innovative ways to manage water supply systems at less cost and with greater safety than current end-of-pipe monitoring and rule-of-thumb system performance targets.

Australia is collaborating on the project with the Netherlands, Sweden, the United Kingdom, France and Germany. To date, Australian researchers have provided the overall approach to data collection, demonstrated with Australian catchment data, and have contributed the framework employed and material for the EU project website (www.microrisk.com).
Innovation Access Programme - Industry

The Innovation Access Programme (IAP) - Industry is designed to foster innovation and competitiveness by increasing the take-up of leading edge technologies and best practice processes by Australian firms and sectors, particularly small to medium-sized enterprises.

Achievements in 2003-04 include:

- the IAP-Industry competitive grants element has provided total funding of $14.3 million to 54 projects;
- three innovation access fora were held on chemicals and plastics, light metals and mining technology services. Support is also being provided for a carbon geosequestration feasibility study in 2004-05;
- industry awareness of emerging technologies was raised through a workshop demonstrating the commercialisation potential of nanotechnologies; and
- the Government-funded service, Industry Techlink, was launched in February 2003. It provides a single point of contact for free technology advice for small and medium enterprises. This is a $6 million, four-year initiative. A high proportion of callers are from regional Australia. It is estimated that for the 399 enquiries received up until August, the project provided a dollar benefit of $10 million in its first seven months of service.

The competitive grants support for technology diffusion from the IAP, became part of the newly established Commercial Ready Programme.

www.ausindustry.gov.au

HIGH-TECH HELP FOR VICTORIA’S GIPPSLAND

More than 65 small and medium-sized companies in Victoria’s Gippsland region are benefitting from the latest technology thanks to a two-year-old project run by Monash University.

The technology gateway network project is run by the university using funding of $439,000 from the Technology Diffusion Programme*. Under the programme, small to medium-sized companies in Gippsland have access to a national network to provide a range of technology transfer services. Companies from industries like wine, manufacturing, health, construction and forestry are participating.

One example of the technology network is the development of an intelligent system that predicts and improves the quality of wine and grapes which also involves piloting the technology by a group of Gippsland wineries. There is significant potential for the technology to be commercialised and made available to the wine industry, and to be adapted for a range of different industry sectors.

*The Technology Diffusion Programme was the predecessor to IAP
Information Technology Online Programme

The Information Technology Online (ITOL) Programme encourages industry groups and small business to identify and adopt commercial uses of the internet to support productivity and profitability. The preferred e-business solutions are open and inclusive for all participants.

Since 1996, almost $12 million has been allocated to 110 projects in sectors as diverse as agriculture, health and pharmaceuticals, building and construction, automotive and welfare groups. These projects have been located in regional and metropolitan areas and in all Australian States and Territories.

In recent ITOL funding rounds, industry solutions have demonstrated high levels of innovation and reflected emerging e-commerce applications such as wireless applications, value chains, introduction of industry standards and promoting interoperable solutions. A common feature of many of the successful applications has been a high level of collaboration between businesses.

The programme is currently funded until 2005 at $2.5 million a year through Backing Australia’s Ability.

www.dcita.gov.au

A “POCKET” SIZED E-BUSINESS SOLUTION

Ipswich small businesses have benefited from the PhonePOS system which was developed and implemented with the support of the Information Technology Online Programme.

PhonePOS is a mobile phone payment method that allows customers to make fast and secure payments using mobile phones for any service that is delivered at the customer’s home or away from a primary place of business. With PhonePOS, any plumber, roofer, electrician or other small business operator can now use their standard mobile phone to take credit card payments anywhere, anytime. Businesses using this system include home maintenance and repairs, building and construction and health services.

PhonePOS was recently awarded the prestigious Asia Pacific Information and Communication Technology Award for its application in the building and construction industry.

http://www.phonepos.com/
Pharmaceuticals Partnerships Programme

Pharmaceuticals Partnerships Programme (P3) is a $150 million, five-year programme to June 2009 designed to increase the level of high quality pharmaceutical R&D undertaken in Australia. It provides companies with 30 cents for every additional dollar of pharmaceutical R&D undertaken in Australia, up to a $10 million cap. P3 encourages partnerships between multinationals, biotechnology companies and researchers. The Programme has three competitive entry rounds (where funding will commence on 1 July 2004, 1 July 2005 and 1 July 2007) to ensure that companies at every stage of the business planning cycle may apply.

Eleven successful first round applicants were announced in April 2004 and were offered $87 million in grants to undertake almost $290 million in pharmaceutical R&D.

www.ausindustry.gov.au

Pharmaceutical Industry Investment Programme

The Pharmaceutical Industry Investment Programme (PIIP) provided partial compensation for the impact on industry activity of the Pharmaceutical Benefits Scheme (PBS), in return for the suppliers undertaking additional activity in Australia, including manufacturing and R&D activity. In the year ending 30 June 2003, PIIP participants increased their R&D expenditure by 2%, undertaking over $204 million of activities. The PIIP, which was allocated up to $300 million over four years, concluded on 30 June 2004.

PFIZER OPENS $14 MILLION BIOMETRICS CENTRE IN SYDNEY

Pharmaceutical company Pfizer opened its $14 million Regional Biometrics Centre in Sydney in 2003 with assistance from the Pharmaceutical Industry Investment Programme.

The Sydney biometrics centre is one of only three regional centres that Pfizer operates around the world. It designs and analyses a variety of global clinical research projects undertaken by Pfizer, with more than 80% of its work destined for overseas markets.

The western Sydney site provides services for Australian clinical trials as well as clinical trials in the Asian region and globally. Projects include assessment of medicines for improving bone mineral density in women at risk of osteoporosis and assessment of a new medicine to alleviate the pain associated with nerve damage from diabetes.

The decision of Pfizer to choose Sydney over countries like Singapore and India is an example of the company's high regard for Australia's high-quality research skills and infrastructure.
New Industries Development Programme

The New Industries Development Programme (NIDP) improves Australia’s performance in the commercialisation of new, innovative agribusiness products, services and technologies.

Under Backing Australia’s Ability, NIDP was a five-year programme with funding of more than $20 million to June 2006. It has been extended by $14 million to June 2011 through Backing Australia’s Ability – Building Our Future through Science and Innovation. Funds will be used to provide:

- competitive-based funding assistance for Pilot Commercialisation Projects (PCP) to assist new innovative niche agribusiness ventures that encourage through-chain approaches and involve at least one partner that is a small to medium agribusiness;
- In-Market Experience Scholarships that enable emerging managers to gain experience in specific areas of business management and new markets;
- development of supply chain management and market analysis initiatives to encourage stronger, more innovative solutions to supply chain and marketing arrangements;
- a capital raising and business development initiative to change attitudes and increase understanding of what investors want and providing new businesses with access to commercial skills; and
- quality information for agribusinesses based on projects that showcase successful, market-driven innovation. Initiatives include the Made in Australia magazine series and sponsorship of the Prime television programme On the Land.

www.daff.gov.au/agribiz

PROCESSING PREMIUM COFFEE

Through combining world’s best harvesting and processing concepts, Mountain Top Coffee is producing a premium quality coffee with a distinctive flavour, capturing the attention of markets in both Australia and overseas.

A New Industries Development Programme In-Market Experience Scholarship provided the opportunity for Gerard Dwyer, Mountain Top Coffee’s production system manager, to study mechanised harvesting and processing technology and apply it to specialty coffee production and marketing.

The business has combined production and processing principles from around the world to develop a harvesting and production system that minimises labour costs while maximising product quality and consistency. The system ensures the highest quality coffee, with a low environmental impact.

The flavour profile of Mountain Top’s beans combined with the firm’s quality assurance standards and environmental accreditation has allowed the business to target the top end of the coffee market with a premium specialty coffee.

Top: Mountain Top Coffee is harvested with a US-built machine that straddles the low bushy trees and uses rods attached to rotating poles to remove the berries.

Bottom: This property has its own microclimate due to its geographic location, which means that it produces specialty coffee that is significantly different from other coffees grown in Australia and around the world.

Credit: Images provided by the Department of Agriculture, Fisheries and Forestry.
Textile, Clothing and Footwear Strategic Investment Programme Scheme

The Textile, Clothing and Footwear Strategic Investment Programme Scheme, known as the TCF (SIP) Scheme, has received funding of $677.7 million over five years to 2004-05 to foster sustainable, competitive textile, clothing and footwear industries in Australia. The scheme is open to enterprises undertaking eligible activities relating to manufacturing in Australia of textiles, clothing, footwear and processed leather.

In 2003-04, $122.9 million in grants was paid to 247 businesses for eligible capital, innovation, value-added and regional restructuring expenditure. Seminars on the scheme were held nationally, including sessions on criteria for R&D and innovative product development grants.


Automotive Competitiveness and Investment Scheme – Motor Vehicle Producer Research and Development Scheme

In December 2002, the Australian Government announced details of the post-2005 tariff changes and the post-2005 assistance package for the Australian automotive industry. Part of these arrangements included a motor vehicle producer R&D Scheme as part of the Automotive Competitiveness and Investment Scheme (ACIS) budget. The Scheme was launched in July 2004 to increase the amount of R&D by motor vehicle producers in Australia. The scheme:

- offers up to $150 million in R&D assistance between 2006-10;
- is accessible to all four motor vehicle producers registered under ACIS;
- is competitively-based;
- provides successful projects with 45 cents for each dollar spent on eligible R&D;
- involves a minimum of two funding rounds; and
- limits total funding for an individual motor vehicle producer to $75 million.


Renewable Energy Commercialisation Programme

The Renewable Energy Commercialisation Programme is a $54 million competitive grants programme designed to foster development of the renewable energy industry in Australia and reduce the emissions of greenhouse gases.

It is administered by the Australian Greenhouse Office and provides funds for projects that lead to the commercialisation of innovative renewable energy equipment, technologies, systems and processes. It also incorporates a $6 million industry development component.

The programme has provided funding of between $135,000 and $1 million for 48 projects, including solar photovoltaic, solar thermal, wind, biomass, hydro, wave and hot dry rock developments. Eight projects were successfully completed in 2003-04, bringing the number of completed projects to 22.

It is estimated that 500 direct jobs will be created from the programme. Private sector investment of up to $238 million and exports of $120 million could also be achieved.

It is estimated that greenhouse gas abatement of up to six million tonnes of carbon dioxide equivalent is possible by 2010 from the uptake of the technologies commercialised under the programme.

Greenhouse Gas Abatement Programme

The Greenhouse Gas Abatement Programme (GGAP) targets projects that will achieve large-scale, cost-effective and sustained abatement of greenhouse gas emissions from any sector of the economy. In 2004-05 funding of $17.9 million is being provided by the Australian Government. A criteria for funding is the extent to which projects accelerate efforts to research, develop and deploy new technologies or innovative processes.

Activities include:

- applying the latest industrial plant, equipment and techniques to the mining, minerals and energy sectors to deliver greenhouse gas abatement. For example BHP has transferred Vocsidizer technology from manufacturing facilities to a waste coal mine gas electricity generation project. Queensland Alumina Limited has replaced rotary kilns with several energy efficient calciners; and

- training refrigeration technicians through the National Refrigeration and Air Conditioning Council to ensure they use environmentally sensitive practices to minimise synthetic greenhouse gas emissions.

www.greenhouse.gov.au

NEW TECHNOLOGY CUTTING GREENHOUSE GASES

BHP Billiton Illawarra Coal, with the support of the Australian Greenhouse Office, is developing a major new project to mitigate greenhouse gas emissions from its West Cliff Colliery in the Illawarra region of New South Wales, through the reduction of fugitive methane in mine ventilation air.

The $13 million West Cliff Ventilation Air Methane Project (WestVAMP), which includes up to $6 million contributed through the Greenhouse Gas Abatement Program, is the final step in proving a technology capable of mitigating the bulk of the Illawarra Coal’s fugitive greenhouse gas emissions while producing electricity as a product. The project builds upon the successful pilot plant at Illawarra Coal’s Appin Colliery in 2001.

WestVAMP will use 20% of West Cliff’s available mine ventilation air to achieve a reduction in greenhouse gas emissions of 200,000 tonnes of carbon dioxide equivalent each year. This is equivalent to eliminating the emissions from 45,000 cars a year, or producing enough electricity for 20,000 homes.

The technology converts low concentration methane to carbon dioxide and water vapour through an oxidation, or flameless combustion process. High efficiency heat exchangers recover the large levels of thermal energy released to produce steam. The steam is used to drive a conventional steam turbine to generate electricity.

This technology has the potential to be used in other coal mines in Australia and is an example of how technology can play a key role in reducing Australia’s greenhouse gas emissions.

Further information is available at http://illawarracoal.bhpbilliton.com, select ‘Operation and Projects’ then ‘WestVAMP’.

Aerial graphic of proposed site layout
Credit: Image provided by BHP Billiton
Commercialising innovative ideas is a complex exercise, often involving interdisciplinary research teams and cooperative ventures between researchers, investors and technologists. It also requires the careful management of risk. For these reasons collaboration is often a preferred path for the conduct of research and for the translation of research into commercially sustainable products, services and processes. Recognising this, the Australian Government has in place a range of programmes designed to encourage and facilitate effective collaboration, especially between public sector researchers and private sector investors and firms.

At the level of the research process itself, the Australian Research Council (ARC) provides competitive Linkage Grants that encourage excellent collaborative research within universities and across the innovation system, including internationally, and between universities and industry. The Cooperative Research Centres (CRC) programme emphasises the importance of collaborative arrangements to maximise the benefits of research through an enhanced process of utilisation, commercialisation and technology transfer. It also has a strong education component with a focus on producing graduates with skills relevant to industry needs.

An important focus of Backing Australia’s Ability – Building Our Future through Science and Innovation is an increased emphasis on collaboration between the key players in the innovation system. The new Commercial Ready Programme will encourage collaboration between Australian businesses and public research providers to work together to develop competitive new products and processes with strong commercial potential.

Cooperative Research Centres Programme

The Cooperative Research Centres (CRC) Programme was established in 1990 to bring together researchers and research users. CRCs turn their research results into commercial products and services or transfer new know-how to industry or other users. They also train researchers in the skills needed to work in industry and improve private sector R&D.

At October 2004, there were 69 CRCs operating in six sectors: environment, agriculture and rural based manufacturing, information and communication technology, mining and energy, medical science and technology, and manufacturing technology.

Funding for the programme was increased under Backing Australia’s Ability – Building Our Future through Science and Innovation. An extra $65 million is being provided over six years, demonstrating a commitment to CRC selection rounds in 2006 and 2008, as well as to fund successful applicants from the 2004 round. The CRC Programme has never had such a long-term funding commitment. This extra funding builds on the $62.5 million additional funding provided in the 2003-04 Budget. A total of $925.9 million is being provided for administered grants between 2006 and 2011.

New application guidelines were announced in 2004 which focus on the contribution CRCs will make to Australia’s industrial, commercial and economic growth. This shift will benefit Australian businesses as well as the broader community by contributing to Australia’s economic growth. Researchers also stand to benefit from increased returns from their research efforts.

Since the programme’s inception to the end of June 2003, CRCs have produced nearly 20,000 published works. In addition more than 23,000 publications and technical reports have been developed for industry and end users. At June 2004, CRCs were employing more than 3,700 full-time equivalent research staff and supporting more than 2,400 postgraduate students. Over the life of the programme CRCs have reported that about 2,200 students have left to take up employment with relevant industry and other end-users.

CRCs have undertaken nearly 5,400 research contracts for industry and other end-users, earning $419 million. In the period since 2000-01 CRCs have reported 294 licence agreements, creation of 38 spin-off companies, and 72 technology commercialisation agreements. For the 2002-03 financial year, CRCs reported filing 78 patents in Australia and 25 overseas. A total of 220 patents are held in Australia and 406 overseas.
Australian Government Space Forum

The Australian Government Space Forum (AGSF), established in July 2003, is a network of government agencies with an interest in the space sector. It is an initiative of the Department of Industry Tourism and Resources to facilitate a whole-of-government effort in the area. Its objectives are to:

- exchange and coordinate the dissemination of information about government space-related policies, programmes and activities;
- identify issues that would benefit from a collaborative approach among Australian Government agencies;
- be an initial point of contact for domestic and international sources about Australian Government space activities; and
- be a source of expertise or referral on space related matters for the Australian Government or agencies.

www.industry.gov.au/space

Intellectual Property

Backing Australia’s Ability intellectual property (IP) initiatives focus on protection and improved awareness. A strong intellectual property protection regime, including easy access to information on IP protection, is central to building a strong national innovation system. It promotes R&D by capturing returns from commercialising Australian ideas and products.

IP Awareness

IP Australia is committed to raising the level of awareness and understanding of the importance of IP protection and the role it plays in the commercialisation process. Its work is recognised internationally and it has played a leading role in several projects around the world to develop public education and awareness activities.

Initiatives include:

- Relationship marketing, with IP Australia communicating to more than 6,000 academics and research staff in tertiary institutions throughout Australia on a regular basis in partnership with commercial arms from various universities. The IP Professor website is an important source of IP information for this market.
- The InnovatED newsletter which consists of a range of resources and activities including a newsletter which encourages teachers to include innovation in their lesson plans for children aged nine to 13, a learning journey CD ROM based game entitled Big Ideas and the InnovatED website that has lesson plans games and more information about innovation in Australia.
- Assisting IP offices in the Asia and Pacific regions to develop public education and awareness programmes to raise the level of IP understanding amongst their key target markets.
- Encouraging greater penetration of the IP Toolbox into the business adviser and SME market through price discounting. A proposal is also being developed to make specific IP Toolbox modules available online.
- A new resource, called Attorney Central, to help meet the specific needs of the legal profession.
- Smart Start, an IP guide, which is one of the most valuable IP information resources for the SME market.
The Cooperative Research Centre for Polymers developed technology jointly with Olex Cables to produce cables that enable the electric systems of buildings to continue to function during fires.

Special plastic insulation transforms into a protective ceramic barrier under heat, rather than degrading like normal plastics. This cable is the first in the world that does not use mica glass tape, ensuring greater flexibility, cheaper installation and improved performance in emergency situations.

The Pyrolex™ Ceramifiable® cables are expected to generate $75 million in sales during the next five years in Australia. Major buildings across Australia including the Melbourne Cricket Ground, Austin and Dandenong Hospitals in Melbourne and Westfield Shopping Centre in Bondi are being fitted with this cable. Production of the cables will create 20 jobs.

Monash University, the University of New South Wales, the Defence Science and Technology Organisation, the Royal Melbourne Institute of Technology University and CSIRO also collaborated in the project. This world-first technology is protected by four patent applications.

Through a spin-off company, Ceram Polymerik, the CRC is exploiting other non-cable applications and exploring commercial opportunities with Australian, American, and UK companies. Applications for this technology include glazing seals, wall panels, seals for wall penetrations and caulking – a global market estimated to exceed $1 billion a year.
Promoting IP Australia's centenary year (2004). To help celebrate, a range of activities were implemented including a series of innovation theme postage stamps and an innovation theme for the covers of the 2004-05 Telstra White Pages, and a publication celebrating the last 100 years of Australian innovation.

An ongoing program of seminars targeting a range of audiences including SMEs, universities, designers and other technical industry groups.

**IP Protection**

The *Designs Act 2002* came into effect on 17 June 2004 and replaces the *Designs Act 1906*. The reforms implement significant changes to enhance the effectiveness of the industrial designs registration system in Australia by providing a stronger design right system and improved enforcement mechanisms. A design right now lasts 10 years.

**Review of the Trade Marks Legislation.**

A review of the Trade Marks Legislation was undertaken during 2004. The review sought to ensure that the Trade Marks Legislation and Regulations meet the needs of users of the trade mark system. The outcome of this review will be considered along with the recommendations of the Review of Trade Mark Enforcement by the Advisory Council on Intellectual Property. Any subsequent legislative changes will most likely be progressed in 2005.

**Advisory Council on Intellectual Property**


**Report on Trade Mark Enforcement**

ACIP recommendations are mainly focused on strengthening trade mark rights to provide more certainty about the validity and scope of the rights with the intention that this will help reduce the need for businesses to take enforcement actions.

The Government released the following ACIP reports during 2004 and is currently considering its response to these reports.

**Should the jurisdiction of the Federal Magistrates Service be extended to patent, trade mark and design matters?**

ACIP recommended that the jurisdiction of the Federal Magistrates Service (FMS) be extended to include patent, trade mark and designs matters and that magistrates with IP expertise should be appointed to the FMS at an early stage. It also recommended that both the FMS and Federal Court of Australia should streamline their court practices and procedures, more pro-actively case manage IP disputes and more fully utilise alternate dispute resolution processes. ACIP believe these proposals could help address the problems businesses experience in pursuing IP litigation including issues of high costs, complexity, timeliness, uncertainty of outcome and the judiciary’s limited expertise in IP matters.


ACIP recommended that business systems remain patentable for the time being, but that the issue continue to be closely monitored. ACIP also proposed further improvements to the assessment processes used by IP Australia, and recommended improvements be made to the information available to the public to better assist the business community in managing this new area of intellectual property.
ACIP is currently undertaking reviews into:

- Crown use of patents and designs;
- interface between trade marks, business and company names and domain names;
- patenting and experimental use; and
- the exclusion of plant and animal matter from the Innovation Patent.

ACIP expects to report its findings on these reviews to Government in late 2004 or early 2005.

www.ipaustralia.gov.au

www.acip.gov.au

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The framework provided by the White Paper is backed up by substantial new initiatives that cover a wide range of fields relevant to exploration, production, distribution and use of energy in Australia. The White Paper included the following energy innovation initiatives:

- **Low Emissions Technology Demonstration Fund**
  The $500 million fund will support industry-led projects for the large-scale demonstration of low-emissions technologies with significant long-term greenhouse gas abatement potential.

- **Renewable Energy Development Initiative**
  $100 million will be provided over seven years to support strategically important renewable energy initiatives with strong commercial and smaller emissions-reduction potential. Funding will comprise $50 million from the Commercial Ready programme and $50 million in new funding.

- **Solar Cities**
  $75.3 million will be provided to fund a series of trials to gauge the benefits of the concerted use of solar and energy efficient technologies combined with interval metering. The trials will provide a working model of how sustainable energy systems may work in the future.

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INTELLECTUAL PROPERTY RESEARCH INSTITUTE OF AUSTRALIA

The Intellectual Property Research Institute of Australia (IPRIA) is a national multi-disciplinary (law, economics and management) research centre established in 2002 as a *Backing Australia's Ability* initiative. IPRIA is funded by IP Australia, the Victorian State Government and its host institution, the University of Melbourne. IPRIA conducts high quality research on the whole of the innovation cycle from intellectual property creation through to marketable product. It uses internal and external publications (27) information seminars (14) and conferences (one) to disseminate research results. IPRIA also makes specific contributions to the law reform and policy debates through submissions to Australian Law Reform Commission, Advisory Council on Intellectual Property and relevant parliamentary committees. The 2004 edition of its annual R&D and IP Scoreboard was launched in August 2004 and IPRIA hosted a major conference on Patent Systems and Innovation in November 2004.
- **Technology assessments**
  Comprehensive technology assessments will be used to guide priority setting and decision making in relation to energy innovation. These assessments will be incorporated into existing energy innovation measures. The assessments will be reviewed regularly to ensure that they are consistent with international and domestic developments.

- **International energy technology agreements**
  A review of international energy technology agreements will be conducted by the end of 2004 to ensure a strategic focus on international cooperation is retained.

- **Advanced electricity storage technologies**
  $20.4 million will be provided for the development of advanced storage systems for electricity from intermittent generation systems.

- **Wind forecasting capability**
  $14 million will be provided to support the development of a wind forecasting system and software that is suitable for Australian conditions.

These programs will be overseen jointly by the Minister for Industry, Tourism and Resources, and the Minister for Environment and Heritage.
BACKING AUSTRALIA'S ABILITY

PART THREE - Developing and Retaining Australian Skills

Building and maintaining a strong innovation system requires more than the skills and knowledge related to the study of science and technologies. It also requires the ability to generate new ideas, manage the processes of innovation and capitalise on innovative ideas. Australia has a broad human capital base to underpin science and innovation, with our education and training systems providing a wide range of skills. A strong skills base is important as it provides us with the ability to grasp and create new opportunities from technology developments and innovation.

A decline in the proportion of year 12 students, and participation at the undergraduate level in university, in the physical sciences suggests that the long-term sustainability of Australia’s skills base in the enabling sciences could be under pressure. A lack of interest in the enabling sciences appears to be an international trend, with a European Commission report stating that evidence of falling interest in the ‘classical’ fields, such as mathematics and physical sciences was very clear in France, Germany and the UK.

The Australian Government recognises that strengthening our skills base is an investment in Australia’s future prosperity and long-term growth. To ensure its long-term sustainability the Government has set in place initiatives focusing on both the school and higher education system, and on fostering entrepreneurship and awareness of science and innovation in Australia. Backing Australia’s Ability programmes which focus directly on skills development and science awareness represent an investment of $660 million over 10 years.

Highlights in 2003-04 included:

- Funding of $151 million provided 2,000 additional targeted university places in 2002, with a priority on mathematics, science and information and communications technology. This number will grow to about 5,470 places in 2005 as students continue in their courses. Funding extension to the programme through Backing Australia’s Ability – Building Our Future through Science and Innovation will provide additional funding of $199.5 million over five years from 2006-07.

- Australian students ranked amongst the best internationally in biology, chemistry and physics at the Olympic Games for Science.

- The Higher Education Loan Programme (HELP) will be introduced in 2005. HELP includes a new loan programme called FEE-HELP. It will ensure that most full fee-paying students are not prevented from studying by being unable to pay their fees up front. The total value of a student’s fees that may be paid using FEE-HELP is $50,000 over the student’s lifetime.

SCHOOLS

Encouraging an interest in science in the early stages of schooling is important in ensuring long-term participation in science and technology. Internationally, Australian students perform well in reading, mathematics and scientific literacy, however the fall in numbers of students undertaking specialised mathematics and science subjects in senior years is a cause for concern. Participation in science subjects is a significant factor in ensuring not only a supply of candidates for undergraduate science degrees, but also leads to an adequate understanding of science and technology issues among the population as a whole.
Participation (as a proportion of total year 12 enrolments) in both physics and chemistry had fallen to below 20 per cent (17 per cent for chemistry and 16 per cent for physics) by 2002 (compared to 25 per cent for all biology).

Data available from 1976 show the decline in participation in physics, chemistry and biology subjects in year 12. This is partly compensated for by emerging participation in other sciences, for instance, psychology.

The 2003 Review of Teaching and Teacher Education stated that science, technology and mathematics education must be given a high priority. *Backing Australia’s Ability – Building Our Future through Science and Innovation* does this, building on earlier initiatives, by providing $38.8 million over seven years for the Boosting Innovation, Science, Technology and Mathematics Teaching initiative, and continuing the Fostering Scientific, Mathematical and Technological Skills and Innovation in Government Schools measure first introduced under *Backing Australia’s Ability*.

**Fostering Foundation Skills**

Through *Backing Australia’s Ability*, the Australian Government is contributing $184.3 million over five years to government schools where the enrolment benchmark adjustment (EBA) is triggered to:

- achieve better scientific, mathematical and technological skills;
- develop school-based innovation; and
- build supportive school environments.

States which trigger the EBA must submit a strategic plan each year setting out the proposed activities to strengthen the science, mathematics and technology curriculum in government schools.

For 2004 the total amount of the EBA liability is $94.2 million. It has been triggered in New South Wales, Victoria, Queensland, South Australia and Western Australia.

Fostering foundation skills will continue under *Backing Australia’s Ability – Building Our Future through Science and Innovation* with the Australian Government providing an estimated $373 million over the next four years.

The Learning Federation: Schools Online Curriculum Content Initiative

The Australian Government committed $34.1 million over five years (2001-2006) to help develop online learning materials and accompanying services and systems for schools. This collaborative initiative is funded through the Australian Government’s Backing Australia’s Ability on a matched funds basis with all States and Territories. The New Zealand Government joined the initiative in 2002, contributing a further $4.8 million.

Achievements in 2003-04 include:

- creating 27 new content development projects in six curriculum areas including Science; Mathematics and Numeracy; Studies of Australia; Languages Other than English; Literacy for Students at Risk; and Innovation, Enterprise and Creativity;
- developing the Schools Online Thesaurus, a system that describes the subject matter of online content and helps teachers to search for content that is suitable for their curriculum requirements;
- developing software to help teachers use learning objects within Microsoft PowerPoint; and
- involving 74 curriculum expert teachers in content design workshops and educational soundness reviews.

www.thelearningfederation.edu.au

Finders Keepers is an online literacy learning programme that received rave reviews by school students when it was trialled in classrooms in 2003. The approach being used by The Learning Federation to develop the online content is the ‘learning object’ model. The model has been selected because it provides greater flexibility as each learning object is reusable in multiple contexts for multiple purposes.

Finders Keepers allows students to navigate through a three-dimensional house, collecting clues and useful objects to discover hidden treasure and uses a series of reflective questions about a range of everyday texts to encourage students to read.

Students use a range of strategies to decode written and visual texts, consider the author’s purpose, construct and combine literal and implied meaning to solve problems, and take action based on information in written and visual texts.


National Youth Science Forum

The National Youth Science Forum (NYSF) brings together industry and education partners to provide 288 year 12 students from around Australia with information about a range of career possibilities in science, technology and engineering.

The Forum, a two-week residential programme in Canberra, involves a mix of scientific and social activities, including visits to science and engineering institutions such as CSIRO research establishments, the John Curtin School of Medical Research at the Australian National University and the Australian Defence Force Academy. Participating students are chosen on the basis of a demonstrated interest in pursuing careers in science, technology or engineering-related fields, as well as their interest in extra-curricular activities such as sport, drama or music.

In 2003, the Australian Government committed $40,000 per year over three years to support the Forum.

www.nysf.edu.au

The Smart Olympiads

Physics, biology and chemistry

In 2004, thousands of Australian students competed for places on three teams at the Rio Tinto Australian Science Olympiads. These teams then went on to compete against the brightest students in the world. In 2004, 12 of the 13 competitors were awarded medals (including three gold medals) and Australia ranked amongst with the best internationally in biology (placed ninth out of 43 countries) chemistry (fifteenth out of 62) and physics (twelfth out of 72 countries).

These prestigious Olympic Games for Science are held annually in different countries, with Australia hosting the 15th International Biology Olympiad in July in Brisbane. To produce the event, the Rio Tinto Australian Science Olympiads formed a partnership with the Universities of Queensland, Griffith University and Queensland University of Technology. The event was the biggest ever, with 43 countries competing. The Australian Government provided $355,000 to support the event.

Mathematics and informatics

At this year’s International Mathematical Olympiad in Athens, the Australian Team placed 27th out of 85 countries, winning a gold medal, a silver medal, two bronze medals and an honourable mention.

Professor Peter Taylor, Executive Director of the Australian Maths Trust, which administers Australia’s involvement in the International Mathematical Olympiad acknowledged, the Australian Government’s commitment, $1.8 million for three years to support the Australian Maths Trust and the Rio Tinto Australian Science Olympiads as well as the teams representing Australia at the Olympiads.

www.rtaso.org.au

www.amt.canberra.edu.au
Higher Education

*Education at a Glance: OECD Indicators 2004* states that higher stocks of human capital enhance the development and diffusion of new technologies, and it is estimated that the increased long-run effect on economic output per capita of one additional year of education in the OECD area generally lies between 3% and 6%\(^3\). Higher education students in science, technology and engineering underpin Australia’s ability to continue generating new ideas and the capacity to adapt and adopt emerging technologies.

The number of science and engineering (S&E) graduates from Australia’s universities has increased from 17,082 in 1989 to 46,472 in 2002. S&E graduates as a percentage of total graduates remained steady in the 1990s (around 19%) and rose rapidly in the last few years, to 22.7% in 2002. However as a percentage of total graduates Australia is below the OECD mean of 26.1%.

The Australian Government has introduced a number of initiatives to increase numbers of university graduates with science and engineering degrees, including the continuation of the university places originally allocated under *Backing Australia’s Ability* in 2001.

In August 2004 a skills audit was announced, which will address areas of scientific skills shortage in Australia. The audit will evaluate the supply and demand of graduates from the major scientific disciplines, and report on skills shortages in sub-disciplines such as statistics, applied physics and entomology. This will provide an understanding of where shortages lie, and allow government, industry and research organisations to better meet these skills needs.

![Figure 24: Science and engineering graduates from Australia’s universities, 1989 to 2002](image)

Source: The Science and Innovation Analysis Section, DEST.

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2,000 Additional Targeted University Places

Through *Backing Australia’s Future – An Innovation Action Plan for the Future* funding of $151 million was provided for 2,000 additional targeted university places in 2002, with a priority on mathematics, science and information and communications technology. This number will grow to about 5,470 places in 2005 as students continue in their courses.

Funding extension to the programme through *Backing Australia’s Ability – Building Our Future through Science and Innovation* will provide additional funding of $199.5 million over five years from 2006-07.

The initial bids for places were assessed on their approaches to teaching and learning and whether these were designed to meet the needs of industry and attract talented students to careers in science and technology.

Courses with *Backing Australia’s Ability* places include:

- Bachelor of Science/Bachelor of Computer Science;
- Bachelor of Telecommunications Engineering;
- Bachelor of Science/Bachelor of Education;
- Bachelor of Computer Systems Engineering;
- Bachelor of Information Management;
- Bachelor of Engineering (Bioinformatics);
- Bachelor of Engineering (Photovoltaics & Solar Energy);
- Bachelor of Science Nanotechnology; and
- Diploma in Innovation Management.

The number of Australia’s PhD graduates in science and engineering has tripled since 1989, amounting to 1,746 persons in 2002, of which two-thirds were in science (including life sciences, physical sciences, mathematics and statistics, and computing) and one third in engineering (including engineering and engineering trades, manufacturing and processing, architecture and building). S&E PhD graduates as a proportion of total PhD graduates have dropped from 46.9% in 1989 to 37.2% in 2002.

Figure 25: PhDs in Science and Engineering from Australia’s universities, 1989 to 2002

Source: Science and Innovation Analysis Section, DEST
**Research Training Scheme**

The broad aim of the Research Training Scheme (RTS) is to strengthen Australia’s knowledge base and research capabilities by enhancing the higher education research training system. The RTS provides block grants, inclusive of a capital component, to eligible higher education institutions to support research training for students undertaking doctorates and masters by research.

RTS funding rose from $527.4 million in 2003 to $540.8 million in 2004.

The announcement of a simplified RTS was made in August. The new scheme will provide funding certainty and reduce the administrative burden for universities.


**Postgraduate Education Loans Scheme**

The Postgraduate Education Loans Scheme (PELS) provides loans to eligible students who are enrolled in fee-paying, postgraduate non-research courses. It is designed to remove barriers to national investment in education, training and skills development and increase enrolments in fee-paying postgraduate non-research courses.

PELS enables students to obtain a loan to pay all or part of their tuition fees. The Australian Government pays the amount of the loan directly to the student's provider on their behalf. The repayment arrangements for PELS loans are the same as under the Higher Education Contribution Scheme (HECS). Students repay their loan through the Australian taxation system once their income reaches the minimum threshold for compulsory repayment ($35,000 in 2004-05).

In 2003, the Australian Government paid $193 million to institutions on behalf of 39,810 students who had elected to take out a PELS loan for their tuition fees. These students filled the equivalent of 18,112 full-time places, or 47% of the 39,351 full-time places provided in domestic fee-paying postgraduate non-research courses.

The Higher Education Loan Programme (HELP) will be introduced in 2005 as part of the Australian Government’s higher education reform package, *Our Universities: Backing Australia’s Future*. HELP includes a new loan programme called FEE-HELP which will replace PELS and a number of other loans schemes that assist people to pay tuition fees.

PELS students who commenced their course of study before 1 January 2005 will be able to access FEE-HELP for that course of study under the current PELS eligibility criteria until the end of 2008, or until they complete or discontinue their course of study.

FEE-HELP will make loans for tuition fees more broadly available to fee paying students, including undergraduate fee paying students, and will enable Australian citizens and holders of a permanent humanitarian visa who are not in a Commonwealth Supported (HECS) place to obtain loans to pay all or part of their tuition fees. It will ensure that most students who wish to accept a full fee-paying place in a course of their choice are not prevented from doing so by being unable to pay their fees up front. The total value of a student’s fees that may be paid using FEE-HELP is $50,000 over the student’s lifetime.


Australian Postgraduate Awards programme

The Australian Postgraduate Awards (APA) programme aims to:

- support postgraduate research training in the higher education sector; and
- provide financial support to postgraduate students of exceptional research promise who undertake their higher degree by research at an eligible Australian higher education provider.

APAs are available for a period of two years for a masters by research degree or three years, with a possible extension of six months, for a doctorate by research degree. APA holders receive an annual stipend and may also be eligible for other allowances.

Participating institutions are provided with funding for continuing awards and a notional number of 1,550 new awards each year. The allocation of awards to participating institutions reflects their overall research performance. All students receiving APAs are also funded through the Research Training Scheme.

In 2004, total funding for the scheme was $89.2 million. This will increase to $91.1 million in 2005. From 2006, under the new reform package *Our Universities: Backing Australia's Future*, the number of new APA scholarships awarded each year will be adjusted to accommodate population growth. This will ensure that postgraduate research opportunities do not decrease on a per capita basis as the population grows.


International Postgraduate Research Scholarships programme

The Australian Government provides research awards under the Endeavour International Postgraduate Research Scholarships (IPRS) programme to high quality international students.

The IPRS was established to maintain and develop international research links and to:

- attract top quality international postgraduate students to areas of research strength in Australian higher education institutions; and
- support Australia's research effort.

The programme was integrated into the Endeavour Programme in 2004 following the announcement in *Our Universities: Backing Australia's Future*.

Endeavour IPRS are available for a period of two years for a masters by research degree or three years for a doctorate by research degree, with the possibility of a one year extension. The scholarship covers the student's tuition fees and health insurance premiums for them and their dependants.

There are about 1,000 students on Endeavour IPRS at any given time. In 2004 about 330 new IPRS were awarded at a cost of $17.4 million. This will increase to $18.1 million in 2005.

The global science and technology labour market is becoming increasingly competitive. Data from the ABS suggest a small net loss of S&T professionals when only Australian residents are considered, however, over the last five years 1998-99 to 2002-03, Australia has experienced net gains in scientists and engineers through its migration programme, including 17,487 computing professionals, 15,216 engineers, 2,868 national & physical scientists, and 223 mathematicians, statisticians and actuaries.

Federation Fellowships

The ARC's Federation Fellowships are highly prestigious awards designed to build world-class research capability in Australia. The Fellowships are designed to support and encourage researchers to stay in or return to Australia by providing an internationally competitive salary.

On 16 June 2004 the Australian Government announced 25 new Federation Fellowships, with funding commencing in 2004. Of the 25 Fellowships awarded, 10 are to expatriate Australians who will leave international organisations to return home, and five are to foreign nationals who will bring their experience and talent to Australia. The new fellowships bring the total number awarded under the scheme to 72.

Left to right: Professor Stephen Hyde (2004 Federation Fellow), Dr Stephen Walker (then Acting Chief Executive Officer Australian Research Council), Professor Michael Neilson (2004 Federation Fellow), Professor Chennupati Jagadish, the Hon Dr Brendan Nelson (Minister for Education, Science and Training), Professor Peter Hodgson (2004 Federation Fellow), Professor Mathias Trau (2004 Federation Fellow), Professor Ary Hoffmann (2004 Federation Fellow)

Credit: Image supplied by the Australian Research Council
Skilled Immigration

Immigration initiatives were introduced in 2001 under Backing Australia’s Ability to increase the number of ICT skilled persons entering and retained in Australia through the permanent migration and temporary entry programs.

Since late 2001, however, there has been a reduced demand for overseas ICT workers. In July 2002, priority visa processing arrangements for ICT workers were suspended following the advice that the demand for ICT workers had plateaued.

Migrants entering under the permanent skilled migration stream are given additional points where their occupation is on the Migration Occupations in Demand List (MODL). In December 2003, the Department of Immigration and Multicultural and Indigenous Affairs, in consultation with the Department of Employment and Workplace Relations, removed all ICT specialisations from the MODL.

The electronic lodgement of applications for all temporary business (long stay) visas including temporary resident ICT workers has been developed. The program has been in place since November 2003, the current take-up rate of electronic lodgement is around 60% of all temporary business (long stay) related applications.

HARDIER CROPS

Australian scientist Professor Mark Tester is investigating the effects of random gene activation in specific cell types of cereal crops that survive in poor soils to develop hardier crops and plants with altered concentrations of nutrients in their leaves and grain.

Professor Tester has received an ARC Federation Fellowship worth $240,000 a year from 2003 to 2007. As part of the Fellowship, Professor Tester returned to Australia from Cambridge University in the United Kingdom to join the Australian Centre for Plant Functional Genomics (ACPFG) headquartered at the University of Adelaide. The ACPFG is a partnership between the Australian Government, several universities, State governments and industry.

Australia is a leading player in the important emerging field of plant functional genomics, which may unlock our ability to grow crops in drought conditions and saline or acidic soils.

Research conducted by the ACPFG will directly benefit Australia’s $8 billion agricultural industry, in particular grain growers. Professor Tester’s work on salinity tolerance will build on work at Cambridge on sodium transport at the cellular level.
Fostering Entrepreneurship and Awareness of Science and Innovation

An understanding of innovation supports sound business decision making and attracts young people into innovative and entrepreneurial careers. In 2001 Newspoll conducted a survey providing a snapshot analysis of the importance of S&T, investment in S&T, and interest in developments in S&T across Australia. It found that 72.5% of adult Australians have an interest in scientific and technological developments. However, the 18 to 24 and 50+ age groups recorded the lowest ‘very interested’ rates and also the highest ‘not interested’ rates.

The Government funds a variety of programmes to ensure that benefits from science and innovation are publicly disseminated. Backing Australia’s Ability – Building Our Future through Science and Innovation will ensure this continues with initiatives such as the new Science Connections Programme, which is receiving $25.8 million over the next seven years.

National Innovation Awareness Strategy

The National Innovation Awareness Strategy (NIAS) is a $35 million, five-year initiative under Backing Australia’s Ability which aims to assist in building a culture that appreciates and rewards innovation and science. NIAS aims to raise understanding of the importance of science, encouraging the continuing study of science in senior secondary school, and also seeks to promote the commercial potential of innovation, especially among small to medium-sized enterprises and young Australians.

The programme is jointly managed by the Department of Industry, Tourism and Resources and the Department of Education, Science and Training (DEST).

NIAS - Department of Education, Science and Training

The overall purpose of the DEST administrated elements of NIAS is to finance effective public science events and activities which celebrate achievements in science, attract community interest and encourage young people to consider continuing studies in science, mathematics and engineering. The Prime Minister’s Prizes for Science recognise and reward the outstanding contributions of Australia’s exemplars of science and science teaching. National science outreach and extension programmes such as ABC Science On-line, National Science Week and the Rio Tinto Australian Science Olympiads are also supported by the programme.

Achievements in 2003-04 include:

- awards of the 2003 Prime Minister’s Prizes for Science to Professor Jacques Miller, Dr Howard Wiseman, Dr Chris Helliwell, Dr Pamela Garnett and Ms Sarah Tennant. See www.sciencegrants.dest.gov.au/scienceprize/pages/home.aspx;
- a capital contribution of $1 million to the Messel Endowment, which will fund the operating costs of the Professor Harry Messel International Science School. This residential school, held once every two years, is run by the Science Foundation for Physics in the University of Sydney’s School of Physics;
- extending support to ABC Science Online. The ABC will receive $3.2 million over three years to assist its delivery of a range of science programme initiatives through “The Lab”, the ABC’s on-line science site;
- National Science Week – a successful celebration of science in August 2003;
- awards of Eureka Prizes for science communication to Dr Cathy Foley and Ms Sonya Pemberton; and
- increasing funding to nationally significant science programmes:
  - Science meets Parliament, an initiative of the Federation of Australian Scientific and Technological Societies;
Science in the City, run by the Australian Museum ($190,000 over three years);

the University of Newcastle’s Science and Engineering Challenge ($680,000 over three years); and

Sleek Geek Week, the nationally touring science entertainment extravaganza created by Dr Karl Kruszelnicki and Adam Spencer.

Through Backing Australia’s Ability – Building Our Future through Science and Innovation the Australian Government is providing $25.8 million over the next seven years for the Science Connections Programme to continue these key science awareness elements.

The University of Newcastle’s Science and Engineering Challenge is an innovative and stimulating competition that is designed to encourage students to take-up science and mathematics subjects – and it’s working.

The Challenge started in 2000 when 14 schools in the Newcastle region took part. Last year, 140 schools participated in several New South Wales regional areas, and for the first time, the Challenge was also staged in Adelaide.

The Challenge usually runs for one school day, with up to eight schools competing. The events range from problem solving to design and build exercises, and aim to introduce and apply underlying principles of technology that students may not have appreciated previously. Activities include the building and testing of model boats, siege catapults, flying dirigibles, and balsa bridges. These activities also promote teamwork, inspire leadership, encourage self-confidence and dispel myths about what a career in science and engineering actually involves.

The regional spread and take-up of the Challenge is due not only to the efforts of the dedicated University of Newcastle team, but also to community-based assistance from Rotary, Engineers Australia, and local councils, businesses and schools.

The Challenge has had some remarkable impacts in New South Wales. In those schools participating in the Challenge, enrolments in physics, chemistry and advanced mathematics have grown at rates faster than those in the rest of New South Wales. The impact is particularly dramatic for physics, where enrolment growth in Challenge schools has been six times greater than the State average.

In June 2004 the Australian Government, through its National Innovation Awareness Strategy, agreed to provide $680,000 to the Challenge over the two and a half years of June 2004 to December 2006. Funds will be used to build more Challenge kits, train new presenter teams and expand the Challenge to other parts of New South Wales and Australia. To oversee this expansion, the University of Newcastle has created a National Council which will be chaired by Mr Tim Besley AO.

The Science and Engineering Challenge won Engineers Australia’s Sir William Hudson Award for Engineering Excellence in November 2003, the Institute of Physics (UK) award for the Public Promotion of Physics in 2002 and was runner-up in 2001 for the Australian Government Eureka Prize for Promoting Understanding of Science.
NIAS – Department of Industry, Tourism and Resources

The Department of Industry, Tourism and Resources will spend $13.9 million over five years to advance the National Innovation Awareness Strategy.

In 2003-04 projects supported included:

- **Pathways to Innovation** by Ryebuck Media Pty Ltd. An education and public awareness pilot training programme to implement an innovation culture in schools and communities;
- **EngQuest** by Engineers Australia. An education competition involving primary and high schools, motivating students to study science, mathematics and technology;
- **Black Box Innovation Lecture and Award** by B2B Café. A series of lecture events profiling innovative business people and outlining their vision for Australia;
- **From Boomerangs to Satellites** by National Indigenous Radio Service Ltd. A series of broadcasts on the history of innovation in Indigenous cultures; and
- **Fresh Innovators** by ScienceNOW!Inc. Gives recognised young innovators national and international media exposure, including a four day course in how to present their work.

Business Plan Competition Grants are also part of NIAS. Participating in a business plan competition provides valuable real-life experience and encourages participants to establish new, innovative and entrepreneurial companies.

Other NIAS grants included $150,000 to support the 2004 Australian Innovation Festival and $250,000 to Young Achievement Australia, a not-for-profit organisation providing school students in Years 7 to 10 with the entrepreneurial skills required to establish and manage a business.


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**HIGH SCHOOL STUDENTS APPLY INNOVATION PRINCIPLES TO THEIR OWN COMMUNITIES**

How to apply innovative problem solving skills to manage water for a sustainable future was on the agenda when over 600 students from schools in Canberra, Melbourne, Hobart, Adelaide, Brisbane and Sydney participated in a Youth Challenge held by Ryebuck Media in 2004.

The pathways that lead to innovation were discussed and highlighted by guest speakers working in innovative fields. Local innovators provided real life insights into their business experiences and spoke about the importance of innovation for achieving their outcomes.

Students were invited to conduct an audit of innovations in their own community and submit a report for judging. Two winners from each State will be selected to make a presentation to a future national innovation conference.

The strength of this programme lies not only in encouraging students and teachers to consider innovation in a number of ways and to take the ideas back with them to the broader community, but also in planting the motivational seed that will see students eager to pursue innovative and entrepreneurial careers.

The challenge is part of the Australian Government’s National Innovation Awareness Strategy.
Questacon – The National Science and Technology Centre

Questacon, Australia’s National Science and Technology Centre, delivers creative interactive exhibitions, programmes and face-to-face science performances across Australia to increase awareness of science and innovation through inspirational learning experiences. Exhibitions also travel overseas to help market and raise Australia’s education and research capability.

Highlights of 2003-04 include:

- 10 different exhibitions which travelled across Australia and overseas, reaching more than 600,000 visitors;
- outreach programmes which attracted 276,074 participants, mainly in regional and rural Australia;
- the Shell Questacon Science Circus which enabled Australians in regional and rural areas to experience a high quality, portable science centre in their own communities. It is also the training ground for science communication graduates; and
- Indigenous Outreach which worked with remote communities to develop appropriate science and technology awareness programmes.

www.questacon.edu.au

Questacon Smart Moves

Questacon Smart Moves is designed to raise awareness of science, technology, innovation and related careers in regional and rural secondary schools.

During 2003-04, the programme travelled through regional and rural secondary schools in Queensland, the Northern Territory, northern New South Wales, coastal New South Wales and South Australia and had 87,076 student participants. There were 114,028 visitors to the Smart Moves website.

During 2004-05, the programme will travel to regional and rural secondary schools in Western Australia, Tasmania, Victoria, Queensland and the Northern Territory and is expected to involve a minimum of 70,000 students.

In September 2003, a pilot for a Questacon Smart Moves youth conference (the Invention Convention) was run. It gave 15 aspiring youth entrepreneurs the opportunity to learn new business and entrepreneurial skills, and to network with already established young entrepreneurs.

The programme will now continue through to 2010, with the Australian Government providing an extra $11.4 million over seven years through Backing Australia’s Ability – Building Our Future through Science and Innovation.

http://smartmoves.questacon.edu.au

National Innovation Council

The National Innovation Council assists the Minister for Industry, Tourism and Resources and the Department for Industry, Tourism and Resources communicate the benefits of innovation to students, small and medium-sized businesses and the community. It provides strategic guidance to the operation and direction of National Innovation Awareness Strategy – Department of Industry, Tourism and Resources.
As part of the implementation of *Backing Australia’s Ability*, the Australian Prime Minister announced four National Research Priorities (NRP) in late 2002:

- An Environmentally Sustainable Australia;
- Promoting and Maintaining Good Health;
- Frontier Technologies for Building and Transforming Australian Industries, and
- Safeguarding Australia.

These are areas of particular social, economic and environmental importance to Australia, and areas in which a whole-of-government focus has the potential to improve research and broader policy outcomes. The setting of these research priorities is expected to result in significant long-term benefits to Australia by increasing research effort in key areas.

The four National Research Priorities are broadly based, thematic and multidisciplinary in nature, and are underpinned by a set of goals (Appendix 7). The priority goals were enhanced during 2003 to strengthen the contributions of social sciences and humanities research.

During 2003, research-funding and research-performing agencies developed implementation plans showing how they would encompass National Research Priorities, and these were considered by a seven member Expert Committee, chaired by the Chief Scientist. The Committee’s considerations of the plans led to recommendations that:

- the NHMRC and the ARC work together to look at ways to overcome existing barriers to collaboration;
- NHMRC take a lead role in addressing the need for a more substantial research effort in relation to ‘A healthy start to life’ and ‘Ageing well, ageing productively’;
- the Department of Prime Minister and Cabinet establish a new unit to coordinate scientific support for counter-terrorism. This unit was announced in the *Backing Australia’s Ability – Building Our Future through Science and Innovation* package, with funding of $7.2 million over the next four years; and
- the Attorney General’s Department work with other agencies in addressing the need for a more substantial research effort in relation to the priority goals ‘Critical infrastructure’ and ‘Protecting Australia from terrorism and crime’.

All public sector research and research funding bodies of the Commonwealth are expected to participate in implementing the priorities to the extent that they are consistent with their mandates or missions. In late 2003, the Australian Government endorsed plans submitted by agencies to implement the research priorities. During 2004 agencies further aligned their implementation plan and associated activities to capture priority goals relating to social sciences and humanities research. A Standing Committee, chaired by the Chief Scientist, is to be established and is expected to meet annually to assess agencies’ progress in implementation, and report to Government. Agencies will report on their progress with the implementation of the priorities through their own annual reports, and this Innovation Report.

During 2003-04, in its first full year of operation, the National Research Priorities initiative has been embraced by all Government-funded research-producing and research-funding bodies. While some agencies have a very wide coverage of the goals, others are, because of their specialist nature, concentrating their effort towards just a few of the goals.
The following brief selection of examples are derived from NRP-reporting agency reports on progress with implementation for 2003-04, and provide examples of part of what the agencies are doing to address the research priority goals.

**Priority - An Environmentally Sustainable Australia**

**Goal: Water – a critical resource**

_Agricultural land use and sediment transport to the Great Barrier Reef_. CSIRO’s dataset for _Advanced Time Series for Natural Resource Management_ enables improved understanding and management of the relationship between agricultural land use and sediment transport to the Great Barrier Reef. Uptake of this information in the agricultural sector is delivering improved yield forecasting (e.g. dairy, sugar). The Bureau of Rural Sciences (BRS) is also investigating use of the dataset for drought exceptional circumstances assessment and monitoring.

_Water management_. The Australian Bureau of Agricultural and Resource Economics (ABARE) released several reports on water management issues during 2002-04:

- The ‘_Water rights and trade: meeting the reform agenda_’ report (March 2004) examined the issue of unbundling water property rights into their individual access rights and the potential to trade these individual access rights. The aim is to improve the efficiency of water and infrastructure use.

- The _Government purchase of water for environmental outcomes_ (Nov. 2003) report identified the options for purchasing environmental water, the price advantage of competitive tendering over entering the market where markets are thin or non-existent, and the potential for sourcing water purely on the basis of price to concentrate the withdrawal of water from certain regions.

- A report for the Queensland Department of Natural Resources and Mines (2002-03) evaluated policy options to address externalities associated with water harvesting, delivery and use.

- _Monitoring the health of our waterways_. Knowledge of Australian flora, fauna, fungi, and other organisms is critical for environmental impact studies and biosecurity risk.

**Goal: Transforming existing industries**

_Best management practice in cotton industries_. The Cotton R&D Corporation (CRDC) commissioned an independent review of the cotton industry’s environmental management system, _Best Management Practices (BMP)_ in early 2004, as part of an Australian Government National Heritage Trust project. The review identified significant, positive change in all the areas of farm management covered by the BMP manual over the last five years. The review identified the independent auditing system developed by CRDC as the major factor influencing external stakeholders’ recognition of BMP as a valid, effective and measurable environmental management system. The audit program will provide growers with a more cost-effective and integrated system for becoming fully BMP-compliant and maintaining that status over time.

_Assessment and monitoring of impacts of a range of industries on natural systems_. During 2003-04, the Australian Biological Resources Study (ABRS) supported research on algae and fauna of marine and freshwater waterways. Research priorities for aquatic groups and for providing reliable, comprehensive and easily used tools to identify aquatic organisms are determined through consultation and continuing collaboration with national and State water resource managers. This increasing knowledge base will assist in monitoring the health of our waterways and the related sustainability of water related industries such as irrigation farming, fishing, oyster farming and tourism.
Goal: Overcoming soil loss, salinity and acidity

Dryland salinity. Land and Water Australia (LWA) has a brief that is almost solely focused on natural resource management issues. In 2003–04 LWA’s National Dryland Salinity Program, as part of its final year, has concentrated on integrating the information learnt and gained over the past 10 years to better inform primary producers and rural communities about what actions can be taken to alleviate or avoid salinity problems. Products and services emanating from the program have synthesised and promoted the latest salinity management systems, data, technology and knowledge drawn from a decade of national research and development. Major products delivered during 2003-04 include: Managing Dryland Salinity in Australia (full resource kit and CD-ROM); Breaking Ground: Salinity Key Findings and Research Outcomes; Dryland Salinity and Catchment Management; and Dryland Salinity: On-farm Decisions and Catchment Outcomes.

Habitat restoration and rehabilitation: soil biota. Accurate knowledge of the composition and distribution of the Australian flora, fauna, fungi, and other organisms is essential for surveys and monitoring of changes (such scientifically and historically based knowledge) and is essential for appropriate habitat restoration and rehabilitation. ABRS supports research on organisms that interact with and affect our soil biota. Works completed this year include Catalogue of Australian Liverworts and Hornworts, Key to the Genera of Australian Macrolichens, Field Guide to the Mosses & Allied Plants of Southern Australia, and a significant new Flora of Australia volume on lichens. Other works currently underway and funded in part or entirely by ABRS include the development of an interactive key and synopsis of the genera of macrofungi in Australia, studies of Australian Myxomycetes and studies of litter-feeding flies.

Spatial modelling software. In China and Australia, large-scale revegetation using perennial plants (grasses, shrubs and trees) is currently under-way, and more is planned, under an Australian Centre for International Agricultural Research (ACIAR)-funded project. The principal reason for revegetating the hilly parts of the Loess Plateau region of western China is to reduce soil erosion and improve water quality of the Yellow River.

In Australia revegetation is used to reduce the impact of salinity and waterlogging caused by excess water entering regional groundwater systems. However, in both countries the impacts of large-scale revegetation on broad-scale hydrology are poorly understood. An Australian ACIAR-funded international project team, led by CSIRO’s Land and Water, is developing spatial modelling software that will help agricultural policymakers run scenarios to assess the eco-hydrologic changes likely to result from proposed land-use changes. In Australia, the scenarios include pine and eucalypt plantations, and changing annual pastures to deep-rooted perennials such as lucerne. The work is focused on the middle and upper Murrumbidgee catchment, and is being undertaken in association with the CRC for Catchment Hydrology. In the first phase of the work, regional databases of meteorological, water yield and GIS data-layers (digital elevation models, land cover and soils data) covering a 10–30 year period have been collected and are being incorporated into the modelling software. The final product could be extended to other areas in the Murray Darling Basin.

Goal: Reducing and capturing emissions in transport and energy generation

Petroleum and greenhouse gas advice. Through its participation in the new CRC for Greenhouse Gas Technologies (CO2CRC), Geoscience Australia is playing a leading role in developing the technical basis for underground geosequestration of carbon dioxide, as well as contributing to the work of the Inter-Governmental Panel on Climate Change on geosequestration. The agency is also playing a leading role in development of the technical requirements for regulation of geosequestration.

As foreshadowed in its plan, the CRC has established a company, Innovative Carbon Technologies Pty Ltd, to commercialise the intellectual property developed by the CRC. To ensure better focus of the agency’s scientific research into geosequestration and produce closer links with the agency’s government advice function, all related projects have been transferred into the agency’s Petroleum and Greenhouse Gas Advice Group.
Goal: Sustainable use of Australia’s biodiversity

The rezoning of the Great Barrier Reef was successfully implemented on 1 July 2004. The rezoning was based on the Representative Areas Programme managed by the Great Barrier Reef Marine Park Authority which used the best scientific information available to map the biodiversity of the Great Barrier Reef. This is a major step towards protecting the biodiversity of the Great Barrier Reef Marine Park and addressing the environmental sustainability of Australia.

Assessment of seabed biodiversity. Increased effort to better describe the biodiversity of seabed communities is identifying many new species and species records, showing just how much remains to be discovered in relation to marine resources. The Australian Institute of Marine Studies (AIMS) is working closely with State and Australian Government agencies to ensure this information is available for their management planning.

Sustainable development Darwin Harbour. An integrated study of Darwin Harbour, undertaken by AIMS in close consultation with other agencies in the Northern Territory, is focusing efforts to improve sustainable coastal development.

Impact of agricultural chemicals and human activities on our coral reefs and water quality. Our marine environment is under increasing threat from such factors as the impacts of urban, agricultural and industrial development on estuaries and coastal waters, which in turn threaten the sustainability of living resources. AIMS’s historical capability in water quality studies has provided strategic leadership in the development of water quality guidelines and the Reef Water Quality Action Plan. More recently AIMS has provided important input to the development of monitoring strategies essential to measure the performance of this important State-Commonwealth initiative to protect the Great Barrier Reef World Heritage Area.

Goal: Developing deep earth resources

Attracting oil exploration in Australia. In 2003-04, Geoscience Australia commenced a new petroleum initiative to attract oil exploration investment to Australian waters in the very competitive global market for exploration capital. The initiative is designed to open up frontier areas for exploration to maximise the opportunity for discovery of a new oil province and mitigate the progressive reduction in Australian crude oil production. The underlying statistics on reserves, production forecasts and petroleum industry activity are available in the annual publication Oil and Gas Resources of Australia (available online).

Airborne mapping for minerals. In April 2004, CSIRO signed an unincorporated joint venture agreement with the Australian company HyVista Corporation to provide C-Vista (using hyperspectral imaging from a camera in a plane to discriminate between objects on the ground such as rocks and vegetation) as a commercial service. Airborne hyperspectral data will be acquired worldwide and large area multi-flightline data processed to produce seamless mineral mapping products. By more reliably identifying prospective environments before deploying ground personnel, the total costs of mineral discovery are reduced.

Goal: Responding to climate change and variability

Interaction of transport and climate. During 2003-04 the Bureau of Transport and Regional Economics (BTRE) developed projections of greenhouse gas emissions from transport, produced a report on the effects of climate change on road infrastructure, and estimates of environmental costs caused by transport. Together with ABARE and CSIRO, the Bureau also produced a major report on the economic issues surrounding the further development of a biofuels industry in Australia.
Antarctic sea ice processes. The Australian Antarctic Division’s (AAD) work on sea-ice and on the Amery ice-shelf, (in collaboration with scientists from China and the USA, and the Antarctic CRC), contributes to the Government’s goal for the Australian Antarctic programme of “Understanding the role of Antarctica in the global climate system”. The study is extending the understanding of the processes of melt and refreeze of sea ice during the year-related to the transference of heat in ocean water, which in turn is one of the major drivers of the world’s climates.

Nuclear technology to assess the impact of human activity. The Australian Nuclear Science and Technology Organisation (ANSTO) began a major project called ‘Human Activity and Climate Variability’ in 1999, using nuclear technology to study current and future human activity and climate. The project involved extensive collaboration, and 19 Australian and many international organisations have been involved during the past year. This project has made an important contribution to rural and regional environmental sustainability. Among its findings are that human activity is the dominant cause of changes in the landscape, while climate variability acts as a catalyst. The project developed a large data set on aerosol pollution in South East Asia that is being used to model long-term effects on global and local climates. This project is providing the foundations for an ANSTO business that is consulting to environmental agencies, local governments and industry, and two new research projects - ‘Cosmogenic Climate Archives of the Southern Hemisphere’ and ‘Isotopic Tracers in Atmospheric Transport’.

Priority - Promoting and Maintaining Good Health

Goal: A healthy start to life

Study of Australian children’s development. Data collection on the landmark study Growing Up in Australia (the longitudinal study of Australian children) based at the Australian Institute of Family Studies (AIFS) commenced with a trial of all study instruments and processes on a preliminary sample of just over 500 families in late 2003. In March 2004, recruitment commenced of 5,000 infants and 5,000 four year old children and their families to the study. By the end of this first data collection period in September, it is expected that about 10,000 families will have been recruited to the study.

The study aims to provide the evidence base for a comprehensive understanding of children’s development in Australia’s current social, economic and cultural environment, and to become a major element of the evidence base for future policy and practice regarding children and their families. The study is concerned with all aspects of children’s development – their physical and mental health, social adjustment, cognitive development, and school achievement.

Indigenous health. As the principal agency funding health and medical research in Australia, the NHMRC is taking the lead for implementing the Promoting and Maintaining Good Health priority. The NHMRC has undertaken swift action in relation to this priority, inviting applications under the A healthy start to life goal. The NHMRC is offering funding of $7 million over five years to support collaborative research that has the potential to improve the maternal, infant and childhood health of Aboriginal and Torres Strait Islander Peoples.

Extensive consultations on Aboriginal and Torres Strait Islander health research, undertaken through an NHMRC/Office of Aboriginal and Torres Strait Islander Affairs collaborative venture between 2000 and 2003, have provided a substantive basis for this call. In line with the outcomes of the consultation, the structure of this research initiative reflects the recognition that long-term improvements in the health of Aboriginal and Torres Strait Islander peoples have the best chance of success when the interaction between health and non-health issues are taken into account. Funding for successful applicants will commence in 2005.
Goal: Ageing well, ageing productively

**CSIRO’s Total Wellbeing Diet.** With increasing concern over obesity, and pressure to contain the costs of healthcare, successful lifestyle intervention strategies will be an increasingly important part of community health programs and personal health management. CSIRO’s scientifically credible dietary information has been enthusiastically received by the public and health professionals. The concept of low glycemic load diets, such as the CSIRO Total Wellbeing Diet, has been supported by Professor Jenny Brand-Miller, an expert in carbohydrate metabolism, and other researchers who believe that glycemic load plays a role in disease.

**Marine biochemistry for health.** AIMS continued its search for marine biochemistry with the potential to combat diseases associated with ageing; to fight tropical diseases, such as tuberculosis (TB), and potentially fatal bacteria, such as E.coli; and to be developed into anti-cancer and anti-tumour agents.

Goal: Preventive healthcare

*Health costs of transport pollution.* In 2003-04, BTRE completed estimates of the economic costs of the health impacts of transport emissions.

**Dedicated Research in Indigenous Health.** Over the last year, the Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS) shifted priorities so that the Research Fellows and staff in Health are now 100% dedicated to the CRC for Aboriginal Health (CRCAH). The Health Fellows (in combination with inter-institutional colleagues) have completed five papers commissioned by the CRCAH. These were:

- Governance as a Social Determinant of Health Outcomes for Aboriginal People: a scoping paper for the CRC for Aboriginal Health;
- Social and emotional well being of Aboriginal and Torres Strait Islander people within the broader context of the social determinants of health;
- Social Capital and Aboriginal and Torres Strait Islander Health: Problems and Possibilities;
- Framework for Research on Aboriginal Health and the Physical Environment; and
- Culture in Health Research and Practice.

Goal: Strengthening Australia’s social and economic fabric

**Regional development.** BTRE is developing significant new information products providing a deeper understanding of regional development issues in Australia. They include the Bureau’s *Focus on Regions* data and analysis series on industry structure and education, skills and qualifications (two reports completed in 2003-04). The Bureau has also completed a major investigation on government interventions in pursuit of regional development, and is currently preparing a report on the spatial dynamics of Australian development.

**Profiling Indigenous Knowledge Systems and Capacity.** AIATSIS research staff focus on projects that enhance understandings of cultural transmission, education, language, cultural heritage and governance. The publication *Success in Aboriginal Communities: a Pilot Study* has been recently completed. The report profiled the elements of success in two Indigenous organisations: Wangka Maya Language Centre and Durri Aboriginal Corporation Medical Service. A Visiting Research Fellowships in Cultural Transmission and Education, and Social Organisation has been awarded for the start of 2005. The AIATSIS 2004 Conference entitled Sharing the Space will contain a number of major sessions specifically examining such issues as Indigenous knowledge systems, ATSI tertiary curriculum, Indigenous and European world views and the transmission of cultural information.

**Publications about rural issues.** BRS’s *Country Matters: a social atlas of rural and regional Australia* provides easily accessible spatial information on the economic and social indicators of non-metropolitan Australia while providing comparisons with indicators from metropolitan areas, based on recent Australian Census data. This was a major research project that included agriculture, fisheries, forestry and dairy social profiles.
Priority - Frontier Technologies for Building and Transforming Australian Industries

Ceramic nanoparticle technology. ANSTO is developing materials and process technology for encapsulating and releasing a wide range of active molecules from ceramic micro- and nano-particles. The particles have a defined microstructure which can be tailored to commercial requirements for specific dose and release rates. ANSTO regards this MuCaps technology as being especially advantageous in home, health and personal-care. Over the past year ANSTO has concentrated on reaching proof-of-concept stage for medical and industrial applications and on prospecting for future industrial collaborations. ANSTO has also developed (and is patenting) a novel method for producing nanoparticles with the size and long-term release capabilities necessary for the passive targeting of tumours.

Research on road-user charging. BTRE undertook research in 2003-04 on road user charging which describes the scope for using new technologies for vehicle identification, tracking and the potential of user charges in changing transport industry technologies and user behaviour.

Commercial application of biotechnology. One of the highlights of the year for the Rural R&D Corporations (RDCs) was the continuing evolution of genetically modified cultivars in the Australian cotton industry, which is the only major agricultural industry in Australia that uses commercial applications of biotechnology.

The CRDC-funded development and subsequent commercialisation of insect and herbicide tolerant varieties of cotton, has led to major reductions in insecticide and herbicide use and helped to maintain profitability for cotton farmers in the face of an ever-narrowing gap between costs and income. Glyphosate herbicide-resistant cotton using Roundup Ready® technology has also given cotton farmers a new tool to help manage weeds more efficiently, at less cost and with the use of less residual herbicide.

Goal: Breakthrough science

CSIRO’s Safer Aircraft Structures, is a demonstrator system built for NASA, which can detect and evaluate high speed particle impacts. It has no central controller, handles data from many sensors, and makes intelligent decisions based on damage evaluation, diagnosis and prognosis in a distributed system. CSIRO’s growing expertise in understanding emergent behaviour in multi-agent systems may lead to major breakthroughs affecting many technologies in which large amounts of data are handled.

Spatial data modelling and visualisation tools. The CRC for Spatial Information (CRC SI) has been established, and includes five spatial information programmes. The CRC is developing models and visualisation tools to promote seamless exchange of spatial information between Australian users and interoperability between collections, processing and delivery systems. As a core partner of the CRC SI, Geoscience Australia plays a lead role in several of the CRC SI programs. All Geoscience Australia programs include substantial investment in the development and application of geo-informatics, which ultimately contribute to enhanced national geo-informatics capability and spatial data infrastructure for the nation.
Goal: Advanced materials

Fire-resistant toughened plastic. The CRC for Polymers has developed a plastic that toughens into ceramic barriers that resist the passage of fire. The plastic is used in the construction of public buildings, factories and hospitals.

New biodegradable polymer. A new CSIRO spin-off company, PolyNovo Biomaterials Pty Ltd, has been established by CSIRO and Xceed Biotechnology Ltd to develop this new platform technology. CSIRO and Xceed will each own 50% of PolyNovo and Xceed Biotechnology will invest $5.1 million in the new company. The company’s research will be directed towards tailoring the polymer for applications in orthopaedics, orthodontics, drug delivery, wound care, tissue engineering and cartilage repair.

Goal: Smart information use

The Defence Science and Technology Organisation’s (DSTO) program of information sciences research is a major contributor to the Smart Information Use goal. DSTO has initiatives in future command and intelligence environments, advanced signal processing and surveillance techniques, modelling and simulation, distributed systems, mobile communications, information security and network centric warfare. DSTO has established several collaborative agreements with National ICT Australia.

New scheduling system for Royal Australian Navy. A new scheduling system was used in the evaluation of tenders for the Royal Australian Navy’s replacement patrol boat project, to ensure that the maintenance regimes required by the boats could be scheduled around the required missions. Analysis of multi-crewing scenarios using crew boat mission were also key inputs in determining how many crews to use. These decisions are critical to the ongoing performance of the patrol boat fleet, and hence to the security of Australia.

Goal: Promoting an innovation culture and economy

Benefits to the Australian furniture industry. The Australian furniture industry needs to improve efficiency to compete internationally. The Furnishing Industry Association of Australia has established an ongoing industry technology support service team to help apply this knowledge to individual factories using CSIRO software tools. Zuster furniture manufacturers have achieved a 59% increase in revenue, a 45% increase in the number of units and a 27% increase in return on cost of sales. Other results include a 42% production lead time in one showcase company and a 6.5% overall profit gain in another.

Priority: Safeguarding Australia

CSIRO’s Safeguarding Australia Program. Under it’s Secure Australia program (involving 11 CSIRO Divisions), CSIRO has identified three areas in which it has current capability to make significant impact – biosecurity, counter-fraud devices and detection technologies. Research over the past year has included the development of powerful diagnostic reagents against emerging biowarfare agents (including anthrax) by two La Trobe PhD students co-supervised by CSIRO and DSTO. Also, CSIRO and Australian Customs have begun construction of a commercial-scale version of CSIRO’s unique neutron scanner with the ability to detect explosives, drugs and other prohibited imports. In addition CSIRO’s Optical Variable Devices research program, which has led the world in cutting-edge counter-fraud devices for over a decade, has developed a new optical encryption technology for currency, which will be more difficult to counterfeit and has the potential to dramatically reduce production costs.

Goal: Critical infrastructure

The Attorney-General’s Department (AGD), together with other Australian Government agencies with responsibilities for Critical Infrastructure Protection, is seeking to strengthen relationships between the Australian research community and the owners and operators of the nation’s critical infrastructure.

Through the Trusted Information Sharing Network, the Department aims to enable research to be conducted which is of direct relevance to the owners and operators of critical infrastructure and to assist researchers conducting studies in these areas to receive funding from the various Australian research funding bodies.
Achievements in this arena include:

- **National Information Infrastructure Research:** In late 2003, 20 research related organisations responded to the Australian Government’s Invitation to Register Interest in National Information Infrastructure (NII) Research Proposals. Several proposals relating to the protection of the NII and broader e-security activities were selected for further development and limited project funding.

- **Bilateral discussions with USA, April 2004:** Bilateral discussions with the USA on critical infrastructure protection led to positive information exchanges between IAAGs and their USA counterparts on areas of possible research collaboration.

- **Links with academia and research funding bodies:** AGD has continued its programme of meetings with researchers interested in critical infrastructure protection with an aim to facilitate the coordination of multi-disciplinary research on critical infrastructure protection.

**Protecting infrastructure through bushfire smoke management and forecasting.** Smoke management advice is now issued twice each day for all States in Australia to support decision-making by land managers planning prescribed burns. The aim is to help avoid ignitions when smoke from such fires may impinge on urban or settled areas. The system uses the Bureau of Meteorology’s mesoscale numerical weather prediction system to provide forecast fields of wind and temperature, and a transport and dispersion model to predict smoke concentrations.

**Goal: Understanding our region and the world**

*Indigenous Cultural Publications and Resources.* AIATSIS has produced a corpus of published reports, papers, chapters, books, films and community reports, which address the AIATSIS goal Strategic Knowledge Creation – about the historic and contemporary role and importance of Australian Indigenous societies and their culture in our region and the world.

**Goal: Protecting Australia from invasive diseases and pests**

*Biological weed control.* The weed *Chromolaena odorata* (Siam weed), originally from the tropical Americas, has spread through the wet tropics of Asia and Africa, and is regarded as a serious threat to Australia. The productivity of infested agricultural and grazing land in Indonesia and Papua New Guinea has been substantially reduced. The weed is a prolific seed producer in favourable environments, where it spreads rapidly. Chemical and manual control methods are costly and not always effective. Successful offshore control of the weed is Australia’s first line of defence.

ACIAR has funded work led by researchers from the Queensland Department of Natural Resources and Mines, aimed at achieving biological control of Chromolaena in neighbouring countries, especially the eastern islands of Indonesia and Papua New Guinea. Populations of two insects (a leaf-eating moth and a stem-galling fly) that specifically attack Chromolaena have been established in several parts of Indonesia, where they are controlling or limiting the spread of the weed. The current focus of the work is in Papua New Guinea, where the combination of public awareness campaigns to encourage reporting of outbreaks, and successful introduction of the same two biocontrol agents into eight provinces, is also giving promising results.
Taxonomic information for quarantine and biosecurity. ABRS’s databases provide valid species names and synonyms of taxonomic groups of interest to Australian plant and animal health scientists, quarantine services and Biosecurity Australia. ABRS checklists provide authoritative sources of basic species information including names, distribution and biological information for around 37,000 species of insects, spiders, mites and allies. ABRS-funded studies and checklists also provide baseline information supporting agricultural services, especially studies of potential biocontrol agents, and for rehabilitation work on degraded sites.

Protecting the sugarcane industry from diseases. The Sugar R&D Corporation (Sugar RDC) funded a program of screening sugarcane varieties and advanced clones in Indonesia for resistance to sugarcane smut. This programme was significantly expanded in 2003-04 following negotiation of a new contract between BSES Limited and the Indonesian Sugarcane Research Institute. Sugarcane smut was discovered in the Ord River district of Western Australia in July 1998, but has not been found in eastern Australia. The identification of resistance levels in advanced clones has enabled the number of crosses with resistant or intermediate parents to increase from 22% in 2000 to 72% in 2003.

Following on from a previous SRDC-funded project that identified stem borers as the greatest exotic insect threat, plans to combat the arrival of exotic borers have now been developed for several species, which are serious pests of sugarcane in Papua New Guinea and South-east Asia.

Goal: Protecting Australia from terrorism and crime

Scientific support for counter-terrorism. To provide scientific support for counter-terrorism, the Science, Engineering and Technology (SET) Unit for Counter-Terrorism in the Department of the Prime Minister and Cabinet was established in August 2003. As the lead agency for coordinating research in counter-terrorism the Unit has consulted extensively with counter-terrorism agencies to identify their capability gaps and research needs, engaged with research providers from publicly funded research agencies, universities and industry and enhanced international research cooperation opportunities for Australian researchers.

The SET Unit has identified nine priority areas as the main (but not sole) focus of the programme which have been endorsed by the Australian Government Counter-Terrorism Policy Committee. The Unit has held workshops on priority areas with representatives from State, Territory and Australian Government counter-terrorism agencies to identify specific capability gaps for possible research tasks, with industry participation to highlight current and planned industry capabilities. It has also increased its knowledge of Australian research capabilities by inviting research organisations to register their capabilities or technology through the Unit’s website and has worked towards establishing bilateral research and development arrangements with the US Technical Support Working Group for Combating Terrorism and the US Department of Homeland Security.

DSTO is supporting SET, and also has increased support to Defence’s principal counter-terrorism force - Special Operations Command. Chemical, biological, nuclear and radiological defence research is a high priority and is done in collaboration with CSIRO, ANSTO and other agencies. DSTO’s support to intelligence agencies continues to be a priority.

The Australian Institute of Criminology’s (AIC) research mainly falls under this goal, and during 2003-04 the agency formalised effective working partnerships with research institutes and Federal law enforcement agencies; extended internal capacity to undertake research on trans-national crime and high tech-crime; and produced information and reports on major issues related to, for example, sexual assault, violent and property crime, drug-related offending, deaths in custody and juvenile detention.

Safeguarding radioactive source material. ANSTO is participating in a coordinated international initiatives to secure radioactive sources in the Asia-Pacific region. The program will build on ANSTO’s regional relationships through provision of support and training in radioactive source identification and safeguards advice.
**Goal: Transformational defence technologies**

*Defence-wide science and technology initiatives.* DSTO has focused on priority Defence-wide science and technology initiatives, and this has resulted in significant outcomes. Contributions in the battlespace automation initiative resulted in the first operational deployment of an unmanned aerial vehicle manufactured by an Australian company.

DSTO’s network centric warfare (NCW) initiative contributed substantially to Defence’s production and current implementation of an NCW roadmap. DSTO, in partnership with other Australian research institutions and industry, has increased its engagement with US defence agencies to secure greater access to US defence transformational technologies. Key success areas include information network defence, the Joint Strike Fighter project, hypersonic propulsion, missile defence, quantum computing and counter-terrorism technologies.

**Monitoring services to detect atmospheric explosions.** Geoscience Australia commissioned a new infrasound monitoring station, at Bucklands in Tasmania, during the year, which further improved Australia’s (and the global research community’s) ability to detect atmospheric explosions.

**Funding Research Across All Four National Research Priorities**

In addition to the above examples, the activities of many agencies extends across all four of the National Research Priorities.

For example, the establishment of ARC Research Networks (announced on 12 December 2003) will build collaborative networks among researchers in areas of National Research Priority; build connections between people, disciplines, organisations and countries, bringing together more than 3,400 participants from Australia and overseas; and assist groups of researchers to coordinate and communicate their research activities across disciplinary, organisational, institutional and geographical boundaries. The networks are expected to foreshadow where new centres of research excellence may be emerging in Australia. In particular they will:

- target the Government’s National Research Priorities;
- foster broad, innovative research networks in emerging areas;
- encourage younger researchers to take an active role in shaping the future direction of competitive areas of research; and
- break down communication barriers, across disciplines and also between universities, government and non-government research agencies and professional organisations.

The establishment of 24 new research networks to help coordinate leading-edge research across Australia was announced in August 2004. The research networks will have a strong focus on areas identified by the Government as National Research Priorities. For example, the:

- Research Network for a Secure Australia will advance the National Research Priority of ‘Safeguarding Australia’ by strengthening our research capacity for protecting critical infrastructure;
- Australia-New Zealand Research Network for Vegetation Function will advance the National Research Priority of ‘An Environmentally Sustainable Australia’;
- Australian Nanotechnology Network will advance the National Research Priority of ‘Frontier Technologies for Building and Transforming Australian Industries’; and
- Australian Research Alliance for Children and Youth and Ageing Well will advance the National Research Priority of ‘Promoting and Maintaining Good Health’.

The ARC and the NHMRC will jointly provide $42 million over five years to foster collaboration among researchers at the forefront of their fields of expertise. Five of the networks will be co-funded by the ARC and NHMRC, with $9.25 million used to bring researchers together to develop new biotechnology tools and new health diagnostics, to improve childhood development and the quality of life among older populations, to help control and eradicate parasites, and to understand better the relationship between genes and environment.
The Australian Government relies on a range of data gathering and advising bodies to inform its policies and directions. This information and advice is important for future planning, as well as reviewing past activities. High quality data and advice is an integral part of setting National Research Priorities.

Highlights in 2003-04 included:

- The Australian Bureau of Statistics is compiling a major innovation survey focusing on innovation activities, cooperation and links, sources of information, technology transfer and innovation expenditure.
- In 2004 the Australian Government established the National Collaborative Research Infrastructure Strategy which will foster collaborative research and use of infrastructure.
- *Backing Australia’s Ability – Building Our Future through Science and Innovation* is the culmination of an intensive planning and review process and constitutes a 10 year, $8.3 billion funding commitment stretching to 2011.

**Key Institutions**

**Australian Bureau of Statistics**

Through the Australian Bureau of Statistics (ABS), Australia has one of the world’s best systems for collecting highly reliable statistics on innovation, R&D and related topics. These ABS statistics conform to OECD standards, which enables broad international comparisons to be made.

A major innovation survey is being conducted for 2003, with survey results expected in February 2005. Topics covered include innovation activities and outputs, cooperation and links, sources of information, technology transfer, innovation barriers and innovation expenditure. A focus is to provide reliable data needed to assess the impacts of innovation on the productivity and performance of businesses. This will be achieved through linking business innovation data to other sources of productivity and performance data (both ABS and non-ABS).

For many years the ABS has conducted R&D surveys of businesses, higher education institutions, government organisations and not for profit organisations. The major topics covered include resources devoted to R&D (both financial and human) and expenditure by a range of variables (such as industry, location, business size and source of funds).

The ABS is compiling an information and communications technology (ICT) satellite account for 2002-03 to gain a more detailed understanding of the sources of supply and use of ICT goods and services. Results of this work are expected to be available early in 2005. Satellite accounts enable attention to be focused on a certain field, within the context of the balanced supply and use framework of the national accounts. An ICT satellite account enables data on all ICT goods and services produced and consumed by all industries to be brought together, enabling better measurement and analysis of the impacts of these activities on the economy.

In September 2003, *Measures of a Knowledge Based Economy and Society* was released on the web. This is a new type of electronic ABS product designed to be continuously updated as source data is made available. It describes Australia’s characteristics and performance as a knowledge-based economy and society.

Chief Scientist

Australia’s Chief Scientist, Dr Robin Batterham, advises the Australian Government on science, technology and innovation issues, including goals and priorities for national investment. His report, *The Chance to Change*, was a key impetus for *Backing Australia’s Ability*.

The Chief Scientist is also the executive officer of the Prime Minister’s Science, Engineering and Innovation Council. He advises on membership, agenda items and overall operations and chairs the Council’s non-ministerial standing committee, which discusses strategies and directions and current issues in science, engineering and innovation.

During 2003-04, Dr Batterham chaired the reference group that contributed to the report *Mapping Australian Science and Innovation*. He provided advice to the government on developing *Back ing Australia’s Ability - Building Our Future through Science and Innovation* (May 2004) and continued as a member of the board of the Australian Research Council, the Cooperative Research Centres Committee, the Coordination Committee on Science and Technology, the Commonwealth, States and Territories Advisory Council on Innovation, and the Science Prizes Committee.

Dr Batterham’s approach centres on the need for science to invest in excellence, to focus on collaboration and to engage the science agencies and departments in their focus on the National Research Priorities framework.

www.dest.gov.au/chiefscientist

Prime Minister’s Science, Engineering and Innovation Council

The Prime Minister’s Science, Engineering and Innovation Council (PMSEIC) is the Australian Government’s principal source of independent advice on issues related to science, engineering and innovation. The council is chaired by the Prime Minister.

In 2003-04, PMSEIC met twice to deal with issues including recycling water for our cities, closer Australia-US engagement through the free trade agreement, science awareness and education, science and technology in sport, growing technology-based small to medium-sized enterprises and future opportunities for Australian astronomy.

Non-ministerial members include the Chief Scientist and leaders of many scientific, educational and business organisations. The Council’s terms of reference are to:

- advise on important issues in science, technology, engineering and relevant aspects of education and training. This includes their relationship to economic growth, employment creation, the development of new industries and the sustainable development of new resources;
- examine the contribution of science, technology and engineering to the innovative capacity and economic and social development of Australia;
- enhance awareness in the community of the importance of science, technology and engineering for Australia’s economic and social development;
- examine Australia’s science and engineering resources and the effectiveness of their organisation and use; and
- examine Australia’s science and engineering infrastructure and its effectiveness in applying science and technology to the economic and social development of Australia.

**Australian Biotechnology Advisory Council**

The Australian Biotechnology Advisory Council, established in March 2002, comprises 10 members from the research, business, industry, health, agriculture and environment sectors. Its chair is Professor John Hearn, Deputy Vice Chancellor (Academic) at the University of Sydney.

The Council's role is to:

- provide high-level independent advice on the role of government, industry and research in biotechnology development in Australia, to the Commonwealth Biotechnology Ministerial Council. This includes advice on development and implementation of the National Biotechnology Strategy;
- advise on important biotechnology issues and their relation to economic growth, employment creation, the development of new industries and the sustainable development of new resources; and
- undertake work as requested through working groups, to advise on government policies and programmes in support of biotechnology development in Australia.

The Council has provided extensive input to the mid-term review and final evaluation of the National Biotechnology Strategy and Biotechnology Australia, including a presentation to the Ministerial Council. It has written to State Premiers and Chief Ministers regarding the genetic modification moratoria issue and has provided advice on the development of government biotechnology related programmes. It has also been active in raising its public profile.

Activities for 2004-05 include:

- increasing public awareness of the biotechnology industry and the council’s role;
- addressing the issue of education, skills and training in biotechnology, which includes working with the Australian Universities Teaching Committee on issues in biotechnology education and investigating how to assist skills attraction and retention; and
- working with government, Biotechnology Australia, the industry and other groups to continue developing a national approach on biotechnology.


**Commonwealth, State and Territory Advisory Council on Innovation**

The Commonwealth, State and Territory Advisory Council on Innovation (CSTACI) was established by the Commonwealth, State and Territory Industry Ministers in February 2000. With a targeted and strategic approach to innovation issues, the Council improves the effectiveness, integration and coordination of the national innovation system.

The Council comprises senior representatives of each Commonwealth, State and Territory industry department, as well as each State and Territory innovation council or equivalent. Various Chief Scientists also attend. Meetings are held twice a year.

**The Industry Research and Development Board**

The Industry Research and Development (IR&D) Board is an independent statutory body supported by a number of committees. The Board administers a range of Australian Government programmes designed to stimulate innovation through R&D and commercialisation to promote growth and job creation including:

- Biotechnology Innovation Fund;
- Commercialising Emerging Technologies;
- Innovation Investment Fund;
- Pharmaceuticals Partnerships Programme;
- Pre-Seed Fund;
- Renewable Energy Equity Fund;
- R&D Start; and
- R&D Tax Concession.

The board comprises up to 15 members including an ex-officio member from the Department of Industry, Tourism and Resources. Board members are drawn largely from the private sector and bring extensive technical skills and experience across a range of industry sectors.

The Chairman is Mr David Miles, Consultant to Corrs, Chambers, Westgarth; Chair of the National Innovation Council and Chair of Uniseed.

www.ausindustry.gov.au

**Business/Industry/Higher Education Collaboration Council**

The Business/Industry/Higher Education Collaboration Council (BIHECC) and the Collaboration and Structural Reform Fund were created in response to the need for greater collaboration and communication between higher education and business and industry, and between higher education institutions.

BIHECC’s mission is to increase collaboration within the higher education sector and between higher education and business, industry, vocational education and training and regional/community organisations.

There are three overarching areas of focus for the new Council:

- business/industry involvement in the higher education sector;
- collaboration between Australian universities; and
- the interface between higher education and vocational education and training.

The Collaboration and Structural Reform Fund will have $36.6 million to channel to worthwhile collaboration and structural reform projects from 2005-2007. BIHECC will advise the Minister on priorities for funding.

The members of the Business/Industry/Higher Education Collaboration Council come from across the business and academic world, bringing with them vast and varied experience and most importantly, their ideas and leadership.

**Government Reviews**

**Mapping Australian Science and Innovation**

The report, *Mapping Australian Science and Innovation*, released by the Minister for Education, Science and Training in November 2003, provides a detailed overview of Australia’s science and innovation system. It includes a quantitative and qualitative assessment of the available data about Australian scientific performance, public and private R&D and innovation activities at State, Territory and national levels. It highlights the main features of Australia’s science, engineering, technology and innovation system and maps how the elements of the system interact.

The report focuses on strengths and challenges in Australia’s performance and global standing; our capacity to innovate and produce new ideas, products and technologies; the state of our research infrastructure; our human capital; the strength of national and international linkages; and investment and support. Though the data available for the report predated the effect of initiatives of *Backing Australia’s Ability*, the study validated the actions taken in the package, and provided the factual basis for continuation of the package under *Backing Australia’s Ability – Building Our Future through Science and Innovation*. 
Evaluation of the Knowledge and Innovation Reforms

The Australian Government released its Knowledge and Innovation Policy Statement in December 1999. Knowledge and Innovation set out the reform policy framework for research and research training, and also initiated the current mix of block and competitive based funding to higher education institutions which is designed to encourage research institutions to build capacity in their individual research strengths.

In May 2003, the Australian Government announced it would undertake a detailed programme to evaluate Australian research and innovation. This included a comprehensive evaluation of the 1999 Knowledge and Innovation reforms to ensure the effectiveness of the policy framework.

The evaluation found that the reforms were working well and that institutions felt they were helping them to move in the direction intended. Institutions also felt they could demonstrate they were using their institutional funding in a strategic manner.

Major issues identified related to the adequacy of funding, research quality, the balance between block and competitive funding, including the need to simplify the Research Training Scheme, and the continuation of the Regional Support Package.


National Research Infrastructure Taskforce

The National Research Infrastructure Taskforce was established as part of Our Universities – Backing Australia’s Future.

Chaired by Dr Mike Sargent AO, the taskforce included representatives from agencies such as the Australian Research Council, National Health and Medical Research Council and the CSIRO.

In August 2003 the taskforce consulted members of the research community and State and Territory governments in each capital city to ensure the research community understood the scope of its work. More than 130 submissions were received, mainly from universities, publicly funded research agencies, groups of researchers and stakeholders with common research interests. A second round of consultations was held in October 2003 before the taskforce released the final version of its discussion paper.

Its final report, released in March 2004, recommended that a more strategic and collaborative approach be developed in the acquisition, management and use of research infrastructure. It also proposed the development of a national strategy to address these issues.


Review of Closer Collaboration between Universities and Major Publicly-Funded Research Agencies

The Review of Closer Collaboration Between Universities and Major Publicly-Funded Research Agencies (PFRAs) was announced in May 2003. It investigated collaboration between the four major PFRAs (CSIRO, DSTO, ANSTO and AIMS) and universities. The review also considered different approaches and models for closer collaboration, commercialisation and funding between these agencies and the 38 universities and industry.

The final report was released in March 2004. The review found there was extensive collaboration between PFRAs and universities, especially at the individual researcher level. There were also opportunities to enhance collaboration at organisational and strategic levels. The review suggested this could be done by establishing a new body to build on the roles of existing advisory bodies and councils.

Moving Forward with Confidence

The Government responded to the major recommendations of the above three reviews through the $5.3 billion package *Backing Australia’s Ability – Building Our Future through Science and Innovation*.

Recommendations were made on important issues such as collaboration and linkages, research infrastructure, research quality assessment and enhancement and the funding of university research.

Recommendations made by the National Research Infrastructure Taskforce will be addressed through the National Collaborative Research Infrastructure Strategy (NCRIS), a $542 million initiative. This initiative will also address many of the recommendations made by the other two reviews. The NCRIS is designed to strengthen the coordination of the Australian Government’s investment in research infrastructure. It will provide researchers with access to major infrastructure, link infrastructure funding more directly to Australia’s national research priorities and foster greater research collaboration and the collaborative use of infrastructure.

The issue of quality and accessibility for publicly funded research will be examined over the next two years. Two frameworks will be developed in consultation with universities and publicly funded research agencies: a Research Quality Framework to measure the quality of research conducted in universities and publicly funded research agencies, as well as its benefits to the wider community; and a Research Accessibility Framework to ensure that information about research and how to access it is available to researchers and the wider community. The Australian Government is providing $2.8 million to develop these frameworks.

After nationwide consultation, the overhaul of the Research Training Scheme (RTS) was announced in August 2004. The simplified scheme will provide universities with greater funding certainty and reduce their administrative burden. However as recommended by the evaluation of the Knowledge and Innovation Reforms, the Government will be maintaining the current balance between competitive and performance driven block funding of research in Australia’s universities.

*Backing Australia’s Ability – Building Our Future through Science and Innovation* continues and strengthens the substantial investment made in *Backing Australia’s Ability*. Combined the initiative represents an unprecedented $8.3 billion 10 year commitment, taking Australia into the second decade of the 21st century.
**APPENDICES**

| Appendix 1. | Major flows of funding for R&D in Australia, 2002-03 |
| Appendix 4. | *Backing Australia’s Ability* (BAA) 10 year funding table |
| Appendix 5. | Summary of Major Commonwealth support for science and innovation through the budget and other appropriations |
| Appendix 6. | R&D by States/Territories and sectors of performance (2002-03) |
| Appendix 7. | National Research Priorities and associated Goals |
| Appendix 8. | *Backing Australia’s Ability* 2,000 Additional Targeted University Places |
| Appendix 9. | Cooperative Research Centres |
| Appendix 10. | ARC Key Centres for Teaching and Research |
| Appendix 11. | ARC Centres of Excellence |
| Appendix 12. | ARC Centres |
| Appendix 13. | ARC Special Research Centres |
| Appendix 14. | Rural and Research Development Corporations |

**NOTE:** The term ‘Commonwealth’ is used in the following charts and tables to distinguish Australia’s Central Government from that of the Australian States and Territories.
Appendix 1

Major flows of funding for R&D in Australia, 2002-03

Sources of R&D Funding

- Commonwealth: $4,612 million
- Business: $5,688 million
- State and local government: $826 million
- Other Australian: $602 million
- Overseas: $523 million
- Other: $602 million

Sectors of R&D Performance

- Commonwealth: $1,531 million
- Higher education: $3,430 million
- State/Territory: $951 million
- Private non-profit: $360 million
- Business: $5,979 million

Source: Science and Innovation Analysis Section, DEST, based on ABS R&D data.
Appendix 2

Overview of Australia’s gross domestic R&D performance – by sector of performance, 1978-79 to 2002-03

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Source: Science and Innovation Analysis Section, DEUST, based on ABS R&D data including unpublished data provided to the section in September 2004.
### Appendix 3

Overview of Australia’s gross domestic R&D performance – by source of funds, 1978-79 to 2002-03

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**Chain Volume Measures ($million at 2002/03 prices)**

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Source: Science and Innovation Analysis Section, DEST, based on ABS R&D data.
### Appendix 4

**Backing Australia’s Ability (BAA) 10 Year Funding Table** *(a) (b) (c)*

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*CONTINUED*
## Backing Australia’s Ability

### Initial Additional 10 Year

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**CSIRO National Flagship Initiative (d)**
- 30.0
- 35.0
- 40.0
- 50.0
- 50.0
- 50.0
- 50.0
- 305.0
- 305.0

**Health and Medical Research - overhead infrastructure support**
- 26.0
- 27.0
- 28.0
- 29.0
- 30.0
- 30.0
- 200.0
- 200.0

**Building on IT Strengths (BITS) Advanced Network (d)**
- 8.3
- 7.3
- 5.4
- –
- –
- –
- –
- 21.0
- 21.0

**ICT Centre of Excellence (a)**
- 4.5
- 8.8
- 12.0
- 30.0
- 42.0
- 48.0
- 17.4
- 24.2
- 24.8
- 51.0
- 126.3
- 193.3

**R&D Tax Concession (f)**
- 6.0
- 4.0
- 3.6
- 2.6
- 1.7
- 1.3
- 1.5
- 24.0
- 24.2
- 26.0
- 59.0
- 190.0
- 400.0

**Research Support for Counter Terrorism (a)**
- 1.0
- 2.0
- 2.1
- –
- –
- –
- –
- 7.2
- 7.2

**SKILLS DEVELOPMENT**

#### Questacon - Smart Moves
- 0.7
- 1.2
- 1.2
- 0.6
- –
- 3.7

#### Questacon - Raising Science Awareness
- 1.0
- 1.7
- 1.7
- 1.8
- 1.3
- 1.8
- 1.8
- 15.1

#### National Innovation Awareness Strategy
- 4.3
- 5.8
- 6.4
- 0.6
- 0.3
- 0.6
- 0.3
- 38.1
- 38.8

#### Science Connections Programme
- 33.1
- 34.9
- 38.8
- 40.8
- –
- –
- –
- 114.3
- 118.3

#### Science, Maths and Technology in Government Schools
- 13.9
- 24.7
- 33.0
- 33.5
- 39.9
- 39.9
- 39.9
- 39.9
- 39.9
- 39.9
- 39.9
- 39.9
- 39.9

#### Fostering Scientific, Mathematical, Technological Skills and Innovation in Government Schools (g)
- –
- –
- –
- 0.0
- 184.3

#### 2000 Additional Targeted University Places (h)
- 13.9
- 24.7
- 33.0
- 33.5
- 39.9
- 39.9
- 39.9
- 39.9
- 39.9
- 39.9
- 39.9
- 39.9
- 39.9

#### Online Curriculum Content
- 4.5
- 7.2
- 7.4
- 7.5
- 6.6
- 6.4
- 6.3
- 38.8
- 38.8

#### Attaching ICT Workers
- 0.5
- 0.6
- 0.7
- 0.7
- 0.6
- 0.7
- 0.6
- 7.2
- 7.2

#### National Biotechnology Strategy and Biotechnology Australia (d)
- 5.0
- 5.0
- 5.0
- 5.0
- 5.0
- 5.0
- 5.0
- 20.0
- 20.0
- 20.0
- 20.0
- 20.0

#### Total
- 170.8
- 355.5
- 617.7
- 889.4
- 1067.6
- 1026.7
- 1064.5
- 1123.8
- 1931.8
- 3313.8
### Total Funding for the ARC and CRC

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<th>Year</th>
<th>Total Funding (Total $m)</th>
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<tbody>
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<td>2001-02</td>
<td>265.2 298.3 413.9 481.4 556.5 566.3 577.7 591.9 603.7 615.8 2,015.3 2,955.4 4,970.7</td>
</tr>
<tr>
<td>2002-03</td>
<td>283.3 413.9 481.4 566.3 577.7 591.9 603.7 615.8 2,015.3 2,955.4 4,970.7</td>
</tr>
<tr>
<td>2003-04</td>
<td>282.0 393.9 298.4 281.7 190.2 180.7 196.1 151.5 895.3 925.9 1,821.2</td>
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<tr>
<td>2004-05</td>
<td>145.3 148.6 193.9 203.4 187.3 210.2 180.7 161.5 895.3 925.9 1,821.2</td>
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<tr>
<td>2005-06</td>
<td>145.3 148.6 193.9 203.4 187.3 210.2 180.7 161.5 895.3 925.9 1,821.2</td>
</tr>
<tr>
<td>2006-07</td>
<td>145.3 148.6 193.9 203.4 187.3 210.2 180.7 161.5 895.3 925.9 1,821.2</td>
</tr>
<tr>
<td>2007-08</td>
<td>145.3 148.6 193.9 203.4 187.3 210.2 180.7 161.5 895.3 925.9 1,821.2</td>
</tr>
<tr>
<td>2008-09</td>
<td>145.3 148.6 193.9 203.4 187.3 210.2 180.7 161.5 895.3 925.9 1,821.2</td>
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<td>2009-10</td>
<td>145.3 148.6 193.9 203.4 187.3 210.2 180.7 161.5 895.3 925.9 1,821.2</td>
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<td>2010-11</td>
<td>145.3 148.6 193.9 203.4 187.3 210.2 180.7 161.5 895.3 925.9 1,821.2</td>
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</table>

This table shows the total funding for the Australian Research Council’s National Competitive Grants Programme and the Cooperative Research Centres (CRC) Programme over this period. It includes base funding and additional funding provided through BAA.

**NOTES**

- Totals may not sum due to rounding. 2001-02 to 2005-06 numbers (orange) are as announced for BAA in the 2001-02 Budget. There have been some movements between years since then but it remains approximately a $3 billion package. 2004-05 to 2010-11 numbers (blue) include continuing BAA initiatives and decisions in the 2003-04 Budget ($275 million for ARC, $625 million for the CRC Programme and $41 million for the R&D Start Programme in 2006-07) and in the 2004-05 Budget. Programmes that have been merged or refocused in the 2004-05 Budget are grouped together.

- The National Competitive Grants Programme will allocate funding to the National Stem Cell Centre ($27.5 million) and the ICT Centre of Excellence ($124.7 million) in addition to the funding provided to the centres directly, over the period 2006-07 to 2010-11. Funding of $7.2 million over four years will also be provided from this programme to the Department of Prime Minister and Cabinet to fund targeted counter-terrorism research. Total funding for the ARC (including base funding) is $556.5 million in 2005-06 and $566.3 million in 2006-07.

- For the CRC Programme, because BAA funds have been moved to later years to better align the funding profile with expenditure under the programme, the five year and seven year totals are not the sum of the respective years. The five year total includes the amount committed in the 2001-02 Budget and the seven year total is the additional funds committed in the 2003-04 Budget ($62.5 million) and 2004-05 Budget ($65 million).

- The Pre-Seed Fund was originally provided with $78.7 million over five years when BAA was announced as follows: $6.4m in 2001-02, $16.9m in 2002-03, $21.8m in 2003-04, $21.8m in 2004-05 and $11.8m in 2005-06. This programme was replaced in August 2001 over 10 years to reflect the change from a grant programme to a loan programme.

- Continues an existing programme that was not previously included in BAA.

- Funding for MNRF has been rephased since the Government’s announcement of BAA in 2001-02 to allow for earlier expenditure of funds. With rephased MNRF funding of $407 million in 2005-06, total funding for MNRF and Systemic Infrastructure in 2005-06 is $97.3 million. This compares with funding of $100.3 million provided in 2006-07 under the National Collaborative Research Infrastructure Strategy. R&D tax concession figures include the premium tax concession, the tax offset and streamlining the 125% tax concession. These figures were the best estimates available at the announcement of BAA in the 2001-02 Budget and have been refined since this date. The refined estimate is $77 million in 2005-06. This compares with $80 million for 2006-07.

- Reassuring for this programme does not have a budget impact beyond 2005-06 as provision for this funding is already in the Forward Estimates (with a total of $93.2 million a year being provided from 2004-05 to 2010-11). An estimated $373 million will be provided for this programme to those States/Territories that trigger an Enrolment Benchmark Liability over the next four years.

- Funding in 2006-07 to 2010-11 is an estimate of the nominal cost of these places that are now funded within the general allocations for universities.

- PELS has now been integrated into a new loan facility, FEE-HELP as part of the Our Universities - Backing Australia’s Future initiative announced in the 2003-04 Budget. Funding for PELS continues, however estimates have not been included beyond 2005-06 in this table as the objectives of this programme are now being funded through a separate initiative.
# Appendix 5

## Summary of Major Commonwealth support for science and innovation through the budget and other appropriations - actual cost in year incurred

<table>
<thead>
<tr>
<th></th>
<th>Cash Outlays (tm)</th>
<th>Accrual Expenses (tm)</th>
<th>est. actual 2003-04</th>
<th>budget est. 2004-05</th>
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<td><strong>Intramural expenditure on Science &amp; Innovation</strong></td>
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<tr>
<td><strong>Major Federal Research Agencies</strong></td>
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<tr>
<td>• Defence Science &amp; Technology Organisation</td>
<td>267.6</td>
<td>254.9</td>
<td>212.1</td>
<td>221.3</td>
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<td>• CSIRO</td>
<td>417.6</td>
<td>444.5</td>
<td>466.8</td>
<td>475.4</td>
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<tr>
<td>• Other R&amp;D Agencies</td>
<td>236.2</td>
<td>279.8</td>
<td>256.4</td>
<td>244.2</td>
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<td><strong>SUB-TOTAL</strong></td>
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<td>979.2</td>
<td>935.3</td>
<td>940.9</td>
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<td><strong>Extramural expenditure on Science &amp; Innovation</strong></td>
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<td><strong>Business Enterprise Sector</strong></td>
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<td>• IR&amp;D Tax Concession</td>
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<td>• R&amp;DStart</td>
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<td>62.4</td>
<td>102.7</td>
<td>130.7</td>
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<tr>
<td>• Other Innovation Support</td>
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<td>65.4</td>
<td>37.7</td>
<td>96.6</td>
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<td><strong>SUB-TOTAL</strong></td>
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<td>652.8</td>
<td>560.4</td>
<td>597.3</td>
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<tr>
<td>• Australian Research Council</td>
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<td>• Performance Based Block Funding</td>
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<td>• R&amp;D Support under Former Funding Framework</td>
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<td>1,610.5</td>
<td>1,675.4</td>
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<td>• Other R&amp;D Support</td>
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<td>2.5</td>
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<td><strong>SUB-TOTAL</strong></td>
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<td>1,613.2</td>
<td>1,677.9</td>
<td>1,739.7</td>
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<td>• NH&amp;MRC and Other Health</td>
<td>163.9</td>
<td>167.0</td>
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<td>• Cooperative Research Centres</td>
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<td>142.3</td>
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<td>• Rural</td>
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<td>• Energy and Environment</td>
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<td>25.2</td>
<td>8.9</td>
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<tr>
<td>• Other Science Support</td>
<td>14.3</td>
<td>24.7</td>
<td>28.7</td>
<td>12.1</td>
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<tr>
<td><strong>SUB-TOTAL</strong></td>
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<td>472.2</td>
<td>515.8</td>
<td>508.1</td>
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<tr>
<td><strong>TOTAL COMMONWEALTH SUPPORT</strong></td>
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<td>3,717.4</td>
<td>3,689.4</td>
<td>3,786.0</td>
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<tr>
<td>% Total Commonwealth Expenditure</td>
<td>2.93%</td>
<td>2.55%</td>
<td>2.48%</td>
<td>2.58%</td>
</tr>
</tbody>
</table>

**NOTES**

a. Prior to the 1999-00 financial year budget expenditures were reported on a cash accounting basis. Expenditures from the 1999-00 financial year onwards are reported in accordance with the principles of accrual accounting.

b. Intramural expenditure is Commonwealth Government financed R&D performed in Commonwealth Government establishments.

c. Extramural expenditure refers to Commonwealth Government financed R&D performed in the business enterprise, higher education and private non-profit or State government sectors. Under this heading, ‘Multisector’ includes programmes that may be accessed by several sectors, including Commonwealth Government Agencies.

d. The amounts indicated for the R&D tax concession are estimates only. The estimates presented in the table relate to the year in which companies undertake the R&D for which they subsequently claim the concession. They depend on data published in the Taxation Expenditures Statement 2003 and self-reported returns as new taxation data becomes available.

e. New funding arrangements due to the establishment of the Australian Research Council (ARC) as an independent statutory authority and the introduction of new performance block funding schemes for research and research training under the Australian Research Council (Consequential and Transitional Provisions) Act 2001 have resulted in a break in the series for the published breakdown between ARC and other R&D support prior to 2000-01. However, the sub-sector shares are comparable throughout the series.

f. This refers to funding arrangements for the higher education sector prior to implementation of the Knowledge and Innovation Reform announced in 1999.

g. For the 1995-1996 FY, government expenses were still expressed on a cash accounting basis. Therefore, the ratio is not comparable with subsequent years where government expenses are recorded on an accrual basis.
## Appendix 6

### R&D by States/Territories and sectors of performance, 2002-03(a)

<table>
<thead>
<tr>
<th>Location</th>
<th>Business Sector (BERD)</th>
<th>Commonwealth Gov. Sector</th>
<th>State/Territory Gov. Sector</th>
<th>Higher Education Sector</th>
<th>Private Non-Profit Sector</th>
<th>Total R&amp;D Expenditure in States/Territories</th>
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</thead>
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<td>Current Prices $’000</td>
<td>Current Prices $’000</td>
<td>Current Prices $’000</td>
<td>Current Prices $’000</td>
<td>Current Prices $’000</td>
<td>Current Prices $’000</td>
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<tr>
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<td>Per capita $</td>
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<tr>
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<td>% of GSP (%)</td>
<td>% of GSP (%)</td>
<td>% of GSP (%)</td>
<td>% of GSP (%)</td>
<td>% of GSP (%)</td>
<td>% of GSP (%)</td>
</tr>
<tr>
<td>NSW</td>
<td>2,138,858</td>
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<td>0.80%</td>
<td>267,382</td>
<td>43.81</td>
<td>0.10%</td>
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</tr>
<tr>
<td>Victoria</td>
<td>1,906,622</td>
<td>385.33</td>
<td>0.99%</td>
<td>374,969</td>
<td>75.78</td>
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<tr>
<td>Queensland</td>
<td>660,541</td>
<td>172.01</td>
<td>0.52%</td>
<td>147,701</td>
<td>38.46</td>
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<td>527,092</td>
<td>344.20</td>
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<td>225,486</td>
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<td>WA</td>
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<td>89,099</td>
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<td>Tasmania</td>
<td>61,526</td>
<td>128.19</td>
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<td>109,668</td>
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<tr>
<td>NT</td>
<td>30,409</td>
<td>153.04</td>
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<td>20,622</td>
<td>103.78</td>
<td>0.23%</td>
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<td>ACT &amp; ExtTerr.</td>
<td>42,214</td>
<td>130.86</td>
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<td>294,932</td>
<td>91.42</td>
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<td>Overseas</td>
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<td>1,472</td>
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<td>TOTAL</td>
<td>5,978,615</td>
<td>298.80</td>
<td>0.70%</td>
<td>1,531,311</td>
<td>76.53</td>
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(a) R&D data sourced from Table 4 in the ABS Research and Experimental Development: All Sector Summary - Australia (ABS Cat. no. 8112.0 - September 2004). In each of the five main groupings, the first column indicates the expenditure (in current prices) on R&D within that particular sector. The second column provides a per capita amount for the State/Territory in relation to the sector, with the third column providing a percentage of the gross State (Territory) product (GSP) for that State/Territory. The population figures for calculating the second column in each grouping are taken from ABS Population, Australian States and Territories cat. no. 3239.0.55.001 May 2004, with the gross product figures for the States/Territories in the third column being sourced from ABS Australian National Accounts, State Accounts cat. no. 5220.0 November 2003.

(b) In each of the five main groupings, the figure of the third column, representing the total expenditure within the States and Territories as a percentage of GDP, is calculated by the figure at total of the first column divided by the GDP as at November 2003.
Appendix 7

National Research Priorities and associated Goals

An Environmentally Sustainable Australia

- Water – a critical resource;
- Transforming existing industries;
- Overcoming soil loss, salinity and acidity;
- Reducing and capturing emissions in transport and energy generation;
- Sustainable use of Australia’s biodiversity;
- Developing deep earth resources; and
- Responding to climate change and variability.

Promoting and Maintaining Good Health

- A healthy start to life;
- Ageing well, ageing productively;
- Preventive healthcare; and
- Strengthening Australia’s social and economic fabric.

Frontier Technologies for Building and Transforming Australian Industries

- Breakthrough science;
- Frontier technologies;
- Advanced materials;
- Smart information use; and
- Promoting an innovation culture and economy.

Safeguarding Australia

- Critical infrastructure;
- Protecting Australia from invasive diseases and pests;
- Protecting Australia from terrorism and crime;
- Transformational defence technologies, and
- Understanding our region and the world;
### Appendix 8

**Backing Australia’s Ability 2,000 Additional Targeted University Places**

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<tr>
<th>Universities</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
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<td>139</td>
<td>164</td>
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<td>Southern Cross University</td>
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<td>University of New England</td>
<td>70</td>
<td>123</td>
<td>162</td>
<td>191</td>
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<tr>
<td>University of New South Wales</td>
<td>100</td>
<td>175</td>
<td>231</td>
<td>273</td>
</tr>
<tr>
<td>University of Newcastle</td>
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<td>0</td>
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<tr>
<td>University of Sydney</td>
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<td>140</td>
<td>185</td>
<td>219</td>
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<tr>
<td>University of Technology Sydney</td>
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<td>105</td>
<td>139</td>
<td>164</td>
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<tr>
<td>University of Western Sydney</td>
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<td>35</td>
<td>46</td>
<td>55</td>
</tr>
<tr>
<td>University of Wollongong</td>
<td>100</td>
<td>175</td>
<td>231</td>
<td>273</td>
</tr>
<tr>
<td>Deakin University</td>
<td>60</td>
<td>105</td>
<td>139</td>
<td>164</td>
</tr>
<tr>
<td>La Trobe University</td>
<td>40</td>
<td>70</td>
<td>93</td>
<td>109</td>
</tr>
<tr>
<td>Monash University</td>
<td>100</td>
<td>175</td>
<td>231</td>
<td>273</td>
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<td>Royal Melbourne Institute of Technology</td>
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<tr>
<td>Swinburne University of Technology</td>
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<td>278</td>
<td>328</td>
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<tr>
<td>University of Ballarat</td>
<td>60</td>
<td>105</td>
<td>139</td>
<td>164</td>
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<tr>
<td>University of Melbourne</td>
<td>50</td>
<td>88</td>
<td>116</td>
<td>137</td>
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<td>Victoria University of Technology</td>
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<tr>
<td>Central Queensland University</td>
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<td>175</td>
<td>231</td>
<td>273</td>
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<tr>
<td>Griffith University</td>
<td>90</td>
<td>158</td>
<td>208</td>
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<tr>
<td>James Cook University</td>
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<td>175</td>
<td>231</td>
<td>273</td>
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<tr>
<td>Queensland University of Technology</td>
<td>120</td>
<td>210</td>
<td>278</td>
<td>328</td>
</tr>
<tr>
<td>University of Queensland</td>
<td>100</td>
<td>175</td>
<td>231</td>
<td>273</td>
</tr>
<tr>
<td>University of Southern Queensland</td>
<td>10</td>
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<td>23</td>
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<td>University of the Sunshine Coast</td>
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<tr>
<td>Curtin University of Technology</td>
<td>90</td>
<td>158</td>
<td>208</td>
<td>246</td>
</tr>
<tr>
<td>Edith Cowan University</td>
<td>60</td>
<td>105</td>
<td>139</td>
<td>164</td>
</tr>
<tr>
<td>Murdoch University</td>
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<td>0</td>
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<tr>
<td>University of Notre Dame Australia</td>
<td>50</td>
<td>88</td>
<td>116</td>
<td>137</td>
</tr>
<tr>
<td>University of Western Australia</td>
<td>70</td>
<td>123</td>
<td>162</td>
<td>191</td>
</tr>
<tr>
<td>Flinders University of South Australia</td>
<td>60</td>
<td>105</td>
<td>139</td>
<td>164</td>
</tr>
<tr>
<td>University of Adelaide</td>
<td>50</td>
<td>88</td>
<td>116</td>
<td>137</td>
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<tr>
<td>University of South Australia</td>
<td>55</td>
<td>96</td>
<td>127</td>
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<tr>
<td>Australian Maritime College</td>
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<tr>
<td>University of Tasmania</td>
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<td>114</td>
<td>150</td>
<td>178</td>
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<tr>
<td>Batchelor Institute of Indigenous Tertiary Education</td>
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<td>0</td>
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<tr>
<td>Charles Darwin University</td>
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<tr>
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<tr>
<td>University of Canberra</td>
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<tr>
<td>Australian Catholic University</td>
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</table>

Total: 2,000 3,500 4,625 5,469
Appendix 9

Cooperative Research Centres as at October 2004

AJ Parker CRC for Hydrometallurgy
http://www.parkercentre.crc.org.au

CRC for Cochlear Implant and Speech & Hearing Aid Innovation Research
http://www.bionichear.org/crc/index2.html

CRC for Sensor Signal & Information Processing
http://www.cssip.edu.au

Australasian CRC for Interaction Design
http://www.interactiondesign.com.au

CRC for Construction Innovation
http://www.construction-innovation.info

CRC for Smart Internet Technology
http://www.smartinternet.com.au

Australian Biosecurity CRC for Emerging Infectious Disease
http://www.abcr.org.au

CRC for Diagnostics
http://diagnosticscrc.org/

CRC for Spatial Information
http://www.spatialinfo.crc.org

Australian Cotton CRC
http://www.cotton.pi.csiro.au

CRC for Enterprise Distributed Systems Technology
http://www.dstc.edu.au

CRC for Sugar Industry Innovation through Biotechnology
http://www.crcsugar.com.au

Australian Photonics CRC
http://www.photonics.com.au

CRC for Freshwater Ecology

CRC for Sustainable Aquaculture of Finfish
http://www.aquafincrc.com.au

Australian Sheep Industry CRC
http://www.sheep.crc.org.au

CRC for Functional Communications Surfaces
http://www.crc-fcs.com

CRC for Sustainable Production Forestry
http://www.forestry.crc.org.au

Australian Telecommunications CRC
http://www.telecommunications.crc.org.au

CRC for the Great Barrier Reef World Heritage Area
http://www.reef.crc.org.au

CRC for Sustainable Resource Processing
http://www.csipq.com.au

Bushfire CRC
http://www.bushfirecrc.com

CRC for Greenhouse Accounting
http://www.greenhouse.crc.org.au

CRC for Sustainable Rice Production
http://www.crcsrp.com

CRC for Aboriginal Health
http://www.crcah.org.au

CRC for Greenhouse Gas Technologies
http://www.co2crc.com.au

CRC for Sustainable Tourism
http://www.crectourism.com.au

CRC for Advanced Composite Structures
http://www.crc-acs.com.au

CRC for Innovative Dairy Products
http://www.dairycrc.com

CRC for Technology Enabled Capital Markets
http://www.tcem.org

CRC for Antarctic Climate and Ecosystems
http://www.acerc.org.au

CRC for Innovative Grain Food Products
http://www.grainfoodcrc.com.au

CRC for Tropical Plant Protection
http://www.cppq.edu.au

CRC for Asthma
http://www.asthma.crc.org.au

CRC for Integrated Engineering Asset Management
http://www.cieam.com

CRC for Tropical Rainforest Ecology and Management
http://www.rainforest-crc.jcu.edu.au

CRC for the Australian Poultry Industries
http://www.poultrycrc.com.au

CRC for Intelligent Manufacturing Systems & Technologies
http://www.crecimst.com.au

CRC for Tropical Savannas Management
http://savanna.ntu.edu.au

CRC for Australian Weed Management
http://www.weeds.crc.org

CRC for Irrigation Futures
http://www.iregistrationfutures.org.au

CRC for Vaccine Technology
http://www.cvc.vt.qims.edu.au

CRC for the Biological Control of Pest Animals
http://www.pestanimal.crc.org.au

CRC for Landscape Environments & Mineral Exploitation
http://leme.anu.edu.au/

CRC for Value Added Wheat

CRC for Bioproducts
http://www.bioproducts.org.au
CRC for MicroTechnology
http://www.microtechnologycrc.com

CRC for Viticulture
http://www.crcv.com.au

CRC for CAST Metals Manufacturing
http://www.cast.crc.org.au

CRC Mining
http://www.crcmining.com.au

CRC for Water Quality & Treatment
http://www.waterquality.crc.org.au

CRC for Catchment Hydrology
http://www.catchment.crc.org.au

CRC for Oral Health Science
Not available

CRC for Welded Structures
http://www.crcws.com.au

CRC for Cattle and Beef Quality
http://www.cattlecrc.org.au

CRC for Plant-based Management of Dryland Salinity
http://www.crcsalinity.com

CRC Wood Innovations
http://www.crcwood.unimelb.edu.au

CRC for Chronic Inflammatory Diseases
http://www.crccid.com

CRC for Polymers
http://www.crep.com.au

Desert Knowledge CRC
http://www.desertknowledge.com.au

CRC for Clean Power from Lignite

CRC for Predictive Mineral Discovery
http://www.pmdcrc.com.au

Environmental Biotechnology CRC
http://www.ebcrc.com.au

CRC for Coal in Sustainable Development
http://www.ccsd.biz

CRC for Railway Engineering and Technologies
http://www.railexc.rcq.edu.au

Molecular Plant Breeding CRC
http://www.molecularplantbreeding.com

CRC for Coastal Zone, Waterway and Estuary Management
http://www.coastal.crc.org.au

CRC for Satellite Systems
http://www.cress.csiro.au

The Vision CRC
http://www.visioncrc.org

Source: CRC Directory 2004
Appendix 10

ARC Key Centres for Teaching and Research

Asia Pacific Social Transformation Studies
http://www.capstrans.edu.au/

Smart Foods
http://www.uow.edu.au/research/centres/smartfoods/

Tropical Wildlife Management
http://www.wildlife.ntu.edu.au/

Human Factors

Polymers Colloids
http://www.kcpc.usyd.edu.au/

Ethics, Law Justice and Governance
http://www.gu.edu.au/centre/kceljag/

Appendix 11

ARC Centres of Excellence

Advanced Silicon Photovoltaics and Photonics

Autonomous Systems
http://www.cas.edu.au/

Biotechnology and Development
Website not available

Integrative Legume Research

Mathematical and Statistical Modelling of Complex Systems
http://www.complex.org.au/

Quantum-Atom Optics
http://www.acqao.org/

Quantum Computer Technology
http://www.ph.unimelb.edu.au/marc/about/about_CoE.htm

Ultrahigh-bandwidth Devices for Optical Systems
Appendix 12

ARC Centres

Complex Dynamic Systems and Control
http://murray.newcastle.edu.au/cdsc/

Perceptive and Intelligent Machines in Complex Environments
Structural and Functional Microbial Genomics

National Centre for Solar Energy Systems
http://solararc.anu.edu.au/

Kangaroo Genome
Website not available

Genome-Phenome Bioinformatics
Website not available

Functional Nanomaterials
Website not available

Nanostructured Electromaterials
Website not available

Complex Systems (ACCS)
http://www.accs.uq.edu.au/

Appendix 13

ARC Special Research Centres

Multiphase Processes
http://www.multiphase.newcastle.edu.au/

Research on Ecological Impacts of Coastal Cities

Tectonics
http://www.tsrc.uwa.edu.au/

Offshore Foundation Systems
http://www.cofs.uwa.edu.au/

Subatomic Structure of Matter

Cross-Cultural Research
http://www.anu.edu.au/culture/

Ore Deposit Research
http://www.codes.utas.edu.au/

Functional and Applied Genomics
http://www.imb.uq.edu.au/

*CONTINUED
Molecular Genetics of Development  
http://www.cmgd.adelaide.edu.au/  

Environmental Stress Adaptation Research  
http://www.latrobe.edu.au/cesar/  

Ultra-Broadband Information Networks  
http://www.ec.mmu.oz.au/research/cubin/  

Particulate Fluids Processing  
http://www.pfpc.unimelb.edu.au/  

Particle and Material Interfaces  
http://www.unisa.edu.au/iwri/  

Green Chemistry  
http://web.chem.monash.edu.au/greenchem/  

Cognitive Science and Cognitive Neuropsychology  
http://www.maccs.mq.edu.au/  

Applied Philosophy and Public Ethics  
http://www.cappe.edu.au/  

## Appendix 14

### Rural Research and Development Corporations

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<tr>
<td>Fisheries RDC</td>
<td><a href="http://www.frdc.com.au">www.frdc.com.au</a></td>
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<tr>
<td>Forest &amp; Wood Products RDC</td>
<td><a href="http://www.fwprdc.org.au">www.fwprdc.org.au</a></td>
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<td>Grains RDC</td>
<td><a href="http://www.grdc.com.au">www.grdc.com.au</a></td>
</tr>
<tr>
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<td><a href="http://www.gwrdc.com.au">www.gwrdc.com.au</a></td>
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<td>Land &amp; Water Australia</td>
<td><a href="http://www.lwa.gov.au">www.lwa.gov.au</a></td>
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<td>Rural Industries RDC</td>
<td><a href="http://www.rirdc.gov.au">www.rirdc.gov.au</a></td>
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<td>Sugar RDC</td>
<td><a href="http://www.srdc.gov.au">www.srdc.gov.au</a></td>
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<td><strong>Private companies:</strong></td>
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</tr>
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<td>Australian Pork Limited</td>
<td><a href="http://www.apl.au.com">www.apl.au.com</a></td>
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<td>Australian Wool Innovation</td>
<td><a href="http://www.wool.com.au">www.wool.com.au</a></td>
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<td>Horticulture Australia Ltd</td>
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<td>Meat &amp; Livestock Australia</td>
<td><a href="http://www.mla.com.au">www.mla.com.au</a></td>
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<td>Dairy Australia</td>
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