FEDERATION OF AUSTRALIAN SCIENTIFIC AND TECHNOLOGICAL SOCIETIES

Science and Technology for the Social, Environmental and Economic Benefit of Australia

Australian Science:

an Investment

for the 21st Century

2000 edition

Contents

Statement of Principles

1. **Investment in science and technology is the key to quality of life and a healthy economy.**

2. **Education and training in science and mathematics underpins a knowledge-based, high-wage economy.**

3. **Australia must nurture, attract, and retain an internationally competitive workforce.**

4. **Support of the nation's science and technology infrastructure — universities, CSIRO, research institutions — is a public responsibility.**

5. **The nation has a particular responsibility to support long-term basic research, which stimulates innovation.**

6. **Industry and government have a joint interest in investing in applied research and development.**

7. **A coordinated science policy is essential for stability of funding, long-term planning and whole-of-government implementation.**

Australian Science: An Investment for the 21st Century

Not so long ago, the idea that scientific knowledge drives the global economy was dismissed in political circles as left-leaning ideology or as special pleading for funds by naive scientists. But recently, the idea that social and economic well-being is critically dependent on knowledge and its application has gained credence world-wide.

For Australia to participate fully in the knowledge-based economy, our science policy needs urgent attention. Developed countries with comparatively scarce natural resources, such as Sweden and Switzerland, have long relied on innovation for competitive advantage and will make the transition to the 21st century with ease. For Australia, with an historic dependence on natural resources and, until recently, a poor record in commercialising research, the transition may be more difficult.

FASTS represents some 50,000 working scientists and this document presents their ideas on policies that would boost the Research and Development capacity of the nation and catapult us into the next century.

The document calls for a national vision of science and technology. This does not mean that government should attempt to pick winners, although it may need to compensate for market weaknesses in certain sectors from time to time. Rather, government should recognise that spending on basic research and research training is a long-term investment in the nation's future prosperity and should therefore set reasonably high targets for that investment.

In the international arena, Australian scientists punch far above their weight. By almost any criterion, be it research output, Nobel Prizes, or invitations to prestigious meetings, Australian scientists do it well. This highly skilled pool of scientists and technologists is a precious national resource, an intangible asset of great strategic value if properly nurtured. But the scientific effort, held together by a shoestring and good old Aussie enterprise, is starting to unravel.

At the very time when our trading partners are sharply increasing investment in R&D, the government here is cutting funds for universities and for many public research agencies, so our talented young people are heading overseas.

Government must be deeply concerned that business expenditure on R&D is collapsing, so it may yet implement the structural reforms necessary to stimulate private investment in R&D. I am confident that once these taxation and legislative reforms are in place, we will see just how enterprising our scientists and technologists can be in commercialising their research. Let's first monitor the effects of these structural reforms, which should stimulate innovation, before changing the funding allocations to universities in a way that over-rewards those with the ability to attract industry funds and consultancy money.

Australia is truly at the crossroads of economic destiny. One important step into the knowledge-based economy is the government's commitment to double the funds of the National Health and Medical Research Council over the next six years. FASTS applauds this initiative. Another step would be to restore stability to the higher education sector through realistic annual indexation of university funding to help meet negotiated salary increases and rising research infrastructure costs.

This policy document suggests the many steps that must be taken, not only by government but also by the community, by industry, by educators and by scientists themselves, to achieve the long-term social and economic well-being of the nation. The suggestions are unashamedly driven by the conviction that generating and harnessing scientific knowledge is at least as important as are natural resources and capital in determining Australia's current and future prosperity.

Sue Serjeantson PhD
President, FASTS
November 1999

1 A National Science and Technology Vision

Australia's science and technology sector has the potential to bring major social, economic and environmental benefits to all Australians:

> *"Over the last sixty years science and technology have increased our material well-being to an extent that is unequalled in any other period in history. ...It is widely recognised that the development, acquisition and application of knowledge is now vital to the functioning of our society and economy. [Developments arising from science and technology] will continue to be important, perhaps even more so than in the past. They have the potential to further transform our lives and the nation's economy.[1]"*

This role must be recognised and appropriately supported by government, business and the community. But first Australia needs to develop a national vision for its future development.

POLICY 1.1
Australia needs a national vision and an implementation strategy that will reap the benefits of the country's science and technology.

Strategy 1.1.1
Government should engage in a wide community consultative process e.g. through a multilateral summit, to determine a national vision.

Once a national vision is established, this can be used to define national priorities across many sectors. FASTS considers that scientific and technological activity should support the national priorities. Science and technology should be the cornerstone of a knowledge-based, high-wage path towards achieving our national objectives, and the required investment in this sector would be clearly defined as a result of the national vision.

Government has a special role in this process. Because it dominates the funding of many research and education sectors, it is able both to mediate and to implement national priorities. However, the Commonwealth agencies alone cannot set national priorities because so many national resources (e.g. land, vegetation, water) have a component of State and Territory ownership. National priorities should be set by an interactive political process between the Commonwealth, States, and Territories (e.g. through COAG — the Council of Australian Governments), and should be informed by scientific input.

POLICY 1.2
FASTS advocates a knowledge-based, high-wage path towards achieving our national objectives.

Strategy for FASTS 1.2.1
FASTS will promote investment in science and technology as the key to national wealth creation.

Strategy for FASTS 1.2.2
FASTS will contribute scientific and technological input to the debate on national priorities.

The setting of priorities for scientific research within a national priorities framework means that there will be areas of Australian science and technology that are singled out for special support. There is a case for establishing very broad research priorities which reflect Australia's competitive advantage or unique geo-scientific position, or that might address deficiencies in Australia's scientific and technological framework. Mechanisms such as creating economic incentives to attract high technology industries, introducing new money for high priority projects, or establishing sector-specific organisations (such as AIMS and AGSO) in areas of strategic national interest can be used to augment the fundamental scientific base.

POLICY 1.3
Government should invest strategically in areas of national priority to exploit strengths or remedy deficiencies in Australia's scientific and technological base.

Strategy for FASTS 1.3.1
FASTS' member societies will advise government on broad discipline-based and interdisciplinary priorities that relate to national goals.

1 *Future Needs 2010*, ASTEC, 1994.

2 Coordination of Science and Technology

Australia should adopt a "whole-of-government" approach to coordinate the national science and technology research effort. Science and technology issues have as broad a national significance as economic issues, and are central to most portfolios. Science and technology are fundamental to ministries with responsibility for industry, health, communications, defence, mining, agriculture, the environment, employment and education.

POLICY 2.1
There should be a whole-of-government approach to national science and technology planning.

Strategy 2.1.1
Integrate science policy and planning across State and Federal jurisdictions.

The central importance of science and technology is reflected in the many publicly supported research organisations and funding agencies. This diversity of funding mechanisms does not imply inefficiency. A plurality of funding mechanisms can mean greater flexibility, both for the fund provider and for the research organisation.

The ability of different government bodies to support science and technology in areas of relevance to them is a feature of a mature marketplace. A diversity of organisational missions and time frames ensures that capabilities ranging from short-term, commercial, applied science and technology to long-term, public good, basic research can be nurtured by government. It is less likely that gaps will occur under such a pluralistic system than under a single, centralised funding authority.

However, there is a need to ensure that science and technology contributes to each of these sectors in a coordinated fashion.

POLICY 2.2
It is important for government to support diverse — yet well coordinated — contributions to the national science and technology effort.

Strategy for FASTS 2.2.1
FASTS will continue to monitor and advise government on the effectiveness of our research funding system.

FASTS believes that the decision-making process should combine priority setting by government with direct input from major players in the scientific community. As the peak body on science and technology issues chaired by the Prime Minister, PMSEIC plays an important advisory role and provides a unique interface between science and government. FASTS commends the Prime Minister's ongoing support of PMSEIC.

POLICY 2.3
FASTS supports PMSEIC as the key body to address Australia's science and technology policy.

Strategy for FASTS 2.3.1
As a member of PMSEIC, FASTS will harness the expertise of 50,000 scientists to contribute to the discussion of science and technology issues.

It is important for Australia to nurture a capacity both within and outside government to analyse science policy and education issues. There is a concern that recent Public Service reductions have inhibited the capacity of the bureaucracy to provide in-depth advice on scientific and technological issues. Independent external analytical capacity can be found in the university sector. However, any outsourcing of expert advice for government should be an open process which encourages a diversity of inputs, and should be subject to quality assessment.

POLICY 2.4
Government should provide sufficient resources, both within and outside the bureaucracy, to enable it to obtain high quality, independent scientific advice.

Strategy for FASTS 2.4.1
FASTS will assist government in obtaining high level scientific advice from a range of sources, including its member societies.

FASTS sees a continuing central role for the Chief Scientist who, with cross-portfolio knowledge and a neutral stance, can advise the Government, its agencies and funding bodies. The position of the Chief Scientist should be full-time. Not only is the scope of the responsibilities of the Chief Scientist immense, but having a full-time Chief Scientist sends a clear message of the importance

that government places on this role. FASTS believes the position should be restored to the Department of Prime Minister and Cabinet to facilitate a whole-of-government approach.

POLICY 2.5
FASTS strongly supports the continuation of the office of Chief Scientist.

Strategy for FASTS 2.5.1
FASTS will press for a full-time role for the Chief Scientist within the Department of Prime Minister and Cabinet.

Large, complex and highly sophisticated laboratory facilities are an essential component of advanced science, as are museums, major collections and information bases. The need for major facilities is infrequent, sector priorities are sometimes difficult to predict, and international collaborations can arise outside the national planning process. Further, a balance must be struck between the cost effectiveness of small and large scale activity, particularly when networking of small laboratories can be an effective way of utilising resources. FASTS therefore recommends that funding of major national facilities becomes a permanent Federal budget item which can be rolled over from year to year. This will allow Australia flexibility to support initiatives of a world class and visionary nature.

Major national facilities often cross portfolio boundaries, and government should establish a process to assess submissions against national priorities. The responsibility for this could reside with the Chief Scientist.

POLICY 2.6
Major national science and technology facilities must be recognised and supported as tools for collaborative research.

Strategy for FASTS 2.6.1
FASTS will assist its member societies to coordinate applications to government for establishment of major national facilities.

3 Investing in Basic Research

Basic research is crucial to economic performance because it is the source of a nation's ideas. It provides a nucleus of innovators able to create new products and services, exploit new developments, and solve new challenges.

A study prepared for the US National Science Foundation found that 73% of scientific articles cited in patent applications in the US are based on research funded by American governments or foundations[2]. This emphasises the reliance of industry on public funding which provides the bulk of support for basic research. Without basic research, a country is forced to import costly new technologies and products.

Australia has a proud record of achievement in basic research and has in the past contributed strongly to the world scientific knowledge base in many areas of basic, strategic and 'public good' research. In 1997, Australia was ranked 4th out of 16 OECD countries in terms of percentage of GDP spent on basic research — just ahead of the United States, Korea and Japan.

FIGURE 1: Basic research as a percentage of GDP, 1997 or latest available year.[3]

2 *The Increasing Linkage Between US Technology and Public Science*, Francis Narin, CHI Research, 1997.

3 *The Knowledge-Based Economy*, OECD,1999.

Since then, the USA, Korea, Japan, France, Germany, UK and Canada have significantly increased public investment in basic research[4], recognising that it is essential for their economic development.

However in Australia, university infrastructure continues to erode, government support in real terms for basic research is in decline, and Australia's role as a major world contributor to basic research is under threat. Australia needs to increase its public funding of basic research if it is not to fall further behind our international competitors — we must compete through being innovative.

POLICY 3.1
Support for basic research at a world-class level should be provided as a public responsibility.

Strategy 3.1.1
Increase government funding for basic research to internationally competitive levels.

Funding basic research should be one component of a national approach which also allows funding for priority areas. However, overly restrictive planning has the potential to stifle the prospects for truly significant advances, as well as reducing the nation's flexibility to respond to sudden developments or crises.

There are many examples of the difficulty of predicting winners in specific fields of basic research. If, in the early 1960s, Australia had invested only in research supporting the agricultural, industrial or resources interests of the time, we would never have had today's world class laser technology or optical communications industries.

Ongoing research across a spectrum of disciplines also earns us a 'seat at the table' as new challenges emerge. Australia was well placed to contribute to important studies on the HIV/AIDS epidemic thanks to its investment in high quality basic medical research. A range of state-of-the-art basic research thus allows us to tap into promising areas for the future.

4 *The Case for Additional Investment in Basic Research in Australia*, BHERT Policy Statement, April 1999.

A balance has to be struck between market-driven and basic research. The concept that science and technology should be harnessed for immediate national goals must not diminish support for free-ranging scientific research that can uncover new realms of technology.

POLICY 3.2
Australia must maintain research across a range of disciplines, and strike a suitable balance between basic and applied research.

Strategy for FASTS 3.2.1
Through its member societies, FASTS will monitor the representation of basic research disciplines and encourage investment in them by promoting their benefits.

Investment in the people who conduct research is as important as investing in the infrastructure that supports it. Significant problems are being experienced in attracting and retaining our best researchers because research funding and salaries are low and career paths uncertain. Nobel Prize winner Professor Peter Doherty has said he will continue to work in the US because of these difficulties. Astrophysicist and Young Australian of the Year Dr Brian Gaensler is also moving to the US because of a lack of opportunities in Australia. The Government needs to help attract and retain both present and future generations of researchers.

POLICY 3.3
Australian researchers must be attracted and rewarded appropriately in keeping with their key role in national wealth creation.

Strategy 3.3.1
Increase researchers salaries and research funding to internationally competitive levels.

Strategy for FASTS 3.3.2
FASTS will recommend methods for improving the career opportunities for outstanding young researchers — e.g. by increasing the number of ARC fellowships.

CSIRO and other government agencies provide the most efficient means of addressing a range of strategic national opportunities and needs. Consistent support for such publicly funded research is essential. FASTS will oppose unrealistic targets for external funding for public sector research organisations. Research aimed at short-term economic goals should be the responsibility of the relevant industry.

POLICY 3.4
Public sector research organisations must be responsive to national priorities, but must be given sufficient security to address long-term goals.

Strategy for FASTS 3.4.1
FASTS will support triennium funding arrangements for public sector R&D and higher education institutions.

Strategy for FASTS 3.4.2
FASTS will oppose unjustified increases in target earnings for public sector R&D organisations.

4 ARC and NHMRC

The ARC and the NHMRC support a significant part of Australia's basic research. They provide research funding based on a national perspective and peer review, which encourages and recognises excellence in scientific endeavour.

POLICY 4.1
The ARC and NHMRC should continue to be the principal sources of government funds for basic research.

Strategy for FASTS 4.1.1
FASTS will oppose measures which divert ARC and NHMRC resources away from basic research and towards short term applications.

Unfortunately, declining publication and citation rates in international journals indicate that the impact of Australia's basic research is falling.[5] This is in part due to under-resourcing of the Australian fundamental research base. The cost of equipment required to maintain research at an internationally competitive level is increasing as the technology becomes more complex, and as the Australian dollar has declined in value over the long term. Whilst these costs are rising, the ARC budget has diminished in real terms. This has had two adverse outcomes: fewer grants are funded, and the successful grants are too small.

FASTS welcomes the announcement in the 1999 Federal budget of a doubling of the NHMRC budget over the next 5 years. We believe that the ARC, as the other main source of peer-reviewed research funding, should be supported by an equivalent increase. The career opportunities for early stage researchers should also be strengthened as an investment in Australia's future.

POLICY 4.2
The ARC and NHMRC should be funded at a level sufficient to maintain Australia's role as a leading contributor to basic science.

Strategy 4.2.1
The Government should seize the opportunity offered by the Chief Scientist's Review of Australian Science Capability to augment support for basic scientific research, including that provided through the ARC and NHMRC.

Peer-reviewed funding is the primary source for basic research throughout the world. This system remains the best available and represents international best practice.

The ideal is to support excellent people and original ideas wherever they may be, but it is also recognised that critical intellectual mass is important in allocating finite resources. Aggregation and networking of groups can be an effective way of synergising research efforts, but should only be supported where there is a demonstrable advantage.

POLICY 4.3
Peer review is the best mechanism for allocating basic research funding.

Strategy 4.3.1
Allocate funds on the basis of critical mass only where there is a demonstrable advantage.

FASTS supports an enhanced strategic role for the ARC, placing it on a statutory basis with administrative independence from DETYA. The amalgamation of research-granting mechanisms (project, fellowships, infrastructure etc.) is not necessarily the most efficient practice, and will need careful monitoring.

In particular, Key Centres for Teaching and Research and Special Research Centres are important mechanisms for addressing areas of national priority. Also, the linking of research infrastructure to project grants may ensure that the best research is properly resourced, but in practice this may lead to an erosion of centralised services such as libraries and computing facilities.

FASTS believes that ARC and NHMRC granting processes can be improved, as detailed in the Strategies below.

POLICY 4.4
FASTS supports an independent ARC operating at best international practice.

Strategy 4.4.1
Conduct two rounds of fellowship and project applications per year to allow for greater employment opportunities of early career scientists and for greater research productivity.

Strategy 4.4.2
Fast track notification of grant outcomes e.g. by dispensing with the need for explicit Ministerial approval.

Strategy 4.4.3
Set salaries of ARC and NHMRC funded researchers at levels that are internationally competitive without requiring institutional supplementation.

Strategy 4.4.4
Provide funding bodies with discretionary power to award a five year grant for complex or multi-disciplinary projects.

5 *Monitoring Research in the Periphery: Australia and the ISI Indices*, P Bourke, L Butler and B Biglia, ANU 1996; *Impact of Australian Science*, L Grigg, Australian Academy of Science, 1996.

5 International Networks

Our scientists and mathematicians are highly respected as part of the international scientific community. Through them Australia gains ready access to international facilities and immediate knowledge of the latest developments in science and technology. This supports innovative Australian industry and allows us to adapt the best science and technology in the world in areas as diverse as land-care management and human health.

It is important that Australian researchers can participate internationally by exchanges of scientific personnel and by building professional networks. However, this is becoming more difficult, as indicated in the recent report of the Australian Academy of Science.[6]

It is becoming less common for Australian scientists to receive formal training overseas. Previously, such experiences formed the basis of the international networks enjoyed by many of our senior scientists. Opportunities for our scientists — whether employed in universities, CSIRO or other public sector research organisations — to spend extended periods in overseas laboratories are diminishing, due to increasing work pressures and financial constraints. At the same time, fees for overseas students, and visa and immigration restrictions on the appointment of postdoctoral workers in Australia and elsewhere, limit the international mobility of young scientists.

Exchange schemes such as those operated by the Academy of Science, the ARC (IREX) and DETYA (IPRS) encourage mobility of scientists but are very limited in scope. There should be a substantial expansion of the IPRS scheme, and students supported through this scheme should be provided with both a full fee-waiver and a realistic living allowance. Similar schemes should be developed to support short-term international secondments of Australian students overseas and for exchanges at the postdoctoral level.

Without such initiatives Australian science will be marginalised and we will become isolated from technological developments abroad.

POLICY 5.1
Australian researchers should be properly supported to participate in the international scientific community.

Strategy 5.1.1
Expand scientific exchange schemes such as those operated by the Academy of Science, the ARC (IREX) and DETYA (IPRS).

Strategy 5.1.2
Encourage public and private sector organisations to provide opportunities for their scientists to work and study overseas.

Strategy 5.1.3
Target government and university support at postgraduate students and other young scientists to enable them to attend international conferences and visit overseas laboratories.

Strategy 5.1.4
Remove visa and migration barriers, and supplement tourist and work visas with science visas to allow host institutions to pay a living allowance to visiting scientists.

6 *International networks and the competitiveness of Australia's science and technology*, F Wood and K Boardman, Australian Academy of Science, 1999.

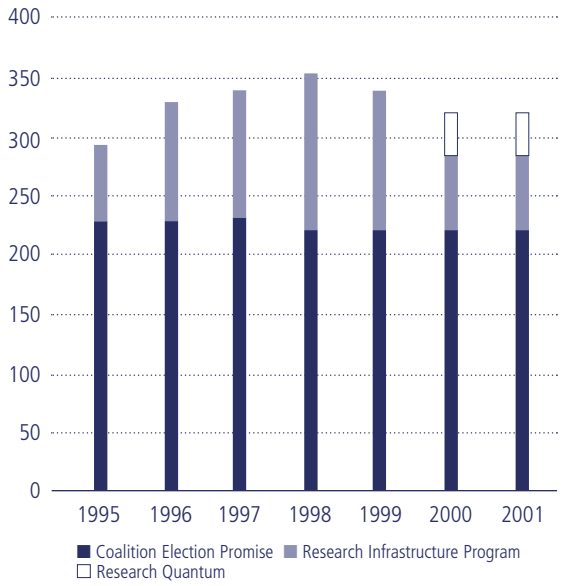
6 University Funding and Infrastructure

Scientific advances derived from basic research contribute to applied science and innovation. Australia's basic research capacity exists mainly in the university sector. It is therefore essential for innovation that the research capability of our universities is among the best in the world.

However, our higher education system is now seriously underfunded. The chairman of the AVCC, John Niland, has stated:

"If we don't get more funding to universities, then what has been for 25 years a world-class university system will start to go backwards, and if that happens everyone will be a loser.[7]"

FIGURE 2: Research infrastructure funding sources (M$–1999 constant price levels).[8]



It is a public responsibility to fund universities so they can advance knowledge through research, enthuse students through teaching, and ensure that discovered knowledge is transmitted from generation to generation. Maintaining the infrastructure base in both research and teaching is essential to a skilled workforce. In addition, Australia's $3 billion per annum education export industry makes it an important player in the national economy.

POLICY 6.1
Our universities' teaching and research capabilities are essential to a modern economy and must not be allowed to erode further.

Strategy 6.1.1
Government must increase funding to address the current crisis in the higher education sector.

Universities are increasingly operating on outdated and failing equipment which has long since reached the end of its useful life, especially in the more expensive science and technology areas. Many university research laboratories no longer meet basic OH&S requirements or minimum industry standards. Australia's capacity to sustain effective access to the global network of information and knowledge is diminishing, and maintenance of collections, libraries, and reference resources of national and disciplinary significance is being neglected.

POLICY 6.2
Funding for university research and teaching infrastructure should be at the same level as that of comparable OECD nations.

Strategy 6.2.1
Identify and target infrastructure funding to support the needs of teaching and research.

The quality of teaching and research is dependent on the ability of universities to attract and hold scholars of international repute. However, low salaries in Australia, inadequate support for research, reduced access to administrative and technical staff, and excessive teaching loads are driving Australia's best academics overseas. Several key disciplines-including statistics, some branches of mathematics and IT-are experiencing difficulties in attracting high calibre applicants to advertised positions. Australian salaries and conditions are no longer internationally competitive in many key disciplines.

POLICY 6.3
Salaries and conditions for university academic staff should be internationally competitive.

7 *Sydney Morning Herald*, p.37, 16/10/99.

8 Presentation by Professor Niland at the FASTS Forum: *Australian Needs, Australian Research*, 14 July, 1999. Statistical source — DETYA Higher Education Triennium Funding Reports

Strategy for FASTS 6.3.1

FASTS will continue to urge government to provide realistic annual indexation of academic salaries.

University academic staff need time for scholarship, research and teaching. If our young people are to be enthusiastic about scientific knowledge and its application they must be taught by people who are actively involved in the practice of science. However, a recent study has shown that a 10 per cent increase in teaching hours can cut research by 20 per cent.[9] In addition, the current low levels of technical and administrative assistance are further detracting from teaching and research.

POLICY 6.4
The nexus between research and teaching must be preserved.

Strategy 6.4.1

Reduce student/staff ratios and administrative loads to ensure that the teaching and research capacity of university staff is not compromised.

9 Kevin Fox and Ross Milbourne, Economic Record, p.256, September, 1999.

7 Cooperative Research Centres

The transfer of information and technology from government and university laboratories to private industry is a vital link in any national economic strategy. In the past, major Australian discoveries and inventions have been allowed to wither, or have been lost offshore, because they were not transferred effectively to Australian industry.

FASTS endorses government programs designed to foster research collaboration and technology transfer between the public and industrial sectors. Cooperative Research Centres (CRCs) have involved many scientists in industry and government research laboratories in closer collaboration than was the case up to a decade ago, and they are internationally admired as a model for bringing research and commerce together. Postgraduate students trained within CRCs are highly employable people for the collaborating industries.

State as well as Federal Governments have important roles to play in stimulating links with the private sector. State Government-funded technology parks are important examples. The Queensland Government has provided infrastructure to attract research-based enterprises associated with large multinational companies. Victoria has also been successful in starting up and supporting high technology companies. Government support of such programs must be maintained, in order to develop effective, long-term links between public sector research organisations and private enterprise, to enable technology transfer that will capitalise on our world standard research activities.

POLICY 7.1
Government has a role in nurturing partnerships between industry, university and other public sector research organisations.

Strategy for FASTS 7.1.1
FASTS will encourage strong bipartisan support for continuation of the CRC program on a stable, long-term basis.

8 Enhancing the Commercialisation of Research

High technology industries, generated by research, are essential as creators of wealth and jobs. Today's research underpins the industries of the future. Australia has yet to fully embrace this principle, and all sectors in the process — industry, government, research organisations, the general population and scientists and technologists — have issues to address. These include[10]:

- cultural attitudes of all parties in the commercialisation process
- the nature of government programs to support R&D
- the business skills of scientists and impediments to movement between industry and public sector research
- a program to increase the awareness in industry and government of the value of investment in science
- incentive schemes to encourage research scientists to commercialise their work

POLICY 8.1
All sectors in the innovation process should consider a long term strategy to change cultural attitudes in Australia.

Strategy 8.1.1
Create and publicise role models, lighthouse companies and education programs to foster acceptance and support for research-driven, high technology industries as creators of wealth and jobs.

Australia could be a more attractive place for industry and capital to invest in high-tech enterprises if aspects of taxation and company law were reformed. Suggested strategies are outlined in Sections 9, 10 and 11 of this document.

POLICY 8.2
The successful commercialisation of science should be encouraged through the structural reform of taxation and incentive measures.

Greater provision should be made for the holding of joint positions in public research organisations and on company boards.

10 *Scientists Commercialising Their Research*, T Gascoigne and J Metcalfe, FASTS Occasional Paper No. 2, 1999.

Transfer of scientists between the public and private sectors should be encouraged.

Many scientists and research managers recognise their lack of familiarity with the commercialisation process and with the way industry operates. This includes the recognition and protection of intellectual property (IP) in universities and research organisations, the handling of which can impede attempts to commercialise research.

POLICY 8.3
Scientists and technologists should have the skills and ability to move freely between industry and public sector research institutions.

Strategy 8.3.1
Foster commercial awareness and build the commercial skills of scientists and research managers.

Strategy 8.3.2
Encourage government, research organisations and industry to remove barriers to free movement such as high salary differentials, terms of employment and superannuation.

Strategy 8.3.3
Create mentoring and incubator systems to help commercially-minded scientists.

Strategy 8.3.4 Add units on commercialisation and innovation to all undergraduate and post-graduate science and technology degrees.

Strategy 8.3.5
Unite university technology-transfer arms such as Unisearch, ANUTech and Uniquest into regional groups to consolidate expertise, with scientists able to approach any of them for advice.

Any new sustainable industry which generates jobs in the 21st century will depend on science and technology. Despite this, there is a lack of public and political awareness of the power of science to generate wealth.

POLICY 8.4
Strong role models, case studies and cost-benefit analyses are all effective tools to build up awareness and support for science and technology.

Strategy 8.4.1
Highlight successful industries and entrepreneurial scientists through prizes, awards, publications, media and open days.

Strategy 8.4.2
Consolidate the existing cost-benefit analyses of investment in research to provide a comprehensive picture; and establish guidelines and a common methodology for future cost-benefit analyses.

The incentive systems in universities and research organisations do not adequately reward commercial activities in cases of promotion and appointment, or through financial incentives. These activities should be recognised in promotion cases, along with scholarly activities, teaching, and service to the research organisation.

POLICY 8.5
The criteria for promotion and appointment in research organisations should be broadened to include commercial activities.

Strategy 8.5.1
Reward scientists and technologists with the option of equity if their work is commercialised.

9 A Government Role for R&D

Corporate research and development is a crucial component of the wealth creation process, and is essential to maintain international competitiveness.

"Investments in R&D have high rates of return. The social rate of return which may be close to 50%, exceeded the high private rate of returns, of 20 to 30%, by a considerable amount because of 'spillovers' — benefits that accrue as other researchers make use of new findings, often in applications far beyond what the original researcher imagined.[11]"

R&D allocations should be seen as an investment, not as expenditure, and consequently should be referred to as Business Investment in Research and Development (BIRD).

POLICY 9.1
Business Expenditure on R&D (BERD) should be regarded as an Investment and renamed 'BIRD'.

Strategy for FASTS 9.1.1
FASTS will promote the use of 'BIRD' as the appropriate terminology for private sector research funding.

Australia's historically poor performance in private sector R&D has been well documented. Currently, Australian 'BIRD' is well behind our OECD competitors as a percentage of GDP.

From a peak in 1996 (0.86%), Australian 'BIRD' has fallen dramatically to 0.72% in 1998. All other OECD countries (except France) increased 'BIRD' as a percentage of GDP during the same period.

POLICY 9.2
The level and quality of Australian 'BIRD' should be at least equal to that of comparable OECD countries.

Strategy for FASTS 9.2.1
FASTS will work with business and government to promote investment in private sector R&D.

FASTS supports the use of a balanced range of incentive schemes. These include:

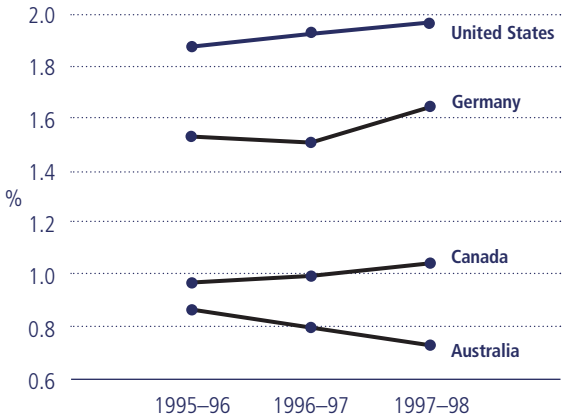
- the use of tax deductibility and tax credits for genuine R&D investments
- mechanisms providing linkages to university and government research sectors e.g.
  - — the CRC program
  - — the Start and SPIRT grant schemes
  - — Australian Postgraduate Award (Industry) scholarships
- incentives for attracting long term venture capital, including an internationally competitive capital gains tax system
- incubator schemes and measures to protect high technology start up companies from premature takeover.

FIGURE 3: 'BIRD' as a percentage of industry domestic product (1997 or latest year).[12]

11 *Supporting R&D to Promote Economic Growth: The Federal Government's Role*, US President's Council of Economic Advisers, October, 1995.

12 *The Knowledge-Based Economy*, OECD,1999.

FIGURE 4: Changes in 'BIRD' as a percentage of GDP.[13]



POLICY 9.3
Government should lift 'BIRD' by providing stronger incentives for industry to invest in R&D.

Strategy for FASTS 9.3.1
FASTS will work with business and government to determine a balanced range of government R&D incentives.

Industry has been deterred from investing in R&D by frequent changes to incentive programs, and by the reduction in the value of these programs. Ideally these incentives should be applied under a long-term strategic plan, flowing from a national vision (section 1) which recognises the role of such investment in strengthening Australian industry and commerce.

While the present Start scheme is a positive contribution to the suite of government incentives for private sector R&D, it was undersubscribed in its early years partly as a result of complex administrative procedures which negated the benefits to the company.[14] In general, FASTS supports a higher level of government incentives to 'BIRD', but these must be cost-effective to implement.

13 *Research and Experimental Development*, Businesses, 1997–8, ABS catalogue 8104.0.

14 *Scientists Commercialising Their Research*, T Gascoigne and J Metcalfe, FASTS Occasional Paper No. 2, 1999.

POLICY 9.4
Government incentives should be sufficiently simple and attractive to encourage R&D investment, and should be consistent to enable long-term planning.

Strategy for FASTS 9.4.1
FASTS will lobby for long-term 'BIRD' incentives which are well targeted and cost-effective.

Government also has a role to encourage industries with common interests to set up research funding bodies via voluntary sector levies. These funding bodies can then consider specific research proposals from universities, government and private organisations which relate to generic areas of interest for the industry, rather than for proprietary applications.

This is a particularly important innovation for small to medium-sized enterprises (SMEs), which on their own may not be able to perform R&D requiring a high level of investment. FASTS supports the continuance of the Rural Industry R&D Corporations as an appropriate model.

POLICY 9.5
Provision must be made for the R&D needs of SMEs to enable them to invest in and benefit from advances in scientific research and high technology.

Strategy for FASTS 9.5.1
FASTS will strongly support the establishment and the continuance of voluntary industry sector research bodies funded by internal sector levies, with support from government.

10 Taxation and Legal Reform to Stimulate R&D

Australia should be an attractive place to invest in high technology companies. But at present there is a range of impediments to the development of knowledge-based, high technology industries in this country. Some of these are structural, and can be addressed by government reform of taxation and legal structures, including reforms to existing incentive programs for private sector R & D. FASTS believes that changes to four major areas are needed.

A. R&D tax deductibility

Current studies[15] indicate that compared to the original (1985) R&D tax deductibility of 150% at the 1985 company tax rate of 49%, the present 125% R&D deductibility for a corporate tax rate of 36% would need to increase to nearly 170% to return the same net tax benefit. The R&D deductibility would need to increase to 185% if a 30% corporate tax rate were introduced. These values are to be compared with overseas rates of deductibility which in some cases reach 200%.[16]

As shown by the Canadian system[17], tax credits may be a better alternative to the R & D deduction since credits immediately benefit companies which do not show a profit in their early development phase. Tax credits may help create a favourable environment for high technology start-up companies which frequently do not become profitable for a number of years; in addition, tax credits could be targeted at SMEs below a certain turnover threshold.

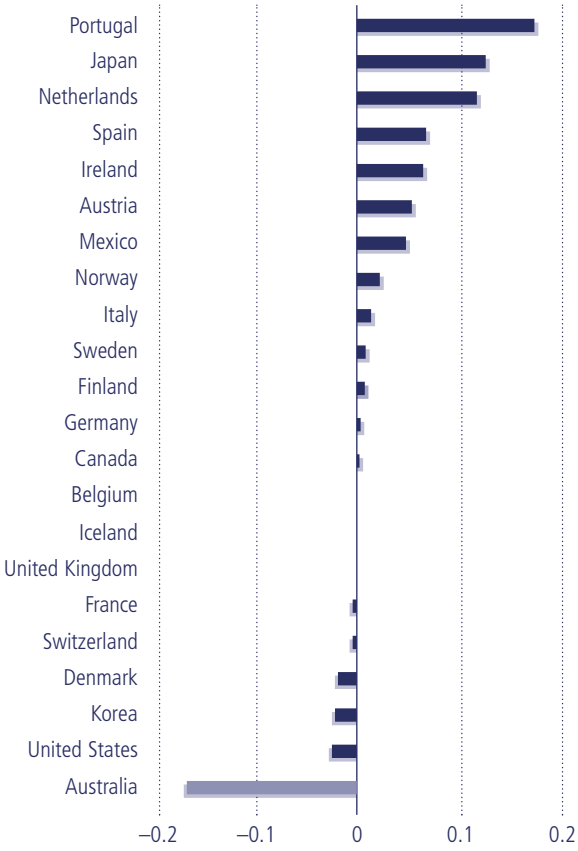
POLICY 10.1
Australia's corporate tax deductibility for R&D should encourage 'BIRD' and should be internationally competitive.

Strategy 10.1.1
Increase the R&D tax deduction rate to match the original net tax benefit.

Strategy 10.1.2
Introduce tax credits as a way of assisting high technology start-up companies in the pre-profit phase.

15 Michael Johnson and Associates, submission to the Ralph Review on company taxation, 1999.
16 Singapore National Science and Technology Board: http://www.nstb.gov.sg/
17 *Expanding Canada's Knowledge Base*, Nature, v.397, 543, 11 February,1999., OECD,1999.

FIGURE 5: Change in tax subsidies for $1 of R&D for large firms, 1990–1998. [18]



B. Capital gains tax

Australia's capital gains tax (CGT) rate compares unfavourably with many foreign competitors[19], thereby acting as a disincentive for international venture capital investments in Australian high technology companies. Typically such companies do not show profits for many years because of the need to reinvest in growth. As a result, venture capitalists can only reap returns by exiting the investment and realising capital gains, which currently are not internationally competitive.

A more favorable CGT rate, reduced in proportion to the length of time the asset is held (as exemplified by the UK taper system), would attract investment without destabilising either the long term prospects for high technology industry

18 *The Knowledge-Based Economy*, OECD,1999.
19 *An International Comparison of Capital Gains Tax Rates*, American Council for Capital Formation, 1998

(due to speculative movements of capital), or long term social equity. Further support for investment in high technology industries could be encouraged by strictly targeting this sector.

POLICY 10.2
Australia's CGT rates should be internationally competitive.

Strategy 10.2.1
Reduce CGT rates whilst simultaneously tapering them to attract long term venture capital.

C. Company takeover laws

Current Australian law allows the relatively easy takeover of start-up companies early in their development, particularly at a stage when cash flow is critical. This not only sees the loss of promising high technology companies to overseas interests, but also acts as a disincentive to investors who may wish to realise long term gains. Takeover legislation should be modified if Australian high technology companies are to be protected during their incubation period.

POLICY 10.3
Company takeover laws should nurture the development of start-up companies in the initial growth phase.

Strategy for FASTS 10.3.1
FASTS will support schemes aimed at limiting the premature takeover of companies.

D. Intellectual Property Protection

IP rights are an important factor in protecting the research investment of knowledge-based economies. Currently, IP rights allow exclusive licensing of technology to organisations which take on the development of products requiring further investment; the rights thus act as an incentive to commercialisation of new technology. This should not necessarily be seen as a breach of competition policy, since without such exclusive intellectual property agreements commercialisation may be compromised and development moved offshore where the Trade Practices Act cannot reach it.

FASTS believes that Australian innovations in scientific R&D are not always captured for the economic, environmental and social benefit of Australia; and nor are they always protected from exploitation by outside agencies. Australian scientists and technologists must protect their IP via the patent system and by appropriate strategic alliances with industrial partners. As such, IP protection should be an allowable R&D deduction.

POLICY 10.4
Protection of our intellectual property must become as important as its discovery and development.

Strategy 10.4.1
The National Competition Council should retain technology licensing as a means of exploiting the benefits of R&D.

Strategy 10.4.2
Make patent costs eligible for the R&D tax concession.

Strategy for FASTS 10.4.3
FASTS will promote awareness of IP protection among its members.

In many instances IP protection is vital if Australia is to realise the benefits of the work of its scientists and technologists. However, FASTS believes that factual information in the sciences (including, for example, gene sequences) should not be patentable. Otherwise, key facts may become unavailable for wider wealth creation or for the greater public good. Patents should be limited to technological processes and to methodology based on such facts.

POLICY 10.5
Patents should cover technical processes and methodology rather than factual information.

Strategy for FASTS 10.5.1
FASTS will lobby against the patenting of factual information.

11 Venture Capital

The amount of venture capital available in Australia for investment in high risk but potentially highly profitable industries based on science and technology is low by international comparisons, and is falling further behind.

A cultural change is needed in the Australian financial sector to allow recognition of the long term economic benefits of investing venture capital in high technology growth industries.

POLICY 11.1
The availability of venture capital in Australia should be comparable to our international competitors.

Strategy for FASTS 11.1.1
FASTS will encourage a cultural change in the risk-averse nature of the Australian financial sector by promoting the wealth creation prospects of high technology industries.

To encourage this cultural change, government incentives are needed. FASTS believes that the structural improvements outlined in section 10 will help attract venture capital to Australian high technology investments. These include improvements to:

— the capital gains tax system

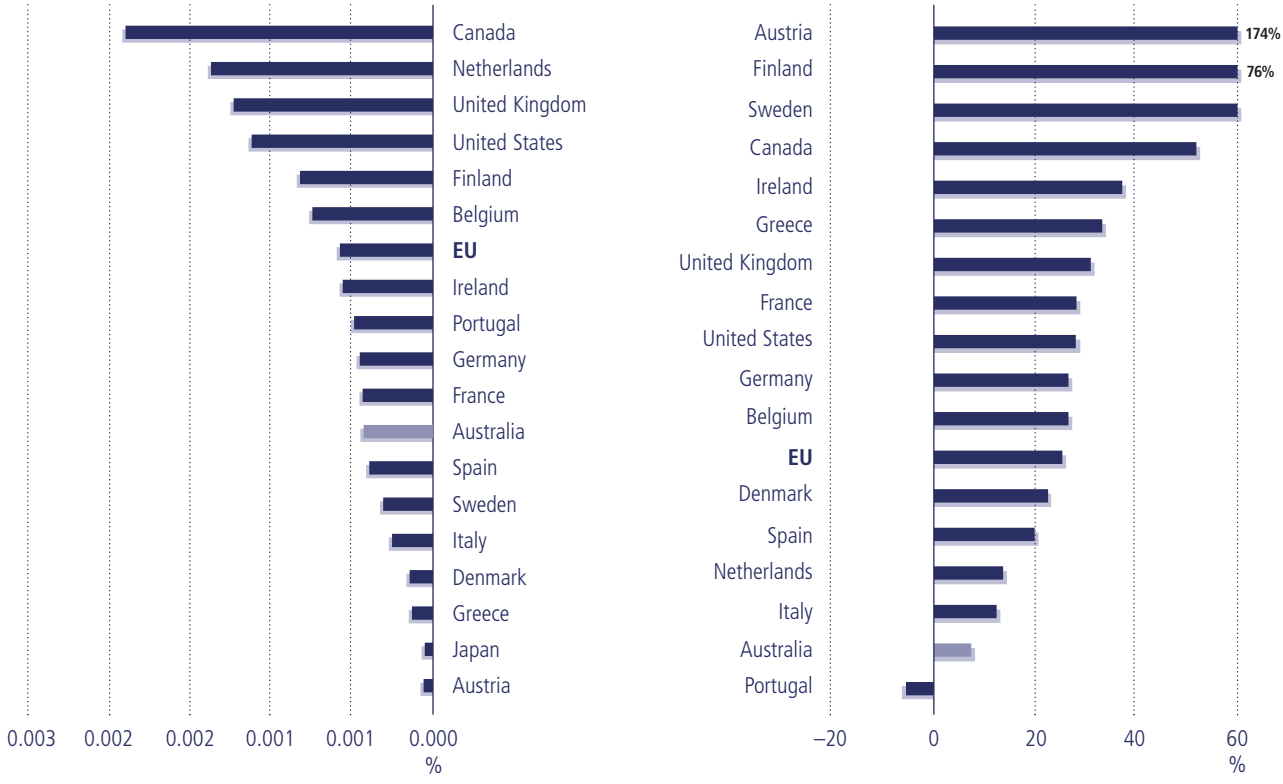
— company takeover laws

— intellectual property protection

However, it is important to realise that these structural changes alone are insufficient to improve the accessibility of venture capital for innovative industries. Global policy measures introduced by government are needed to augment structural change.

In this regard, FASTS is supportive of government schemes such as the Pooled Development Funds and the Innovation Investment Fund which encourage investment

FIGURE 6: Left: Investment in venture capital as a percentage of GDP (1997 or latest year). Right: Average annual growth rate of investment in venture capital, 1995–97.[20]



20 *The Knowledge-Based Economy*, OECD,1999.

in early stage high technology companies. Government purchasing is another very important factor in this area. The earlier Factor f scheme (now overtaken by the Pharmaceutical Industry Investment Program — PIIP) also represents an excellent investment of taxpayers' money, and has created a growth area of employment in Australia.

FASTS also believes that these incentives could be augmented by additional measures — such as allowing R&D tax deductibility for interest and dividends earned by investors in trusts and/or funds set up specifically for investment in R&D and in high technology industries. Recently the UK government established a related scheme of Venture Capital Trusts for investments in approved sectors that do not attract capital gains tax. [21]

POLICY 11.2
Government has a role to play in providing incentives for venture capital investment in high technology industries.

Strategy 11.2.1
Interest and dividends earned by investors in trusts and funds set up specifically for investment in R&D and scientifically innovative projects should attract the R&D tax concession.

FASTS also recognises that while investment by large financial institutions such as the US pension funds may be needed to increase the range of venture capital available, it is important that this does not distort the mix of financial institutions investing in high technology. Indeed, FASTS questions why Australia's superannuation funds are not playing a more important role as a source of domestic venture capital for start-up companies in the high risk, high technology sector. [22]

It is also important that massive flows of capital over the short term do not destabilise long term investment in high technology wealth creation. In particular, speculative investment strategies and fluctuations associated with changes in market confidence should be guarded against in industries based on science and technology, which require long lead times to reach profitability. In this respect, a tapered capital gains tax system (as discussed in section 10) may help attract long term venture capital investment.

POLICY 11.3
The Australian venture capital market should have an appropriately diverse mix of financial institutions

Strategy for FASTS 11.3.1
FASTS will encourage business and government to investigate the most beneficial mix of venture capital sources.

21 *Impediments Imposed by Capital Gains Taxes on Seed and Startup Companies*, John Howard and Associates, Coopers and Lybrand, May, 1998.

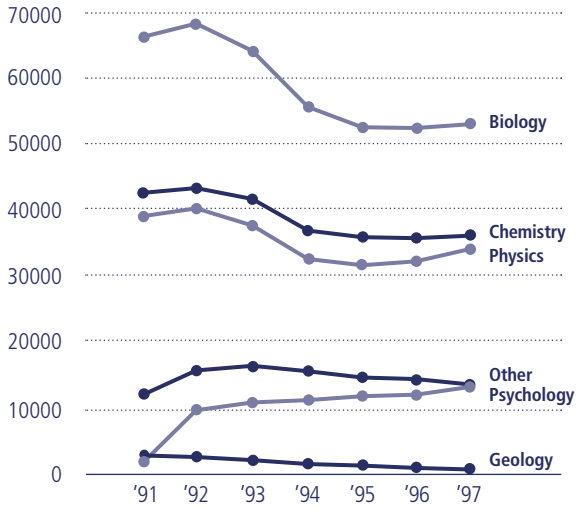
22 Ibid.

12 School Science and Mathematics Education

A primary and secondary school education in science and mathematics provides the foundation for the effective understanding, dissemination and application of scientific knowledge in a modern technological society. All students should gain an understanding of mathematical and scientific principles and methods, and be aware of mathematical, scientific and technological applications in everyday life. This should be a cultural goal, as an integral component of fundamental literacy. It enables people to make informed judgements about the benefits and risks of sciences and technologies.

Unfortunately, the number of secondary school students enrolling in science and mathematics is decreasing. A recent report by the Australian Council of Deans of Science[23] notes that between 1989-1997 (a period in which the total number of students increased by 3%), Australia-wide enrolments in Year 12 chemistry, physics, geology and biology dropped by 12%, 8%, 62% and 17% respectively. Poor teaching conditions and resources may be contributing to this apparent fall in participation in these core science courses in senior secondary years.

FIGURE 7: School science enrolments by science subject, 1991–97.[24]



A most serious threat to high-quality science and mathematics education is the shortage of suitably qualified and positively motivated teachers. It is important that in schools, especially in senior years, teachers should typically have a university major or higher degree in the relevant discipline. Based on this criterion, current data indicate that many teachers are not appropriately qualified, and this situation is projected to worsen, particularly in the physical sciences and mathematics[25]. To address this issue, incentives should be provided for primary and secondary teachers to develop their knowledge and abilities to the highest level, and to make teaching more attractive as a vocation.

POLICY 12.1
Science and mathematics should be taught only by those who have appropriate qualifications in the relevant discipline.

Strategy 12.1.1
Ensure that the current and projected inadequate supply of teachers qualified in science and mathematics is recognised and addressed.

Strategy for FASTS 12.1.2
FASTS will advocate better remuneration for teachers at all levels, and higher salary rates for teachers who have higher level qualifications and expertise in particular learning areas.

Strategy 12.1.3
Improve in-service and retraining schemes for primary and secondary teachers to increase the level of teacher expertise in science and mathematics disciplines.

The current situation where HECS fees for science subjects are higher than those for other education and teacher-training courses is a strong disincentive for prospective teachers to undertake formal coursework in science and mathematics. It is inequitable that a science and mathematics teacher with a tertiary qualification in these fields should be faced with a higher HECS burden than a colleague lacking that qualification but employed to do the same work and for the same salary.

23 *Trends in Science Education*, I Dobson and A Calderon, Australian Council of Deans of Science, 1999.

24 Ibid.

25 *Teacher Supply and Demand to 2004: Updated Projections*, B Preston, Australian Council for Deans of Education 1998.

POLICY 12.2
HECS liabilities for teachers should be at the lowest rate irrespective of discipline.

Strategy for FASTS 12.2.1
FASTS will seek the introduction of a HECS equalisation scheme to remove the higher debt burden incurred by teachers in science and mathematics.

Science laboratories in many secondary schools are in a deplorable condition, and well-equipped science rooms in primary schools are almost non-existent. New technologies offer very exciting and innovative possibilities for teaching science and mathematics, but their adoption requires financial commitment to infrastructure, curriculum materials and support for teachers.

POLICY 12.3
Public funding of primary and secondary schools should provide the infrastructure needed for a quality science and mathematics education.

Strategy for FASTS 12.3.1
FASTS will press for increased funding for facilities such as libraries, teaching laboratories, computers and access to new technologies.

Many students lack appropriate course and careers advice and, in particular, the importance of studying science and mathematics for future employment in a broad range of careers is often not appreciated.

POLICY 12.4
An increased participation in advanced level mathematics and science courses at senior secondary levels should be encouraged.

Strategy 12.4.1
Improve career awareness, especially by providing information for science and mathematics teachers.

The Third International Mathematics and Science Study (TIMSS) revealed both strengths and weaknesses in Australian students' performance. It also showed an alarming level of dissatisfaction among teachers[26]. School curricula must include a range of challenging and relevant science and mathematics courses for students of differing ability and aspirations, particularly in senior years, and must cater to the needs of a culturally diverse society.

Excellence and rigour should be the criteria for achievement in science and mathematics education at all levels, and curricula should be at international best practice as assessed against TIMSS and other comparative data. The present Australian science and mathematics statements and profiles for schools, recent developments in some year 11 and 12 certificates, and the current preoccupation with measuring outcomes rather than improving curricula and resources are sometimes inconsistent with these goals. These impediments discourage good teachers who want challenging curricula and enough time and resources to teach well.

POLICY 12.5
Mathematics and science curricula must reflect international best practice, and schools must allow an appropriate amount of time for them to be well-taught.

Strategy for FASTS 12.5.1
FASTS will support full and open consultation with both teacher-based and its own professional societies in the development of coordinated national science and mathematics curricula.

26 For example see *Maths and Science on the Line: Australian Junior Secondary Students' Performance*, J Lokan, P Ford and L Greenwood, Australian Council for Educational Research, 1996.

13 University Teaching

Tertiary science and mathematics education provides individuals with problem-solving and decision-making skills valuable in both private and public sector management. People with these skills often choose to perform roles such as teaching or administration which lie outside their specific discipline areas. Therefore the supply of highly skilled graduates and postgraduates in science and mathematics should not simply be limited to the number of positions available within these disciplines. In view of the long lead time required to train such highly qualified people,[27] it is important to encourage them to look more widely at career options.

POLICY 13.1
Graduates and postgraduates in science and mathematics are essential for the nation's economic, social and cultural well-being. The generic skills that they bring to research, business, industry and commerce should be recognised.

Strategy 13.1.1
Provide enough postgraduate scholarships for all first class honours applicants, and increase the postgraduate stipend for high-performing science and mathematics students.

Strategy for FASTS 13.1.2
FASTS will encourage its member societies to publicise non-traditional professional pathways and encourage flexible options for new graduates.

The current university funding crisis has caused staff reductions in many science and mathematics departments in an uncoordinated fashion, a process which has the potential to threaten the viability of these disciplines on a national level. Cooperative action between universities must be considered, as well as the possible introduction of incentives for students wishing to relocate in order to broaden their experience, or to undertake specific courses or postgraduate study at the most appropriate institution in their field.

27 The age profile of academics and teachers, reported in discipline reviews (e.g. National Committee for Mathematics, *Mathematical Sciences: Adding to Australia*, 1996), shows that many will retire in the next 10 years.

POLICY 13.2
Australia's university system should maintain a strong, internationally competitive, science and mathematics base over a range of disciplines.

Strategy 13.2.1
Encourage universities to cooperate so that major disciplines can be offered over multiple sites in each region, with all disciplines being offered in at least one institution.

Strategy for FASTS 13.2.2
FASTS will encourage its member societies to monitor and facilitate the process of coordinating courses.

The change to up-front fees for the majority of coursework postgraduate degrees needs to be investigated. It has led to the demise of many postgraduate courses. Further, students are often encouraged into research degrees when personal and industry needs may be better met by coursework.

There is a case for increasing the number of professions (in addition to initial teacher training) for which postgraduate HECS places are available. In particular, up front fees threaten the provision of courses which allow many teachers and scientists to upgrade their skills or to change careers. This is partly why the provision of professional development, both in the private and public sector, is poor compared to many other countries.

POLICY 13.3
HECS places for coursework degrees for initial training and for professional development should be more widely available.

Strategy for FASTS 13.3.1
FASTS will encourage DETYA to undertake a study of the effect of HECS changes on postgraduate coursework degrees.

Strategy 13.3.2
Encourage industry to play a greater role in vocationally-oriented postgraduate training.

Adequate funding for laboratories, field experience and access to new technologies and equipment must be recognised as integral to the

teaching process and should reflect the practical nature of science and technology education. It is here that many young scientists find real enthusiasm for their field, which often translates into encouragement of other young people to consider these courses. Similarly, it must be recognised that proficiency and appreciation of science and mathematics is enhanced through the teaching of science and mathematics 'service' courses (as part of other degrees) by practitioners of science and mathematics.

POLICY 13.4
The quality of university science and mathematics education must reflect international best practice.

Strategy for FASTS 13.4.1
FASTS will encourage its member societies to monitor and accredit courses, teaching practices and resource levels.

Strategy 13.4.2
Promote teaching of science and mathematics 'service' courses by the relevant science and mathematics departments.

14 Valuing Science in the Clever Country

Australia needs a cultural change in the social perception of science and technology. The community needs to consider the importance of science and technology to business, investment, employment, society and the environment. The community also wants to question scientists and to have a say in science-based policy. Widespread public unease at the introduction of genetically-modified food is one example of public resistance to technology change. A climate needs to be developed in which scientific issues with implications for economic health and personal safety can be discussed comfortably. Scientists must use forms of communication that allow the community more room to express its concerns. The mass media also have an important role to play in promoting informed debate.

POLICY 14.1
Informed discussion of science and technology should be encouraged in all sectors of the community, by all sectors of the community.

Strategy 14.1.1
Use new interactive methods of communication such as consensus conferences to promote community discussion on contentious issues.

Strategy 14.1.2
Encourage major media networks to employ professional science journalists.

Scientists and technologists must themselves become more aware of public issues, and be prepared to inject a scientific note into public debate. FASTS will encourage scientists and technologists to take active roles in community and education.

POLICY 14.2
Scientists should contribute actively to public debate on scientific issues.

Strategy 14.2.1
Train scientists to communicate their ideas to the public both directly and through the media.

Strategy for FASTS 14.2.2
FASTS will encourage its member societies to apply their valuable experience to public discussions on major public issues such as global warming, the information superhighway and genetic engineering.

Strategy for FASTS 14.2.3
FASTS will encourage its member societies to work with representatives of law societies to ensure that balanced expert views are available for the determination of scientific evidence.

Strategy 14.2.4
Applicants for research funding should state in lay terms the benefits of their research, which may include the advancement of knowledge.

Government is in a unique position through a range of portfolios to inform the general public about the importance of science and technology in wealth creation, employment, the community and the environment. The Government's Science and Technology Awareness Program should be extended as one important driver of this change. The program needs clear aims and methods of evaluation. In particular, whether young people pursue a direct career in science or use their scientific education in other employment, there is a role for government in promoting science and mathematics education. This can be achieved as much by creating attractive career paths with appropriate remuneration, as by awarding prizes for excellence.

POLICY 14.3
Government has a clear role in determining a national program of scientific understanding and awareness.

Strategy 14.3.1
The Government's Science and Technology Awareness Program should be strengthened and reformed and its activities governed by a Council representing industry, regional and Federal governments, and the scientific and general community.

Strategy for FASTS 14.3.2
FASTS will encourage its member societies and education authorities to participate in improving career advice to students.

Strategy for FASTS 14.3.3
FASTS will encourage achievement through excellence, such as the science and mathematics Olympiads.

Business and industry derive many benefits from publicly funded science. There is a pressing need for a high level of scientific and technological literacy in the boardrooms and senior management of the private and public sectors in Australia. This will enable business and industry to play a more active role in recruiting young scientists and in promoting more widely the benefits of investment in science.

POLICY 14.4
Business and industry should actively promote science as a key element of wealth creation.

Strategy for FASTS 14.4.1
FASTS will encourage member societies to use links with business and industry to engage them more actively in promoting the importance of science.

Strategy 14.4.2
Improve the knowledge of science in business and industry by e.g. incorporating science management components in MBA programs.

Strategy 14.4.3
Encourage companies to appoint scientifically and technologically literate people at board level.

Glossary of Acronyms

ABS	Australian Bureau of Statistics
AIDS	acquired immune deficiency syndrome
AIMS	Australian Institute of Marine Science
ANU	Australian National University
ARC	Australian Research Council
ASTEC	Australian Science and Technology Council
AVCC	Australian Vice Chancellors Committee
BERD	Business Expenditure on Research and Development
BIRD	Business Investment on Research and Development
COAG	Council of Australian Governments
CRC	Cooperative Research Centre
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DETYA	Department of Education, Training and Youth Affairs
GDP	gross domestic products
HECS	Higher Education Contributory Scheme
HIV	human immunodeficiency virus
IP	intellectual property
IT	information technology
IPRS	International Postgraduate Research Scholarships
IREX	International Researcher Exchange Program
MBA	Master of Business Administration
NHMRC	National Health and Medical Research Council
OH&S	Occupational Health and Safety
OECD	Organisation for Economic Cooperation and Development
PIIP	Pharmaceutical Industry Investment Program
PMSEIC	Prime Minister's Science, Engineering and Innovation Council
R&D	Research and development
SME	small- to medium-sized enterprises
S&T	Science and technology
SPIRT	Strategic Partnerships with Industry — Research and Training Scheme
TAFE	Technical and Further Education
TIMSS	Third International Mathematics and Science Study

The Federation of Australian Scientific and Technological Societies

The FASTS Office

Mr Toss Gascoigne, Executive Director
Federation of Australian Scientific and Technological Societies (FASTS)
PO Box 218
Deakin West ACT 2600

Phone: (02) 6257 2891, (02) 6257 2895
Fax: (02) 6257 2897

Email: fasts@anu.edu.au

Web: **http://www.usyd.edu.au/fasts/**