BACKING AUSTRALIA’S ABILITY

The Australian Government’s Innovation Report 2003-04
PRIME MINISTER’S FOREWORD

Innovation has always been at the heart of the way Australians have adapted and succeeded on this island continent. As we look to our future in an increasingly globalised world, innovation remains central to our prosperity.

The Australian Government’s $3 billion innovation statement Backing Australia’s Ability is generating real results and real jobs by supporting the creation, development and implementation of new ideas. Science and innovation is now one of the government’s strategic priorities, further strengthening our commitment to Backing Australia’s Ability.

Innovation is a team effort. We need skilled and motivated people to take on the challenges of creating and developing new ideas. We need a strong economy that is able to support investment in innovation at all levels, from the genesis of ideas through to the commercialisation of products. And we need a society that encourages and appreciates excellence in science and innovation.

This report shows how government, industry and the research sector are meeting those challenges by working in partnership through Backing Australia’s Ability. The strategy focuses on strengthening Australia’s ability to generate ideas and undertake research, accelerating the commercial application of these ideas, and developing and retaining Australian skills.

The Australian Government’s Innovation Report 2003-04 also celebrates the success of innovative enterprises. It provides many examples of successful collaboration internationally, as well as between universities, government agencies and businesses at home. With support from Backing Australia’s Ability these enterprises and organisations are helping to turn great ideas into jobs and income here in Australia.

The Hon John Howard MP
Prime Minister
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FOCUS ON THE FUTURE

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LIST OF ABBREVIATIONS

AAD         Australian Antarctic Division
AARNet      Australia's Academic and Research Network
ABAC        Australian Biotechnology Advisory Council
ABS         Australian Bureau of Statistics
ACIS        Automotive Competitiveness and Investment Scheme
AIMS        Australian Institute of Marine Science
ANSTO       Australian Nuclear Science and Technology Organisation
APA         Australian Postgraduate Awards Scheme
ARC         Australian Research Council
BAA         Backing Australia's Ability
BAF         Backing Australia's Future
BERD        Business Expenditure on R&D
BIF         Biotechnology Innovation Fund
BITS        Building Information Technology Strengths
BMP         Best Management Practice
BMRC        Bureau of Meteorology Research Centre
COMET       Commercialising Emerging Technologies
CRC         Cooperative Research Centre
CRDC        Cotton R&D Corporation
CSIRO       Commonwealth Scientific and Industrial Research Organisation
CSTACI      Commonwealth, State and Territory Advisory Council on Innovation
DAFF        Department of Agriculture, Fisheries and Forestry
DCITA       Department of Communications, Information Technology and the Arts
DEST        Department of Education, Science and Training
DIMIA       Department of Immigration and Multicultural and Indigenous Affairs
DITR        Department of Industry, Tourism and Resources
DSTO        Defence Science and Technology Organisation
EEBPP       Energy Efficiency Best Practice Program
IAP         Innovation Access Program
ICT         Information and Communications Technology
IP          Intellectual Property
IPRIA       Intellectual Property Research Institute of Australia
IPRS        International Postgraduate Research Scholarship Scheme
ITOL        Information Technology On-Line
KBE/s       Knowledge based economy or society
MNRF        Major National Research Facilities
MODL        Migration Occupations in Demand List
MP          Member of Parliament
NFIS        National Food Industry Strategy
NHMRC       National Health and Medical Research Council
NIAS        National Innovation Awareness Strategy
NICTA       National ICT Australia
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>NIDP</td>
<td>New Industries Development Program</td>
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<tr>
<td>NSCC</td>
<td>National Stem Cell Centre</td>
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<tr>
<td>NYSF</td>
<td>National Youth Science Forum</td>
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<tr>
<td>OECD</td>
<td>Organisation for Economic Cooperation &amp; Development</td>
</tr>
<tr>
<td>PELS</td>
<td>Postgraduate Education Loans Scheme</td>
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<tr>
<td>PFRA</td>
<td>Publicly-Funded Research Agencies</td>
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<td>PIIP</td>
<td>Pharmaceutical Industry Investment Program</td>
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<tr>
<td>PISA</td>
<td>Program for International Student Assessment</td>
</tr>
<tr>
<td>PMSEIC</td>
<td>Prime Minister’s Science, Engineering and Innovation Council</td>
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<tr>
<td>PSF</td>
<td>Pre-Seed Fund</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Research and Development</td>
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<tr>
<td>RECP</td>
<td>Renewable Energy Commercialisation Program</td>
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<tr>
<td>REEF</td>
<td>Renewable Energy Equity Fund</td>
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<tr>
<td>RIBG</td>
<td>Research Infrastructure Block Grants</td>
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<tr>
<td>RRDC</td>
<td>Rural R&amp;D Corporations</td>
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<tr>
<td>SAE</td>
<td>Society of Automotive Engineers</td>
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<tr>
<td>SII</td>
<td>Systemic Infrastructure Initiative</td>
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<tr>
<td>SIS</td>
<td>Shipbuilding Innovation Scheme</td>
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<tr>
<td>SME</td>
<td>Small to Medium-sized Enterprise</td>
</tr>
<tr>
<td>TCFSIP</td>
<td>Textiles, Clothing and Footwear Strategic Investment Program</td>
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<tr>
<td>VCLP</td>
<td>Venture Capital Limited Partnership</td>
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EXECUTIVE SUMMARY

The Innovation Report reviews progress in implementing the Australian Government’s five year, $3 billion Innovation Statement Backing Australia’s Ability, and also reports more broadly on the outcomes from the Australian Government’s support for science and innovation, which is currently in excess of $5 billion annually. The report focuses on the three key elements of Australia’s science and innovation base: developing and retaining skills, research and development, and the commercial application of research.

Developing and retaining skills

The Australian Government invests in human capital at every level of education, through funding to public and private schools, vocational education and training, higher education, and research training as well as providing fellowships to develop and retain highly skilled researchers. In addition to baseline funding, the Government, with an investment of over $360 million, put in place several initiatives under Backing Australia’s Ability to address specific needs.

The Organisation for Economic Cooperation and Development’s (OECD) Program for International Student Assessment found that Australia’s 15-year old students are among the highest performers internationally in mathematical and scientific literacy. Australian students continue to perform among the world’s best in the International Science and Mathematics Olympiads. Backing Australia’s Ability is providing over $180 million to improve scientific, mathematical and technological skills in schools. It also supports The Learning Federation, one of the most advanced programmes in the world for developing and delivering online curriculum content for schools.

At university level, Backing Australia’s Ability provided 2000 additional university places targeted at science and technology. The most recent data show that award course completions in science, technology and engineering increased by 37 percent between 1993 and 2002, representing 20 per cent of all award course completions in 2002, compared with 18 percent in 1993. In 2002, some 3627 domestic students completed research doctorates in Australian universities – an increase of 196 percent over 1992. Increased funding for the Australian Research Council through Backing Australia’s Ability has enabled the number of postdoctoral fellowships awarded each year to double to 110. Australia continues to enjoy a strong net gain through immigration of people qualified and skilled in science and technology.

Research and development

Research and development (R&D) is an important driver of economic growth. A domestic R&D capability not only contributes to productivity growth in its own right, but also enables Australia to absorb and adapt leading edge technology from abroad. R&D also makes an important social contribution in areas like health and the environment.

Australia, like most OECD countries, performs most of its R&D in the business sector. Australia’s business R&D is relatively low compared with the OECD average and most industrialised OECD countries. Backing Australia’s Ability introduced a number of initiatives to foster business investment in R&D, including a 175 percent (premium) Tax Concession for additional labour-related R&D expenditure, in addition to the existing 125 per cent R&D Tax Concession. As at 31 August 2003, some 4707 companies had registered for the Tax Concession for the 2001-02 financial year, with a total reported R&D expenditure of $6.0 billion. This is an all-time record. After several years of decline, Australia’s business R&D increased by 13 per cent in real terms in 2000-01, and by a further 8 per cent in 2001-02, the most recent year for which Australian Bureau of Statistics data is available.

Australia’s publicly-funded research is carried out primarily in the universities and government research agencies like CSIRO. According to the most recently available OECD figures, R&D in
universities amounts to around 0.41 per cent of GDP, higher than the OECD average and in the same range as France, Germany, the United Kingdom, Japan and the United States. Australia spends 0.35 per cent of GDP on R&D in government research agencies, again well above the OECD average of 0.27 per cent. Australian government research agencies will spend a total of $1.3 billion in 2003-04.

Relative to our size, Australia’s research output in terms of published research findings is well above the international average. The additional $2.2 billion investment in research and development under Backing Australia’s Ability, including doubling of funding through the Australian Research Council, will further enhance this performance. Two major initiatives under Backing Australia’s Ability, the two centrepiece research centres, National ICT Australia and the Biotechnology Centre of Excellence, the National Stem Cell Centre, commenced operations in 2002 and 2003, respectively.

**Commercial application of research**

The Australian Government has taken important steps to foster the venture capital market in Australia. In 2002-03, the Innovation Investment Fund (IIF) provided close to $30 million to 34 investee companies, of which $17.9 million was provided by the Australian Government. The total amount of Australian Government funds invested since the start of the IIF programme is $110.8 million. Under the $100 million Pre-Seed Fund, established by Backing Australia’s Ability, four venture capital funds have been set up to commercialise university and public sector research. Legislation was enacted in December 2002 to encourage non-resident foreign investment into the Australian venture capital market through Venture Capital Limited Partnerships (VCLPs). As of end September 2003 there were five VCLPs conditionally registered.

Over 800 clients have received assistance through the Commercialising Emerging Technologies Programme (COMET), with 126 products or services launched, and $161 million of capital having been raised by COMET recipients at the end of June 2003. Some 275 start-up companies have been accepted into the ten Building Information Technology Strengths (BITS) incubators around Australia, and the number of graduate companies has grown to 127. BITS has received $78 million funding from the Australian Government.

Under Backing Australia’s Ability, the budget for the highly successful Cooperative Research Centres (CRC) programme will increase to $202 million in 2003-04, up from $148.6 million in 2002-03. The programme will support 71 CRCs, up from 62 in 2002-03. CRCs have undertaken nearly 5000 contracts for industry and other users, earning over $350 million.

**The way ahead**

In November 2002 the Prime Minister announced that the Government would commence work in the second half of 2003 on policy to apply when Backing Australia’s Ability completes in 2005-06. This work is being carried out by the Science and Innovation Committee of Ministers, chaired by the Prime Minister.

To reinforce the focus of the Australian Government’s commitment to science and innovation, the Prime Minister announced in December 2002 the first set of National Research Priorities (NRPs). The four priorities provide a clearer vision for research by focusing Australia’s research effort, building on strengths while seeking new opportunities in emerging areas. The NRPs will also strengthen collaboration between research bodies and with industry, and build critical mass of excellence in those key research areas.
To inform its consideration of science and innovation initiatives beyond 2005-06, the Government is undertaking a detailed programme to assess and evaluate Australia’s research and innovation system. This includes:

- Mapping Australia’s Science and Innovation System—a major exercise to build a comprehensive picture of Australia’s science and innovation effort, and to enable a better understanding of where our research activity is taking place;
- a Review of Teaching and Teacher Education;
- establishment of a taskforce to develop a national research infrastructure strategy;
- comprehensive evaluation of the 1999 Knowledge and Innovation reforms to ensure that the policy framework for Australia’s university block research funding schemes is effective; and
- establishment of a taskforce to examine the scope for closer collaboration between universities and major publicly funded research agencies.

This work will be completed in the context of the 2004-05 Budget, and will represent the next step along a continuous path of building our national capacity for innovation.
SECTION 1 - Where we are at today

Innovation in Australia today

Innovation—developing skills, generating new ideas through research, and turning them into commercial success—is a key driver of productivity and economic growth.

Innovation occurs through a complex set of institutions and interactions—the ‘national innovation system’. This system includes major institutions involved in innovation, such as businesses, government, the education and training sector, and public research institutions; the role of these institutions in key innovative activities; the innovation linkages between these institutions; and cultural norms, such as attitudes to entrepreneurship and change. Sound economic framework conditions that encourage productivity and innovation are also an essential element.

Over the past decade, many other developed nations, including Canada, Korea, Singapore, the United Kingdom, and the United States, have developed substantial government policies to foster innovation. Australia has been at the forefront in developing a whole-of-government programme, Backing Australia’s Ability, to support the national innovation system.

Backing Australia’s Ability

In January 2001, after an extensive consultation and review process that included the Innovation Summit, the final report from the Innovation Summit Implementation Group, Innovation: Unlocking the Future, and the Chief Scientist’s report, A Chance to Change, the Prime Minister, the Hon John Howard MP, announced a comprehensive and integrated package of funding for science and innovation called Backing Australia’s Ability (BAA).

BAA’s scope includes programmes directed to public sector and business research and development (R&D); adoption of technology; commercialisation of research; venture capital; school and university education; skilled immigration; intellectual property protection; public awareness of science and innovation; and entrepreneurship. It reaches right across government—BAA programmes encompass five portfolios. The level of its implementation is extensive, through the Science and Innovation Committee (SIC) of Ministers chaired by the Prime Minister.

Building on earlier initiatives, Backing Australia’s Ability is providing an additional government investment of $3 billion over five years for a range of programmes to address issues in our science and innovation system. The total amount outlaid by the Australian Government in 2003-04 on science and innovation will be in excess of $5 billion.

Reporting our progress

As part of Backing Australia’s Ability, the Prime Minister gave a commitment to provide an annual whole-of-government report on science and innovation to the community, which would report on results achieved. The Australian Government’s Innovation Report 2003-04 is the third of these annual whole-of-government reports. Additionally, the Prime Minister undertook to provide broader information on the performance of Australia’s science and innovation system, including the role of the private sector. This information is presented in a separate report, Mapping Australian Science and Innovation.

The 2001–02 Innovation Report focused on the Australian Government’s aim to strengthen the foundations of innovation across the country, taking the right actions, and staying on the right track.
The 2002–03 Innovation Report reviewed Australia’s innovation structure. It summarised the Government’s many programmes under the general heading of Backing Australia’s Ability, and included the first Australian Innovation Scorecard — a biennial series measuring innovation. The scorecard will reappear in the 2004–05 Innovation Report.

The 2003–04 Innovation Report updates the aims and vision for Australian innovation. It tells about our successes and how we are rising to meet the challenges we face. It provides further detail on the progress and achievements of government science and innovation initiatives and programmes, as well as outlining the current ways that the vision for Australian innovation is being designed. A highlight of the report is the many examples of collaboration between the private and public sectors, between universities and industry partners, and between national and international partners.
SECTION 2 - Supporting and improving Australian science and innovation

Australia is a small nation on the international stage, but despite our size, we have a research base that, especially in our universities and public sector research agencies, performs well above average in producing new knowledge. We provide education and training that is among the world’s best and Australian graduates in many disciplines are highly sought after overseas. Additionally, Australia is a fast adopter of new technologies, such as those in information and communications technology (ICT), and this combined with the highly skilled workforce, means that Australia’s human capital is often cited as a major reason for multinational companies establishing offices and research and development (R&D) centres here.

The Australian Government recognises that we must build on our strengths and continue to improve. To pave the way, the Government has put strategies in place to enhance both short and long-term capabilities.

Part 1 of this section looks at the support provided for the development and retention of skills. Part 2 examines the initiatives and agencies that support and undertake research and development, and Part 3 moves further along the innovation path to the commercial application of research.

This section also highlights some of the success stories of Australian researchers and companies taking ideas to the marketplace.

PART I - Developing and retaining skills

Human capital is a key driver of economic growth and prosperity. Firstly, skilled labour is a direct input to production. Secondly, raising the skill level of the workforce can facilitate the uptake of technology. Finally, increasing numbers of researchers and managerial and entrepreneurial skills can raise the rate at which innovations are generated and commercialised in domestic R&D.

Empirical studies, as summarised in the work of the Organisation for Economic Cooperation and Development (OECD) Growth Project, have confirmed the role of human capital in economic growth. For example, the long run effect on the level of gross domestic product (GDP) per capita of an additional year of education is estimated to currently be in the range of 4-7 per cent for OECD countries.1

The OECD Economic Survey of Australia found that models of economic growth over the past quarter of a century showed a positive estimated effect of investment in human capital on per capita growth in Australia. The estimated coefficient was the fourth highest of OECD countries which suggests particularly high long run returns to investment in education in Australia.2

Other recent studies have examined the role of human capital in OECD countries’ abilities to absorb foreign R&D and catch up to the technological frontier. These studies show significant effects from human capital on absorptive capacity.3 The adoption of technology requires the ability to understand the technology in order to integrate it into the company’s existing infrastructure and to maintain it once adopted – this requires high level and appropriate skills.

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1 *The Sources of Growth in OECD Countries*, OECD 2003, p. 76.
**Schools**

Ensuring a supply of people entering undergraduate degrees in science and technology relies on adequate levels of continued participation in science, mathematics and technology subjects by Year 12 students.

Australian 15-year-old students are among the highest performers internationally in mathematical and scientific literacy. The OECD’s Program for International Student Assessment (PISA) in 2000 found that in both of these fields only students from Japan and Korea significantly outperformed Australian students.

**Chart 1: Mathematical and scientific literacy of 15-year-olds – by OECD countries, 2000**

Participation by Year 12 students in science subjects is a significant factor in ensuring not only a supply of candidates for undergraduate science degrees, but an adequate level of science and technology literacy amongst the population as a whole. It is a matter of some concern that the proportion of year 12 students enrolling in some science and technology subjects has been falling since 1992.

The Australian Government has put in place several measures with a focus on science, technology and mathematics education, to address these issues, including a National Review of Teaching and Teacher Education.
Table 1: Year 12 students, rates of participation in science and technology subjects

<table>
<thead>
<tr>
<th>PERCENTAGE OF YEAR 12 STUDENTS</th>
<th>1993</th>
<th>1998</th>
<th>2001</th>
</tr>
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<tbody>
<tr>
<td>Mathematics</td>
<td>86.3</td>
<td>87.5</td>
<td>84.3</td>
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<tr>
<td>Chemistry</td>
<td>22.6</td>
<td>20.3</td>
<td>17.8</td>
</tr>
<tr>
<td>Physics</td>
<td>20.4</td>
<td>20.0</td>
<td>16.6</td>
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<tr>
<td>Biology</td>
<td>31.7</td>
<td>25.2</td>
<td>25.4</td>
</tr>
<tr>
<td>Computer studies</td>
<td>20.7</td>
<td>27.7</td>
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</tr>
<tr>
<td>Technical studies</td>
<td>16.9</td>
<td>23.2</td>
<td>16.4</td>
</tr>
</tbody>
</table>


Programmes and initiatives

- Fostering foundation skills
- The Le@rning Federation
- National Youth Science Forum
- Olympiads for bright minds
- Review of Teaching and Teacher Education

Fostering foundation skills

Fostering young people’s foundation skills in science, maths and technology is ensuring that today’s students can generate and test new ideas and contribute to the scientific developments and innovation of tomorrow.

Through Backing Australia’s Ability, the Commonwealth is contributing $183.5 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 their government schools.

For 2003, New South Wales, Queensland and Western Australia were required to submit strategic plans. These plans included:

- **NSW** ($39.4 million) – the continuation of initiatives outlined in the previous strategic plan as well as two new initiatives. The first is an expansion of technology initiatives to include the provision of assistance to schools with technical support and provision of assistance to allow some rural and remote schools to access the internet via satellite. The second is to provide 25 additional secondary science and mathematics teachers in ‘difficult to staff’ locations through a nine month tertiary re-training programme followed by in-school mentoring.

- **Queensland** ($4.8 million) – funding is utilised in the continuation of the Technology, Maths and Science Centres of Excellence.
A unique exchange of online educational material between Australia and the United States has taught the two countries that learning across the miles can be inspiring.

The Le@rning Federation and the Virtual Internet School in Oklahoma Network (VISION) conducted a six-month pilot between six organisations, exchanging online content. The aim was to determine what would happen when software designed for one educational, technological and cultural environment was taken ‘away from home’ and used in another environment. Would it have any value and would the technology cope?

The pilot, conducted between November 2002 and April 2003, revealed that the online content developed by each country mirrored the approaches to teaching. The VISION maths, therefore, tended to be linear and instructional, while the Le@rning Federation science content was very much based on an enquiry and constructivist model.

Feedback from the students participating in the pilot was positive. As one student explained: ‘...the computer programs present real life situations…it’s interactive and different from classroom learning. You can do things you can’t normally do in class.’

The organisations that participated in the pilot are: The ACT Department of Education, Youth and Family Services; Lyneham High School, ACT; Western Heights High School, Oklahoma State; OneNet, Oklahoma; Microsoft™ Australia; and Australia’s Academic and Research Network (AARNet).

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**Western Australia** ($2.5 million) – three initiatives dealing predominantly with professional support and pedagogy innovation in mathematics, science and technology.

The Le@rning Federation

The Le@rning Federation, the first initiative of its type in Australia and only one of a handful like it in the world, is an engine for knowledge creation in the schools education sector.

Under Backing Australia’s Ability, the Australian Government has committed $34.3 million to the project, with funding being matched by State and Territory governments.

The five-year initiative, from 2001–02 to 2005–06, focuses on building human capacity through a standardised approach to high quality online, interactive curriculum. It supports teachers, enhances student learning, improves educational experiences, and stimulates domestic educational online content.

Activities and achievements in 2002–03 include:

- commissioning 19 projects from 14 content developers in six subject areas;
- releasing the first round of content in science;
- developing The Exchange (a content management system); the Basic E-Learning Tool Set (an open source software system); and a Schools Online Thesaurus;
- publishing and distributing a wide range of e-learning materials, including fact sheets, CD-ROMs, operational papers, and pamphlets; and
- conducting in-school evaluations—involving some 132 schools, more than 2000 students and approximately 400 teachers.

www.thelearningfederation.edu.au

National Youth Science Forum (NYSF)

Each year the National Youth Science Forum (NYSF), in partnership with Rotary, brings together industry and education partners to provide almost 300 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, such as visits to science or engineering institutions. Participating students have demonstrated an interest in pursuing careers in science, technology or engineering-related fields.

The Australian Government has committed $40,000 per year over the next three years to support the Forum.

www.nysf.edu.au

Olympiads for bright minds

Physics, biology and chemistry

Three teams from the Rio Tinto Australian Science Olympiads have taken on the brightest students in the world, ranking with the best internationally in biology, chemistry and physics. And this year, the Physics Olympiads achieved their best ever results, placing fifth out of 54 countries. The biology team placed seventh out of 41 countries, and chemistry twelfth out of 60.


Credit: Photos by Eddison Photographics.
These prestigious ‘Olympic Games for Science’ are held annually in different countries, and in 2004, the Biology Olympiad will be hosted in Brisbane by the Rio Tinto Australian Science Olympiads in partnership with the Universities of Queensland, Griffith University and Queensland University of Technology. The Australian Government is providing $355,000 to support the event.

Mathematics and Informatics

At this year’s International Mathematical Olympiad in Tokyo, the Australian Team placed 26th out of 82 countries, winning two silver and two bronze medals. The team for the International Olympiad in Informatics, the newest of the disciplines, had one of its best ever performances in an extremely competitive field, bringing home three bronze medals.

The Australian Government has committed $1.8 million for three years to support the Australian Maths Trust—organisers of the Australian Mathematics Competition for the Westpac Awards 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

Review of Teaching and Teacher Education

The Review of Teaching and Teacher Education is an initiative under Backing Australia’s Ability. The purpose of the Review was to identify strategies which will increase the numbers of talented people who are attracted to teaching as a career, especially in the fields of science, technology and mathematics education, and build a culture of continuous innovation at all levels of schooling in Australia.

An independent Committee, drawn from school, university and industry sectors, was established by the Minister for Education, Science and Training, the Hon Dr Brendan Nelson MP, on 8 August 2002, to oversee the Review. A broad-based Reference Group — deans of education and science, teacher professional associations of science, technology and mathematics, business organisations, parents’ groups, principals, teachers’ unions, teacher education bodies, educational organisations and others — was established to assist the Review Committee. A Review Secretariat from the Department of Education, Science and Training was established to manage the progress of the review.

The Review Committee released two Discussion Papers, Strategies to Attract and Retain Teachers of Science, Technology and Mathematics on 5 September 2002, and Young People, Schools and Innovation: towards an action plan for the school sector on 21 March 2003. These releases were accompanied by national calls for submissions, and provided an opportunity for parents, educators and all those interested in teaching and schooling to contribute their ideas.

The response to the Discussion Papers was extremely encouraging, and the submissions provided a rich source of ideas and information for consideration by the Review Committee. Submissions came from a wide range of organisations, including government and non-government school education authorities; most universities; teacher professional associations; industry, peak parent, principal, teacher and union bodies; as well as a diverse group of individuals. A total of 241 submissions was received.
In addition to its collective experience, the Committee consulted widely, held meetings and discussions across the country, visited schools already in the vanguard of innovation, reviewed Australian and international experience and research literature, and commissioned a number of papers to inform its work, and these are available on the Review’s website.


**Key messages from the Review are that we need to:**

- Improve the scientific, technological and mathematical literacy of all Australians and create a well-educated and skilled workforce that embraces lifelong learning;
- Enhance Australia’s capacity to train, inspire and retain outstanding teachers of science, technology and mathematics who can in turn inspire their students’ learning in these areas; and
- Equip Australia with more world-class scientists and innovators able to take ideas through to successful application and commercialisation.

In addition to these key messages the Review Committee has identified five broad priority areas for attention. Action is required in each of these priority areas if Australia is to attract and retain world-class teachers, particularly of science, technology and mathematics, and to initiate and sustain cultures of innovation to achieve high quality learning outcomes for all students. These are:

**Energising the sciences and technology, and prioritising innovation in schools:** Only by commitment to a shared national vision can this be achieved. This requires collaboration by all the stakeholders and needs a concerted effort. The target is to promote a broad culture of innovation in all schools and to ensure that all students receive expert teaching in science, technology and mathematics.

**Planning and collaboration to attract and retain quality teachers:** For the teaching workforce of the future a sufficient number of talented people must make teaching a career of choice. A shared understanding of workforce needs with targeted incentives and attractive working conditions are essential.

**Revitalising the teaching profession:** To strengthen the quality and standing of teaching, recognition of flexible career paths and moves to establish teaching as a nationally recognised and mobile profession are required.

**Strengthening teacher education and professional learning:** Initial teacher education of a very high standard is an essential requirement for an effective, resourceful, diverse teaching profession. It must be built upon through career long professional learning.

**Supporting future schools through leadership, teams and partnerships:** The key to innovation in schools is giving scope to the inspiration, capability and leadership of teachers themselves. Working together, in wider partnerships with the community, and mobilising a wide array of resources, teachers of the future can transform Australia into a knowledge-based, learning society.

The Australian Government will now give full consideration to the Report’s recommendations.

Universities and postgraduate research and research training

Universities play a key role in preparing a workforce capable of meeting the demands of a knowledge economy.

The most recent data\(^4\) show that in 2002, some 29,734 non-overseas students completed courses in natural and physical sciences, information technology, and engineering and related technologies at Australian universities. Completions in these fields increased by 37 per cent between 1993 and 2002—representing 20 per cent of all award course completions in 2002, as compared to 18 per cent in 1993.

The proportion of young science and technology graduates entering the workforce is an important indicator of the flow of technologically-skilled graduates in the workforce and the economy’s capacity to adapt and adopt emerging technologies.

In 1999, the year for which most recent internationally comparable data are available, Australia had 1303 science graduates per 100,000 persons in the labour force aged 25 to 34 years of age against an OECD country mean of 917.\(^5\) Completed science and engineering doctoral degrees totalled 95 per million population in Australia, compared with 146 for Germany, 93 for the United States and 52 for Japan.\(^6\)

Programmes and initiatives

- 2000 additional targeted university places\(^{BAA}\)
- Science Lectureship Initiative
- Research Training Scheme
- Australian Postgraduate Awards Scheme
- International Postgraduate Research Scholarships Scheme
- Postgraduate Education Loans Scheme\(^{BAA}\)
- Backing Australia’s Future – Review of Higher Education

2000 additional targeted university places\(^{BAA}\)

Total funding of $151 million over five years from 2001-02 to 2005-06, has been provided under Backing Australia’s Ability to create 2000 additional university places in key innovation areas such as ICT, mathematics and science. This initiative will strengthen our national skills base and meet employers’ needs for high-calibre graduates in these fields.

\(^6\)National Science Foundation, Science and Engineering Indicators 2002, Appendix table 2–42 (degree statistics); OECD, Main science and technology indicators 2003/1, Annex 2E (population.)
The Australian Government provided $25 million over three years from 2000–01 for the Science Lectureship Initiative, a competitive grants scheme that provided support for 28 projects involving 29 universities and a wide range of industry partners to develop innovative approaches to science-related education (including university lectureships, course design and delivery). The initiative also aimed to encourage industry to invest in education and training, and attract more school leavers into science-related courses.

University of Wollongong engineering students are on top of the world after becoming the first international team to win the United States Formula SAE title, for a car they designed and built from the ground up.

The team’s car also placed first in the engineering design, endurance and fuel economy sections, and fourth in sales presentation. The students had to raise $55,000 in sponsorship to get themselves and the car to the United States.

The international competition is run by the Society of Automotive Engineers and is considered an ideal launch pad for students developing skills and seeking careers in automotive design and engineering with major car manufacturers.

Judged in a series of categories including design, cost analysis, sales presentation and performance, the Australian team raced to the top and took first place overall.

Professor Chris Cook, from the Faculty of Engineering, said the win is an endorsement of the unique approach the university has to its engineering degree: ‘Our theory is that with broad training, our students can turn their hand to anything. They have proven we are right by producing the best car in the world.’
Postgraduate research and research training

People with doctoral or masters degrees are particularly well-equipped to generate new ideas, and make an important contribution to innovation.

In 2002, some 3627 domestic students completed research doctorates in Australian universities—an increase of 196 per cent over 1992. As well, 18,473 domestic students completed an award at the doctorate by coursework or masters’ level—an increase of 163 per cent over 1992.7

Research Training Scheme

The Research Training Scheme allocates funding for higher degree research training to institutions on the basis of performance. In 2003, universities received $527 million in funding and provided approximately 22,000 research training places.

Australian Postgraduate Awards (APA) Scheme

This scheme provides financial support to Australian postgraduate students of exceptional research promise who undertake their higher degree by research in Australia. There are approximately 4500 students on APA scholarships at any time and around 1550 new awards are made each year. In 2003, the Australian Government provided $87.1 million in funding to the scheme. This will increase to $89.2 million in 2004. The scheme is managed by the Department of Education, Science and Training.

International Postgraduate Research Scholarships (IPRS) Scheme

This Scheme provides financial support to high quality international postgraduate students coming to Australia to support the country’s research effort. There are approximately 1000 students on IPRS scholarships at any time. In 2003, 310 new IPRS scholarships were awarded, through Australian Government funding of $17.3 million. Funding will increase to $17.7 million in 2004. The IPRS Scheme is managed by the Department of Education, Science and Training.

Postgraduate Education Loans Scheme (PELS)

This scheme provides loans to students enrolled in fee-paying, postgraduate non-research courses. PELS helps remove financial barriers to education and training and increase enrolments in fee-paying postgraduate coursework courses. During four years from 1 January 2002, when the scheme was created, the Australian Government will provide loans totalling an estimated $910 million to students, helping them update and acquire new skills. In 2002, the Australian Government paid a total of $115 million to institutions on behalf of more than 25,000 students. The PELS take-up rates in the priority areas of communication technology, and science and mathematics were higher than average.

7 DEST, Students 2003 (first half-year): selected higher education statistics; preliminary tables, appendix table 3.
Backing Australia’s Future – Review of Higher Education

In 2002, the Australian Government conducted a review of Australia’s higher education system. The Review began with the release of an overview paper entitled Higher Education at the Crossroads in April 2002, setting out some of the characteristics of the higher education sector, and the challenges it faces. There were 355 submissions from a variety of stakeholders in response to the overview paper.

Between June and September 2002 a series of issues papers was produced to explore a variety of key issues in more depth. These papers were:

- Striving for quality: Learning, teaching and scholarship
- Setting firm foundations: Financing Australian higher education
- Varieties of excellence: Diversity, specialisation and regional engagement
- Achieving equitable and appropriate outcomes: Indigenous Australians in higher education
- Meeting the challenges: The governance and management of universities
- Varieties of learning: The interface between higher education and vocational education and training

There were 373 submissions received in response to the six issues papers, once again from a variety of stakeholders including higher education institutions, business groups, student organisations, unions and individuals.

Following the closure of the submission process, a series of 48 forums were held across Australia in all major cities with around 800 stakeholders participating. The public consultation process concluded in October 2002 with a two day ministerial forum held at Parliament House in Canberra.

The Government’s response to the Review was announced on 13 May 2003 as part of the 2003-2004 Budget process. The Reform package lays the foundation for a ten year vision for Australian higher education, with approximately $1.5 billion additional Australian Government funding being invested in the sector over four years.


Gaining and retaining skills

A benefit of circulating highly skilled and qualified workers between countries is the diffusion of skills and experience this creates. However, it is necessary to provide appropriate opportunities to attract Australians back, so that their newly acquired skills and experiences (including entrepreneurial skills, management experience and access to global networks and venture capital) can be incorporated into the workforce. While the actual costs and benefits of ‘brain drain and regain’ are still a matter of contention, Australia enjoys a net gain of people qualified in science and technology.
Figure 1: Net gains in scientists and engineers through migration, by selected occupations, 1991–92 to 1999–2000

Source: DIMIA, unpublished data provided to Science and Innovation Analysis Section, DEST, in August 2003.

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**Research Fellowships**

Research fellowships enable highly qualified and talented researchers to be employed on specific research projects, primarily in the higher education sector. Agencies such as the Australian Research Council (ARC) and the National Health and Medical Research Council (NHMRC) offer a range of fellowships from early career postdoctoral fellowships to senior professorial fellowships. Nurturing the talent and skills of early career researchers is critical to the ongoing development and renewal of Australia’s world-class research effort.

Under *Backing Australia’s Ability*, an additional $736.4 million over five years is being invested in research administered by the ARC. Part of the additional funding provided by BAA is being used to fund the Federation Fellowships scheme, improve the competitiveness of researchers’ salaries, and double the number of new postdoctoral fellowships awarded each year to 110.

In 2003, the ARC awarded 24 Federation Fellowships including six to Australians returning from overseas and two to foreign nationals. The ARC also funded 166 Fellowships under Discovery-Projects, comprising 110 postdoctoral fellowships, 31 research fellowships and 25 professorial fellowships.
Under the Linkage grants scheme, the ARC awarded 42 postdoctoral fellowships, including ten new Linkage–Australian Postdoctoral Fellowships (CSIRO) aimed at strengthening collaboration between universities and CSIRO.

www.arc.gov.au
www.csiro.au

New NHMRC funding in 2002 supported at least 3400 Australian researchers, granted 146 new scholarships (valued at nearly $9 million) and 24 new Investigator Project Grants (about $6 million). In addition, 73 new Training Fellowships were awarded ($20 million) and $12 million was invested in the career development of 37 post-doctoral researchers.

The NHMRC provides a wide range of both research and training fellowships in a variety of formats. Recent developments include the Trans-Tasman Joint Initiative Award to encourage collaboration with New Zealand health and medical researchers and the Industry Fellowships to provide opportunities for researchers to work in industry as well as in a research institution.

www.nhmrc.gov.au

RELIEF FROM ARTHRITIS

Research on new ways to treat rheumatoid arthritis and other chronic inflammatory diseases has earned Dr Paul Egan a National Health and Medical Research Council Industry Fellowship.

‘The Fellowship allows me to apply cutting edge medical research directly to the development of new drugs for treating rheumatoid arthritis,’ says Dr Egan. ‘By collaborating with an industry partner, I’m gaining experience in the work needed to take a discovery out of the laboratory and using it to treat a significant disease.’

The treatment involves blocking the activity of key proteins produced by the body that cause joint inflammation. Dr Egan’s work is being carried out in collaboration with Amrad Corporation Ltd.

Dr Paul Egan, Walter & Eliza Hall Institute, 2002 NHMRC Industry Fellow.
Image supplied by WEHI.
Federation Fellowships

The Australian Research Council’s Federation Fellowships are innovative and highly prestigious awards designed to build world-class research capacity in Australia. By providing an internationally competitive salary, the Federation Fellowships will support and encourage researchers to stay in, or return to, Australia to conduct research of significant national economic, environmental and social benefit.

The Federation Fellowships are a key initiative of Backing Australia’s Ability, with up to 25 Fellowships being awarded each year from 2002 to 2006. The Fellowships provide salaries of $230,000 per annum (2002 dollars) plus 26 per cent on-costs.

In 2003 Federation Fellowships were awarded to researchers working on a wide range of projects including: quantum and atom optics, cellular plasticity in the brain, and atomic-scale devices in silicon.

www.arc.gov.au

Skilled immigration

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

In 2002-03 there was a continued net gain in ICT workers in Australia with more ICT workers entering Australia than departing. Since September 2001, there has been a falling demand for overseas ICT workers on temporary visas. The drop in demand stabilised in 2002-03 with more Australian residents returning to Australia and less departing over that period, compared with previous years. 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 March 2003, the Department of Immigration and Multicultural and Indigenous Affairs, in consultation with the Department of Employment and Workplace Relations, reduced the number of ICT specialisations on the MODL to twelve, from a high of 26 in May 2001.

The electronic lodgement of applications for temporary business (long stay) visas for temporary resident ICT workers has been developed. The program is currently in pilot phase and full implementation is scheduled for November 2003.

www.immi.gov.au

2003 Federation Fellows with the Minister for Education, Science and Training, the Hon Dr Brendan Nelson MP.

Credit: Photography by Andrew Tatnall, Big Island Photographics.
Wafer-thin materials of extraordinary strength—that can withstand the pressure of a two tonne truck—have been developed by University of Sydney Professor Marcela Bilek.

The materials, which include metals, glass, plastics, and fabrics, have earned Professor Bilek the Malcolm McIntosh Prize for Physical Scientist of the Year in 2002 and a Federation Fellowship in 2003.

Using plasma arcs and beams, magnetic fields and high energy electrical pulses, Professor Bilek has become a world leader at stitching together unique materials one atomic layer at a time. She says her work uses a similar approach to the abalone, whose shell is composed of soft and brittle materials that combine to create super strength.

Results from this nano-scale revolution are already being delivered with materials being put to work in leading edge industrial and bio-medical applications.

The potential use for Professor Bilek’s materials is limited only by the imagination and they are even ideal for use in bio-medical devices such as artificial hearts.

‘Industry are coming to us and asking us to develop materials for them,’ said Professor Bilek.

The first woman to take up the position of Professor of Applied Physics at the University of Sydney, Professor Bilek is recognised as a world leader in the design and fabrication of plasma processing devices and new materials.

In the last two years alone Professor Bilek’s work has led to three new provisional patents being lodged.
Part 2 - Public face of innovation—fostering entrepreneurship and awareness of science and innovation

The Australian Government is involved in the promotion of science and innovation through a variety of programmes and activities. Institutions such as Questacon, the National Science Week and the Innovation Festival, as well as the Prime Minister’s Science Prizes, have a dual role to fulfil. They focus public attention on the efforts of Australian scientists and researchers who make an enormous contribution to our daily lives, and they capture people’s imagination and open their minds to the potential of science and innovation. By demonstrating how exciting science and innovation can be, they will encourage more young people to pursue careers in the sciences as well as innovative and entrepreneurial careers, and contribute to Australia’s future prosperity.

Programmes and initiatives
- National Innovation Awareness Strategy
- National Innovation Council
- Prime Minister’s Science Prizes
- Questacon
  - Smart Moves
- Eureka Prizes

National Innovation Awareness Strategy (NIAS)

The National Innovation Awareness Strategy (NIAS) Program is a $35 million, five-year initiative under Backing Australia’s Ability designed to build a culture that appreciates and rewards science and innovation.

NIAS responds to a continuing need to encourage a wider interest and knowledge of science and innovation in the community, and to promote the achievements of Australia’s scientists, science teachers and innovators. This is to demonstrate the central role of science, technology and innovation in achieving Australia’s socioeconomic goals, to ensure a continued supply of science-aware and entrepreneurial Australians, to ensure Australian industries are both aware of and can incorporate innovation into their activities, and to ensure Australians remain receptive to scientific and technological advances.

ABC Science Online, funded through NIAS, continued its strong performance, topping 1.5 million website hits per week for ten months of the year. Its flagship site, “The Lab” (regarded as one of Australia’s five “hottest” science sites) celebrated its 6th birthday in July 2003. The Lab also supports “Lab Notes”, a major on-line teaching resources and an interactive site for over 500 science teachers across Australia.

www.abc.net.au/science
In 2003 NIAS continued its support for National Science Week (August 2003), delivering $400,000 through 30 grants to community-based projects nationally. Over half a million people attended the 800+ National Science Week events.

As well during 2002–03, NIAS provided funding of $279,194 for competitive grants and $218,800 to support the Business Plan Competition in 19 universities and institutes of Technical and Further Education (TAFE). Other grants included:

- a $100,000 grant for the 2003 Australian Innovation Festival, which comprised over 300 events held across Australia and involved more than 153,000 participants;
- a $250,000 grant 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 in Australia; and
- grants of $20,000 to the XIXth International Genetics Congress (Melbourne) and $50,000 to the Vth International Congress on Industrial and Applied Mathematics (Sydney).

Further grant rounds will be undertaken in the next financial year with a primary focus on industry initiatives.

NIAS is continuing its support for other projects including “Science Meets Parliament” which took place in October 2003.

www.dest.gov.au/nias

National Innovation Council

In February 2003, the Minister for Industry, Tourism and Resources, the Hon Ian Macfarlane MP identified new terms of reference for the National Innovation Council, which has replaced the National Innovation Awareness Council.

The new Council will assist the Minister for Industry, Tourism and Resources and the Department of Industry, Tourism and Resources in relation to communicating the benefits of innovation to students, small to medium-sized enterprises (SMEs), and the broader community.

The Council will meet quarterly and report directly to the Minister for Industry, Tourism and Resources, with the first meeting taking place on 27 November 2003.

www.innovation.gov.au

Prime Minister’s Science Prizes

The Prime Minister’s Prizes for Science were established in 2000 and are a national tribute to excellence in Australian science.

An initiative of Backing Australia’s Ability through the National Innovation Awareness Strategy, the prizes are part of the Government’s ongoing commitment to supporting and promoting the important contributions that research and teaching in science make to the betterment of Australia.

The prizes and their awards are:

- Prime Minister’s Prize for Science ($300,000)
- Science Minister’s Prize for Life Scientist of the Year ($50,000)
- Malcolm McIntosh Prize for Physical Scientist of the Year ($50,000)
Prime Minister’s Prize for Excellence in Science Teaching in Primary Schools ($50,000)

Prime Minister’s Prize for Excellence in Science Teaching in Secondary Schools ($50,000).

Emeritus Professor Jacques Miller AC, of the Walter and Eliza Hall Institute of Medical Research, is the winner of the 2003 Prime Minister’s Prize for Science.

Professor Miller was awarded the prize for his ground-breaking work on the immune system. His work has shed light on how the immune system might fail, leading to allergic diseases and autoimmune disorders. Professor Miller’s discoveries have also paved the way for the pioneering work of other research scientists, including Nobel Prize-winning researcher Professor Peter Doherty.

The winner of the 2003 Science Minister’s Prize for Life Scientist of the Year was Dr Christopher Helliwell of the CSIRO. The Malcolm McIntosh Prize for Physical Scientist of the Year prize went to Dr Howard Wiseman of Griffith University.

In 2002, two new awards were created to reward the contribution, commitment and dedication to effective and creative science teaching.

The 2003 Prime Minister’s Prize for Excellence in Science Teaching in Primary Schools went to Ms Sarah Tennant, from Sydney Grammar School, New South Wales. The Prime Minister’s Prize for Excellence in Science Teaching in Secondary Schools for 2003 was awarded to Dr Pam Garnett from St Hilda’s Anglican School for Girls, Western Australia.


Questacon

Questacon (The National Science and Technology Centre), Australia’s largest science centre, based in Canberra, aims to make science fun and relevant for everyone. Through six galleries packed with more than 200 interactive exhibitions, science shows and education programmes, Questacon engages people in discovering science and technology. It also operates science outreach programmes and travelling exhibitions throughout Australia and overseas.

Last year close to 350,000 visitors experienced the fun at Questacon, and more than one million experienced a travelling program or exhibit. And over 860,000 visitors explored Questacon’s award-winning web site.

In 2002 under Backing Australia’s Ability, Questacon developed the Smart Moves programme to take science and innovation out to secondary schools in rural and regional areas.
Smart Moves

Smart Moves is an interactive, humorous and high energy look at Australian inventions including the ‘smart bra’, a safe spider catcher and the brakeboard – a skateboard with brakes, futuristic sciences and ethically charged issues like human cloning, all designed to capture students’ imaginations.

The Australian Government, through Backing Australia’s Ability, is providing $3.7 million for Smart Moves.

Over 2002-03 Smart Moves presented shows to 54,778 students in regional and rural schools in NSW, Victoria and Tasmania, including Lord Howe Island, Norfolk Island, the Christmas and Cocos Islands, King Island and Flinders Island. In the coming year the program expects to see another 60,000 regional and rural secondary students in Northern NSW, South Australia, Northern Territory and Queensland.

www.questacon.edu.au

Fifteen young innovators from around Australia rubbed shoulders with successful entrepreneurs and scientists and exchanged views on how to take an idea to market, at an inaugural Invention Convention in Canberra.

Participating in the convention enabled the young entrepreneurs to learn new business and entrepreneurial skills, develop their ideas, meet with other young innovators, and hear from inspirational speakers.

Held from 29 September to 3 October 2003 the convention was part of Questacon’s Smart Moves—an Australian travelling outreach programme offered to students in Years 9-12 that promotes research, exploration and entrepreneurship in science, engineering and technology. The young innovators who attended the convention had their expenses paid for through Smart Moves.

Evaluation of visits to the Questacon Smart Moves revealed that 94 per cent of teachers and 97 per cent of students said they thought the programme made a positive impact.

Students’ comments on Smart Moves included: ‘It opened my mind to science and career opportunities’, and ‘Having this presentation made me realise that there are heaps of opportunities in science/business and all you need is a good idea and an imagination’.

www.smartmoves.questacon.edu.au
Australian Museum Eureka Prizes

A record $210,000 was presented to 21 winners at the 13th annual Australian Museum Eureka Prizes dinner. The 2003 Prizes recognised scientific and industrial achievements including:

- a revolutionary wireless electricity meter that could save 5 per cent off electricity bills (NSW);
- a clean industrial plant that converts old tyres into useful products with no waste (Qld);
- a way of growing grain sustainably using native grasses (WA);
- a continental knowledge base helping save endangered native birds (Vic); and
- a new class of drugs to fight heart disease, cancer and blindness (NSW).

In congratulating the winners, Brian Sherman, President of the Australian Museum Trust said, ‘The Eureka Prizes are made possible through a unique partnership between the NSW and the Australian Government, major private sector organisations, and educational institutions. I pay tribute to these groups and to their commitment to the pursuit of scientific excellence in Australia.’

A full list of prize winners is at Appendix Table 13.

SUPERCONDUCTOR CATHY

With superhuman effort, Dr Cathy Foley has held hundreds of talks with schools and community groups, made an huge number of television appearances and been interviewed on a host of radio segments, all in the name of science and all while pursuing her career as leader of a team in high temperature superconductivity research.

Cathy works at CSIRO’s Division of Telecommunication and Industrial Physics. ‘She is a role model to all scientists on how to both maintain a science career and engage the wider community in her science,’ said Brian Sherman, President of the Australian Museum Trust. ‘Cathy has brought science and science-related issues to the attention of an enormously diverse and large segment of the public for almost two decades.’

For her enormous contribution, Cathy was awarded with a Eureka Prize for the Promotion of Science sponsored by the Department of Education, Science and Training.

The prize is awarded for outstanding effort to promote interest in, and enthusiasm for, science to the general community, which goes well beyond the scope and activities of the winner’s occupation.
Nanobes are ten times smaller than any known organism. But are they alive?

That question is at the heart of Sonya Pemberton’s documentary, *Alien Underworld*, which has won her a Eureka Prize for science journalism.

Named ‘nanobes’ by their discoverer, Queensland geologist Dr Philippa Uwins, these structures are so tiny that their size defies conventional biological wisdom. The documentary film accompanies Dr Uwins as she struggles to convince the international scientific community that nanobes are alive.

The documentary uses extraordinary visualisation—from the edges of the solar system to the minute details of nanoscopic life—and strong personable characters, to take the viewer on a journey, without ever compromising scientific integrity.

‘Alien Underworld’ has been sold to many international broadcasters and last year won the Grand Prix at the 2002 Beijing International Science Festival,’ says Brian Sherman, President of the Australian Museum Trust.

Sonya was awarded the Education, Science & Training Michael Daley Eureka Prize for Science Journalism for her invaluable work on the documentary.

This Eureka Prize is awarded to an Australian journalist or communicator for an entry assessed as having most effectively communicated scientific and/or technological issues to the public.

www.amonline.net.au/eureka
Part 3 - Research and development

Public and private sector science and innovation

The OECD Growth Project identified R&D as an important driver of economic growth, and concluded that:

Foreign R&D is particularly important for most OECD countries (the United States being an exception), since the bulk of innovation and technological change in small countries is based on R&D that is performed abroad. But domestic R&D (i.e. business, government and university research), is also an important driver of multi-factor productivity growth. It is also key in tapping into foreign knowledge; countries that invest in their own R&D benefit most from foreign R&D. The important role of R&D in multi-factor productivity growth and the rise in R&D spending suggests that there may be unexploited potential for improved growth performance in many OECD countries. 8

Sound economic policies incorporating a stable, low-inflation macroeconomic environment, strong competition, and flexible production and labour markets are essential for economies to realise the full benefits of technological advances. The important characteristic of R&D is that it can permanently lift the rate of economic growth.9

Business research and development

There is an emerging consensus that private gross returns in the range of 20 to 30 per cent for firms’ investments in R&D are both common and plausible. Taking account of risk premia10 required to finance commercial R&D, as well as depreciation rates on R&D capital, the net private return on R&D investment appears to be broadly comparable with the return on investment in physical capital.

Microeconomic studies confirm the existence of significant spillovers of knowledge from the firms performing R&D to other firms and industries. Taking account of measured spillovers typically raises the estimated gross rate of return on business investment into the range between 30 and 40 per cent. However, authors warn that these are likely to be underestimates of the true social rate of return, because the microeconomic studies do not usually cover all economic sectors.

Macroeconomic studies, which by definition cover all sectors of the economy, do indeed find significantly higher returns to business R&D in OECD countries, with estimates ranging from 50 per cent to over 100 per cent.11

10 The difference between the expected return on a security or portfolio and the ‘riskless rate of interest’ (the certain return on a riskless security) is often termed its risk premium. Underlying the terminology is the notion that there should be a premium (higher expected return) for bearing risk.
Publicly-funded research and development

The impact of basic research carried out in universities and government research agencies has been characterised by the United States Committee for Economic Development as:

Publicly-funded basic research is critical to private sector innovation. Although private industry conducts basic research, these efforts are primarily to ‘fill-in-the-gaps’ within broader programs of applied research aimed at new product development. Industry depends on the intellectual foundations provided by basic researchers in the non-profit and public sectors for innovation products and services.12

A particular feature of basic research is the timeframe over which discoveries diffuse into new applications with tangible economic results. The timeframe has been estimated at an average of 20 years.13

Macroeconomic studies that distinguish between public and private sector R&D and allow for longer lags to assess effects on productivity, find that public sector R&D contributes significantly to productivity, although less strongly than private sector R&D.14 Cost benefit studies of applied research carried out by Australian Government research agencies and universities, particularly agricultural research, show very high benefit to cost ratios, even when the cost of unsuccessful research projects are taken into account.15 16 17

International studies, for example of the Boston area in the United States,18 have shown that concentrations of universities can have a strong effect on economic growth in neighbouring locales through spin-off companies and other linkages and flow-ons from R&D activity.

The impact of public research on industry is dependent on the capacity of both the region and nation to commercialise the research. In the past, this may have been a clear weakness in Australia’s innovation system and Australia has no ‘Silicon Valleys’. More recently though, there has been evidence of improvement,19 20 and a number of BAA and other government programmes are directed at fostering the benefits of collaboration for both business and public research sectors.

Universities

Australia’s universities spent almost $2.8 billion on R&D in 2000-01 (the most recent year for which data is available). Eight Australian universities individually spent more than $100 million on R&D during the year and this ‘Group of Eight’ collectively performed 62 per cent of all university research. The largest research expenditure was by the University of Melbourne ($291 million), the Australian National University ($284 million), the University of Queensland ($268 million) and the University of Sydney ($255 million).

Expenditure on R&D in universities was 0.41 per cent of GDP. This is higher than the OECD average of 0.38 per cent and in the same range as France, Germany, the UK, Japan and the United States.

14 ibid. p.16.
19 Australian Research Council, Commonwealth Scientific and Industrial Research Organisation and National Health and Medical Research Council, National Survey of Research Commercialisation Year 2000, pp. 11-12.
The most recent statistics show some 86 per cent of R&D in universities is funded by the Australian Government, including R&D from general university funds.

The future standing of Australian research relies in part on our involvement in the global research environment, which in turn depends on: national and international collaboration between researchers and research institutions; access to increasingly sophisticated and expensive research facilities and networks; and, access to extensive digital datasets.

**Research infrastructure**

One of the Australian Government’s priorities under *Backing Australia’s Ability* is to fund collaborative research infrastructure proposals.

Through initiatives such as the Major National Research Facilities programme, and the establishment of world-class centres of excellence in information and communications technology and biotechnology, the Government intends to enhance progress in innovation.

In May 2003, the Minister for Education, Science and Training, the Hon Dr Brendan Nelson MP, announced the establishment of the National Research Infrastructure Taskforce. The Taskforce was created to develop a nationally-integrated and forward looking strategy for research infrastructure—to support Australia’s research, across the sector, within the framework of Australia’s National Research Priorities. The Taskforce will be reporting to the Minister by the end of 2003.

Infrastructure and facilities for universities and other public sector research agencies include:

- expensive infrastructure items such as X-ray diffraction facilities, electron and atomic force microscopes, and nuclear magnetic resonance machines
- larger infrastructure such as telescopes, supercomputers, ship and aircraft time, animal houses, biological field stations, and synchrotrons
- systemic infrastructure such as major data sets and networks
- the acquisition, provision and operation of, and access to, international facilities.


**Programmes and initiatives**

- Australian Research Council
- Special Research Funding
  - *Institutional Grants Scheme*
  - *Research Infrastructure Block Grants*
  - *Systemic Infrastructure Initiative*
- Major National Research Facilities
- Food Innovation Centres
- National Health & Medical Research Council
- Rural Research & Development Corporations
- World Class Centres of Excellence
A new icon of science, Mount Stromlo, is set to resume its mantle as the home of Australian astronomy.

Six months after bushfires in Canberra destroyed more than $40 million worth of facilities and equipment at the internationally-renowned astronomy, research and education facility, reconstruction is underway.

The Australian National University (ANU) began planning reconstruction the day after the fires, when staff determined that the new Stromlo would truly reach for the stars. The Australian Government responded by committing $7.3 million.

‘Mt Stromlo is renowned as a powerhouse of research and innovation around the globe and is the workplace of a number of the world’s leading researchers,’ said ANU Vice-Chancellor Professor Ian Chubb. ‘The University, the Australian Government, the international scientific community, and the Australian public would not accept a second-class facility.’

The redevelopment emphasises the site’s heritage, and includes plans to restore the heritage-listed 1911 Oddie telescope and the 1924 heritage-listed Old Administration Building, designed by John Smith Murdoch, the architect of Old Parliament House.

The 1868 Farnham Telescope, which miraculously escaped the fires, will be rehoused in a dome and replaced with ‘The Phoenix’, a new robotically-controlled and vastly more powerful telescope.

The 1868 Great Melbourne Telescope, the largest in the world when first built, was damaged too badly for restoration. The Skymapper Telescope, the world’s fastest, will carry its work forward.

The Skymapper will offer exciting new capabilities. It will have a huge viewing area 30 times larger than the full moon and more than three times bigger than any other telescope in the world. It will use a cutting edge 300-million pixel digital camera 100 times more sensitive than the human eye.

The redevelopment will also include a new virtual reality theatre that will fly visitors through our universe in 3D and an Advanced Instruments and Engineering Facility.

The Director of the Research School of Astronomy and Astrophysics, Professor Penny Sackett, said Mt Stromlo opened the eyes of tens of thousands of Australians to science and served as a vital resource to international astronomy for decades—and will continue to play this role in the future.
New ‘clocks’ capable of the most exquisite precision are being built by an Australian research team.

The timing devices—1000 times more accurate than their closest competitor worldwide—are being developed by physicists from The University of Western Australia with support from the Australian Research Council.

As well as receiving one of the largest ARC Discovery grants ever awarded, a total of $1.2 million over five years, the research team has received almost every kind of ARC research fellowship available from early career postdoctoral fellows to senior professorial fellows.

The clocks herald major improvements in global communications and navigation and will be used to test Einstein’s theories of relativity with unprecedented accuracy. They will test the effect of gravity on time, and measure the speed of light to see if it is constant or whether, as some astronomers have recently suggested, it is beginning to slow.

The team of 20 researchers, led by Associate Professors Andre Luiten (ARC Australian Research Fellow), Michael Tobar (ARC Professorial Fellow) and Dr Eugene Ivanov, has already built the world’s most accurate timepiece, the microwave-actuated sapphire clock. The team has been asked by the European Space Agency to adapt the sapphire clock so it can fly on the International Space Station as part of the Atomic Clock Ensemble in Space mission during 2006–08.

‘One of the technological reasons for the space mission is that all the world’s telecommunications systems rely on timing with pinpoint accuracy,’ says Professor Luiten. ‘As traffic builds up around the globe, it becomes ever more critical to synchronise each country’s time with all the others.’

In addition to the ARC fellowships and Discovery project funding, the research team also holds ARC Linkage-International funding to enable close collaboration with researchers in France and the United States. A great deal of the infrastructure in the optics part of the group was delivered through an ARC Linkage-Infrastructure grant.

Left: Jimmy Anstie (Australian Postgraduate Award recipient) holds the spherical heart of the new sapphire clock which is destined for the International Space Station. The ‘heart’ is a hollow silver plated dimpled copper sphere containing an industrial sapphire. To ‘tell the time’, the researchers inject microwave radiation in via the dimples which sets the sapphire sphere into vibration. The purity of the vibration is used as the definition of time.

Right: Dr John Harnett – an ARC Postdoctoral Fellow – shows off some of the crystals that have been tested for their time-keeping ability. The manufactured crystals include sapphire (clear), ruby (red), quartz (clear) and chromium doped yttrium aluminium garnet (green). Sapphire is the best choice because of its ability to ring with the highest purity.

Credit: Images supplied by the Faculty of Life and Physical Sciences, University of Western Australia.
**Australian Research Council (ARC)**

The Australian Research Council’s mission is to advance Australia’s research excellence to be globally competitive and deliver benefits to the community.

Under the National Competitive Grants Program, the ARC supports research and research training in all fields of science, social sciences and the humanities.

Under *Backing Australia’s Ability*, the Australian Government provided an additional $736.4 million of funding for research grants, over five years. Initiatives include:

- establishing Federation Fellowships from 2002
- doubling the number of ARC-funded postdoctoral positions to 110
- improving the competitiveness of researchers’ salaries
- increasing funding available for research projects to improve grant application success rates and average grant sizes
- providing funds for two world-class centres of research excellence—in information and communications technology, and biotechnology.

**National Competitive Grants Program**

The *Discovery* and *Linkage* programs are the main elements of the National Competitive Grants Program, which is funded through the Australian Research Council (ARC).

In the 2003 *Discovery* and *Linkage* funding rounds the ARC targeted over 33 per cent of new funds to four areas of research priority: nano-materials and bio-materials; genome/phenome research; complex/intelligent systems; and photon science and technology.21

**Discovery**

Through *Discovery–Projects*, the ARC supports a continuum of activities—from smaller research projects to clusters of larger projects—to meet the needs of researchers in different disciplines and at different stages of their careers.

In the 2003 funding round announced in October 2002, the ARC awarded 921 *Discovery–Projects* grants worth $231.2 million over the five years from 2003 to 2007. Of the 921 successful applications, 476 reported 1036 instances of international collaboration with 62 countries.

As a result of funding increases under *Backing Australia’s Ability*, in 2003 the average size of *Discovery–Projects* grants increased to $251,007 (over the life of the project); the success rate of applications increased to 25.8 per cent; and the salaries of new and existing fellowships further increased by between four and nine per cent (having increased by between 15 and 43 per cent in the 2002 funding round).

Support is also provided under *Discovery–Projects* for early career researchers. The ARC funded approximately 160 early career researchers in both 2002 and 2003.

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21 These research priorities for the ARC were announced by the Minister for Education, Science and Training in January 2002 to be applied for 2003 grants. Subsequently National Research Priorities were announced by the Prime Minister in December 2002.
Linkage
Linkage–Projects supports collaborative research projects between higher education researchers and industry. In the 2002 application year (for funding in 2003), the ARC introduced two rounds of applications under Linkage–Projects to address industry concerns that long lead-times for funding under the program were affecting the development of collaborative partnerships.

Across the two rounds of applications (announced in October 2002 and May 2003), the ARC is supporting 586 new linkage project grants and awards worth $105.7 million over the five years to 2007.

As a result of Backing Australia’s Ability funding increases, the average size of Linkage–Projects grants awarded in 2003 increased to $180,313 (across the life of the grant), up from $163,145 in 2002 and $130,879 in 2001.

Each year the ARC targets 20 per cent of new funding under Linkage–Projects to research that will directly benefit regional and rural Australian communities. For projects commencing in 2003, this target was exceeded, with over 40 per cent of Linkage–Projects benefiting rural and regional issues.

In the 2003 funding round, the ARC awarded 67 Linkage–Infrastructure Equipment and Facilities grants worth $25.2 million. This funding will support the acquisition of facilities and equipment worth $40.8 million.

ARC Centres of Excellence
Under Backing Australia’s Ability, the Government has committed $89 million over the period 2003–07 to establish ARC Centres of Excellence in the ARC’s designated areas of research priority.

The eight new ARC Centres of Excellence will provide the scale and focus needed for Australia to maintain and develop its international standing in the ARC priority research areas. The centres will also aim to build national research capability and produce economic, social and cultural benefits to Australia. Other objectives include:

- linking existing Australian research strengths and building new capacity for interdisciplinary, collaborative approaches
- building Australia’s human capacity by attracting, from within Australia and abroad, researchers of high international standing
- providing high quality postgraduate and postdoctoral training environments
- offering Australian researchers access to world-class infrastructure and equipment, and key research technologies
- developing relationships and building new networks with major international centres and research programs.

A list of the ARC Centres of Excellence is at Appendix Table 9.

ARC Centres
The Minister for Education, Science and Training, the Hon Dr Brendan Nelson MP, announced in August 2003 funding for nine ARC centres valued at $47.1 million over five years. The ARC Centres facilitate collaborative research with industry and between Australian and international researchers in the ARC’s designated areas of research priority. A list of the nine Centres is at Appendix Table 11.
Crunching complex mathematical problems millions of times faster than is currently possible, and 100 per cent secure encryption of messages, are just two outcomes that are now within reach thanks to world-leading research being conducted at The Australian National University in Canberra.

A team of scientists from the university’s ARC Centre of Excellence for Quantum-Atom Optics is building upon research outcomes from 2002—when they teleported a laser beam—to focus on the teleportation of the properties of atoms.

Using delicately controlled laser light beams to nudge individual atoms together, the scientists have learned how to make a new state of matter called Bose-Einstein Condensate (BEC), in which matter-waves of individual atoms overlap to produce unusual and unexpected properties and behaviours.

The Centre is also aiming to develop a quantum toolbox for atoms and photons, and to apply this to conduct fundamental research on the quantum nature of multi-particle states comprising atoms, photons or both. This could lead to better ways of storing information and new quantum information-based communication technologies.

The Centre is collaborating with many institutions and leading atom optics groups, including the Imperial College (UK), Swinburne University of Technology (Melbourne), University of Auckland (NZ), Universität Hannover (Germany), University of Otago (New Zealand), Université Pierre et Marie Curie (France), University of Queensland (Brisbane), and Vrije Universiteit (The Netherlands).

**Special Research Funding**

Special research funding under the Higher Education Funding Act (HEFA 1988) administered by the Department of Education, Science and Training totals an estimated $1.1 billion in 2003-04 for research training through the Research Training Scheme, Australian Postgraduate Awards, the International Postgraduate Research Scholarships Scheme, the Institutional Grants Scheme, the Research Infrastructure Block Grants Scheme and the Systemic Infrastructure Initiative. With the exception of the competitive grants under the Systemic Infrastructure Initiative, these schemes provide performance-based competitive block funding to universities.
**Institutional Grants Scheme (IGS)**

The Institutional Grants Scheme (IGS) supports research and research training activities in higher education institutions. It was created in 2002, with funding previously allocated under the Research Quantum and the Small Grants Scheme.

Grants are allocated using a formula that accounts for each institution’s success in attracting research students and research income and in the quality and output of its research publications.

In 2003, $277.6 million was allocated under the IGS.


**Research Infrastructure Block Grants (RIBG)**

Research Infrastructure Block Grants (RIBG) are provided to institutions to support high quality research. Funding is provided for the overhead resources or infrastructure essential for undertaking research and training projects or programmes.

Approximately $338 million over five years in funding from the Australian Government’s Backing Australia’s Ability initiative has been allocated to the scheme (from 2001-02 to 2005-06). In calendar year terms, RIBG funding rose from $113.9 million in 2002 to $136.7 million in 2003, and will rise to $156.3 million in 2004 (2002-03 prices).

This project-specific research infrastructure initiative is maintaining infrastructure support at 20 cents for each competitive research dollar obtained by universities.


**Systemic Infrastructure Initiative (SII)**

Australia’s research capacity and growth depends in part on robust research infrastructure. Upgrades to infrastructure, to support world-class research and research training at universities, are being made possible through the Systemic Infrastructure Initiative, which is supported through Australian Government funding under the Backing Australia’s Ability programme of $245 million (over five years to 2006).

In 2002, $26 million was directed to 22 projects to strengthen ‘overhead’ resources across a range of areas, including bandwidth, data and information repositories, and to enhance interoperability. Funds ($42.5 million) have also been allocated over 2002–04 to establish a Australian Research and Education Network, the next generation communications network for universities and the wider research community. A further $22 million will be spent during 2003–04 to fund projects that will advance knowledge and its application in the effective management of research information, including storage, access and authentication issues.


**Major National Research Facilities (MNRF)**

Better access for Australian researchers to world-class specialised research facilities will be facilitated through the Major National Research Facilities. As part of the Backing Australia’s Ability package, the Australian Government will provide $150 million in funding to the MNRFs over five years from 2001-02.

Studying how the earth has evolved over the past 4.5 billion years is leading to breakthrough scientific information on how the geosystem works. The geosystem sustains all life and controls the distribution of water, mineral and energy resources. It is the earth’s support system.

Macquarie University’s National Key Centre for Geochemical Evolution and Metallogeny of Continents (GEMOC) is leading the ‘Advanced Technology for a Clever Geoscience Future in Australia’ project, with more than $5 million in funding from the Australian Government through the Systemic Infrastructure Initiative.

The initiative is enabling Australia to maintain its leading edge in the micro-analysis of solids and fluids in geoscience and material sciences. Funding is being used to share, with five partner institutions, the high cost of purchasing instruments (one per year for three years) and pioneering technology development.

The project is already proving its worth with breakthrough advances being made in several areas, including the development of a novel method for using zircon grains to define the evolution of regions of the earth’s crust. This methodology is being commercialised as ‘TerraneChron™’. It is a powerful tool being used for important mineral exploration and is a cost-effective mechanism for mapping remote or unknown geological terrains ‘with uncanny accuracy’, according to one industry partner.

The facilities provided by the Systemic Infrastructure Initiative have also assisted in attracting Professor Simon Turner to Macquarie University as an ARC Federation Fellow. Professor Turner arrived at Macquarie after completing a Royal Society Fellowship at the University of Bristol in the United Kingdom.

www.es.mq.edu.au/GEMOC
Food Innovation Centres

The establishment of two Food Centres of Excellence—the Australian Food Safety Centre and the Centre for Functional Foods—was announced in July 2003 by National Food Industry Strategy (NFIS) Ltd. NFIS Ltd is an industry-led, Commonwealth-funded company which drives Australia’s National Food Industry Strategy—a five-year blueprint for growth in the industry. The Strategy is overseen by a joint government-industry council comprising six Commonwealth Ministers and leading figures from the food industry. The council is supported by the Department of Agriculture, Fisheries and Forestry (DAFF).

NFIS will provide total funding support of $10 million over four years from 2003-04 to 2006-07.

When 32 Australian companies travelled to Washington DC to take part in BIO 2003, the world’s largest biotechnology conference, a fluorescent proteomics stain, called Beljian Red, was one of 14 research projects the Australian Government had backed to win—either through funding organisations responsible for the research or through direct financial support for commercialising their research.

FLUOROtechnics is one company making great strides thanks to Australian Government support through access to the Australian Proteome Analysis Facility (APAF) and the Biotechnology Innovation Fund.

A spin-off company from Macquarie University, FLUOROtechnics began trading in July 2002. It is ‘incubated’ within the university and continues to draw on a strong relationship with the APAF.

In their first 12 months FLUOROtechnics had developed and tested its first product, the proteomics stain, which is now being exported to Germany, Korea, Taiwan, the United States, and the United Kingdom.

In September 2003 FLUOROtechnics announced a global distribution agreement signing with Amersham Biosciences for the exclusive worldwide supply and distribution of Deep Purple™ Protein Stain. “We are delighted that as an Australian company, we have developed a product that will be distributed worldwide through Amersham Bioscience,” said FLUOROtechnics CEO Professor Duncan Veal. “We are also really pleased that we have been able to keep the manufacturing at home. This means that we not only share in the benefits of this deal but are also able to provide additional employment for local biotechnology specialists”.

FLUOROtechnics has grown from zero staff to 16 in just one year and further growth is expected as new products are developed.

www.fluorotechnics.com
The two Food Innovation Centres will assist the Australian food science and the food industry to consolidate efforts to establish Australia as an international centre of excellence for food industry innovation, and to support the country’s food industry in becoming world class.

www.nfis.com.au
www.affa.gov.au

National Health and Medical Research Council (NHMRC)

The National Health and Medical Research Council (NHMRC) brings together, and draws upon the resources of, all components of the health system, including governments, medical practitioners, researchers, teaching institutions, community organisations, and consumers, to:

- raise and develop consistent health standards across Australia
- foster public health and medical research and training throughout Australia
- advise on clinical practice
- encourage national debate on ethical and emerging issues relating to the wider health environment
- implement, and ensure compliance with, a range of legislation.

The NHMRC works across all national health priority areas including cancer, heart disease, stroke, depression, human genetic information, human cloning, and reproductive technology.

In 2002–03, the Council approved 911 new funding awards and continued to manage 1526 existing funding awards. The total value of expenditure from the Australian Government for these awards was more than $271 million.

During 2002, NHMRC committed additional funding of nearly $9 million to increase the links between Australia’s health researchers and industry through the funding of 20 Development Grants (proof of concept) and 5 Industry Fellowships, the latter designed to enable outstanding researchers to contribute to the commercial development of research discovery. This funding compares with 8 awards valued at $2.5 million in 2001. The NHMRC now funds two rounds of Development Grants each year to make the funding more responsive to the needs of researchers and industry.

In 2002–03 the NHMRC also:

- established a Guidelines Assessment Register
- continued to publish research results, ranking above world average in publishing activity, including first in Health Research
- established a new, single Research Committee (combining the former Research Committee and the Strategic Research Development Committee)
- continued to form national and international partnerships in the research arena, including:
  - collaborating with the Wellcome Trust of the United Kingdom and the Health Research Council of New Zealand to jointly invest $30 million to support research that will improve health, and health research capacity, in developing countries in South and South East Asia and the Pacific islands
  - collaborating with the New York-based Juvenile Diabetes Research Foundation International, and this year establishing the Diabetes Vaccine Development Centre at the University of Melbourne
Safe food to the nation and the world is the vision of Australia’s new Food Safety Centre.

In conjunction with Food Science Australia, the Australian Food Safety Centre will apply world-class expertise to advance the country’s position and reputation as a producer and manufacturer of ‘clean, green, and safe food’, according to the Managing Director of NFIS Ltd, Richard Brooks.

Food exports were close to $26 billion in 2002, which accounts for almost a quarter of all Australian products sold overseas.

The Centre will coordinate, plan and implement strategic food-safety related research and development, to assure appropriate levels of safety at all points in the food chain—from ‘farm to fork’.

Based at the Institute of Agricultural Research (University of Tasmania), the new Centre will receive $4.5 million over four years from the Australian Government through NFIS, as well as $7.7 million in funding from other levels of government and industry (including major food groups such as meat, seafood and dairy).

www.foodsafetycentre.com.au

Functional foods with benefits that add value beyond basic nutrition are the focus of a new Australian Centre of Excellence.

The Centre for Functional Foods will apply its expertise to researching, and ultimately taking to market, a range of foods that will benefit consumers through their ability to provide much more than basic nutrition.

The major drivers for the potential development of this new range of foods, in Australia and overseas, include ageing, the increasing desire to lead healthier lives, and disease prevention.

The new Centre will receive $5.5 million in funding over four years from the Australian Government through the NFIS. It will be based at the University of Wollongong, and will work in partnership with the CSIRO Division of Health Sciences and Nutrition and Food Science Australia.

www.nceff.com.au
The world’s first dedicated proteome centre is enabling researchers to remain at the forefront of this emerging technology, in a sector that is estimated to grow in market value to an estimated US$6 billion in 2005.

Funded at $16.25 million under the Australian Government’s Major National Research Facility (MNRF) programme, the Australian Proteome Analysis Facility (APAF) is one of 15 MNRF grants awarded in 2002 and the largest in the biotechnology sector.

Proteomics is an extremely sensitive process used to separate, identify, and characterise proteins. Australian researchers developed the concept of proteomics and continue their work in the area through the APAF and many associated research centres and companies.

APAF already has established three new nodes—at the University of NSW, the University of Sydney and TGR Biosciences in Adelaide. With the grant, the APAF will expand its range of ‘functional proteomics’ and other technologies, and increase its abilities in the high detail structural analysis of proteins.

Facilities like APAF are enabling Australia to be a major player in this emerging sector through spin-off companies such as FLUORoTechnics.

www.proteome.org.au
A high-powered international collaboration backed in part by more than $11 million from the Australian Government will be applied to a range of research projects that could save millions of lives each year in the Asia–Pacific region.

The NHMRC has joined forces with the UK-based Wellcome Trust and New Zealand’s Health Research Council to address a range of major health issues, including preventable diseases, diabetes, heart disease, and obesity.

The total funding from all three parties, for 11 projects, is more than $29 million.

Former Federal Minister for Health and Ageing, Senator Kay Patterson, said the innovative scheme could have benefits worldwide and would harness the significant scientific talent that exists in Australia, New Zealand and a range of countries in the region.

“These projects will not only focus on some of the most pressing health concerns of the region, they will provide valuable two-way training, and any research outcomes have the potential to be groundbreaking and of use to countries worldwide facing similar health problems,” Senator Patterson said.

The Director of the Wellcome Trust, Dr Mark Walport, said, ‘It’s particularly gratifying to see the diversity amongst the research programmes that will be supported and the range of developing countries involved.’

Projects include:

- research and training to reduce morbidity and mortality from malaria in Papua (Indonesia) and Papua New Guinea
- reducing deaths from pesticide poisoning
- pathways to improved, sustainable morbidity control and prevention of schistosomiasis in the People’s Republic of China
- Enterovirus 71 in the Asia–Pacific region.

TOP: Professor Peter McMinn, Telethon Institute for Child Health.

MIDDLE: Enterovirus 71 magnified 50,000 times. A research team from the Institute of Child Health Research (ICHR) in Perth, lead by Professor Peter McMinn and in collaboration with the University of Malaysia Sarawak, will conduct surveillance for Enterovirus 71 encephalitis in the Asia-Pacific region. The team will also use cutting-edge biotechnological techniques to develop and test a genetically defined, live attenuated vaccine strain. The project will receive $1 million from the NHMRC and Wellcome Trust through the International Collaborative Grants Scheme.

Credit: Images supplied by Peter McMinn, ICHR.

BOTTOM: Professor Alan Lopez outside the UQ Medical School looking towards the Public Health building at Royal Brisbane Hospital.

Professor Lopez will lead a team of researchers from the University of Queensland, Monash University, Mahidol University, Thailand, and the Thai Ministry of Public Health to examine the policy options and health system reform in Thailand by evaluating the effectiveness of major health interventions to reduce diseases and injuries from major risk factors, such as tobacco and unsafe sex. The team will receive $3.2 million under the International Collaborative Grants Scheme.

Dr Mark Walport, Director of the Wellcome Trust, in announcing the projects in London said “It is important to point out that this is the first time the Trust has joined with governments outside the UK, to fund a specific program. The success of this endeavour gives us confidence that such partnerships will in the future, be one way to maximise the impact of funding for research to improve health.”

Credit: Chris Stacey, The University of Queensland.
signing a five-year collaboration agreement on Indigenous Health Research with the Canadian Institute of Health Research and the Health Research Council of New Zealand.

The Australian Health Ethics Committee, one of the NHMRC’s principal committees, has been invited to host the 2004 Global Summit of National Bioethics Commissions—a vote of confidence in the international standing of the committee.

www.nhmrc.gov.au

Rural R&D Corporations (RRDCs)

The Rural R&D Corporations (RRDCs) represent a partnership between the Australian Government and rural industries. Developed to meet the R&D needs of the rural sector, activity during 2002–03 included:

- providing incentives for increased industry expenditure on R&D
- integrating industry and government priorities for R&D
- ensuring R&D investments have a practical outcome.

The fourteen corporations (a full list is at Appendix Table 12) are jointly funded by industry and the Australian Government, with more than $400 million expended during 2002–03. Both funding parties are keen to ensure RRDC investments have practical applications that not only deliver benefits to the rural industries but also to the general Australian community.

The RRDCs have become increasingly active in commercial ventures, with total income from licensing and royalties during the ten years to 2001-02 increasing five-fold to nearly $3.5 million. The larger corporations are active in the commercial arena: for example, during 2002–03 the Grains RDC: filed four provisional patents and 15 plant variety rights applications; licensed 27 individual technology items; spun-off one company to further commercialise a specific R&D output; and applied for one trademark.

Latest priorities for RRDCs have incorporated the new national research priorities, although most of these themes have been embedded in the portfolio’s priorities since the original 1994 priorities statement. This is especially notable when considering the Environmentally Sustainable Australia priority.

www.affa.gov.au

World class centres of excellence

Two world class centres of excellence—in information and communications technology (ICT) and biotechnology—have been established with $176 million in funding made available through Backing Australia’s Ability. Each centre has also received funding, in cash and in kind, from State and Territory governments, industry, and the higher education sector.

National ICT Australia

In May 2002 the Government announced that the National ICT Australia (NICTA) consortium was chosen to establish the ICT Centre of Excellence. The Australian Government has allocated $129.5 million to establish the centre (to June 2006).

The centre will enhance Australia’s ICT research capability with the long-term aim of generating wealth for the nation through the four pillars of research, education, commercialisation and linkages.
A voluntary risk assessment programme, focusing on best management practice, is leading to big results in environmental management for the cotton industry.

Through the Best Management Practices (BMP) programme, the industry has successfully improved land and pest management, reduced pesticide use, improved spray application methods, and reduced water use. The BMP programme is a joint research effort involving the Cotton Research and Development Corporation (CRDC), Land and Water Australia, and the Murray Darling Basin Commission.

The Australian Government’s National Environmental Management Systems Pilot Program will provide $602,250 of National Heritage Trust funds to Cotton Australia and CRDC to expand BMP over the coming years.

These expansion funds will be matched with an additional in-kind contribution of close to $1.4 million from Cotton Australia, the Australian Cotton Cooperative Research Centre, the Australian Cotton Growers Research Association, the Cotton Research and Development Corporation, and the World Wildlife Fund.

BMP focuses on environmental risks associated with pesticide use, but plans over time to cover other key natural resource management issues such salinity, biodiversity, vegetation, water quality, and water-use efficiency.

Almost 60 per cent of Australia’s 2002–03 cotton crops were produced using BMP.

www.crdc.com.au
www.cottonaustralia.com.au
National Information and Communications Technology Australia (NICTA) will be a world-class research and research training institution. Established in October 2002, the centre has been allocated $129.5 million in funding by the Australian Government over its first five years. It is regarded as a leading light in the research community and is well placed to become an institution known for its research excellence and ability to maximise the benefits from ICT research more broadly.

In addition to Commonwealth support through both the Department of Communications, Information Technology and the Arts and the Australian Research Council, strong support is provided by NICTA’s four founding partners—the NSW Government, the ACT Government, the University of NSW, and the Australian National University.

‘Never before has there been such commitment and resolve on the part of Government, universities and the private sector to work together to harness this country’s great ICT potential,’ says NICTA’s Chief Scientist, Professor Brian Anderson AO.

Under the guidance of CEO Dr Mel Slater, NICTA will establish a Fellowship Programme to support high calibre researchers in Australian universities. The Centre will also establish an enhanced PhD training programme. Already, Student Endorsement Panel sessions have been held and 34 PhD students endorsed (as at April 2003). The Centre will eventually host around 320 PhD-qualified researchers and 500 students seeking PhD qualifications.

One of the Centre’s primary goals is to forge mutually beneficial linkages with public and private sector research organisations, major corporations, small to medium-sized enterprises (SMEs), and public sector agencies. To this end, NICTA has joined forces with public sector institutions, including the CSIRO, the Defence Science and Technology Organisation, and the Council of ICT CRCs. These institutions jointly organised Australia’s first annual ICT Outlook Forum (September 2003).

NICTA has sparked the interest of world-renowned institutions, and is forming partnerships to enable Australian-based researchers to access international research resources and enhance training opportunities. This, in turn, will lead to technology diffusion, and assist Australia to remain at the forefront of ICT innovation.

NICTA has also forged links with the private sector. For example, a three-year Memorandum of Understanding was signed with IBM in April 2003. The first project under the agreement will be to increase the performance of open source software.

Other prominent international institutions have expressed an interest in collaborative arrangements including Carnegie Mellon University, Motorola, Microsoft, and Ericsson.

Commercialisation of intellectual property is high on NICTA’s list of priorities. The Centre will also place a great deal of emphasis on creating start-ups and growing SMEs.

NICTA’s research activity for 2003-04 will focus on developing world-class infrastructure technologies, software engineering, intelligent systems, and foundations.

www.nicta.com.au
‘The centre is about capability building,’ said John Rimmer, CEO of the National Office for the Information Economy, part of the Communications, Information Technology and the Arts portfolio, ‘It is designed as a magnet to recruit world-class researchers and aims to produce the next generation of high level researchers, practitioners and teachers’.

**National Stem Cell Centre**
The Biotechnology Centre of Excellence is the biotechnology backbone of *Backing Australia’s Ability*. The centre was awarded $43.5 million over four years through a joint funding arrangement between Biotechnology Australia (part of the Department of Industry, Tourism and Resources), which is providing $21.05 million over four years, and the Australian Research Council, which is providing $22.5 million over three years.

In May 2002, the Government announced that the Centre for Stem Cells and Tissue Repair (now the National Stem Cell Centre) was selected from 11 applicants to operate the centre.

The Hon Mr Ian Macfarlane MP, Minister for Industry, Tourism and Resources and Chair of the Commonwealth Biotechnology Ministerial Council, described the centre as a giant leap forward for Australia’s biotechnology industry: ‘It will draw together expertise and infrastructure to create a critical mass of research, further developing Australia’s expertise and global standing in the field. It is a truly national approach.’

The National Stem Cell Centre will focus on a broad scope of research, including treatments for diabetes, vascular, bone and nerve damage, kidney disease, and diseases of the blood and skin.

The central node will be located in the Monash Biotechnology Science, Technology, Research and Innovation Precinct (STRIP) development (currently under construction in Victoria). New South Wales, Queensland, and South Australia will also have member research institutions linked into the node.

**Australian Government research agencies**

Australia stands out internationally in the proportion of its total research and development activity that occurs in government research agencies. With 0.35 per cent of GDP spent on R&D in Australian and State government research agencies, Australia ranks well above the OECD average of 0.27 per cent. Australian government research agencies will spend a total of $1.3 billion in 2003-04.

Government research agencies exist and receive public funding because they meet research needs that would not be accommodated by other research performers. There is a range of different types of government research agencies, some are ‘stand alone’ agencies established under Acts of Parliament with their own boards such as the CSIRO and the Australian Nuclear Science and Technology Organisation, as well as agencies embedded in government departments such as Geoscience Australia.

**Agencies and initiatives**
- Australian Antarctic Division
- Australian Institute of Marine Science
- Australian Nuclear Science and Technology Organisation
- Bureau of Meteorology Research Centre
- Commonwealth Scientific and Industrial Research Organisation
- Defence Science and Technology Organisation
- Geoscience Australia
- Review of collaboration between publicly funded research agencies and universities
As part of its charter to promote the education of scientists and the broader community on stem cell research and tissue repair, as well as related legal, social and ethical issues, the inaugural National Stem Cell Centre Scientific Conference was held in Melbourne, over 8 October to 12 October 2003.

Attracting leading international scientists from Canada, China, France, Israel, Japan, the Republic of Korea, the Netherlands, Singapore, Sweden, the United Kingdom and the United States, the conference highlighted the role of Australia’s National Stem Cell Centre (NSCC) in cementing Australia’s biotechnology reputation in a highly competitive global research arena.

The importance of the conference’s role in sharing information was highlighted in the opening address given by Mr Bob Moses, Chairman of the NSCC Board.

‘While stem cell research is the forerunner for what will most likely result in a host of treatments for previously incurable diseases – it is the sharing and enhancement of local and global experiences through scientific conferences that will enable us to better deliver on this promise’.

A keynote speaker at the Conference, Professor Ron McKay, from the US National Institute of Neurological Disorders and Stroke, also gave a public lecture, jointly sponsored by the Menzies Foundation and the Victorian State Government, on ‘The Importance of Stem Cells in Science and Medicine’.

‘The high calibre of global and local experts presenting at the conference is a testament to the international standing of the Centre’, according to NSCC Chief Executive Officer, Dr Hugh Niall.

‘The conference, which will be an annual event, enables us to share knowledge and expertise with many of those at the forefront of research. Stem cell research is gathering pace through the world and advances are being made almost on a daily basis so it is important that the international scientific community is given this type of opportunity to swap notes and compare progress’.

The NSCC was established to deliver therapeutic treatments from stem cell and tissue repair biotechnology for economic and social benefits; increase Australia’s biotechnology reputation and global competitive advantage; and enhance public awareness of stem cell and tissue repair treatment.

Over the next five years the Centre will build on Australia’s reputation in specific areas of stem cell research and translate this into successfully treating patients via the commercialisation of therapeutic applications.
**Australian Antarctic Division (AAD)**

The Australian Antarctic Division is an agency of the Department of the Environment and Heritage responsible for administering the Government’s wide-ranging activities in the Antarctic and sub-Antarctic regions.

The AAD’s charter is to advance Australia’s interests in the area and to have ‘Antarctica valued, protected and understood’. The AAD received $84.8 million in Commonwealth funding for research in 2003-04 and aims to:

- lead Australia’s Antarctic programme
- manage Australian National Antarctic Research Expeditions
- conduct and manage scientific research programmes
- protect the Antarctic environment and seek a better understanding of the role of Antarctica in the global climate system
- maintain the Antarctic Treaty System and enhance Australia’s influence in it.

The Australian Antarctic scientific research programme sends about 200 scientists to Antarctica and the Southern Ocean annually, 40 per cent of whom are employed by the AAD and the remainder by Australian and overseas universities and research institutions.

Conducted for the ‘public good’, research takes place in fields including glaciology, meteorology, oceanography, geosciences, astronomy, space and atmospheric sciences, biology, marine living resources, and impacts of human activities in Antarctica.

The Australian Antarctic Division is a partner in a new CRC, established in July 2003 to examine Antarctic Climate and Ecosystems.

During 2002–03, 198 scientists travelled to Antarctica and the Southern Ocean to undertake scientific research; 355 publications were produced; the AAD ran an extensive public information programme; and scientists from many nations collaborated in the Australian Antarctic research programme.

*The Government’s Antarctic Science Advisory Committee evaluated Australia’s Antarctic scientific research programme in 2002, concluding that the country is ‘well served by its Antarctic science programme’ which represents ‘a remarkable contribution by Australia to world science.*


**Australian Institute of Marine Science (AIMS)**

The Australian Institute of Marine Science (AIMS) is Australia’s only research agency entirely devoted to marine science. It brings together some of the world’s best expertise in three broad areas of marine science—marine conservation and biodiversity, coastal processes, and marine biotechnology.

AIMS has 150 staff, supervising some 55 postgraduate research students, and receives $22.1 million in Commonwealth funding in 2003-04.

The Institute’s main laboratory is at Cape Ferguson in Queensland with support bases in Fremantle and Darwin to supplement research undertaken at the main facility. Two AIMS vessels support access to tropical waters off Queensland, the Northern Territory and Western Australia.
Australia’s leadership in Antarctic research was firmly established with the official opening in July 2003 of the Cooperative Research Centre (CRC) for Antarctic Climate and Ecosystems (ACE) in Hobart.

The Government has committed $23.5 million over the next seven years to the ACE CRC. It was the first CRC to be launched from the 2002 selection round that provided $478 million to centres through one of Australia’s leading science programmes.

In officially opening the centre, Federal Science Minister, the Hon Peter McGauran MP, said the new CRC would carry out world-class research with a strong focus on commercial opportunities.

‘Through its team of expert scientists, the CRC will make a significant contribution to our understanding of how living resources in the Antarctic and Southern Ocean should best be managed in the global climate system. The team will make a significant contribution by adopting new approaches and taking full advantage of new found, improved knowledge’ said the Science Minister.

Total resources for the CRC will be $138 million over seven years, combining support from the University of Tasmania, Australian Antarctic Division, CSIRO Marine Research, CSIRO Atmospheric Research, Bureau of Meteorology, Tasmanian Department of Economic Development, Australian National University, Australian Greenhouse Office, and Silicon Graphics.

International interests include the National Institute of Water and Atmospheric Research in New Zealand, the Japanese Marine Science and Technology Centre, and the Alfred Wegener Institute for Polar and Marine Research in Germany.

www.antcrc.utas.edu.au/antcrc/
AIMS also adds value and capacity to its research effort through an extensive collaborative network, which extends across all States and Territories and to over 23 countries. Examples of key outcomes in 2002-03 include:

- **Status of coral reefs of the world: 2002** provides a reference for coral reef managers worldwide.
- **Coral ID** launched—a new research tool that provides a sophisticated, inexpensive means of identifying coral species based on easy-to-distinguish traits.
- **Catchments and corals: terrestrial runoff to the Great Barrier Reef**—produced with support from CRC Reef, this synthesis of 15 years of data provides a comprehensive picture of the impact of runoff to the Great Barrier Reef World Heritage Area.

Planned future research will increase effort on: tropical seabed biodiversity (its resource value and uniqueness); minimising business risk associated with natural variability in ecosystems; discovering useful products from Australia’s marine biodiversity; and developing technologies with application to environmental management and human health.

Research will also continue to address issues of importance at both the national scale, such as water quality on the Great Barrier Reef World Heritage Area, and global scale—for example, the impact of climate change on coral reefs and mangrove ecosystems.

www.aims.gov.au

DOMESTICATING THE BLACK TIGER PRAWN

A major collaborative effort, including industry and key research organisations, is seeking to enable domestication of a key market species, the black tiger prawn (*Penaeus monodon*) to overcome a significant barrier to development of Australia’s prawn aquaculture industry.

The project is being led by the industry’s peak body, the Australian Prawn Farmers Association, and combines the research expertise of AIMS, two divisions of CSIRO (Marine Research and Livestock Industries) and the Queensland Department of Primary Industries (Bribie Island Aquaculture Research Centre). These agencies are working together with three Queensland based prawn farms, each of which is contributing both direct funding and additional in-kind resources to the project.

The exceptionally rapid growth and high survival rates demonstrated by the team in virus-free captive-reared animals has been followed up with further work targeted to removing virus infection in the hatchery. Trials on methods to wash eggs, have led to the identification of a washing agent which appears to enhance larval hatch rates. The project has also, for the first time, demonstrated that reproductive success in prawns can be influenced by the genes.

Jointly funded by the Australian Government’s Fisheries Research and Development Corporation, industry and research organisations, the project continues to seek new ways to enhance industry production of this important marine natural resource.
Coral records researchers have confirmed that European settlement in Australia has increased sediment flux to the inner Great Barrier Reef.

The finding is another successful outcome of the valuable work of AUSCORE, an informal collaboration of the Australian Coral Records Research Group.

The major goal of the research is to produce continuous records of climate and environmental conditions from at least 1700 AD to the present.

Analysis of material from the Australian Institute of Marine Science (AIMS) archive of long coral cores by researchers from AIMS and the Australian National University provided the first clear evidence that European land use practices, including clearing and overstocking, resulted in a substantial increase in the sediment load to the inner waters of the Great Barrier Reef.

The research team measured the barium/calcium ratio in coral skeletons and discovered a marked jump coinciding with the widespread land use changes associated with European settlement.

AUSCORE was established in 1997 at a workshop organised and hosted by AIMS.

**Australian Nuclear Science and Technology Organisation (ANSTO)**

ANSTO is Australia’s only nuclear research organisation and the centre of Australian nuclear expertise. Its operating income in 2002–03 was $137.2 million, comprising $99.1 million from Government, and $38.1 million from product and services sales. It also received appropriations of $14.1 million for the disposition of spent fuel, and $104.2 million from the Government towards the construction of a replacement research reactor.

ANSTO delivers advice, services and products to government, industry, universities, and other research organisations. The organisation also provides students and academic staff with access to its facilities and expertise.

ANSTO’s activities are grouped into one of six core business areas:

- international strategic relevance of nuclear science and technology
- core nuclear facilities operation and development
- nuclear science for environment and sustainability
- treatment and management of man-made and naturally-occurring radioactive substances
- sustainability and international competitiveness of industry
- organisational development and support.
During 2002–03, ANSTO research into transport of contaminated sediments in the coastal zone and water column impacts was a finalist in the 2002 Eureka Award, and short-listed in the International St Andrews Prize for the Environment.

Other significant projects included:

- progressing the international patenting of ANSTO’s sol-gel technology, which has the potential to significantly improve clinical protocols and procedures for the treatment of cancer
- progressing three provisional patent applications related to radioactivity and its effects on the uranium, copper, mineral sands, rare earths, phosphates, niobium/tantalum, aluminium, and steel industries
- establishing ANSTO Green Trends to market services that apply nuclear science and technology to environmental problems such as catchment pollution and the effects of urban sprawl
- hosting a visit from a Russian nuclear science delegation interested in establishing future commercial opportunities for radioactive waste immobilisation.

www.ansto.gov.au

A better understanding of the strength and safety of gas pipelines could save the industry $110 million over the next seven years thanks to an innovative two-year research project.

The project, conducted in conjunction with the Cooperative Research Centre for Welded Structures and the Australian Pipeline Industry Association (APIA), has generated valuable information on, and improved understanding of, pipeline behaviour. The Australian Nuclear Science and Technology Organisation (ANSTO) is a partner of the Centre.

A model, developed to predict pipeline behaviour, enables the safe use of higher operating pressures or thinner walled pipe. Full-scale burst testing, conducted in early 2003, validated the model and established the failure strain profile of modern pipe steel. The results have generated considerable interest internationally and ANSTO is undertaking further research sponsored by APIA.
Bureau of Meteorology Research Centre (BMRC)

The main research activities of the Bureau of Meteorology are carried out by the Bureau of Meteorology Research Centre (BMRC) through a balance of strategic and applied research designed to:

- advance meteorological science
- develop advanced systems and techniques
- promote the application of meteorological science for the general good of the Australian community.

In 2003-04, the BMRC received $9.8 million from the Commonwealth.

The BMRC conducts research in the areas of model development, data assimilation, weather forecasting, climate dynamics, climate forecasting, and ocean and marine forecasting.

In 2002–03, BMRC scientists published research results, served on national and international working groups and advisory committees, collaborated in major international scientific experiments (including the Darwin Area Wave Experiment and the Tropical Rainfall Measuring Mission), and continued their work on national research priorities.

www.bom.gov.au/bmrc

Commonwealth Scientific and Industrial Research Organisation (CSIRO)

CSIRO is one of the world’s largest and most diverse scientific research organisations with more than 6600 staff in 20 research divisions located at 60 sites across Australia and overseas.

In 2003-04 its total revenue is $890 million, of which $568 million is a direct appropriation from the Australian Government.

CSIRO hosts four national research facilities—the Australian Animal Health Laboratory, the Australia Telescope, the Oceanographic Research Vessel Southern Surveyor, and the National Measurement Laboratory (which will form part of the new National Measurement Institute to be established in July 2004).

CSIRO also manages 11 national reference collections including: the Australian National Fish Collection, the Australian National Herbarium, the Australian National Wildlife Collection, and the Scientific Marine Data Collection.

Internationally, CSIRO is involved in more than 900 current or recently completed research activities, working with leading scientific organisations in Europe, Japan and the United States, and with developing countries, especially in Asia. July 2003 data from the Institute for Scientific Information show that CSIRO ranks in the top one per cent of scientific institutions in the world in the majority of disciplines evaluated.

In 2002-03, the CSIRO’s achievements included:

- the launch of the new Flagship Programs, designed to pull expertise from within the organisation to work in partnership with other bodies to address national issues;
- CSIRO education activities directly involving over 300,000 students, parents and teachers, as well as more than 330,000 through the weekly national TV programme, Totally Wild;
- over 210,000 students attending workshops at CSIRO Science Education Centres—located in every capital city plus Townsville;
A $15 million Ocean Forecasting Project will provide Australian oceanographers with the sophisticated information they need to more accurately forecast ocean conditions (currents and eddies, water temperature and salinity).

The five-year Government-funded research project will revolutionise the way Australia uses its extensive marine environment, with positive spin-offs predicted for the transport, defence, coastal and marine, oil and gas, and other industries.

A team effort between the Bureau of Meteorology, Royal Australian Navy and the CSIRO, the initiative involves up to 35 oceanographers, modellers, forecasters, data specialists, and engineers—the largest team of ocean scientists ever assembled in Australia for a single project.

It will bring Australia into line with the United States, France, and other European nations in the ability to analyse and forecast ocean weather. The first four-day forecasts are expected by 2004, and specific regional forecasts of one to two days by 2006.

Among the many benefits of this unique project are better routing options for commercial coastal and trans-ocean shipping; enhanced performance of onboard tactical response systems for the Navy, increased efficiency for the nation’s deep ocean fishing fleet; better understanding of deep ocean conditions affecting pipe and cable laying by energy explorers and generators; improved skill in management of oil spills; the potential to avoid storm systems and counter currents, and longer lead-times on climate forecast, such as El Niño.

‘At the moment, we are at the same point today in ocean forecasting as Australian meteorologists were with atmosphere forecasting in the 1950’s,’ said Dr Neville Smith from the Bureau of Meteorology, who is co-leading the project with Dr Andreas Schiller from CSIRO. ‘By the end of the project, Australia’s capabilities in ocean science will have taken a tremendous leap forward.’
A new $105 million Bioscience Precinct—Australia’s largest facility dedicated to human, animal and plant biotechnological research—is enabling closer collaboration between scientists and paving the way for commercialisation opportunities.

Opened in May 2003, the Queensland Bioscience Precinct will see scientists from CSIRO and the University of Queensland’s (UQ) Institute of Molecular Bioscience join forces on research over a wide range of bioscience areas, including gene discovery, livestock and plant industries, and the development of sustainable ecosystems.

Funding for the Precinct was contributed by: Atlantic Philanthropies ($10 million), the Commonwealth’s Federation Fund ($15 million), the CSIRO ($50 million), the Queensland Government ($15 million), and the University of Queensland (UQ) ($15 million).

Located within four buildings on a 1.6 hectare site on UQ’s St Lucia campus, the Precinct houses 700 scientists from UQ’s Institute for Molecular Bioscience and CSIRO’s divisions of Livestock Industries, Plant Industry, and Sustainable Ecosystems. It features state-of-the-art laboratories, equipment, and dedicated administrative and conference facilities.

CSIRO Chief Executive Dr Geoff Garrett said his organisation welcomed the opportunity to be part of the new precinct, partnering with UQ and other partners.

‘CSIRO is committed to ensuring that scientific research in Australia continues to have impact and provide creative solutions to the major issues facing the nation and internationally. Our decision to be a major stakeholder in the precinct is testimony to that commitment,’ Dr Garrett said. ‘Science in the 21st Century is all about working in large teams on large issues—working across traditional institutional and disciplinary boundaries and harnessing the synergies of diversity.’
over 6000 completed CREST (CREativity in Science and Technology) projects, which encourage and support school students to undertake their own scientific research or technology-based project; and

production by CSIRO Publishing of more than 1500 research papers through 18 peer-reviewed journals, and publication of 50 new book and CD products for global markets.

CSIRO collaborates across a range of sectors and with a range of other organisations from industry to state and federal agencies, NGOs, community groups and universities:

- the University of Melbourne School of Earth Sciences and CSIRO Exploration and Mining worked together to apply second generation nanotechnology of metal complexing to benefit the exploration industry;
- the University of Wollongong formed a strategic alliance with CSIRO’s Textile and Fibre division, with the ultimate aim of producing fully flexible electronic fabrics;
- Australia’s botanical community and the CSIRO struck a formal agreement to collaborate on Australia’s Virtual Herbarium, which provides integrated access to on-line botanical information from the collections and resources of the State and Commonwealth herbaria (6.5 million specimens held across the country); and
- the University of Queensland, the Queensland Departments of Primary Industries, and Natural Resources and Mines have collaborated in an R&D venture with CSIRO to form the Agricultural Production Systems Research Unit (APSRU)—its core modelling tool is widely acknowledged as one of the most significant achievements in the development of a comprehensive computer model of farming systems.

Market outcomes are a key performance measure for the CSIRO and achievements in 2002-03 include:

- income from active licence, options and assignment agreements rose from $11.6 million to $17.1 million, including a one-off transaction of $3.6 million. Running royalties increased by 10 per cent, from $9.7 million to $10.6 million;
- eleven technologies were made available for wider public use;
- the number of contracts rose from 2494 to 2996, with 220 or five per cent of the contracts valued at more than $500 000, and accounting for $344 million or 58 per cent of the total value. This is up from $302 million and 51 per cent respectively in the previous year;
- private sector revenue, domestic and international, amounted to $104.3 million from 2857 contracts, representing 38 per cent of all external revenue; and
- CSIRO is Australia’s leading patenting enterprise. At 30 June 2003, CSIRO had 2002 granted patents (covering 779 inventions) and 62 Plant Breeder Rights (registered pending applications), 287 Australian and 93 foreign Trade Marks, and 5 Australian and 17 foreign Registered Designs.

www.csiro.com.au
A world-first new fire truck protection system, developed in Australia, will help save the lives of fire fighters caught in a bush fire.

Developed by CSIRO researchers, the New South Wales Rural Fire Service (RFS) and the Country Fire Authority of Victoria (CFA), the system will increase the survival rate in accidental ‘burnovers’, situations in which fire fighters are suddenly entrapped by bush fires.

As part of the project, CSIRO produced a unique bushfire simulator to test a prototype protective spray system for fire trucks. ‘Prior to each test, the fire truck is fitted with over 50 sensors measuring everything from radiant heat, air, and surface temperatures, to the type of gases fire fighters inside the cabin will be exposed to during a burnover,’ said CSIRO fire scientist Justin Leonard.

The system consists of a central water supply located on the cabin of the truck. During the simulated fire the nozzles accurately jet a fine spray of water onto the glass surfaces and tyres of the fire truck. Radiation shields behind or in front of windows are an essential component of the new system.

Tested and refined over 12 months, the fire truck protection system has already proven it has what it takes to help the CFA and RFS with their number one priority—fire fighter safety.

The research and development of the system will be continued in the newly established Cooperative Research Centre for Bushfire Research announced by the Australian Government in December 2002, in which CSIRO is a major player.

The testing and development programme was conducted at the RFS Hot Fire Training Facility at Mogo, near Bateman’s Bay in NSW.
The world’s leading technology for rapid analysis of minerals is revolutionising the mining industry.

The QemSCAN technology, developed by CSIRO, is also in demand from the largest mining companies internationally.

QemSCAN’s automated scanning electron microscope rapidly identifies minerals and ores providing detailed information not previously available. The technology improves the efficiency of mining operations and provides mining companies with a deeper understanding of their ores and refining processes.

Sales of QemSCAN have boomed over the last three years with the technology now used by eight of the world’s largest resource companies, including Anglo Platinum, BHP Billiton, Brazilian mining giant CVRD, Falconbridge, Phelps Dodge, and Rio Tinto.

TENDERISING THE CATTLE INDUSTRY

In a world first, Australian researchers have developed a DNA test to identify a ‘beef tenderness’ gene in cattle.

The discovery represents a major breakthrough for the cattle industry, with consumers rating tenderness as more important than juiciness and flavour when it comes to satisfaction with beef.

The new test is a world-first. Known as GeneSTAR® it will enable beef producers to breed animals with more desirable meat. The Australian patented technology has been exclusively licensed to Brisbane-based Genetic Solutions Pty Ltd, which has performed more than 4000 tests for companies in the high-value breeding stock sector since the technology was launched in November 2002.

A collaborative research effort involving CSIRO, the Cattle and Beef Quality Cooperative Research Centre, and Meat and Livestock Australia, the GeneSTAR® test complements GeneSTAR Marbling®—the world’s first commercial DNA test for identifying animals with the desirable trait of fat distributed through the muscle.
Defence Science and Technology Organisation (DSTO)

DSTO is the research arm of the Department of Defence. It ensures the expert, impartial and innovative application of science and technology for the defence of Australia. DSTO has an annual budget of approximately $298 million (2003–04) and employs about 2300 people, the majority of whom are scientists.

DSTO is heavily involved in collaboration with industry, universities and other government research agencies including participation in ten Cooperative Research Centres in 2002-03. DSTO is involved in the funding continuation of the CRC for Advanced Composite Structures. Future activities planned for 2003-04 include establishing a strong link with NICTA, joining two CRCs, the existing CRC for Coastal Zone Estuary and Waterway Management and the new CRC for Integrated Engineering Asset Management, as well as strengthening involvement with the CSIRO and ANSTO.

In 2002-03 DSTO’s achievements included:

- filing four provisional patent applications
- publishing nearly 300 scientific reports and a similar number of articles
- licensing technologies for commercialisation, including: development of a state-of-the-art wide band radio frequency spectrum and signal analyser for defence operations; agreement to develop, market and sell BattleModel, which places Australia as a world leader in the innovative use of simulation technology
- undertaking active marketing of 20 commercial opportunities, including: Automatic Speaker Identification System—a key technology employed by law enforcement, intelligence, national security agencies and financial institutions to identify telephone speakers during criminal investigations, surveillance work and financial transactions; and Computer Forensic Investigative Toolkit—a powerful tool for conducting investigations of illegal computer-based activities.

www.dsto.defence.gov.au

Geoscience Australia

Geoscience Australia is an Australian Government funded program that enhances the potential for the Australian community to obtain economic, social and environmental benefits through the application of first class geoscientific research and information.

Geoscience Australia received $95.8 million in Australian Government funding for 2003-04. In May 2003, new funding of $61 million over four years was provided by the Government to conduct petroleum research and find major new offshore oil.

Onshore geoscience

In 2002–03, research under the National Geoscience Agreement, a collaborative arrangement with the State and Northern Territory geological surveys, encouraged increased levels of exploration in areas previously viewed as having low prospectivity. A better understanding of controls on the distribution of gold deposits led to a major company undertaking new work in the under-explored Yamarna region, east of the known goldfields in Western Australia. New geoscientific knowledge stimulated a search for base metals by Tanami Gold, in alliance with BHP Billiton and Teck Cominco, in the eastern Arunta region of the Northern Territory and also encouraged Tanami Gold and Newmont to explore for gold in the Lake Mackay region, south of the gold-rich Tanami province. As a result of work undertaken in South Australia, in partnership with the Cooperative Research Centre for Landscape, Environment and Mineral Exploration, the central Gawler gold province experienced, for the first time in several years, significant exploration expenditure. The National Mines Atlas, a catalogue of Australia's existing and planned mineral assets, mines, and production and processing centres, was among many products released online.
Leading edge radar and sensor technology designed to accurately detect landmines, which kill and maim about 2000 people around the world each month, was trialled in South Australia in late 2002.

The Rapid Route and Area Mine Neutralisation System will significantly improve the Australian Army’s ability to clear anti-vehicle landmines from unsealed roads and landing areas.

The Minister for Defence, Senator the Hon Robert Hill, said the technology has enormous potential to save lives and significantly reduce injuries—landmines are a major threat to Australian Forces overseas with an estimated 60 to 70 million mines active in at least 70 countries.

‘If successful, the System will be safer, quicker and more affordable. It is capable of safely clearing a three-metre lane at speeds of up to five km per hour, compared to the present very risky manual method of disabling mines at a slow 50 sq metres per hour,’ said Senator Hill.

Made from an Australian-designed metal detector, an imaging system developed by DSTO, and a ground probing radar sourced from the United States, the system is designed to detect metallic and non-metallic mines both buried in, and on the surface of, roads and tracks.

Further trials were conducted in May 2003, with ongoing trialling scheduled for the last quarter of 2003. The trials are the result of a two-year programme by DSTO to develop a prototype mine detection system. It is a world-first patented design developed for use in Australian and South East Asian soil conditions.

By 2005, Australia will have spent at least $100 million removing overseas landmines, rehabilitating survivors and educating communities about the dangers of landmines.

www.dsto.defence.gov.au
During 2002–03, Geoscience Australia created new knowledge about the nature of earthquakes in Australia that contributed to reducing the threat of significant economic loss and social impact from earthquakes and promoting safer and more sustainable communities. Also, for the first time in Australia, the program applied techniques for identifying evidence for prehistoric earthquakes in soil profiles.

**Offshore geoscience**

Geoscience Australia gave technical and promotional presentations at conferences and to companies in Japan, Korea, Europe, and North and South America, as well as in Australia. The program’s presentations resulted in the entry of several companies new to Australian offshore petroleum, including US independents, major Asian companies and small Australian companies.

Geoscience Australia began using the petroleum system concept that links the gas and oil to its primary organic matter source, which had a significant impact on the understanding of prospectivity.

The program’s annual Oil and Gas Resources of Australia, and quarterly petroleum exploration and development activity statistics (used to inform explorers, producers, and government agencies of geoscience knowledge now available) were among a diverse range of outputs that were “web-enabled” during 2002–03.

Through its innovative Virtual Centre of Economic Micropalaeontology & Palynology and industry partners, in 2002–03 Geoscience Australia delivered a geological correlation across Australia’s North West Shelf, using fossil marine algae to determine geological periods. The scheme provided essential information for both exploration and production.

Geoscience Australia, in conjunction with the Department of Foreign Affairs and Trade and the Attorney-General’s Department, continued the technical work necessary for the definition of the areas of extended continental shelf beyond the 200 nautical mile Exclusive Economic Zone around Australia and its island territories. The Australia Government now has the information needed to make a submission to the United Nations Commission on the Limits of the Continental Shelf (UNCLOS), should it decide to do so.

Using the Australian National Research Facility vessel, the RV *Southern Surveyor*, Geoscience Australia scientists discovered new coral reefs in the southern Gulf of Carpentaria in water depths of about 30 metres. The living coral reef area appears to cover more than 100 square kilometres and may be third largest continuous area of modern reef growth discovered in Australia.

Geoscience Australia’s work with the National Oceans Office during 2002 led to the program’s development of a new high-resolution bathymetric map of Australia’s Exclusive Economic Zone. The map will assist environmental managers to identify areas requiring protection to preserve marine biodiversity.

**Spatial information**

Geoscience Australia’s 2002–03 revision of 513 revised map sheets at 1:250000 scale, covering the entire continent, will be used by researchers across disciplines, in areas as diverse as emergency management, exploration investment, immigration, defence and land use assessment and planning, and tourism.

Significant geodetic Global Positioning System (GPS) surveys were carried out in both Australia and the Australian Antarctic Territory to monitor the movement of the earth’s tectonic plates.

Geoscience Australia operates the only ground station outside of the US that downloads data from the Landsat 7 satellite. A second satellite tracking antenna was installed at the Alice Springs data acquisition facility. Preservation of the satellite image archive has ensured the ongoing availability, of all images over Australia since 1979. Many environmental studies rely on these archived images and the Australian Greenhouse Office, for example, has been an important user of historical satellite image data in developing a National Carbon Accounting System for Australia.
The Australian Government turned up the heat on fighting fires with the opening in December 2002 of the new Cooperative Research Centre (CRC) for Bushfire Research.

One of the research tools is a new computerised mapping system that allows forest managers and fire control officers, and anyone with web access, to see online satellite images and topographic maps showing hotspots (possible fire outbreaks) that pose a potential risk to communities and property across Australia.

The online system, known as Sentinel Hotspots, is being used by emergency management bureaus and in other environmental studies, such as National Park management and post-fire damage assessment.

During the peak January 2003 bushfire crisis in south-eastern Australia, the system was in such high demand that a second server was installed to provide secure and more reliable access specifically for emergency agencies. On 19 January 2003 alone, the Sentinel web site had in excess of 20,000 hits.

Sentinel Hotspots is a collaboration output of CSIRO, Geoscience Australia, and the Defence Imagery and Geospatial Organisation.

The Sentinel web site obtains data from the NASA Earth Observation Satellite Terra and Aqua. The satellite orbits the earth collecting data in a path 2330 km wide. It passes over Australia at least once and sometimes up to three times a day.

www.sentinel.csiro.au/sentinel.html

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**TURNING UP THE HEAT**

This Landsat 7 image, acquired on 26 January 2003, shows the effects of fires that swept across the Canberra region. The bush fire smoke appears as pale blue, healthy vegetation appears as green and the burn scars appear as dark red-brown. Satellite imagery is a very useful tool in managing fires and their effects. In the lead-up to the fire season, images are used to assess fuel loads and plan access points and fire breaks. Images are also very useful in mapping the extent of fire scars and assessing damage.

Credit: Images supplied by Geoscience Australia
Geoscience awareness

In 2002–03, Geoscience Australia’s geoscience education centre was visited by 4,283 students, 386 teachers and accompanying adults and 132 other visitors. The centre also conducted specialist courses for about 50 teachers, and developed a range of training booklets for teachers to use in the classroom that included student activities. Public information programs included: the launch of the Australian component of International Earth Science Week; participation in National Science Week activities, including a Geoscience Australia Open Day; and media coverage of key discoveries.

During 2002–03, collaborative activities with industry, academia and other government agencies led to the formation of four Cooperative Research Centres (CRCs) to commence in 2003–04, including the new CRC for Spatial Information and the new CRC for Greenhouse Gas Technologies.

Review of Collaboration between Publicly-Funded Research Agencies and Universities

In the context of its overall innovation policy objectives, the Australian Government is examining the scope for greater collaboration between major publicly-funded research agencies (PFRAs) and universities, including the extent to which such developments can enhance critical mass, improve research outcomes, achieve more effective use of resources, and strengthen institutional performance.

The Minister for Education, Science and Training, the Hon Dr Brendan Nelson MP, announced in May 2003 that a review will be undertaken encompassing all Australian public universities and four major PFRAs – the CSIRO, ANSTO, DSTO and AIMS. The review will also consider alternative funding models, including access by PFRAs to research funding provided through the ARC and the NHMRC.

The review is being undertaken by a high-level Steering Committee, chaired by Mr Donald McGauchie.

The review will examine, consider and report on:

- the potential to exploit greater synergies and collaboration among PFRAs and Universities;
- possible models for closer collaboration between PFRAs and Universities;
- the scope to promote a greater focus on the commercialisation and application of research through collaboration; and
- possible alternative funding models for PFRA research to promote excellence across the national research effort, including the merits of broadening access by PFRAs to competitive public research funding.

The Steering Committee has published an issues paper and called for public submissions as part of the consultative process.

The Steering Committee will report to the Minister for Education, Science and Training in late 2003.
State and Territory government research agencies

State and Territory government research agencies spent just over $940 million on R&D in 2000-01, the most recent data year. While R&D in Commonwealth agencies was spread over a number of research fields and socio-economic objectives, about two-thirds of R&D in state government agencies is focused on health and agriculture. Table 6 in the Appendix provides a more detailed picture of R&D expenditure in the States and Territories by sectors of performance.

R&D in the private non-profit sector

Private non-profit research agencies spent $283 million on research in 2000–01. Research in this sector is mainly carried out in medical and health institutes such as the Walter and Eliza Hall Institute, which spent about $47 million on R&D in 2002, the Garvan Institute of Medical Research ($22 million) and the Baker Medical Research Institute ($18 million). R&D expenditure in private non-profit research agencies increased by 20 per cent in 2000–01 over the previous surveyed period (1998–99).

The business sector

Over half of Australia’s R&D is financed by the business sector, while the main source of Government funding for business R&D is through the R&D Tax Concession and the R&D Start programme.

Programmes and initiatives

- R&D Start
- R&D Tax Concession
- Food Innovation Grants

R&D Start

The R&D Start programme is designed to assist Australian industry with undertaking highly competitive research and development, and its commercialisation. Through a range of grants and loans, the programme supports business R&D projects that aim to develop new or improved materials, products, devices, processes, or services.

In the 2003-04 Budget the R&D Start programme received additional funding of $41 million from the Australian Government to maintain the program until 30 June 2007. This is in addition to the $490 million provided over five years through Backing Australia’s Ability.

Program grants are paid over one to three years, and funding to 2007 enables R&D Start grants to be approved in 2003–04. Total funding since its inception is approximately $1.7 billion.

The program provides assistance for projects through Core Start (grants of up to 50 per cent of eligible project costs for Australian companies with an annual turnover of less than $50 million), Start Plus (grants of up to 20 per cent of eligible project costs for larger Australian companies with group turnover of $50 million or more), and Start Premium (an additional repayable amount that tops up either Core Start or Start Plus assistance to a maximum of 56.25 per cent of eligible project costs for high quality projects).

Start Graduate provides grants to companies with a turnover of less than $50 million to engage a graduate on an R&D project undertaken in collaboration with a research institution. R&D Start Concessional Loans provide up to 50 per cent of eligible project costs to small companies or groups involved in early commercialisation of technical innovations.
The R&D Start program was reopened to new applications in November 2002, following its suspension in April 2002, when unprecedented demand placed pressure on available funds. 156 new applications were considered during 2002-03. Of these, 94 were successful, with a value of just over $92 million. All 94 applications were from SMEs. In addition another $7.2 million was approved to existing projects.

R&D Start is associated with some well known success stories. These companies return their success to Australia in more ways than simply world class technology. Cochlear, renowned world-wide for its unique ear implant, and a recipient of R&D Start grants and other R&D support early in its development, has benefitted Australia through the scale of its activities, earning more than $250 million per annum, returning over $11 million in taxes, and employing around 500 Australians in highly paid highly skilled research manufacturing activities.

www.ausindustry.gov.au

**R&D Tax Concession**

The R&D Tax Concession is the Government’s principal support mechanism to increase the amount of business R&D being conducted in Australia. Through *Backing Australia’s Ability*, the Government provided funding to ensure a range of existing measures continued and a range of new measures were introduced.

The R&D Tax Concession allows companies to deduct up to 125 per cent of eligible expenditure incurred on R&D activities from assessable income when lodging their income tax return. The aim is to enable eligible companies to become more internationally competitive by:

- encouraging the development of innovative products, processes and services
- increasing investment in defined research and development activities
- promoting technological advancement through innovation and high technical risk in defined research and development
- encouraging the use of strategic research and development planning
- creating an environment conducive to increased commercialisation of new processes and product technologies.

A 175 per cent Premium (Incremental) Tax Concession has been introduced. This is designed to further increase the R&D performed by Australian companies by providing a higher deduction for additional labour-related R&D expenditure.

A R&D Tax Offset has also been introduced, to foster growth of small companies, especially those in tax loss, by providing them with a tax offset equivalent to the 125 per cent R&D Tax Concession, and where eligible, the 175 per cent Premium Tax Concession as well.

As at 30 August 2003, some 4707 companies had registered for the R&D Tax Concession for the 2001–02 financial year, with a total reported R&D expenditure of $6.0 billion. This is an all-time record.

Preliminary data on the *Backing Australia’s Ability*-driven tax concession initiatives suggest that the new initiatives are also encouraging business investment in R&D. As at 31 August 2003, 1519 companies registered for the Tax Offset at the 125 per cent Tax Concession rate (with a reported R&D expenditure of $430 million) and 480 companies registered for the 175 per cent Premium R&D Tax Concession (with a reported R&D expenditure of $1.23 billion) for the income year 2001-02. 107 companies registered an intention to claim both the Tax Offset and the Premium (with a reported R&D expenditure of $46.8 million). Initial indications are that the R&D Tax Offset has been successful in reaching its target group – small start-up companies in tax loss.
In 1993, Robert Mailler, a control systems engineer and mathematician, asked his father how technology could best help the family farm. The answer was simple: ‘Make me a tractor that can drive straight’.

In response to the challenge, Robert developed the BEELINE Navigator, a satellite-based guidance system that automatically steers tractors with centimetre precision.

The technology reduces total farming costs by eliminating the need to overlap with each pass when working on a paddock. It saves on fuel, chemicals and seed, and makes farmers more effective (they can take their hands off the wheel and concentrate on what is happening behind the tractor).

BEELINE Technologies received a grant of $1.4 million through AusIndustry’s R&D Start programme.

From its ‘back shed’ beginnings, BEELINE Technologies now claims 63 per cent of the Australian automated guidance technology market and 30 per cent of the international market, with distributors worldwide.

Expenditure reported by registered firms on collaborative research and development arrangements with Registered Research Agencies and Cooperative Research Centres (CRCs) was $102.7 million and $11.4 million, respectively, for the 2001–02 financial year. This amounts to an increase of 28 and 21 per cent respectively, over the 2000–01 financial year.

The number of employees engaged in R&D with registered companies as at 30 June 2003 is 30,200.

An independent review of the R&D Tax Concession is underway. Preliminary results of the review suggest that the program has been effective in encouraging business investment in R&D.

There are many examples of Australian firms, as customers of the R&D Tax Concession, thriving and growing to return benefits nationally, as well as to the company itself. One of these rapidly
developing stories is Norwood Abbey Limited, a small biotechnology company, which has more than doubled its shareholder base since it first listed on the Australian Stock Exchange in August 2002. The company, which specialises in improved drug delivery techniques, has acquired two US corporations and their patent portfolios, established a production base in the US, and now has in excess of 40 patents and applications.

www.ausindustry.gov.au

Food Innovation Grants (FIG)

The Food Innovation Grants (FIG) programme provides matching grants to food businesses operating in Australia to help them to develop innovative ideas involving a scientific or technical challenge and to take the innovation through to commercial results.

FIG helps large and small food businesses undertaking research and development and commercialisation through sharing the risks associated with innovation.

Funded by the National Food Industry Strategy (NFIS) Ltd, the programme provided grants totalling over $7.5 million to 14 projects during 2002–03. A further three rounds of funding are expected to be conducted in 2003–04.

Projects funded through the FIG include family-owned companies, as well as medium-size enterprises and large multinational companies.

www.nfis.com.au

Philanthropy

It is estimated there are at least 2000 philanthropic trusts and foundations in Australia, with total assets of more than $10 billion. Despite this, philanthropic activities in Australia are relatively small. By comparison, there are 88,509 private foundations in the United States, with total assets of almost US$500 billion.

Over the past three years, the Australian Government has been putting legislation and other policies in place to support and encourage philanthropic activities—including changes to the taxation act, designed to provide more incentive to make charitable contributions.
Grateful travellers accessing pay-as-you-go internet kiosks throughout Asia–Pacific have West Australian company, pieNETWORKS, to thank for the service.

The internet kiosk company has defied the odds to become one of the fastest growing technology companies in the region.

Their success is owed in part to funding support from AusIndustry’s R&D Tax Offset, a new element of the Australian Government’s R&D Tax Concession scheme.

A cash rebate meant the growing company could maintain an effective R&D programme, according to Managing Director Campbell Smith. ‘From a business commercialisation perspective, the funds also contributed to our first positive cash flow quarter, which was a great confidence booster,’ says Campbell.

Today, more than 60 per cent of pieNETWORKS’ revenue comes from banking, government and retail use of its self-service terminals and associated services. The kiosks have become a familiar sight in shopping centres, stores, libraries, hotels, banks, airports, and community centres.

After three years and $125 million investment, Holden has released the Adventra, their first all wheel drive crossover vehicle, manufactured specifically for Australia’s unique road and dirt track conditions.

Based on the Cross-Trac, an all wheel drive system designed, calibrated and manufactured by a team of experts in Australia, the Adventra is a ‘…fine showcase of the exciting sort of vehicle our automotive industry is capable of producing,’ said the Hon Ian Macfarlane, MP, Minister for Industry, Tourism and Resources, after putting the car to test at its launch on 10 September 2003. ‘It’s a machine of world-class quality and performance that underlines Australian engineering innovation and expertise.’

Grant Jamieson, Adventra Program’s Engineering Manager, said ‘More than 600,000 durability, development and test kilometres and 1000 complex computer simulations were used to ensure Cross Trac exceeded our test benchmarks.’

The vehicle can handle icy highway conditions, sandy roads or gravel mountain tracks equally well.
Prime Minister’s Community Business Partnership

The Prime Minister’s Community Business Partnership aims to develop and promote a culture of corporate and individual social responsibility.

Comprising a representative group of prominent Australians from the community and business sectors appointed by the Prime Minister in 1999, the partnership advises and assists the Government on community business collaboration. The Prime Minister is the Chair of the Partnership and the Minister for Family and Community Services is the Deputy Chair.

The partnership’s role is advocacy, facilitation and recognition of corporate social responsibility, and partnerships between business and community organisations in Australia. Partners combine their resources and talents to achieve mutual goals, develop creative solutions to local and regional problems and most importantly, strengthen community ties.

‘Working in partnership not only has the potential to enrich people’s lives but can also deliver tangible results for all Australians. Community and business partnerships are a driver to accomplish better outcomes than any group acting alone could achieve,’ said the Hon John Howard MP, Prime Minister of Australia.

The partnership is advising the Government on a range of issues, including regulatory and tax issues, barriers to the development of a culture of philanthropy, and new mechanisms required to encourage greater philanthropy for innovation. It is also writing a report (due in November 2003) on the community’s ideas on ways to increase the level of philanthropic support.

www.partnerships.gov.au

A farmer who survived the drought using farming systems he learned about at a University of Sydney field day has showed his gratitude in a way that will benefit other Australian farmers for many years to come.

By way of thanks, Ted Holtsbaum donated his 1070-hectare property to the university for the creation of technology for agricultural production and natural resource management.

Named the EJ Holtsbaum University of Sydney Agricultural Research Institute, the gift will enable the university to further develop its agricultural research in a special centre, according to Professor Les Copeland, Dean of the Faculty of Agriculture, Food and Natural Resources.

The farm will still be run commercially, with profits used to fund scholarships, teaching and research in agriculture.

THE POSITIVE EFFECTS OF DROUGHT

Professor Les Copeland, the Dean of the Faculty of Agriculture, Food and Natural Resources, University of Sydney and Mr Ted Holtsbaum at handover of his property “Nowley” to be used as a research facility.
Credit: Image supplied by the University of Sydney News
Commercialisation—translating ideas into marketable products, processes and services—is a key aspect of the Australian innovation system. The Australian Government has provided funding and incentives through Backing Australia’s Ability, to assist with the commercialisation of ideas.

The process of taking ideas to market involves firms, universities and research institutions to consulting companies, suppliers, customers and even competitors.

Providing capital for commercialisation

One of the key factors limiting the successful commercialisation of research outcomes is the availability of early stage investment capital. While growing, the Australian venture capital market is relatively small, especially in the pre-seed stage and early stage, when funding is difficult to acquire. To help in building that investment, the following programmes have been implemented.

“...VCs [venture capitalists] want a lot of the company for very little. The VC industry is relatively new in Australia and there are more people looking for funds than dispensing them.”
COMET Customer

Programmes and initiatives

- Innovation Investment Fund
- Pooled Development Funds
- Venture Capital Limited Partnerships
- Renewable Energy Equity Fund

Innovation Investment Fund (IIF)

The IIF programme was established to provide small, high-tech companies with access to equity (venture) capital for improving the commercialisation outcomes of Australia’s R&D.

As at 30 June 2003, the IIF had invested funds in 61 companies, the majority of which are commercialising Internet, information or life science technologies. The total amount of Australian Government funds invested since the inception of the IIF is $110.8 million. In 2002–03, some 34 investee companies received funding of close to $30 million, of which $17.9 million was provided by the Government.

The programme has contributed to an increase in the number of early stage venture capital funds and to the development of IIF fund managers.

www.ausindustry.gov.au

Pooled Development Funds

The Pooled Development Funds (PDF) programme aims to increase the supply of patient equity capital for Australian SMEs. By establishing commercially operating private sector investment companies (the PDFs), the programme develops and demonstrates the potential of the market for providing patient equity capital to eligible companies.
Establishing PDFs is encouraged through providing companies registered as PDFs, and their shareholders, with concessional tax treatment on returns from eligible investments. Since the programme began in July 1992, PDFs have invested more than $540 million into more than 400 Australian companies. There were 116 registered PDFs at 30 June 2003.

www.ausindustry.gov.au

**Venture Capital Limited Partnerships (VCLP)**

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).

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 of America
- non-resident venture capital funds established and managed in the above countries
- taxable non-residents holding less than 10 per cent of the equity in a venture capital limited partnership. 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 of America.

The VCLP changes received Royal Assent in December 2002 and as of end September 2003 there were five VCLPs conditionally registered.

www.ausindustry.gov.au

**Renewable Energy Equity Fund (REEF)**

The Renewable Energy Equity Fund (REEF) is a specialist renewable energy fund developed jointly by the Australian Greenhouse Office and the Industry Research & Development Board. Funding of $17.7 million is provided by the Australian Government.

Its objectives are to encourage development of companies and other incorporated bodies commercialising R&D in renewable energy technologies by addressing capital and management constraints, and develop fund managers with experience in the renewable energy industry.

Technology developments currently being supported under REEF 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.

www.ausindustry.gov.au

**Research to investment-ready stage**

In order for projects to secure the necessary finance to commercialise their products and ideas, they must be sufficiently developed, both in terms of the validation and testing of their scientific and technical basis, and in terms of viable business projections. Private investment is dependent on a competitive value proposition and a fully detailed strategy for delivering this value to the market.

In recognition of the fact that in many cases promising research will not be immediately able to meet this criterion for “investment readiness”, a set of initiatives has been implemented to assist ventures in turning research into an attractive opportunity for investors.

“It is very difficult to get investment funding when one can only offer “potential” without having achieved sufficient “sales” record.” COMET Customer

**Programmes and initiatives**

- Pre-seed Fund
- Commercialising Emerging Technologies
- Biotechnology Innovation Fund
- Building Information Technology Strengths

**Pre-seed Fund (PSF)**

The Pre-Seed Fund is a 10-year, equity-based programme introduced under *Backing Australia’s Ability* designed to help increase the commercialisation of Australian Government public sector research.

The Australian Government has provided $72.7 million in capital and private capital funding is $31.4 million.

The PSF encourages the private sector to take a more active role in funding and managing research projects conducted by universities and Australian Government research agencies.

The programme has established four venture capital funds to invest in projects or companies spinning out from universities or public sector research agencies. The funds are managed by venture capitalists experienced in research commercialisation and the development of sustainable businesses.

AusIndustry, in collaboration with licensed Pre-Seed Fund managers, markets the programme.


**Commercialising Emerging Technologies (COMET)**

COMET is designed to increase the commercialisation of innovative products, processes and services by providing individuals, early-stage growth companies and spin-off companies with a tailored package of support. It is delivered through a network of private sector business advisers located around Australia.

Since the programme’s inception in 1999, over 800 applications for support have been approved, 126 products or services have been launched and 61 instances of manufacturing commencements have been achieved. At the end of June 2003, approximately $161 million of capital had been raised by COMET recipients.

COMET is funded to 30 June 2005, with $7.7 million available in each of 2003–04 and 2004–05.

A long-held vision is now a reality for Brian Hanisch—creating computers simple enough for anyone to use, focusing on spoken language as the natural communication pathway between human and machine.

Homespeak system, a natural language recognition package developed by i2Net that combines with Clipsal’s C-Bus wiring system to take ‘home automation’ one step further, has now been launched across Australia, South-East Asia, the United Kingdom and South Africa.

What places i2Net’s product ahead of other voice recognition software is its natural language capability, which gives the system a ‘user-friendly’ edge, enabling it to respond to verbal commands expressed in all the various forms that everyday language takes.

‘Basically, the user knows what they want done, they tell their ‘electronic partner’, and the partner determines the action required and completes the task,’ says Brian Hanisch, founder and Managing Director.

i2Net formed a research relationship with Flinders University that led to the first prototype. Then electronics manufacturer, Clipsal, came on board and collaborated. Another two prototypes later and the product was ready for commercial release.

Development of the product was assisted by funding through Commercialising Emerging Technologies (COMET)—delivered by AusIndustry.

COMET is designed to assist early-stage and spin-off companies commercialise their innovative products, processes or services. The Australian Government, under Backing Australia’s Ability, provided an additional $40 million to COMET, extending the program until 2004–05 and increasing the focus on regional access.

Brian is now exploring the wider potential of the system, particularly in areas such as independent living for the aged and those with a disability.

www.ausindustry.gov.au
Biotechnology Innovation Fund

The Biotechnology Innovation Fund (BIF) helps biotechnology companies demonstrate ‘proof of concept’ and progress projects from the research stage through to early commercialisation.

Announced as part of the National Biotechnology Strategy in July 2000, the programme was designed to remove major development constraints associated with lack of pre-seed, early stage and seed capital. Under Backing Australia’s Ability, funding for BIF received an additional $20 million for 2001-02 to 2003-04.

Funding allocated to BIF will assist biotechnology companies to:

- increase the rate of commercialisation of Australian biotechnology innovation
- reduce the cost of demonstrating proof of concept
- encourage commercialisation of promising biotechnology developed in Australia

A bus passenger’s entire trip can now be tracked and recorded, and then retraced months later, thanks to a new range of digital surveillance products.

Specifically designed for use in mobile environments, the products provide coordinated date, time, visual, audio, and geographic street references. Of interest to law enforcement, public transport and a range of other service providers, the products were designed and developed by Perth-based company Digital Technology International (DTI) with assistance from AusIndustry’s COMET programme.

DTI’s Managing Director Neil Goodey said the products can record images indexed to vehicle locations, in ‘real time’. It is this integration of high-speed digital video and audio with a unique Global Positioning System tracking technology that sets the products apart from the competition.

The products have placed DTI in a prime position in the international mobile surveillance system market.

Public transport industries in several countries, including Australia, Denmark, Italy, Netherlands and United Kingdom are already using the system. Other potential customers include those providing high-value freight transport (such as payroll and courier services) and police, military and private security services.

www.ausindustry.gov.au

MOBILE SURVEILLANCE ON THE MOVE

Credit: Image supplied by AusIndustry

DTI Image.
- assist in the development of biotechnology innovation to attract private sector investment
- increase the level of commercialisation of Australian biotechnology.

Round Five was announced by the Minister for Industry, Tourism and Resources in July 2003 and 88 applications were received. Successful applicants will be announced in late November 2003.

A total of $18.7 million in BIF grants was awarded to 83 projects in 2002-03. Since the program began in 2000, some $31 million has been granted to 138 successful grants. There have been 32 BIF projects completed to October 2003, and most are proceeding with commercialisation.

www.biotechnology.gov.au

EASING THE PAIN OF HEART PROBLEMS

An Australian innovator of medical devices has developed a machine that offers patients a non-invasive, painless way of having their heart rate measured with real-time data. The machine is enabling specialists to offer patients an enhanced level of care.

Ultrasonic Cardiac Output Monitors (USCOM) measures various cardiac functions, including the flow of blood through cardiac valves, using a continuous wave Doppler ultrasound technique. Vital information, comparing current against previous performance, is produced instantly in numerical and graph forms.

An Australian start-up company, USCOM Pty Ltd, has secured worldwide patents on its technology and Australian regulatory clearance through the Therapeutic Goods Administration. The medical device has also won a prestigious Design Mark in the 2003 Australian Design Awards, a division of Standards Australia.

The Chief Executive of USCOM, Gary Davey, says until now cardiac monitoring has involved specialised equipment and an often-invasive procedure.

The company received a $200,000 grant through the Australian Government’s Biotechnology Innovation Fund to develop the device and was also supported by a $150,000 grant through the Innovation Access Program.

www.uscom.com.au
Building Information Technology Strengths (BITS)

The Australian Government is providing $158 million over five years for the BITS programme to provide support for the development of information and communications technology (ICT) start-up companies, and advanced networks in Australia.

BITS has three core elements, the Incubators Program, the Intelligent Island Program, and the Advanced Networks Program (ANP).

The Incubators Program, with funding of $78 million, is currently supporting 10 incubator centres across Australia. Start-up seed funding and business development services are provided for ICT businesses, and links are established with universities, R&D organisations and venture capitalists. The number of start-up companies accepted into the Incubator Program has grown to reach a total of 275. The number of graduates has grown to a total of 127.

The Intelligent Island Program, with funding of $40 million, focuses on developing the Tasmanian ICT industry, building on both Australian and Tasmanian Governments’ programmes. The programme covers seven key initiatives including: a health and bioinformatics Centre of Excellence; the Intellinc ICT incubator; industry and skills development funds; and an investment attraction programme.

The BITS Advanced Networks Program (ANP) has provided $37.2 million to support the development, trialling, and demonstration of advanced networks, experimental networks and test beds. The program’s objective is to contribute to the development of advanced network infrastructure that will deliver long term benefits to the Australian economy, particularly by supporting progress towards the establishment of a national advanced backbone network.

On 29 May 2001 the then Minister for Communications, Information Technology and the Arts, Senator the Hon Richard Alston, announced three projects selected for ANP funding:

- The Centre for Networking Technology for the Information Economy project (CeNTIE) ($14 million) - a CSIRO-led consortium which has established experimental networks in Sydney and Perth and a multi-gigabit backbone link from Perth to Melbourne. It is undertaking research on next generation networking technologies;

- GrangeNet ($14 million) – this AARNET-led consortium has built a multi-gigabit network with connections to CeNTIE and to universities and research institutions in Brisbane, Sydney, Canberra and Melbourne. The network is being used for e-science projects and grid computing; and

- m.Net Corporation Ltd ($9.23 million) – an Adelaide-based consortium which has established third generation mobile and wireless local area network testbeds to develop commercial mobile applications in such areas as education, health and transport.

www.dcita.gov.au
SECTION 2 - Supporting and improving Australian science and innovation

It will soon be an everyday event to conduct a music class over the Internet with the teacher in a different location to the students. Or produce a movie through collaborate online editing, which will significantly shorten post-production time and give Australia’s world-class film industry an edge.

All thanks to high-speed networking technology.

Established by CSIRO, the CeNTIE (Centre for Networking Technologies for the Information Economy) consortium was launched in April 2003. It is for research into the networking technologies needed for the next generation of business systems for the information economy.

The initiative is supported by the Australian Government through a $14 million grant from the Building on IT Strengths (BITS) Advanced Network Program by the Department of Communications, Information Technology and the Arts.

‘We are working towards wired cities where quality educational, medical and business services are at everyone’s fingertips, independent of location,’ says CeNTIE Director Dr Terry Percival. ‘It will be as if teachers and students are in the same place—seeing, feeling and hearing the same thing even though they are a continent apart.’

Mark Walton, Chair of Performance Outreach and Communications at the Sydney Conservatorium of Music, participated in a demonstration of CeNTIE with the University of Western Australia School of Music.

‘I gave the first trans-continental masterclass to a saxophone quartet of students from the university in Perth,’ said Mark. ‘It was like having the quartet in the same room, with CD sound quality and excellent television quality.’

The CeNTIE network combines new optical fibre infrastructure and leased capacity from innovative carriers such as Flow Communications and AARNet. It links 20 key sites in Sydney’s Global City corridor. A similar network has been commissioned in Perth.

CeNTIE is working with leading end-user groups in the health, education, media and finance sectors to identify new research topics in networking.

‘As well as connecting research institutions, overseas experience has shown that advanced networks boost industry development—new applications, products and services in such areas as telemedicine, bioinformatics simulation software, advanced manufacturing and online education,’ the former Minister for Communications, Information Technology and the Arts, Senator Richard Alston, said. ‘It is important that Australia benefits not just from national connectivity, but also uses this network to link into overseas research and innovation.’

Consortium members are: CSIRO; IP1 Australia; Nortel Networks; the University of New South Wales; the University of Technology, Sydney; and the Western Australian Interactive Virtual Environments Centre.

CeNTIE has also established interlinkage arrangements with both the GrangeNet and mNet consortia.

www.centie.org/
Building linkages to facilitate commercialisation

Enhanced collaboration between the public and private sectors will assist in improving Australia’s current performance in commercialisation. In particular, Australia’s Cooperative Research Centres program is directed to strengthening public/private sector partnerships with the aim of bringing together the capabilities of each sector.

Programmes and initiatives

- Cooperative Research Centres
- Australian Government Space Forum
- Intellectual Property Awareness
- Intellectual Property Protection

Cooperative Research Centres (CRCs)

The CRC programme promotes strategic links between researchers and research users from universities, the public sector and industry.

The programme encourages government, business, education, and research institutions to work productively together to develop Australia’s international competitiveness in fields as diverse as mining, engineering, information technology, agriculture, the environment, and medical technology.

Over the last 12 years, more than $7 billion (cash and in-kind) has been committed to CRCs, including $1.8 billion in direct funding by the Australian Government, $1.8 billion by universities, $1.3 billion by industry, and almost $1 billion by CSIRO.

Under Backing Australia’s Ability, the CRC budget will increase to $202 million in 2003–04, up from $148.6 million in 2002–03. The impact of this additional funding will become evident over the next seven and more years, as the CRCs that successfully achieved funding in 2002 implement their research, education and commercialisation programmes.

In 2003–04, the CRC programme will support 71 CRCs, up from 62 in 2002–03. A full list of CRCs is at Appendix Table 7.

The active involvement of industry and other users of research is crucial to the CRC programme. It ensures that long-term research undertaken will have strategic relevance, and that the research will be used to produce economic, social and environmental outputs beneficial to Australia.

Facilitating strategic links between researchers and research users provides industry with access to a collaborative environment not otherwise readily available. Rather than relying on short-term research projects to address immediate issues, these arrangements enable research and development with broader objectives to open up new directions for Australian industry and address long-term social and environmental issues.

Accordingly, CRCs provide a valuable mechanism for pooling intellectual and other research resources in government, research institutions, industry, and universities to achieve higher quality outcomes than they could achieve in isolation. CRCs have undertaken nearly 5000 contracts for industry and other users, earning over $350 million.

In 2003, the CRC programme was formally evaluated. The evaluation report, finalised at the end of July 2003, will be considered by the Government in setting future directions for the programme.

www.crc.gov.au
When the FedSat scientific and engineering satellite was blasted into space on a three-year mission last December—aboard Japan’s National Space Development Agency’s H-IIA rocket—it heralded the completion of five years’ work by a team of Australian researchers.

FedSat was in orbit 31 minutes after the launch, and a short 10 hours later was communicating with its ground station in Adelaide.

The first satellite built in Australia for more than 30 years, FedSat is transmitting vital information to be used for research and development in space science, navigation, satellite computer systems, and communications.

The Cooperative Research Centre for Satellite Systems (CRCSS) has been awarded $21.3 million over 8 years to 2005 through the CRC programme. The FedSat project, a collaborative effort headed by CRCSS, was also supported by a $2 million Australian Government Innovation Access Program grant.

The main partners in the FedSat project are the University of South Australia, the CSIRO, the Queensland University of Technology, Canberra’s Auspace Limited, Adelaide’s Vipac Engineers & Scientists Limited, the University of Newcastle, and the University of Technology, Sydney.

Chief Executive Dr Andrew Parfitt said the amount of information being transmitted as the satellite orbits 800 kilometres above the earth is increasing every day and strategies for commercialising outcomes of the FedSat mission are being developed with a number of global commercial entities.

“It is all very exciting. If these negotiations are successful, they could lead to millions of dollars of investment into the Centre’s commercial program”, Dr Parfitt said. “Our graduates also tend to be highly sought-after and many have secured challenging, well-remunerated work in space and related industries”.

Experiments to develop new types of computers for use in space are also being carried out. FedSat’s computer uses reconfigurable logic, which allows operators on earth to make changes to the on-board hardware.

FedSat’s primary ground station in Adelaide is communicating with the satellite every day and most weekends. A second ground station—the innovative fast-tracking Ka band in Sydney—opened in February.

www.crcss.csiro.au
Australian Government Space Forum

The Australian Government Space Forum (AGSF), established in July 2003, is a network of Australian 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 this area.

The objectives of AGSF are to:

- exchange and coordinate the dissemination of information about Australian Government space-related space policies, programs and activities;
- identify issues that would benefit from a collaborative approach amongst 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 upon which Government or agencies can draw as required.

www.industry.gov.au/space

Intellectual Property (IP)—improved awareness

IP Australia works to raise the level of awareness and understanding of the importance and value of, and strategies involved in, IP protection and commercialisation. It has been recognised internationally for its role in the development of intellectual property education and awareness programmes, and has participated in several projects to assist IP offices around the world develop their strategies.

In 2002–03, IP Australia continued to focus on its main target audiences:

- small to medium-sized enterprises (SMEs)—almost 700 people attended IP Australia’s national series of SME seminars, presented in conjunction with the Australian Innovation Festival; a new publication, Smart Start, was released, to introduce basic intellectual property concepts when starting or buying a business
- business advisers and professionals—the second version of the IP Toolbox was released, with updated content on copyright, taxation and government incentives, plant breeder’s rights, and useful contacts
- tertiary sector and other research institutions—IP Professor continued with web site updates and a national seminar series
- government—a public education programme was initiated to educate and inform government program managers and marketing/communication officers about IP
- education—the InnovatED programme continued, with involvement in the Australian Science Festival, where more than 3000 students visited the InnovatED stand
- international—public education and awareness programs for IP offices in the Pacific and Asian regions were either developed or enhanced.

www.ipaustralia.gov.au
Flight history has been made with the world’s first flight test of supersonic combustion.

Scramjets, the process used in an air-breathing supersonic ramjet engine, raise the possibility of flying from Sydney to London in just two hours. Using oxygen from the atmosphere instead of propellant, the jets are also set to revolutionise the launch of small space payloads, such as communications satellites, by substantially lowering costs.

The work has emerged from the University of Queensland’s HyShot™ program, which aims to provide the world’s first in-flight tests of scramjet technology.

On July 30 2002, a successful launch of a rocket containing a scramjet payload was held at the Department of Defence’s Woomera Instrumented Range. The launch took the scramjet engine to more than seven times the speed of sound.

‘All indications are that supersonic combustion occurred,’ according to Dr Allan Paull, of the University’s Centre for Hypersonics—the largest university-based hypersonics group in the world. The University of Queensland has some of the world’s most advanced equipment for simulating velocities of eight times the speed of sound to 50 times the speed of sound.

‘Australia has proven we can develop this technology at a fraction of the cost of overseas programs. We must now build on our success and secure the program in Australia so the intellectual property is not lost to the country,’ said Allan. ‘It’s also a magnificent example of international collaboration, involving researchers from Australia, the United States, Britain, France, Germany, Korea and Japan.’

Funding and sponsorship for the research and development came from a wide range of international companies, research laboratories, government space agencies and universities in the USA, Australia, Japan, Germany, and Korea as well as Australian partners, DSTO and the ARC.

LEFT: Jumping for joy...members of the successful HyShot team (from left to right) Judy Odam, Dr Ross Paull, Bert Paull, Dr Allan Paull, Dr Susan Anderson, Myles Frost, Suhee Won and Aggie Branczyk.

RIGHT: The staged Terrier Orion rocket and UQ payload on the launchpad at Woomera.

Credit: Chris Stacey @ University of Queensland.
There are several initiatives aimed at improving the protection of IP in Australia.

New IP Designs Legislation
Reforms embodied in the Designs Bill 2002 and Designs (Consequential Amendments) Bill 2002, to replace the Designs Act 1906, follow from an extensive review and consultation process and represent a modernisation of the Australian industrial designs system. The aim of the Bills is to achieve a balance between encouraging creativity and innovation on the part of designers, through a stronger design right and improved enforcement mechanisms, and the interests of consumers by providing access to well-designed products at competitive prices.

The Senate Economics Legislation Committee has recommended that the Senate approve the Bills which will be considered by Parliament during the 2003 Spring sittings.

Innovation patent
The introduction of the innovation patent system provides innovators with an additional mechanism to protect their lower level and incremental inventions that may not meet the higher inventive threshold requirements of the standard patent system.

Innovation patents are available for most of the types of invention covered by standard patents, but are not available for plants and animals or biological processes for the generation of plants and animals. This exclusion does not include microbiological processes, so innovation patents are available for processes such as cheese and wine making and the synthesis of industrial compounds using micro organisms.

Grace period
The introduction of the grace period allows for public disclosure of an invention (under certain conditions) without affecting the validity of a subsequent patent application. This is to cover those circumstances where the inventor has made an inadvertent or ill-timed publication of an invention before applying for a patent. Prior to the introduction of the grace period, an invention had to be kept secret before an application for a patent was made. The grace period commenced on 1 April 2002.

Initiatives to strengthen the examination of patent novelty and inventiveness
Under these initiatives, a new system for the disclosure of information to the Commissioner of Patents was implemented. Initial experience with this new system showed that it imposed an undue burden on patent applicants and owners and would not meet the Government’s policy objectives. This system will be replaced with a more workable disclosure regime by amendments in the Intellectual Property Laws Amendment Act 2002, which will commence on 26 August 2003.

Madrid Protocol
Under the Madrid Agreement Concerning the International Registration of Marks, international applications can only be based on national trade marks which are already registered. The Protocol Relating to the Madrid Agreement came into force on 1 April 1996, and introduced a number of innovations in the Madrid System with the aim of expanding its geographical coverage. There are currently 56 member States. People who have a trade mark application in their home country may apply by single application for International Registration and protection of their trade mark in one, some or all of the other member countries.

A number of reviews are being undertaken by the Advisory Council on Intellectual Property or earmarked for the future which may result in recommendations for legislative changes related to intellectual property protection.

A Review of Trade Marks Legislation is currently under way and submissions to the review were invited from 1 August to 31 October 2002. The Trade Marks Legislation Review is expected to be finalised in the first half of 2004.

www.ipaustralia.gov.au
Wine aficionados expect to know from a wine label the kind of grape, region and manufacturing style has produced the wine they are about to drink.

Thanks to international agreements like the World Trade Organisation’s Agreement on Trade Related Intellectual Property Rights (TRIPS) wine drinkers and producers are protected from misleading labelling through the enforcement of intellectual property rights of Geographical Indicators and Trademarks.

Trademarks can be a word, phrase, letter, number, sound, smell, shape, logo, picture, aspect of packaging or a combination of these. In today’s global marketplace trade marks are a very valuable asset for businesses. They also play a part in protecting consumers in ‘knowing’ what we are purchasing.

Under the European Union/Australia Wine Agreement, the word Hermitage can only be used to describe Australian wine not being sold in the European Union. Hermitage is actually a Geographical Indicator and in the European Union, the word is protected as a trade mark to describe wine made in Hermitage in the Rhone Valley.

Intellectual property issues like Geographical Indicators and trademark protection are a focus for the Intellectual Property Research Institute of Australia (IPRIA). IPRIA is a national centre for multi-disciplinary research on the law, economics and management of intellectual property (IP).

IPRIA was established in 2002 under Backing Australia’s Ability with funding from IP Australia, the Government agency responsible for granting rights in patents, trademarks and designs, the Victorian State Government, and its host institution, the University of Melbourne.

Core research staff, and affiliated research associates in Australia and overseas focus on ways to improve the protection and management of intellectual property by business, research institutions and other users.

IPRIA holds many high profile conferences with international speakers. In September 2003 IPRIA hosted a one-day conference on Trade Marks which brought together key stakeholders in trade marks development and regulation. Speakers represented academia, the legal and trade marks professions, government and business. The conference provided a variety of perspectives on the law, economics and management of trade marks now and in the future.

IPRIA publishes key papers and reports like the annual R&D and IP Scoreboard as well as commissioned work for government and business. In 2003 IPRIA completed and published a report on Australia’s Innovative Capacity in the 21st Century.

IPRIA also supports high-quality policy development by government in areas relating to intellectual property, and uses research outcomes to generate and contribute to public debate on IP.

www.ipria.org
**Encouraging companies to innovate**

While leveraging Australia’s strength in public research is vital, delivering wealth and other value outcomes from innovation within the private sector is equally crucial. In most cases linkage with the private sector is critical to overcoming many of the hurdles facing public research projects due to easier access to resources and contacts in the areas of business management, finance and marketing.

There is still scope for Government to play a valuable role in facilitating the commercialisation of private sector innovation, especially where there will be benefits across the wider community.

*“The innovation process for many firms involves using expertise and services from more than one source, both internal and external, including often both private firms and public sector research organisations.”* Australian Expert Group in Industry Studies

**Programmes and initiatives**

- Innovation Access Program \(^{BAA}\)
- Information Technology Online \(^{BAA}\)
- Pharmaceutical Industry Investment Program
- New Industries Development Program \(^{BAA}\)
- Shipbuilding Innovation Scheme
- Textiles, Clothing and Footwear Strategic Investment Program
- Automotive Competitiveness and Investment Scheme
- Energy Efficiency Best Practice Program
- Renewable Energy Commercialisation Program

**Innovation Access Program (IAP) \(^{BAA}\)**

The Innovation Access Program aims to promote innovation and competitiveness by increasing Australian access to global research and technologies, and facilitating their uptake by Australian researchers and companies.

The programme, under *Backing Australia’s Ability*, has been allocated $97.8 million over four years from 2001-02 to 2005-06. IAP crosses three government portfolios, DITR, DEST and DCITA, and includes the Information Technology Online programme.

Activities supported in 2002-03 include:

- science, engineering and technology activities under international agreements that give Australian researchers access to leading edge research and technology;
- the Australian InnovationXchange—a web-based service to advance Australia’s innovation capabilities through technology, knowledge diffusion, education and training;
- continued support for Australia’s participation in the Intelligent Manufacturing Systems Program, which is an industry-led, international R&D initiative to develop the next generation of manufacturing processes;
the Australian Materials Technology Network, which will promote and provide a national vehicle for the diffusion of materials technology and capabilities to SMEs in Australia that do not have their own R&D facilities; and

seven international showcasing events under the Technology Australia banner in the ICT, Mining, Environment and Biotechnology sectors.

www.ausindustry.gov.au


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**LINKING INDUSTRY AND TECHNICAL SOLUTIONS**

The Minister for Industry, Tourism and Resources the Hon Ian Macfarlane MP launched the $6 million Industry Techlink in February 2003. A free, national technical advisory service, Industry Techlink assists industry, especially SMEs, with their technology problems.

The initiative has provided invaluable advice to many SMEs.

Robyn Kirby, one of Australia’s foremost herbalists, who is known for her expertise both nationally and internationally, relied on Industry Techlink to help solve a packaging supplier problem her company, Sinusonline.com, was having.

As the Sinusonline.com company manager, Peter Mitchell explained, ‘the packaging problem had been bugging us for some time. We were very pleased with the promptness in responding to our problem. Industry TechLink is a very good service and one which will benefit many small businesses because it alleviates the stress of finding the right option.’

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LEFT: The Minister for Industry, Tourism and Resources, the Hon Ian Macfarlane MP, at the launch of TechLink (from L to R, The Minister, Peter Drill, CEO Consultel, John Harris, Technology Manager, Industry TechLink, and Neil Nyholm, Project Director, Industry TechLink.

RIGHT: Packaging supply issues were solved for Sinusonline.com products through TechLink.

Credits: Images supplied by DITR and Sinusonline.com.
Information Technology Online (ITOL)

The Information Technology Online program encourages industry (especially clusters of SMEs) to adopt business-to-business e-commerce solutions and embrace innovative e-commerce solutions that deliver sustainable economy-wide returns and increase competitiveness. ITOL also encourages industry and small business to identify and adopt commercial uses of the Internet to support productivity and profitability.

Administered by the National Office for the Information Economy, the programme is funded through Backing Australia’s Ability to 2005-06 at $2.5 million per year. Grants are available for up to $200,000, capped at 50 per cent of total eligible project costs.

Since 1996, more than $9 million has been allocated to 94 projects across a range of industry sectors, including agriculture, health and pharmaceutical, building and construction, automotive, and welfare groups.

Industry solutions funded through ITOL demonstrate high levels of innovation. A study on funded projects, completed in 2002, concluded that the majority of ITOL projects raised e-business knowledge in diverse regions, in businesses and in the broader community.

www.noie.gov.au/itol

Pharmaceutical Industry Investment Program (PIIP)

PIIP is helping to develop an internationally competitive pharmaceutical industry in Australia. It partially compensates participating manufacturers for the prices they receive under the Pharmaceutical Benefits Scheme, in return for their commitment to undertake R&D, and value-added production, in Australia.

In the year ending 30 June 2002, PIIP participants increased their R&D expenditure by 19 per cent on 2000–01 expenditure levels, undertaking over $200 million worth of R&D activities.

On 14 February 2003, the Productivity Commission released the Evaluation of the Pharmaceutical Industry Investment Program, which found that PIIP has been effective in stimulating R&D, and to a lesser extent, value-added production. It also found that the additional R&D generated by the program per dollar of subsidy is much higher than has been found for other subsidised research and development. The Commission recommended that a new R&D-only program replace PIIP in 2004.

PIIP has encouraged pharmaceutical companies to undertake activities of global significance in Australia. For example, Bristol-Myers Squibb announced in March 2003 that its R&D facility in Noble Park, Melbourne, had been chose as a global hub for clinical R&D. PIIP also plays an important role in commercialising high quality Australian R&D. PIIP supported Melbourne-based biotechnology company, Amrad to develop its R&D portfolio and position the company to sign a US$112 million collaboration with Merck Sharp & Dohme in June 2003. This is one of the largest collaborations in Australian biotechnology history.

A ground-breaking project involving innovation and a passion for perfection has enabled a Tasmanian food company to create a superbrand of frozen oysters that have been widely embraced by the discerning Japanese market.

It all began a few short years ago when Japan’s Godak Marketing Corporation, which specialises in buying frozen shellfish products from around the world, asked Peter Shelley, from Tasmanian Quality Foods, if he could produce superior half-shell, snap-frozen oysters.

Not one to shy away from a challenge, Peter began researching and with the help of a $100,000 Pilot Commercialisation Project grant from the Australian Government’s New Industries Development Program, created a brand of Pacific oysters called ‘Cat’s Eye’. The name was picked as a reflection of the jewel-like quality and appearance of the oysters. In their first season, the company sold 45 000 dozen to Japan and continues to meet strong demand, both overseas and in a growing domestic market.

‘This was the first major attempt to have a consistent, reliable oyster supply going under a brand to a major market,’ said Peter. ‘We couldn’t afford to risk failure.’

The challenge in part was to maintain the lustre of a freshly shucked oyster after freezing. Working closely with Japanese marketing representatives, Tasmanian Quality Foods implemented new processing systems to ensure the Cat’s Eye oysters would be embraced by highly knowledgeable and particular Japanese consumers.

Custom-moulded packaging, enabling individual packing of oysters, a purpose-built rumbler for cleaning shells to the highest standard, automated oyster-opening technology, and a rapid nitrogen freezing method were all developed. Just as importantly, strict quality assurance systems and health and safety systems beyond those usually required by the Australian Quarantine Inspection Service, were introduced. Exceptional marketing cultivated high brand awareness.

Despite competing against a lower-priced offer from New Zealand, Tasmanian Quality Foods have found that the market prefers to pay extra for the quality of its product.
New Industries Development Program (NIDP)

NIDP works towards accelerating efforts to improve Australia’s performance in the development and commercialisation of new innovative agribusiness products, services and technologies.

Under Backing Australia’s Ability, NIDP has been expanded to a five-year programme to June 2006 with funding of over $20 million.

Use of the funds will include: competitive-based assistance for pilot commercialisation projects to ‘incubate’ innovative niche agribusiness ventures; competitive-based scholarships to enable emerging managers to gain first hand experience in specific areas of business management and new markets; and further development of supply chain management and market analysis issues aimed at encouraging the adoption of stronger, more innovative solutions to supply chain and marketing arrangements.

As Swift as the Wind

A high-speed vessel, built by an innovative Tasmanian firm in a few short months, is now being used by the US Navy as a Mine Warfare Command and Support Ship.

The 98-metre wave-piercing catamaran, christened the HSV 2 Swift (Hull 061), was proudly handed over by Incat, a Hobart company specialising in building world’s record-breaking vessels. It is the fourth Incat Wave Piercing Catamaran to enter military service.

The HSV 2 Swift is capable of supporting dedicated and emerging organic mine warfare missions. An impressive feature of the catamaran is its NAVAIR certified helicopter flight deck. An area protected from the weather for storage and maintenance of two MH-60S helicopters is another feature.

Rear Admiral Paul Ryan, Commander Mine Warfare Command, US Navy, said the name Swift is most appropriate because of the vessel’s ability to reach high speeds—47 knots on sea trials.

Referring to the biblical David and Goliath, Rear Admiral Ryan said: ‘Incat is the “David” of the shipbuilding industry. Ten months from contract award to delivery is almost unheard of in the United States. Shipyards all over the country are jealously eying the technology of Swift. Local shipbuilders are wondering why they can’t do the same thing in the States.’

TOP: US Navy Helicopter lands on the deck of HSV 2 Swift – this helo landing occurred with the ship travelling at 40 knots with 58 knot winds across the deck – this may well be a world record for landing at speed. The deck landing area is made from a specially designed aluminium extrusion developed by Incat to provide permanent grip and avoiding the costly and time-consuming problem of removal and application of heavy non-slip paint.

BOTTOM: The HSV 2 Swift at speed in Tasmanian waters, showing the helo deck, boat handling crane and articulated ramp.

Credit: Photos by Richard Bennett and supplied by Incat Australia Pty Ltd
Achievements in 2002–03 encompass: knowledge creation—all projects supported under the program involve some degree of intellectual property benefit, ranging from formal patents to proprietary know-how and first mover advantage; human capacity—NIDP supported 14 scholarships last year with horticultural and seafood products being the dominant sectors; and collaboration—strong relationships have been developed with business development networks.

www.affa.gov.au/agribiz

Shipbuilding Innovation Scheme

The Shipbuilding Innovation Scheme was established in 1999 to encourage ongoing innovation in the Australian shipbuilding industry, to enable it to build upon its international competitiveness. A total of $51.5 million has been earmarked over five years for allocation to Australian-registered shipbuilders.

Since its introduction, Australian shipbuilders have increased investment in research and development to improve vessel design and speed. Customers include the United States military, which has taken long-term leases on three Australian-built catamarans—two from Incat and one from Austal. A third Incat vessel is being delivered to the United States military in August 2003.

www.ausindustry.gov.au

Textiles, Clothing and Footwear Strategic Investment Program (TCFSIP)

The TCFSIP Scheme is funded by the Australian Government (up to $677.7 million over five years, to 2004–05) to foster the development of sustainable, competitive textile, clothing and footwear industries in Australia. The Scheme is open to enterprises undertaking eligible activities relating to manufacturing and design for manufacturing in Australia of textiles, clothing, footwear and processed leather.

In 2002–03, $109.7 million in grants were paid to more than 200 businesses for eligible capital, innovation, value-added and regional restructuring expenditure. Additionally, seminars on the Scheme were conducted nationally, including sessions on criteria for R&D and innovative product development grants.

www.ausindustry.gov.au

Automotive Competitiveness and Investment Scheme

The Automotive Competitiveness and Investment Scheme (ACIS) provides transitional assistance to encourage competitive investment and innovation in the Australian automotive industry. The aim of the scheme is to assist the industry to achieve sustainable levels of domestic and international growth in the context of trade liberalisation.

In December 2002, the Prime Minister announced that ACIS would be extended from its original finishing date of 2005, to 2015, with funding of $4.2 billion. Funding includes a $150 million research and development fund to assist motor vehicle producers to develop key technologies.

ACIS provided $132.7 million in support for R&D in 2002–03 and continues to be a significant driver for innovation and growth in the Australian automotive industry. For example, the automotive component supplier, Robert Bosch, stated in its submission to the Productivity Commission that ACIS is critical to its continued success in securing and growing our capability to design and manufacture innovative automotive products.

Energy Efficiency Best Practice (EEBP)

The Energy Efficiency Best Practice program was established under the Prime Minister’s 1997 Safeguarding the Future package with funding of $10.3 million for five years. It concluded on 30 June 2003. The aim of the programme was to support and motivate industry to become more energy efficient. Industries which have benefited from participating in EEBP include beverage and packaging, baking, dairy, pulp and paper, supermarkets, wine and vehicle fleets.

It is estimated that by 2010, EEBP will have delivered cumulative reductions of $74 million in industry energy costs and as much as 1.2 million tonnes of greenhouse gas emissions, if all planned projects go ahead. Specific results include: a beverage malting company identified ways to reduce energy consumption by 43 per cent; 32 per cent reduction in total annual energy costs and 48 per cent savings in annual greenhouse gas emissions at Bakers Delight showcase energy efficient bakery; energy cost savings of over $1.6 million per annum identified and being implemented at one company site in the pulp and paper sector.

Two unique approaches were developed under EEBP: the innovation (Big Energy Projects) workshop process, which helped firms achieve large energy savings; and the capacity building (Best Practice People and Processes) workshop process which is an organisational development tool that builds the capacity of organisations to apply and sustain effective energy management practices.

To ensure that the initiatives and results of the former EEBP program continue to benefit Australian industry, an Internet-based resource kit and web-based tools will be available to assist firms seeking to improve their energy productivity.

www.industry.gov.au/energybestpractice
www.aepca.asn.au
www.greenermotoring.com.au
www.greenhouse.gov.au/motors

Renewable Energy Commercialisation Program

The Renewable Energy Commercialisation Program is a five-year (2000–01 to 2004–05), $54 million competitive grants programme designed to foster the development of the renewable energy industry in Australia and reduce the emission of greenhouse gases.

Administered by the Australian Greenhouse Office, it provides funds for projects that lead to the commercialisation of innovative renewable energy equipment, technologies, systems and processes.

The programme has provided funding of between $135,000 and $1 million for 49 projects, including: solar photovoltaic; solar thermal; wind; biomass; hydro; wave; and hot dry rock developments. It is estimated that 500 direct jobs have or will be created as a result of the programme and private sector investment of up to $238 million and exports of $120 million could also be achieved.

Greenhouse gas abatement of up to six megatonnes of CO₂ equivalent is estimated as possible by 2010 from the uptake of the technologies commercialised under the program. Additional benefits include: rural and regional development; waste minimisation; salinity mitigation; job and export creation; and diversification of agricultural incomes.

Using the power of the sun to generate electricity for a remote Aboriginal community is result of an innovative project funded by the Australian Greenhouse Office.

With the assistance of a $1 million grant under the Renewable Energy Commercialisation Program, the Pitjantjatjara Council Inc. and the South Australian Department of Aboriginal Affairs and Reconciliation have built a unique solar power station for the Anangu Pitjantjatjara lands.

Located in the north-west corner of South Australia, these lands cover an area in excess of 100,000 square kilometres and are home to approximately 2500 people.

Solar Systems Pty Ltd, a Melbourne-based company, has constructed the power station, which consists of ten CS500 dishes connected to a mini-grid servicing a number of communities. Each dish has approximately 130 square metres of curved mirrors, which concentrate the sun about 500 times onto highly efficient receivers.

A unique feature of the CS500 is that it can be upgradable to provide significant increases in power for only a fraction of the original cost.

Efficient and cost-effective production of solar power is still a major challenge. This project is an ingenious method of concentrating the energy before conversion.
SECTION 3 - Our future and moving forward

To support its longer-term, strategic approach, the Government relies on a range of data, advising bodies and offices across many portfolios.

- Prime Minister’s Science, Engineering and Innovation Council
- Chief Scientist
- Commonwealth State and Territory Advisory Council on Innovation
- Australian Biotechnology Advisory Council
- Australian Bureau of Statistics

Prime Minister’s Science, Engineering and Innovation Council (PMSEIC)

The Prime Minister’s Science, Engineering and Innovation Council is the Government’s principal source of independent and external advice on issues in the fields of science, engineering and innovation. The Council is chaired by the Prime Minister.

In 2002–03, PMSEIC met twice to deal with issues including science and security, climate change, management skills, neurosciences, healthy ageing, and the impact of frontier technologies.

Non-ministerial members include the Chief Scientist, and leaders of many scientific, educational and business groups (a full list of members is at Appendix Table 14).

The non-ministerial members constitute the Standing Committee of the Council, which oversees and contributes to studies and research aimed at improving understanding of major science, engineering and innovation issues.

The Council’s terms of reference are to:

- advise on important issues in science, technology, engineering and relevant aspects of education and training, including 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 utilisation
- examine Australia’s science and engineering infrastructure and the effectiveness with which it achieves the application of science and technology in the economic and social development of Australia.

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 landmark 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, advising on membership, agenda items and its overall operations. The Chief Scientist also chairs the Council’s non-ministerial standing committee, which discusses strategies and directions for the Council and current issues in science, engineering and innovation.

During 2002–03, Dr Batterham was engaged in the work leading up to the announcement by the Prime Minister on 5 December 2002 of the four national research priorities. He chaired the National Research Priorities Consultative Panel, which stimulated public debate, and encouraged research bodies and organisations to propose possible priorities. The Panel’s report was released in July 2002. The Chief Scientist was appointed as a member of the Expert Advisory Committee, and later, asked to provide advice to the Minister for Science on the adequacy of national research priority implementation plans submitted by research and research funding agencies.

In January 2003, the Minister for Education, Science and Training appointed Dr Batterham as chair of the Reference Group on mapping Australia’s science and innovation system. Dr Batterham is also a member of the Australian Research Council, the Cooperative Research Centres Committee, the Coordination Committee on Science and Technology, and the Commonwealth, State and Territory Advisory Council on Innovation.

www.dest.gov.au/chiefscientist

Commonwealth, State and Territory Advisory Council on Innovation (CSTACI)

The Commonwealth, State and Territory Advisory Council on Innovation (CSTACI) was established in February 2000 by Commonwealth, State and Territory Industry Ministers to improve the effectiveness, integration and coordination of the national innovation system.

CSTACI comprises senior officials responsible for industry, innovation and science policy, the Chief Scientist and his counterparts at the State and Territory level. It provides an opportunity for Australian Government agencies and state and territory agencies to share information and work collaboratively on innovation.

The Council meets twice a year and is jointly chaired by the Australian Government (represented by DITR) and the State or Territory hosting the meeting. Representatives of other Australian Government departments, including DAFF, DCITA and DEST, also attend the meetings.

This year there has been ongoing discussion of intellectual property in innovation programs across States and Territories. The Council also provided input to the process to map Australia’s science and innovation activities across the public and private sectors.

CSTACI met in May 2003 in Darwin. The next meeting is scheduled for November 2003 in Perth, Western Australia.

Australian Biotechnology Advisory Council

The Australian Biotechnology Advisory Council was announced in March 2002 and comprises 10 members drawn from the research, business, industry, health, agriculture and environment sectors.

The Council’s Chair is Professor John Hearn, Deputy Vice Chancellor (Research) at the Australian National University.

SECTION 3 - OUR FUTURE AND MOVING FORWARD
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 (including advice on further development and implementation of the National Biotechnology Strategy);
- advise on important biotechnology issues, including in 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 programs in support of biotechnology development in Australia.

The Council’s major achievement to date has been the development of a work programme that has been approved by the Biotechnology Ministerial Council. Key activities for 2003–04 include:

- contributing to the *Evaluation of the National Biotechnology Strategy and Biotechnology Australia*
- developing key industry benchmarks and performance targets
- identifying national research priorities
- increasing public awareness of both the biotechnology industry and ABAC’s role within it
- encouraging closer integration of agricultural and environmental biotechnology issues with a continued emphasis on health related biotechnology issues.

www.biotechnology.gov.au/ABAC

**Australian Bureau of Statistics (ABS)**

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

For many years the ABS has conducted R&D surveys of businesses, higher education institutions, government, and private non-profit organisations. Major topics covered have included 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). For the business sector, the ABS plans to link these data to other sources of productivity and performance data, to assess R&D impacts on businesses’ productivity and performance.

In August 2002, the ABS released a discussion paper on a wide-ranging framework for measuring Australia’s characteristics and performance as a knowledge-based economy or society across five dimensions—context, innovation and entrepreneurship, human capital, information and communications technology, and economic and social impacts. Based on this framework, a web-based statistical publication containing a range of characteristics and performance indicators within each of these dimensions was released in September 2003.

A major innovation survey is planned for February 2004 (reference year 2003) with survey results to be released around October 2004. Major topics to be covered include: innovation activities and outputs, cooperation and linkages, sources of information, technology transfer, innovation barriers, and innovation expenditure. A major focus of the survey is to provide reliable data on the impact innovation has on the productivity and performance of businesses. This will be achieved through linking business innovation data to other sources of productivity and performance data (ABS and non-ABS).

www.abs.gov.au
Several reviews during 2002–03 have also examined aspects of the National Innovation System.

**House of Representatives Inquiry into Business Investment in Research and Development**

The House of Representatives Standing Committee on Science and Innovation undertook an inquiry into business commitment to R&D in Australia. The Committee’s report, *Riding the innovation wave: the case for increasing business investment in R&D*, was tabled in the House of Representatives in June 2003.

The Committee’s inquiry addressed three questions:

- the economic benefit to Australia from a greater private sector investment in R&D
- the impediments to business investment in R&D
- the steps that need to be taken to better demonstrate to business the benefits of higher private sector investment in R&D.

The Committee made 48 recommendations relating to Australian Government R&D programmes and steps the Government could take to better demonstrate to business the benefits of a greater investment in R&D.

In tabling the report, the Committee Chair, Gary Nairn MP, stated that while the broad range of programmes associated with *Backing Australia’s Ability* ‘...appear to be working well’, they should nevertheless be evaluated when appropriate and refined where necessary.

The Government’s response to this report is expected to be tabled in Parliament in late 2003.

The report is available online at the Committee’s web site:


**ICT Framework for the Future**


The report was developed by a Steering Committee. Additional advice was provided by overseas Australian ICT experts and by McKinsey & Company, who undertook a major survey of global industry trends and opportunities, *Australia: winning in the global ICT industry*.


**Focus on the future**

The Government has set new policy precedents by creating the first ever set of national research priorities. Through a nationally coordinated and strategic approach to science and innovation, the Government integrated Australia’s science and research effort even more closely with the community’s economic, social and environmental goals. In December 2002 the Prime Minister announced four National Research Priorities (NRPs): An Environmental Sustainable Australia; Promoting and Maintaining Good Health; Frontier Technologies for Building and Transforming Australian Industries; and Safeguarding Australia.

All research and research funding bodies of the Australian Government are participating in implementing the priorities and the research community will continue to advise the Government on the best way to proceed.
The NRPs are designed to provide a focus for Australian research, building research strengths while seeking new opportunities in emerging areas. They will also strengthen collaboration between research bodies and with industry, and build critical mass of excellence in those key research areas for the next 20 to 30 years and beyond.

In November 2002 the Prime Minister announced that the Government would commence work in the second half of 2003 on policy to apply when Backing Australia’s Ability completes in 2005-06. This work is being carried out by the Science and Innovation Committee of Ministers, chaired by the Prime Minister.

“New knowledge and new ways of doing science enable us to push the boundary of what is possible with our resources and help build solutions to issues in areas such as health, the environment and industrial development.” Prime Minister’s speech to CEDA, November 2002

To inform its consideration of science and innovation initiatives beyond 2005-06, the Government has commenced a detailed programme to assess and evaluate Australia’s research and innovation system. This includes:

- Mapping Australia’s Science and Innovation System, a major exercise to build a comprehensive picture of Australia’s science and innovation effort, and to enable a better understanding of where our research activity is taking place. The mapping will provide the fundamental building blocks for planning future directions in Australia’s science and innovation;
- a Review of Teaching and Teacher Education;
- establishment of a taskforce to develop a national research infrastructure strategy;
- comprehensive evaluation of the 1999 Knowledge and Innovation reforms to ensure that the policy framework for Australia’s university block research funding schemes is effective; and
- establishment of a taskforce to examine scope for closer collaboration between universities and major publicly-funded research agencies.

Taken together, these closely related streams of work are targeted at further strengthening the framework for research and research training in Australia.

This work will be completed in the context of the 2004-05 Budget, and will represent the next step along a continuous path of building our national capacity for innovation.
Appendix

Charts and tables

1. Major flows of funding for R&D in Australia, 2000-01
4. Backing Australia’s Ability Funding Profile
5. Summary of Major Commonwealth Support for Science and Innovation through the Budget and Other Appropriations
7. Cooperative Research Centres, funded 2002-03
8. ARC Key Centres for Teaching and Research, funded 2002-03
9. ARC Centres of Excellence, funded 2002-03
10. ARC Special Research Centres, funded 2002-03
11. ARC Centres, commencing 2003
12. Rural Research & Development Corporations
13. Australian Museum Eureka Prizes
14. Prime Minister’s Science, Engineering and Innovation Council Membership
Table 1: Major flows of funding for R&D in Australia, 2000-01

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<tr>
<th>SECTORS OF R&amp;D PERFORMANCE</th>
<th>SOURCES OF R&amp;D FUNDING</th>
</tr>
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| Commonwealth
$1,425 million |
| State and local government
$804 million |
| Business
$4,791 million |
| Overseas
$336 million |
| Higher education
$2,775 million |
| State/Territory
$944 million |
| Business
$4,917 million |
| Other Australian
$491 million |
| Private non-profit
$283 million |
| Commonwealth
$3,921 million |
| Other Australian
$1,213 million |
| Private non-profit
$88 million |
| Commonwealth
$1,425 million |
| Business
$4,791 million |
| Private non-profit
$160 million |
| Commonwealth
$884 million |
| Private non-profit
$208 million |
| Business
$4,917 million |
| Private non-profit
$169 billion |

Source: ABS, unpublished R&D data provided to Science and Innovation Analysis Section, DEST in August 2003
Table 2: Overview of Australia's domestic R&D, by sectors of performance, 1978-79 to 2000-01

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Source: ABS, unpublished R&D data provided to Science and Innovation Analysis Section, DEST in August 2003.
Table 3: Overview of Australia’s domestic R&D performance, by sources of funding, 1978-79 to 2000-01

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*Chain Volume Measures ($million at 2000-01)*

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Source: ABS, unpublished R&D data provided to Science and Innovation Analysis Section, DEST in August 2003.
Table 4: Backing Australia’s Ability funding profile (as at 29 September 2003)

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<th>2001-02</th>
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<th>2003-04</th>
<th>2004-05</th>
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<td>150.0</td>
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<td>Innovation Access Programme(b)</td>
<td>0.0</td>
<td>15.5</td>
<td>19.5</td>
<td>23.5</td>
<td>26.1</td>
<td>84.8</td>
</tr>
<tr>
<td>COMET</td>
<td>10.0</td>
<td>10.0</td>
<td>10.0</td>
<td>10.0</td>
<td>0.0</td>
<td>40.0</td>
</tr>
<tr>
<td>BIF</td>
<td>4.5</td>
<td>5.5</td>
<td>10.0</td>
<td>0.0</td>
<td>0.0</td>
<td>20.0</td>
</tr>
<tr>
<td>NIDP</td>
<td>3.8</td>
<td>4.0</td>
<td>2.6</td>
<td>3.6</td>
<td>2.4</td>
<td>16.6</td>
</tr>
<tr>
<td>ITOL</td>
<td>1.0</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
<td>13.0</td>
</tr>
<tr>
<td>Pre Seed Fund</td>
<td>3.7</td>
<td>12.6</td>
<td>12.6</td>
<td>12.6</td>
<td>9.6</td>
<td>51.0</td>
</tr>
<tr>
<td>Subtotal</td>
<td>23.0</td>
<td>50.5</td>
<td>112.6</td>
<td>109.6</td>
<td>156.0</td>
<td></td>
</tr>
<tr>
<td>Skills</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science, Maths and Tech in Gov’t schools</td>
<td>32.2</td>
<td>47.5</td>
<td>36.8</td>
<td>38.8</td>
<td>40.8</td>
<td>183.5</td>
</tr>
<tr>
<td>2000 University places</td>
<td>13.9</td>
<td>24.7</td>
<td>33.0</td>
<td>39.5</td>
<td>39.9</td>
<td>151.0</td>
</tr>
<tr>
<td>Online Curriculum Content</td>
<td>4.5</td>
<td>7.2</td>
<td>7.4</td>
<td>7.5</td>
<td>7.7</td>
<td>34.3</td>
</tr>
<tr>
<td>National Innovation Awareness Strategy(b)</td>
<td>4.3</td>
<td>5.3</td>
<td>5.3</td>
<td>5.9</td>
<td>8.5</td>
<td>31.3</td>
</tr>
<tr>
<td>Smart Moves</td>
<td>0.7</td>
<td>1.2</td>
<td>1.2</td>
<td>0.6</td>
<td>0.0</td>
<td>3.7</td>
</tr>
<tr>
<td>Attracting ICT workers</td>
<td>-0.5</td>
<td>-0.7</td>
<td>-0.7</td>
<td>-0.8</td>
<td>-0.8</td>
<td>-3.5</td>
</tr>
<tr>
<td>PELS (c)</td>
<td>0.7</td>
<td>-2.0</td>
<td>-7.7</td>
<td>-11.7</td>
<td>-15.9</td>
<td>-36.6</td>
</tr>
<tr>
<td>Subtotal</td>
<td>55.8</td>
<td>83.2</td>
<td>75.3</td>
<td>79.8</td>
<td>80.2</td>
<td></td>
</tr>
<tr>
<td>Total BAA ($m)</td>
<td>193</td>
<td>431</td>
<td>633</td>
<td>819</td>
<td>997</td>
<td>3,066</td>
</tr>
</tbody>
</table>

(a) Additional funding for the 2006-07 financial year of $275 m, $41 m and $62.5 m were announced in the 2003-04 Budget for the ARC, R&D Start and the CRC programme, respectively, to enable efficient operation of multi-year grants.
(b) This is a composite figure for both DEST and DITR.
(c) In the 2003-04 Budget, PELS was subsumed by a new loan facility FEE-HELP so revised estimates are not available for this programme.
(d) Figures have been revised since the 2003 May budget.
Table 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>Major Federal Research Agencies</th>
<th>post ref</th>
<th>Cash Outlays ($m)*</th>
<th>Accrual Expenses ($m)*</th>
<th>est</th>
<th>actual</th>
<th>budget est</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSTO</td>
<td>1</td>
<td>247.4</td>
<td>267.6</td>
<td>254.9</td>
<td>245.5</td>
<td>249.2</td>
</tr>
<tr>
<td>CSIRO</td>
<td>2</td>
<td>461.6</td>
<td>417.6</td>
<td>444.5</td>
<td>466.8</td>
<td>475.4</td>
</tr>
<tr>
<td>Other R&amp;D Agencies</td>
<td>3</td>
<td>223.8</td>
<td>232.3</td>
<td>275.7</td>
<td>252.3</td>
<td>240.8</td>
</tr>
<tr>
<td>SUB-TOTAL</td>
<td></td>
<td>932.8</td>
<td>917.5</td>
<td>975.1</td>
<td>964.6</td>
<td>965.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Science And Technology Support</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NH&amp;MRC and other health</td>
<td>4</td>
<td>151.8</td>
<td>163.0</td>
<td>166.1</td>
<td>173.6</td>
<td>193.7</td>
</tr>
<tr>
<td>Cooperative Research Centres</td>
<td>5</td>
<td>103.7</td>
<td>132.7</td>
<td>143.1</td>
<td>146.9</td>
<td>142.3</td>
</tr>
<tr>
<td>Rural</td>
<td>6</td>
<td>130.7</td>
<td>126.5</td>
<td>126.0</td>
<td>140.5</td>
<td>150.2</td>
</tr>
<tr>
<td>Energy and environment</td>
<td>7</td>
<td>19.1</td>
<td>19.6</td>
<td>11.4</td>
<td>25.2</td>
<td>8.9</td>
</tr>
<tr>
<td>Other science support</td>
<td>8</td>
<td>7.7</td>
<td>14.3</td>
<td>24.7</td>
<td>28.7</td>
<td>12.1</td>
</tr>
<tr>
<td>SUB-TOTAL</td>
<td></td>
<td>413.0</td>
<td>456.1</td>
<td>471.3</td>
<td>514.9</td>
<td>507.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Innovation Support</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>R&amp;D tax concession*</td>
<td>9</td>
<td>698</td>
<td>825</td>
<td>525</td>
<td>420</td>
<td>370</td>
</tr>
<tr>
<td>R&amp;D Start</td>
<td>10</td>
<td>45.6</td>
<td>50.4</td>
<td>62.4</td>
<td>102.7</td>
<td>130.7</td>
</tr>
<tr>
<td>Other innovation support</td>
<td>11</td>
<td>87.7</td>
<td>79.0</td>
<td>65.4</td>
<td>37.7</td>
<td>97.1</td>
</tr>
<tr>
<td>SUB-TOTAL</td>
<td></td>
<td>831</td>
<td>954</td>
<td>653</td>
<td>560</td>
<td>598</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Higher Education Research</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ARC</td>
<td>12</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Other R&amp;D support</td>
<td>13</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>R&amp;D support under former</td>
<td>14</td>
<td>1377</td>
<td>1502</td>
<td>1611</td>
<td>1675</td>
<td>1737</td>
</tr>
<tr>
<td>funding framework</td>
<td></td>
<td>1381</td>
<td>1505</td>
<td>1613</td>
<td>1678</td>
<td>1740</td>
</tr>
<tr>
<td>SUB-TOTAL</td>
<td></td>
<td>1358</td>
<td>1533</td>
<td>1571</td>
<td>1688</td>
<td>1754</td>
</tr>
<tr>
<td>TOTAL COMMONWEALTH SUPPORT</td>
<td></td>
<td>3558</td>
<td>3833</td>
<td>3712</td>
<td>3718</td>
<td>3810</td>
</tr>
<tr>
<td>% GDP</td>
<td></td>
<td>0.75</td>
<td>0.76</td>
<td>0.70</td>
<td>0.66</td>
<td>0.64</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) The Defence Decision Support Project is currently re-configuring their budget attribution methodology which is likely to present a different figure. For example $298 million as an indicative budget figure in the earlier DSTO text.
(c) The financial data of the research agencies exclude the Capital Use Charge which was included in previous years. To facilitate comparability with the information from earlier publications, the total CUC applicable for each of the relevant financial years are provided in the table below:

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Capital Use Charge ($m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999-00</td>
<td>169.4</td>
</tr>
<tr>
<td>2000-01</td>
<td>186.9</td>
</tr>
<tr>
<td>2001-02</td>
<td>184.0</td>
</tr>
<tr>
<td>2002-03</td>
<td>211.6</td>
</tr>
</tbody>
</table>
(d) This includes $5 million to support the formal affiliation of the Australian Institute of Marine Science with James Cook University.
(e) 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 2002 and will require revision as new taxation data become available.
(f) 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-totals shown are comparable throughout the series.
Table 6: R&D by States/Territories and Sectors of Performance, 2000-01(a)

<table>
<thead>
<tr>
<th>Location</th>
<th>Business Sector (BERD)(b)</th>
<th>Commonwealth Gov. Sector</th>
<th>State/Territory Gov. Sector</th>
<th>Higher Education Sector(c)</th>
<th>Private Non-Profit Sector(d)</th>
<th>Total R&amp;D Expenditure in States/Territories</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$'000</td>
<td>per capita</td>
<td>$ (%)</td>
<td>$'000</td>
<td>per capita</td>
<td>$ (%)</td>
</tr>
<tr>
<td>NSW</td>
<td>1,698,666</td>
<td>258.69</td>
<td>0.72%</td>
<td>246,129</td>
<td>37.48</td>
<td>0.10%</td>
</tr>
<tr>
<td>Vic.</td>
<td>1,685,859</td>
<td>351.82</td>
<td>0.99%</td>
<td>345,430</td>
<td>72.09</td>
<td>0.20%</td>
</tr>
<tr>
<td>Qld.</td>
<td>512,073</td>
<td>142.13</td>
<td>0.47%</td>
<td>119,555</td>
<td>33.18</td>
<td>0.11%</td>
</tr>
<tr>
<td>SA</td>
<td>294,735</td>
<td>195.07</td>
<td>0.67%</td>
<td>192,124</td>
<td>127.16</td>
<td>0.44%</td>
</tr>
<tr>
<td>WA</td>
<td>472,807</td>
<td>249.70</td>
<td>0.65%</td>
<td>74,210</td>
<td>39.19</td>
<td>0.10%</td>
</tr>
<tr>
<td>Tas.</td>
<td>48,850</td>
<td>103.40</td>
<td>0.42%</td>
<td>91,813</td>
<td>154.35</td>
<td>0.79%</td>
</tr>
<tr>
<td>NT</td>
<td>14,871</td>
<td>74.86</td>
<td>0.17%</td>
<td>16,861</td>
<td>84.88</td>
<td>0.20%</td>
</tr>
<tr>
<td>ACT &amp; Ext Territories</td>
<td>34,478</td>
<td>107.08</td>
<td>0.26%</td>
<td>333,592</td>
<td>1,036.10</td>
<td>2.49%</td>
</tr>
<tr>
<td>TOTAL(e)</td>
<td>4,762,339</td>
<td>246.01</td>
<td>0.71%</td>
<td>1,419,714</td>
<td>73.34</td>
<td>0.21%</td>
</tr>
<tr>
<td>Overseas</td>
<td>62,965</td>
<td>-</td>
<td>5,080</td>
<td>-</td>
<td>2,864</td>
<td>-</td>
</tr>
</tbody>
</table>

(a) The R&D data in this Table are unpublished ABS data as at September 2002, which update and revise the published data in Table 4 of Research and Experimental Development: All Sector Summary – Australia (ABS Cat. No. 8112.0). In each of the five main groupings, the 1st column indicates the expenditure (in current prices) on R&D within that particular sector. The 2nd column provides a per capita amount for the State/Territory in relation to the sector, with the 3rd column providing a percentage of the gross State (Territory) product (GSP) for that State/Territory. Source: Unpublished ABS Survey of Research and Development (as at September 2002). The population figures for calculating the 2nd column in each grouping are taken from Australian Demographic Statistics (ABS Cat. No. 3101.0), with the gross product figures for the States/Territories in the 3rd column being sourced from Australian National Accounts – State Accounts (ABS Cat. No. 5202.0).

(b) The figures indicated for the Business Sector, Government Sector, and Private Non-Profit Sector are for the financial year 2000-01, with the population figures (in the 2nd column) for the respective States/Territories being the averages of the year and the GSP figures (in the 3rd column) being as at June 2001.

(c) The figures indicated for the Higher Education sector are for the calendar year 2000, with the population figures (in the 2nd column) for the respective States/Territories being the averages of the year and the GSP figures (in the 3rd column) being as at June 2001.

(d) Note that the total figure of $280.240 million for the private non-profit sector in this Table is some $2.98 million short of the amount of $283.2 million, which is published by the ABS in Table 4 of Research and Experimental Development: All Sector Summary – Australia (ABS Cat. No. 8112.0 – July 2002).

(e) In each of the five main groupings, the figure at total of the 3rd column, representing the total expenditure within the states and territories as a percentage of GDP, is calculated by the figure at total of the 1st column divided by the GDP as at June 2001.
Table 7: Cooperative Research Centres, funded 2002-03

<table>
<thead>
<tr>
<th>Centre Name</th>
<th>Field of Research</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aboriginal &amp; Tropical Health</td>
<td>Hydrometallurgy</td>
<td><a href="http://www.ath.crc.org.au">http://www.ath.crc.org.au</a></td>
</tr>
<tr>
<td>Antarctica &amp; the Southern Ocean</td>
<td>Innovative Wood Manufacture</td>
<td><a href="http://www.antcrc.utas.edu.au">http://www.antcrc.utas.edu.au</a></td>
</tr>
<tr>
<td>Asthma</td>
<td>Intelligent Manufacturing Systems &amp; Technologies</td>
<td><a href="http://www.asthma.utas.edu.au">http://www.asthma.utas.edu.au</a></td>
</tr>
<tr>
<td>Australian Cotton</td>
<td>Landscape Environments &amp; Mineral Exploration</td>
<td><a href="http://www.cotton.crc.org.au">http://www.cotton.crc.org.au</a></td>
</tr>
<tr>
<td>Australian Photonics</td>
<td>Mining Technology and Equipment</td>
<td><a href="http://www.photonics.com.au">http://www.photonics.com.au</a></td>
</tr>
<tr>
<td>Australian Sheep Industry</td>
<td>Molecular Plant Breeding</td>
<td><a href="http://www.sheep.crc.org.au">http://www.sheep.crc.org.au</a></td>
</tr>
<tr>
<td>Australian Telecommunications</td>
<td>Plant-based Management of Dryland Salinity</td>
<td><a href="http://www.crcsalinity.com">http://www.crcsalinity.com</a></td>
</tr>
<tr>
<td>Australian Weed Management</td>
<td>Polymers</td>
<td><a href="http://www.weeds.crc.org.au">http://www.weeds.crc.org.au</a></td>
</tr>
<tr>
<td>Biological Control of Pest Animals</td>
<td>Predictive Mineral Discovery</td>
<td><a href="http://www.pmdcrc.com.au">http://www.pmdcrc.com.au</a></td>
</tr>
<tr>
<td>Bioproducts</td>
<td>Railway Engineering and Technologies</td>
<td><a href="http://www.bioproducts.org.au">http://www.bioproducts.org.au</a></td>
</tr>
<tr>
<td>Catchment Hydrology</td>
<td>Satellite Systems</td>
<td><a href="http://www.catchment.crc.org.au">http://www.catchment.crc.org.au</a></td>
</tr>
<tr>
<td>Cattle and Beef Quality</td>
<td>Sensor Signal &amp; Information Processing</td>
<td><a href="http://www.beef.crc.org.au">http://www.beef.crc.org.au</a></td>
</tr>
<tr>
<td>Cellular Growth Factors</td>
<td>Smart Internet</td>
<td><a href="http://www.ludwig.edu.au/crc-cgf">http://www.ludwig.edu.au/crc-cgf</a></td>
</tr>
<tr>
<td>Chronic Inflammatory Diseases</td>
<td>Sustainable Aquaculture of Finfish</td>
<td>Not available</td>
</tr>
<tr>
<td>Clean Power from Lignite</td>
<td>Sustainable Production Forestry</td>
<td><a href="http://www.cleanpower.com.au">http://www.cleanpower.com.au</a></td>
</tr>
<tr>
<td>Coal in Sustainable Development</td>
<td>Sustainable Rice Production</td>
<td><a href="http://www.ccsd.biz">http://www.ccsd.biz</a></td>
</tr>
<tr>
<td>Coastal Zone, Waterway and Estuary Management</td>
<td>Sustainable Sugar Production</td>
<td><a href="http://www.coastal.crc.org.au">http://www.coastal.crc.org.au</a></td>
</tr>
<tr>
<td>Construction Innovation</td>
<td>Tropical Plant Protection</td>
<td><a href="http://www.constructor%E5%88%9B%E6%96%B0%E5%8F%91%E5%B1%95.com/">http://www.constructor创新发展.com/</a></td>
</tr>
<tr>
<td>Diagnostics</td>
<td>Tropical Rainforest Ecology</td>
<td><a href="http://www.diagnostics.crc.org/">http://www.diagnostics.crc.org/</a></td>
</tr>
<tr>
<td>Discovery of Genes for Common Human Diseases</td>
<td>Tropical Savannas Management</td>
<td><a href="http://www.gene.crc.org/">http://www.gene.crc.org/</a></td>
</tr>
<tr>
<td>Enterprise Distributed Systems</td>
<td>Vaccine Technology</td>
<td><a href="http://www.enterprise.canberra.edu.au">http://www.enterprise.canberra.edu.au</a></td>
</tr>
<tr>
<td>Eye Research and Technology</td>
<td>Value Added Wheat</td>
<td><a href="http://www.crcert.org/">http://www.crcert.org/</a></td>
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<tr>
<td>Freshwater Ecology</td>
<td>Vitisulture</td>
<td><a href="http://www.enterprise.canberra.edu.au">http://www.enterprise.canberra.edu.au</a></td>
</tr>
<tr>
<td>Functional Communication Surfaces</td>
<td>Waste Management &amp; Pollution Control</td>
<td><a href="http://www.crc-fcs.com">http://www.crc-fcs.com</a></td>
</tr>
<tr>
<td>Great Barrier Reef World Heritage Area</td>
<td>Water Quality &amp; Treatment</td>
<td><a href="http://www.greatbarrierreef.org">http://www.greatbarrierreef.org</a></td>
</tr>
<tr>
<td>Greenhouse Accounting</td>
<td>Welded Structures</td>
<td><a href="http://www.greenhouse.crc.org.au">http://www.greenhouse.crc.org.au</a></td>
</tr>
</tbody>
</table>

Not available

Closed 30 June 2003
Table 8: ARC Key Centres for Teaching & Research, funded 2002-03

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Polymer Colloids</td>
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</tr>
<tr>
<td>Photovoltaics Engineering*</td>
<td><a href="http://www.pv.unsw.edu.au/">http://www.pv.unsw.edu.au/</a></td>
</tr>
<tr>
<td>Smart Foods</td>
<td><a href="http://www.uow.edu.au/research/centres/smartfoods/">http://www.uow.edu.au/research/centres/smartfoods/</a></td>
</tr>
<tr>
<td>Asia Pacific Social Transformation Studies</td>
<td><a href="http://www.captrans.edu.au/">http://www.captrans.edu.au/</a></td>
</tr>
<tr>
<td>Law, Ethics, Justice and Governance</td>
<td><a href="http://www.gu.edu.au/centre/kceljag/">http://www.gu.edu.au/centre/kceljag/</a></td>
</tr>
</tbody>
</table>

*As a condition of the commencement of ARC Centres of Excellence and ARC Centres, these centre grants were relinquished in 2003.

Table 9: ARC Centres of Excellence, funded 2002-03

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantum Computer Technology</td>
<td><a href="http://www.qcaustralia.org/">http://www.qcaustralia.org/</a></td>
</tr>
<tr>
<td>Advanced Silicon Photovoltaics and Photonics</td>
<td><a href="http://www.pv.unsw.edu.au">http://www.pv.unsw.edu.au</a></td>
</tr>
<tr>
<td>Integrative Legume Research</td>
<td><a href="http://cigr.rsbs.anu.edu.au/">http://cigr.rsbs.anu.edu.au/</a></td>
</tr>
<tr>
<td>Quantum-Atom Optics</td>
<td><a href="http://www.acqao.org/">http://www.acqao.org/</a></td>
</tr>
</tbody>
</table>

Table 10: ARC Special Research Centres, funded 2002-03

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Stress and Adaptation Research</td>
<td><a href="http://www.latrobe.edu.au/cesar/">http://www.latrobe.edu.au/cesar/</a></td>
</tr>
<tr>
<td>Particulate Fluids Processing</td>
<td><a href="http://www.pfpc.unimelb.edu.au/mainn.htm">http://www.pfpc.unimelb.edu.au/mainn.htm</a></td>
</tr>
<tr>
<td>Molecular Genetics of Development</td>
<td><a href="http://www.cmgd.adelaide.edu.au/">http://www.cmgd.adelaide.edu.au/</a></td>
</tr>
<tr>
<td>Particle and Material Interfaces</td>
<td><a href="http://www.iwri.unisa.edu.au/overview.htm">http://www.iwri.unisa.edu.au/overview.htm</a></td>
</tr>
<tr>
<td>Tectonics</td>
<td><a href="http://www.tsric.uwa.edu.au/">http://www.tsric.uwa.edu.au/</a></td>
</tr>
<tr>
<td>Ore Deposit Research</td>
<td><a href="http://www.codes.utas.edu.au/">http://www.codes.utas.edu.au/</a></td>
</tr>
<tr>
<td>Cross Cultural Research</td>
<td><a href="http://www.anu.edu.au/culture/">http://www.anu.edu.au/culture/</a></td>
</tr>
</tbody>
</table>

*As a condition of the commencement of ARC Centres of Excellence and ARC Centres, these centre grants were relinquished in 2003.
### Table 11: ARC Centres (commenced in 2003)

<table>
<thead>
<tr>
<th>Centre</th>
<th>Administering Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complex Dynamic Systems and Control</td>
<td>The University of Newcastle</td>
</tr>
<tr>
<td>Functional Nanomaterials</td>
<td>The University of Queensland</td>
</tr>
<tr>
<td>Nanostructured Electromaterials</td>
<td>University of Wollongong</td>
</tr>
<tr>
<td>Perceptive and Intelligent Machines</td>
<td>Monash University</td>
</tr>
<tr>
<td>Structural and Functional Microbial Genomics</td>
<td>Monash University</td>
</tr>
<tr>
<td>Complex Systems</td>
<td>The University of Queensland</td>
</tr>
<tr>
<td>Genome-Phenome Bioinformatics</td>
<td>The University of Queensland</td>
</tr>
<tr>
<td>Kangaroo Genome</td>
<td>The Australian National University</td>
</tr>
<tr>
<td>Solar Energy Systems</td>
<td>The Australian National University</td>
</tr>
</tbody>
</table>

### Table 12: Rural Research & Development Corporations

<table>
<thead>
<tr>
<th>Corporation</th>
<th>Web address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statutory Authorities:</td>
<td></td>
</tr>
<tr>
<td>Cotton RDC</td>
<td><a href="http://www.crdc.com.au">www.crdc.com.au</a></td>
</tr>
<tr>
<td>Dairy RDC*</td>
<td><a href="http://www.dairyaustralia.com.au">www.dairyaustralia.com.au</a></td>
</tr>
<tr>
<td>Fisheries RDC</td>
<td><a href="http://www.frdc.com.au">www.frdc.com.au</a></td>
</tr>
<tr>
<td>Forest &amp; Wood Products RDC</td>
<td><a href="http://www.fwprdc.org.au">www.fwprdc.org.au</a></td>
</tr>
<tr>
<td>Grains RDC</td>
<td><a href="http://www.grdc.com.au">www.grdc.com.au</a></td>
</tr>
<tr>
<td>Grape &amp; Wine RDC</td>
<td><a href="http://www.gwrdc.com.au">www.gwrdc.com.au</a></td>
</tr>
<tr>
<td>Land &amp; Water Australia</td>
<td><a href="http://www.lwa.gov.au">www.lwa.gov.au</a></td>
</tr>
<tr>
<td>Rural Industries RDC</td>
<td><a href="http://www.rirdc.gov.au">www.rirdc.gov.au</a></td>
</tr>
<tr>
<td>Sugar RDC</td>
<td><a href="http://www.srdc.gov.au">www.srdc.gov.au</a></td>
</tr>
<tr>
<td>Private companies:</td>
<td></td>
</tr>
<tr>
<td>Australian Egg Corporation</td>
<td><a href="http://www.aecl.org">www.aecl.org</a></td>
</tr>
<tr>
<td>Australian Pork Limited</td>
<td><a href="http://www.apl.au.com">www.apl.au.com</a></td>
</tr>
<tr>
<td>Australian Wool Innovation</td>
<td><a href="http://www.wool.com.au">www.wool.com.au</a></td>
</tr>
<tr>
<td>Horticulture Australia Ltd</td>
<td><a href="http://www.horticulture.com.au">www.horticulture.com.au</a></td>
</tr>
<tr>
<td>Meat &amp; Livestock Australia</td>
<td><a href="http://www.mla.com.au">www.mla.com.au</a></td>
</tr>
</tbody>
</table>

*From 1 July 2003 the Dairy RDC and the Australian Dairy Corporation merged to form the industry-owned company Dairy Australia Ltd.*
Table 13: Australian Museum Eureka Prizes

The Eureka Prizes are valued at $10,000 each, with Macquarie University and University of Sydney sponsored prizes valued at $11,000 each.

<table>
<thead>
<tr>
<th>Prize</th>
<th>2003 Winners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry and Innovation</td>
<td></td>
</tr>
<tr>
<td>Australian Museum Eureka Prize for Industry</td>
<td>Wireless Monitors Australia</td>
</tr>
<tr>
<td>Australian Computer Society Eureka Prize for ICT Innovation</td>
<td>Soundbyte.org</td>
</tr>
<tr>
<td>Engineers Australia Eureka Prize for Engineering Innovation</td>
<td>John Dobozy</td>
</tr>
<tr>
<td>Research</td>
<td></td>
</tr>
<tr>
<td>Australian Catholic University Eureka Prize for Research in Ethics</td>
<td>Craig Fry</td>
</tr>
<tr>
<td>Australian Skeptics Eureka Prize For Critical Thinking</td>
<td>Brendan McKay</td>
</tr>
<tr>
<td>British Council Eureka Prize for Inspiring Science</td>
<td>$10,000</td>
</tr>
<tr>
<td>GRDC Eureka Prize for Research to Improve the Environmental Sustainability of Graingrowing</td>
<td>CSIRO &amp; University of Western Australia</td>
</tr>
<tr>
<td>Royal Botanic Gardens Sydney Eureka Prize for Biodiversity Research</td>
<td>Birds Australia</td>
</tr>
<tr>
<td>Royal Societies of Australia Eureka Prize for Interdisciplinary Scientific Research</td>
<td>Brain Dynamics Team</td>
</tr>
<tr>
<td>Sherman Eureka Prize for Environmental Research</td>
<td>CSIRO’s Climate Impact Group</td>
</tr>
<tr>
<td>University of New South Wales Eureka Prize for Scientific Research</td>
<td>Professor Levon Kachigian</td>
</tr>
<tr>
<td>Science Communication</td>
<td></td>
</tr>
<tr>
<td>Education, Science and Training Eureka Prize for the Promotion of Science</td>
<td>Dr Cathy Foley</td>
</tr>
<tr>
<td>Education, Science and Training Michael Daley Eureka Prize for Science Journalism</td>
<td>Sonya Pemberton</td>
</tr>
<tr>
<td>Environment Australia Peter Hunt Eureka Prize for Environmental Journalism</td>
<td>Nick Grimm</td>
</tr>
<tr>
<td>Engineers Australia Eureka Prize for Engineering Journalism</td>
<td>Andrew Holland</td>
</tr>
<tr>
<td>Pfizer Eureka Prize for Health and Medical Research Journalism</td>
<td>Daniel Williams</td>
</tr>
<tr>
<td>Reed New Holland Eureka Science Book Prize</td>
<td>The Waterbug Book by John Gooderham and Edward Tsyrlin</td>
</tr>
<tr>
<td>Schools</td>
<td></td>
</tr>
<tr>
<td>Adam Spencer/University of Sydney Eureka Schools Prize for Lateral Thinking</td>
<td>Year 11 Team, Baulkham Hills, NSW High School</td>
</tr>
<tr>
<td>EPA Allen Strom Eureka Prize for Environmental Education Program</td>
<td>EcoRecycle Victoria and Gould League</td>
</tr>
<tr>
<td>Macquarie University Eureka Schools Prize for Earth, Environmental and Planetary Sciences</td>
<td>Year 9 Student, Ryan Bose, Gold Coast</td>
</tr>
<tr>
<td>University of Sydney Faculty of Science Eureka Schools Prize for Biological Sciences</td>
<td>Year 10 Team, Shenton College, WA</td>
</tr>
</tbody>
</table>
Table 14: Prime Minister’s Science, Engineering and Innovation Council Membership

- The Prime Minister, the Hon John Howard MP (Chair)
- The Deputy PM and Minister for Transport and Regional Services, the Hon John Anderson MP (Deputy Chair)
- The Minister for Education, Science and Training, the Hon Dr Brendan Nelson MP
- The Minister for Science, the Hon Peter McGauran MP
- The Treasurer, the Hon Peter Costello MP
- The Minister for Communications, Information Technology and the Arts, the Hon Daryl Williams AM QC MP
- The Minister for the Environment and Heritage, the Hon Dr David Kemp MP
- The Minister for Agriculture, Fisheries and Forestry, the Hon Warren Truss MP
- The Minister for Health and Ageing, the Hon Tony Abbott MP
- The Minister for Industry, Tourism and Resources, the Hon Ian Macfarlane MP

Ex-officio members

- The Chief Scientist, Dr Robin Batterham
- The President of the Australian Academy of Science, Dr Jim Peacock AC
- The President of the Australian Academy of Technological Sciences and Engineering, Dr John Zillman AO
- The President of the Australian Vice-Chancellors’ Committee, Professor Deryck Schreuder
- The President of the Federation of Australian Scientific and Technological Societies, Professor Snow Barlow
- The Chief Executive of CSIRO, Dr Geoff Garrett
- The Chair of the Australian Research Council, Mr MA (Tim) Besley AC
- The Chairman of the National Health and Medical Research Council, Professor John Shine AO
- The Business Council of Australia, represented by Mr Hutch Ranck
- The President of the Australian Chamber of Commerce and Industry, Mr David Gray
- The President of The Institution of Engineers, Australia, Dr Martin Cole
- The Chair of the Industry R&D Board, Mr David Miles
- The 2003 Prime Minister’s Prize for Science winner: Professor Jacques Miller AC
- Chief Defence Scientist, Defence Science and Technology Organisation, Dr Roger Lough

Members appointed in a personal capacity

- Professor Fiona Stanley AC, Director, TVW Telethon Institute for Child Health Research
- Professor Peter Hoj, Director, Australian Wine Research Institute
- Dr Deborah Rathjen, CEO and Managing Director, Bionomics Limited
- Dr Leanna Read, Managing Director, TGR Biosciences Ltd
- Professor Peter Dawkins, Director, Melbourne Institute of Applied Economic and Social Research, University of Melbourne