Science and technology for Australia : statement and speeches / by the Hon. R.J.L. Hawke, Prime Minister, and the Hon. Barry O. Jones, Minister for Science, Customs and Small Business and Minister Assisting the Prime Minister for Science and Technology.

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The Prime Minister, Mr Hawke, (left) and Mr Jones at a Press conference after tabling of the "Science and Technology for Australia" statement in Parliament on 8 May 1989 (Photo: The Canberra Times*).*

SCIENCE AND TECHNOLOGY

Speech to Parliament by the Prime Minister, the Hon. R.J.L. Hawke A.C., M.P. – 8 May 1989

As never before, scientific and technological developments are altering the lives of every person, changing the face of nations, cultures and the international economy, and even throwing into question the very environment in which we live. Medical discoveries are offering relief for the sick and injured, helping childless couples to have children, opening broader horizons for the elderly. Researchers are providing new drugs and new surgical techniques and are even probing the nature of life itself. New manufacturing techniques are revolutionising the way we work, the way we travel, what we eat, how we live. Computers store and manipulate information in quantities and with a speed that would have been inconceivable a few decades ago.

Rapid communications are delivering instant news throughout an apparently shrunken world, crisscrossed with optical fibre networks and surrounded by satellites. Concepts of warfare today are largely unrecognisable to those who fought in the Second World War. Even the most basic cycle of our climate, the purity of the air we breathe, the very borders between sea and land, seem to be affected by technology. Problems such as the greenhouse effect and the depletion of the ozone layer are real issues today that even in the last decade would have seemed incredible outside the pages of science fiction.

One possible response to this vast process of change is despair– the feeling that attempting to control the seemingly remote forces of unleashed innovation is futile. Honourable members who are in contact with their constituents will know that many people, especially many younger Australians, do indeed border on despair when they contemplate the dangers of nuclear war and the despoliation of the environment. A more realistic response is to attempt to understand the nature of these changes and to harness the best endeavours of all people to ensure that the forces of science and technology yield a better future for mankind.

The march of technological change– where it seems possible that it might lead only to a polluted, clamorous, dangerous and uncertain world– must be made to serve our needs and to create a world in which our children and grandchildren can live at ease. Indeed, if Australians of the next century are to inhabit a prosperous nation and a clean and safe world, we today must grasp the challenge of gaining control of the

processes of scientific and technological innovation and ensure that we receive benefit, not disadvantage, from change.

This is a challenge that confronts all Australians. Australians, of course, are used to enjoying a quality of life equal or superior to that anywhere in the world. But just as we accept that our predecessors had to work extremely hard to build this society, so we must recognise that retaining such advantages, so as to pass them on to our children, will require hard work and constant effort.

Since this Government came to office in 1983, we have been single-minded in our determination to ensure that such an effort is made. A crucial foundation for the pursuit of our wider goals is our adoption of the most wide ranging and comprehensive program of structural adjustment in Australia's history. We have taken the decisions—tough ones, many of them—to create a more internationally competitive economy and to remove the impediments which prevent industries and individuals from making their fullest contribution to national prosperity.

In this endeavour, science and technology continue to have an essential role to play. They can open the way for Australia's manufacturing and service industries to be more competitive, and for the men and women who make up the Australian workforce to be more productive. Our agricultural and mining industries, our medical researchers, our astronomers, our communications specialists, are already showing the way, not just with new techniques and new products that can be sold abroad, but with new knowledge, on which no price tag can be placed. This Government is determined that Australia will not fall behind. We are committed to maintaining and enhancing the proven excellence of our researchers, allowing them to further the horizons of basic research and to contribute through their creativity and innovation to Australia's goals.

Since coming to office my Government has pursued a consistent science and technology strategy. This strategy recognises that crucial elements of research must be supported by public funds. It adopts as two important objectives the pursuit of excellence and the closer cooperation between researchers and users of that research. It recognises that science and technology depend on the creativity of individuals. And finally, it seeks to integrate science and technology into the broader community. In pursuit of that strategy, research into science and technology in Australia is supported by public funds totalling about $1.9 billion annually, through direct funding, through institutions of higher education and through tax concessions. We have introduced new research and development promotion and incentive schemes, and reorganised our research organisations. There has been a massive expansion of higher education places and a dramatically lifted school retention rate. The best Australian research can now receive increased support, as researchers must now win a proportion of

their funding by competing with others against a variety of standards, some involving peer review and others commercial criteria.

Since 1982-83, Government support for research through grants, higher education and government agencies has risen by 12 per cent in real terms. Support for industry research and development has trebled in that period that we have been in office. Public funding of research and development in Australia is at about the middle order of Organisation for Economic Cooperation and Development nations. But private sector support has been near the bottom of the ladder. When this Government came to office, 80 per cent of the nation's research activities were publicly funded, with private industry providing the remaining 20 per cent. By 1986-87, within a substantial increase in total research and development expenditure, industry had increased its share in the nation's research effort to 35 per cent. This is a welcome trend. But with this statement today, the Government is saying that it recognises that more needs to be done. More needs to be done to enhance our efforts in the quest for knowledge, as well as to ensure that a sufficient research effort is directed to areas of crucial application for Australia.

The details of the Government's initiatives will be announced directly by the Minister for Science, Customs and Small Business, Barry Jones. Let me take this opportunity—an appropriate opportunity—first to pay tribute to this Minister's determined and far-sighted advocacy of these issues. He is a Minister who makes an invaluable contribution to the Government's consideration of science issues and one in whom the science community can place its trust and confidence. The first element of the Government's statement that I wish to announce today is that I will be appointing Barry Jones as Minister Assisting the Prime Minister for Science and Technology. In this role Mr Jones, who will retain his existing portfolio duties, will exercise, on my behalf, the day to day responsibility for the development and coordination of science policy across the Government.

I also announce the establishment of a new consultative body which will bring together at the highest level all those who have a role to play in setting the nation's priorities in science and technology. This new body will be known as the Prime Minister's Science Council. I will chair it and Mr Jones will be its Deputy Chairman. Its membership will consist of Government Ministers, representatives of the science community and leaders of Australian industry. The first meeting of the Council will be held in October. At the top of its agenda will be a consideration of the status of science in Australia—covering both the state of research in Australia and the nature and effectiveness of linkages between research and industry. The October meeting will also consider the greenhouse effect, to the research on which the Government has recently provided $7.8m. I want my Council to bring a new focus and prominence to discussions on Australia's national priorities in scientific research and a new capacity to make sure that our aims in basic and applied science are properly set and implemented.

To assist in this, I am appointing Professor Ralph Slatyer as Chief Scientist. He will assist me and Mr Jones on science and technology policy, chair the Science and Technology Coordinating Committee and serve on and be the Executive Officer of my new Council. Professor Slatyer is a scientist of national and international distinction, both in research and in the development of science and technology policy. He has served as Chairman of the World Heritage Committee, President of the International Scientific Committee on Problems of the Environment and most recently as Chairman of the Australian Science and Technology Council. The Australian Science and Technology Council (ASTEC) which has been providing analysis of developments in Australian science and technology throughout the term of my Government will continue to provide this valuable service. Indeed, I expect ASTEC to make a substantial contribution to the success of the new arrangements I have just announced and to enjoy an enhanced role as a result of them.

This statement is based on extensive consultation with the science and technology community, and on detailed reviews both of specific problems and of the broader needs and concerns of scientists. It brings together, as the Government promised it would, all the strands of the Government support of science and technology research throughout a number of portfolios. This statement does not represent a conclusion to the debate about science and technology in Australia, nor a reaction to it. It represents a contribution, and I believe a very significant one, to a continuing process of policy development. It provides for the expenditure of additional $390m over the next five years in order to boost Australia's science and technology performance. Taken with the anticipated revenue foregone due to the extension of tax concessions, this represents a $1 billion package of support for science and technology in Australia.

This statement represents our recognition that the pace of change in this country cannot be relaxed. We cannot rest on our laurels. The world will not let us do so. No Australian wants to leave it up to the rest of the world to make the decisions that are so important to shaping our future. With this statement, we are showing our determination that Australia will be a full participant in the exciting and vital processes of scientific discovery, innovation and adaptation.

SCIENCE AND TECHNOLOGY FOR AUSTRALIA

Speech to Parliament by the Minister for Science, Customs and Small Business and Minister Assisting the Prime Minister for Science and Technology, the Hon. Barry Jones, M.P., – 8 May 1989

This is the first statement to consolidate government policy for science and technology. It involves a number of portfolios and announces substantial initiatives. It will further give Australian science and technology an enhanced capability to support the vision that the Government has for Australia and to respond to the opportunities and needs of the next five years.

Science and technology, including engineering, have changed the quality, length and direction of life in the past century far more than politics, education, ideology or religion. Edison and Ford shaped human experience more broadly and enduringly than Lenin and Hitler. Because they are central to our culture and to the success of our economy, governments must be concerned about science and technology and how they benefit us. It is also necessary for people in Australia to be aware of the ways in which science and technology– and I include engineering, of course– is an important factor in our culture. Scientific method is also central to the examination of evidence, developing intellectual rigour and personal autonomy. Society looks increasingly to science and technology to provide knowledge and understanding, to support economic development, to contribute solutions to new and pressing concerns and to help maintain the high standards of living we now enjoy.

Since 1983 the Hawke Government has undertaken a series of major reforms which has moved us away from being a protected, inward looking, insular economy towards accepting the new challenges arising from full participation by Australian industry in the global economy.

The Government has given a high priority to structural adjustment. These changes include reduced levels of government expenditure, converting massive budget deficits into substantial surpluses, floating the dollar, reducing reliance on tariffs, bounties and subsidies, reforming the taxation system, and freeing up banking and capital

markets. There have also been major reforms in the provision of education, health and social security and defence. Government actions have strengthened our manufacturing base, and revitalised existing industries. Large scale job creation, at the highest rate of any Organisation for Economic Cooperation and Development (OECD) nation, is recognised as a major achievement.

Having achieved so much, it is now appropriate to place even more emphasis on other areas including our research and skill base. Four objectives have priority:

- to increase industry's use of technology and investment in research and development (R&D)
- to build a competitive research base that is recognised internationally
- to attract high-quality people into science, technology and engineering
- to provide coordination and cohesiveness of science and technology in Australia.

Industrial Investment in Research and Development

Public funding of research and development (R&D) in Australia is, as the Prime Minister (Mr Hawke) said, about the average of other OECD nations, but private sector support is relatively poor. Such comparisons are important because Australian industries must compete with those of other countries on world markets. In Sweden, Switzerland and the Netherlands, the proportion of industry investment in total R&D is 60 per cent, 79 per cent and 50 per cent respectively.

In 1978-79, government contributed 79 cents to the total research dollar, compared with industry's 21 cents. This ratio was quite unbalanced, reflecting in part the reluctance of a previously closeted manufacturing sector to invest in indigenous R&D. This reluctance was particularly serious in 'development', where costs tend to be higher and the process more protracted than in 'research'. By 1986-87, the proportion was healthier, with the Government share being 63 cents in every research dollar, compared with industry's 37 cents. By the mid 1990s, we should aim for a more even balance of contribution to R&D investment.

Changing this balance in Australia's R&D spending has been essential, and the trend is in the right direction. However, there are still problems with the overall amount of research which will require a concerted effort by both industry and government. Overseas experience suggests that R&D amounting to 2 per cent of Gross Domestic Product (GDP) could

be seen as an appropriate critical mass. If Australia were to achieve a similar figure with balanced contributions from government and industry, industry would need to more than double its R&D funding as a proportion of GDP.

In 1986 the Government introduced the generous 150% tax concession in response to the low level of R&D performance by the private sector; particularly manufacturing industry. The incentive has been enthusiastically welcomed by industry, continues to draw strong support, and has contributed significantly to the large increase in investment in industrial R&D that has taken place in the past few years.

While it was originally intended that the concession would run for five years to June 1991, the Government has decided that it will be now extended for a further two years, to 30 June 1993. Recognising the long-term planning necessary in R&D, the incentive will be phased out, operating at 125 per cent for a further two years. To give an indication of the gross cost to tax revenue of this recent decision, revenue foregone is expected to cost about $200 million in 1988-89, and of the order of $1 billion over the next five years.

The Government believes that Australian researchers should be able to participate as a full partner in international precompetitive R&D programs where the collaboration can help Australian technology enter world markets. The Government has therefore decided to increase funding for international science and technology by $17.5 million over the next five years, including additional support for Bilateral Science and Technology Cooperation programs, which have been seriously undernourished in recent years.

Core Capacity in Science and Technology

Support for industrial R&D is a key part of the Government's policy for science and technology, and provision of a sound core capacity in science and technology is another.

Recent, and ongoing, debates about science have been marred by over-attention to extremes. In reality the situation is far more complex. There is no arbitrary line between treatment of and research in cancer or between weather forecasting and upper atmosphere physics in meteorology. The extremes sharpen our perceptions, and provide rally points for intellectual turf-wars, but our need is to find ways of bringing together their best aspects to serve our visions for Australia's future.

The distinction between 'fundamental' (or basic), 'strategic' and 'applied' research, while convenient, is increasingly blurred in practice because the categories overlap: they are indeed part of a continuum. The labels 'long-term research' and 'short-term research' may be more appropriate. The concept of 'relevance' in research is also increasingly

dubious. When the frontiers of knowledge are pushed forward rapidly, areas which seemed remote or irrelevant a few years ago are now at the forefront of research by universities and corporations; for example, work on AIDS, superconductivity and the greenhouse/ozone phenomena.

There is growing recognition, both in Australia and abroad, of the need to avoid two dangerous fallacies: first, that research must be required to meet utilitarian goals; second, that research for industry is inherently second rate and that product innovation is inconsistent with excellence in science. In much research, for example in molecular genetics, work carried out to expand the frontiers of knowledge was not recognised as having economic potential for many years. The award of Nobel Prizes to researchers in the laboratories of IBM, Bell, Du Pont, EMI, Burroughs-Wellcome and other firms confirms that some of the most intellectually challenging work anywhere is being carried out in industry.

The pursuit of curiosity-driven, basic research is essential to the survival of a rich and lively science and technology in Australia. It provides the best training ground to stimulate and enthuse young scientists. However, the relationship between science and technology is very complex. Science provides the foundation of knowledge and skill formation which makes technology possible; it provides the context of continuity with past experience and future capability. Investment in science helps to provide the core capacity which is an essential precondition to the next stage of development in technology. If science is long-term and cumulative, technology is immediate and perishable in a context of market volatility, and frequent incremental change.

There is a complex and unpredictable interaction between long-term and short-term research and between fundamental and applied research. In addition, there can be important synergistic effects between research projects which are advancing the frontiers of knowledge in different disciplines. For example, interdisciplinary cancer research—including physics, chemistry, biology and computer modelling—appears to have been even more productive than narrowly focussed biological or physiological approaches.

The Government has encouraged major science and technology institutions to be more conscious of national needs and their responsibilities. Although much remains to be done, this process is now well under way.

Change is never easy for those involved, however, and never free from transitional problems. Morale in some sections of the scientific community has understandably been affected. Redistribution of funding, particularly for the universities following creation of the Australian Research Council (ARC) and for CSIRO have raised concerns. In CSIRO's case, its direct budget allocations have been reduced in real terms both to reflect and encourage a move to greater

external funding and industry linkages, and to contribute significantly to the Government's general budget tightening. This has inevitably limited funds for some areas of research. Institutions feel they now lack flexibility to respond to government urgings to re-evaluate priorities. There was some criticism by industry that government was giving ambiguous signals.

In a process of change there must be continuous monitoring. The Government has recently commissioned a number of reviews and investigations of science and technology capacity that have provided advice and information. These reports presented a number of themes indicating matters of general concern.

Among the scientific community there is some apprehension brought about by the changes occurring within science and technology. Although there is broad agreement with the general direction of government policy, some scientists fear that the Government's commitment is lessening and others that their sectoral interests may be damaged. This is related to a general concern about the perceived lack of a clear statement of government science and technology strategy or sufficient mechanisms to coordinate science and technology policy.

It is a general view that decades of neglect and insufficient funding have led to a rundown in science and technology infrastructure. Human resources are also of concern with difficulties in attracting young people to a scientific career. It is a matter of grave concern that the numbers in scientific vocations has fallen in recent years, especially in physics, chemistry, mathematics and engineering, although numbers remain high in computing and the life sciences including medicine. Equally worrying, as noted by the Vice-Chancellors, has been the decline in entry scores for students entering science disciplines compared with other areas. This confirms that there has been a loss of confidence about professional prospects in science.

Frustration was evident from both researchers and research users about the difficulties of cooperating productively. Research users complain that researchers are not interested in addressing their needs. Researchers complain that commerce is not interested in funding research nor in becoming innovative.

The Government takes these expressions of concern seriously and has attempted to provide a response through the measures now announced. Policy development in science and technology is a continuing process and the Government will be monitoring carefully the adequacy of the response.

CSIRO

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) has an excellent track record in strategic and applied research which has largely been earned in the agricultural and mining sectors. Industries in these sectors have been responsible for the creation of much of Australia's wealth and have had a continuous focus on world markets, with all the opportunities and pressures which that implies. These sectors have been continually exposed to fierce competition and, as a result, have felt a strong need to invest in state-of-the-art technology, much of it developed by CSIRO in conjunction with local industry. This research has been widely acclaimed, both here and overseas.

The Organisation will continue to provide vital research support for our rural, minerals and energy industries, as well as playing a major role in the development of Australia's manufacturing and information-based industries. These are areas in which CSIRO must play a major role.

To encourage the Organisation to improve its links with industry, the Government has set a target for external income (ie funds from other than its direct Budget appropriation) of 30 per cent. This is a modest target by international standards and recognises that a significant proportion of CSIRO's research is of broad public benefit and the need to maintain a core of long term, strategic research. To assist it to reach this target, the Government has decided that CSIRO will now retain all external income without reductions in its Budget appropriation. This decision, taken in March 1989, boosted CSIRO's base funding by $2.1 million, $6.6 million and $11.6 million, respectively, in each of 1988-89, 1989-90 and 1990-91.

As a further commitment to enhancing the strength of the 1989 public research sector, the Government began a program in March to replace obsolete equipment in government research organisations, with $5 million for CSIRO in 1988-89. The Government has now decided to allocate a further $90 million over the next five years for equipment and priority projects. The allocation of this $90 million will be decided by the Board of CSIRO, which is in the strongest position to weigh up the relative research importance of a range of technologies such as gene shears, vaccine and biological control, food processing, and other areas competing for funds.

ANSTO and AIMS

Recent government decisions on budget continuity and retention of external revenue have given the Australian Nuclear Science and Technology Organisation (ANSTO) and the Australian Institute of Marine Science (AIMS) the ability and incentive to raise revenue from industry and external sources. As part of the March statement to

allocate additional funds for equipment in government laboratories, ANSTO received $0.5 million and AIMS received $1.1 million. The Government has now allocated a further $2.5 million to ANSTO and $2.5 million to AIMS for new equipment and reserch over the next five years.

Marine Science and Technology

A recent review of Australia's marine industries and marine science and technology capabilities by a committee chaired by Professor Ken McKinnon has identified Australia's achievements, strengths and commercial advantages. I am tabling the Executive Summary of this report and the Government's response to the recommendations. The Government believes that industry development should be targeted to areas in which Australia has particular opportunity and where industry is a willing partner.

The Government has decided to provide an extra $3.9 million for these activities (including additional staff and new projects) over the next five years. In addition, the Minister for Primary Industries and Energy (Mr Kerin) will be announcing details of an extra $2 million for the Bureau of Mineral Resources to maintain its marine seismic exploration capability at the highest standard. The Prime Minister has already announced support for a tidal measurement network and $1.8 million over four years under the greenhouse research initiatives.

Higher Education

The Government has already allocated additional resources to expand the higher education system. During the 1989-91 triennium, an additional $843 million is provided to create 49,000 new places in higher education. Growth will be directed primarily towards priority fields such as engineering, computing, business and management studies. Funds of $430 million will be provided during the triennium to meet capital requirements. In addition a one-off special injection of $19 million has been provided in 1989 for urgent renovation needs.

The Government will increase the resources available for allocation to higher education institutions and researchers on the advice of the ARC.

A total of $977.9 million will be allocated through the ARC over the next five years, an increase of $466.4 million over 1989 funding levels. This will be achieved by a major injection of new funds and by continuing the transfer of funds from institutional operating grants to the ARC. New funds will total $254.4 million over the next five years with $56.9 million going to increase support for postgraduate research students and the remaining $197.5 million to develop the capacity of higher education institutions to support high quality research.

Health and Medical Research

Australian medical researchers working in universities, research institutions and hospitals have won international acclaim and earned Australia a proud record for excellence including the Nobel Prizes won by Florey, Burnet and Eccles. Discoveries by Australian researchers have had a major impact on diagnosis and care.

The National Health and Medical Research Council (NHMRC) has received increased funding for medical research throughout the term of the Hawke Government.

To maintain Australia's very strong international record in medical research, the Government will also provide the NHMRC with an additional $39.8 million over five years to upgrade and replace obsolete biomedical equipment and introduce new areas of research. The NHMRC will now also allocate a proportion of the funds which have been transferred from higher education operating grants to the ARC.

Greenhouse Research

The Government has decided to support a national greenhouse research program so we can better understand and respond to greenhouse-related climate change. As announced by the Prime Minister, it will provide $7.8 million during 1988-89 and 1989-90 for policy support and for research principally by CSIRO and the Bureau of Meteorology.

Human Resources

I now turn to the key resource of the science base, its people; researchers, engineers, technicians and students.

Science and technology depend on the excellence and creativity of individuals and groups of individuals. Without such creativity no amount of money will produce results. If science and technology is to flourish in Australia, first-class minds must be attracted to its pursuit, and they must be offered the chance for intellectual development and a supportive work environment.

There is an unfortunate perception that science is difficult, remote, unrewarded and unrecognised. This is unfortunate because the opportunities for using a background in science and technology in interesting careers are much wider than just as professional scientists or engineers.

A range of initiatives has been taken to encourage students to remain in education and training, particularly in science and related courses. For example, the Commonwealth Government in cooperation with the States is promoting curriculum development in mathematics and science on a national basis. Specific strategies have been put in place to encourage more women to take mathematics and science at senior secondary level.

One recent initiative is CSIRO's introduction of a cash bonus scheme to pay a substantial proportion of royalties earned on CSIRO's projects to reward individual research scientists and teams for excellent research. The full bonuses under this scheme which became effective from July 1988, will be paid to CSIRO scientists in July-August this year.

Over the next five years the Government will upgrade the Postgraduate Awards Scheme. In 1990 the Government will make available $31.8 million sufficient to provide for 1450 continuing research scholarships and 900 new research scholarships. From 1990 all Commonwealth Postgraduate Research Awards will be provided tax-free at a minimum level of $12,734, equivalent to a taxable level of $15,000, compared to the current level of $10,415. Institutions will have the flexibility to set stipends above this level up to $16,433 (equal to $20,000 taxed) according to their own research priorities and local needs.

In addition, 30 new industry research scholarships will be available each year to link directly with industry. It is intended that by 1992 there will be a pool of about 80 or 90 of these awards.

Further details will be given in the statement by the Minister for Employment, Education and Training (Mr Dawkins).

The Minister for Community Services and Health (Dr Blewett) will be announcing extra support for Australia's health and medical research force, and for postgraduate awards costing $5.7 million over five years.

The importance of public understanding of the central role which science and technology can play in economic growth and improved social welfare has already been described as crucial to the Government's policy objectives. To address these issues, the Government set up the Commission for the Future (CFF) to study and advise on the impact of science and technology as we prepare to enter the 21st Century.

The Government has decided to support initiatives which further enhance public awareness of science and technology. It will create the Australia Prize, worth $250,000 tax-free annually. This Prize will be an international award for scientific excellence in promoting the welfare of the peoples of the world. The Government will also increase support for prizes for scientific journalism.

Discussions with leaders of Australian industry have indicated willingness to become involved in raising the nation's long-term scientific capacity and creating the industrial infrastructure needed for the future. The Government has therefore established an Industry-Science Foundation to create a mechanism which will alert business leaders to opportunities for long-term patient capital investments in research-based products and services.

These and other initiatives to improve the public awareness of science will receive $4.0 million over the next five years.

Management and Coordination of Science and Technology

The breadth of the Government's responsibilities in science and technology has persuaded the Government to review its coordination and consultation arrangements.

The Prime Minister (Mr Hawke) has already announced the formation of the Prime Minister's Science Council and the appointment of a Chief Scientist. In addition at the officials level and complementing the work of the Prime Minister's Council, the Coordination Committee on Science and Technology will be chaired by the Chief Scientist with the Chief Science Adviser in the Industry, Technology and Commerce portfolio as deputy chair. It is appropriate to announce the appointment of Professor Michael Pitman, OBE, FAA, to that very important role. This Committee will bring together senior officers from all departments with an interest in science and technology to share information about their programs, policies, problems and opportunities.

This management mechanism will ensure that coherence of policy is maintained and that government science and technology objectives are achieved efficiently.

The Minister for Primary Industries and Energy (Mr Kerin) will be introducing arrangements for a Primary Industries and Energy Research Council to provide high-level representation for R&D in the portfolio and to establish a consultative link with other major science and technology bodies and forums.

The Government accepts that its central role in science and technology means that the decisions it takes will be major influences on developments. However, in accepting the responsibilities this role brings, the Government has rejected any notion that it should dictate in detail the pattern of Australian science and technology. The establishment within CSIRO and other research agencies of independent boards of management reflects this policy.

The Government has aimed to have decisions taken by those best qualified to make the complex judgements required: research managers, researchers themselves and users of research.

The Government is keenly aware that the scientific community is capable of offering useful advice and many worthwhile ideas. There are a variety of forums for this purpose including the Australian Science and Technology Council (ASTEC), the boards of government research establishments, the ARC and its associated committees and the learned academies. Ultimately, the kinds of efforts required if science and technology are to play the role envisaged for them by government are only likely to be made by people deeply committed to the enterprises in which they are engaged.

Funds are limited and we need to make hard choices about priorities. We must be prepared to recognise and support excellence and contribute to world science as we have in the past. We need far more research-industry interaction, but it must be a two-way process.

Government recognises that research is a high-risk activity, where final outcomes are uncertain. Funds are limited and we need to make hard choices about priorities.

We need to clarify the issue of who pays for what. As the work in R&D is advanced toward *production*, it becomes clearly the responsibility of industry. Government should provide the national contribution to long-term research, while recognising that government research organisations (and higher education institutions) ought to be increasingly involved as a resource in industry collaboration, at industry's expense. In the United Kingdom and Canada there has been an increasing emphasis on ensuring that government expenditure is directed towards long-term generic research which contributes to the knowledge base and is generally available, while industry should be taking up and funding near-market research. However, in the United States, Europe and Japan, many major corporations are now undertaking much fundamental long-term research in new areas, long in advance of the identification of products or processes.

Increasingly, the economic performance of modern nations is judged on the basis of their capacity to exploit new developments in technology—to capitalise upon brain power and scientific expertise. To secure maximum benefit for the community the importance of linkages between the development of new knowledge and the ways in which such knowledge can be used must be recognised. Innovation is the means by which we capture the benefits which science and technology may yield. The generation of new products and processes requires that research and development activities be fully integrated into the innovative processes of individual companies.

The sheer complexity of science, in an age of ultraspecialisation, makes policy responses very difficult. Most Australians would admit to a

degree of scientific illiteracy. We tend to downplay the importance of things we do not understand. The result has been that our collective response has sometimes been rather slow: witness our rejection of computers and transistors in the 1950s.

Conclusion

This statement demonstrates the Government's commitment to science and technology as an investment in our nation's future.

Science and technology are an integral part of government policies for structural adjustment of the Australian economy, for education, health and defence and for the environment.

The Government's decision to increase expenditure substantially on science and technology by $390 million over five years, and to forego significant revenue at a time of financial restraint, shows the depth of its commitment, about $1 billion overall.

The Government's policy regarding science and technology is based firmly on achieving a better balance between government and business enterprise-funded R&D. The incentives to industry will encourage increased investment in R&D, and increased use of Australia's technological achievements.

Government policy also recognises the need for high-quality long-term research to provide new ideas and new industries of the 21st century.

In this statement, the Government has made its commitment. Successful implementation of these strategies will need an equally vigorous commitment from researchers and from research organisations, higher education and industry.

We need to add science and scientific method to our culture, both publicly and privately, to recognise its achievements and to see its achievers as role models, to talk it up, and make it part of our lives. This statement is the first step.

I present the following statement.

SECTION 1: BACKGROUND

The purpose of this statement is to provide an overview of the Government's science and technology strategy. It sets out the major issues essential to developing the nation's scientific and technological capacity and enhancing its contribution to meeting national needs.

The importance of science and technology

Science and technology have created the modern world and increasingly influence our society and shape its progress.

Science and technology - including engineering - are fundamental to:

- generation of economic growth with equity
- the health and well being of Australia's citizens
- protection of the environment and responsible use of Australia's natural resources
- an appropriate role and image for Australia in world affairs
- the maintenance of national security, and
- concern for human values and culture.

Science and its applications have a central role to play in achieving an internationally competitive Australian economy. Science and technology, properly employed, can ensure that Australia's industries are at the forefront of world performance, providing a strong competitive advantage. In the primary sector science and technology can add value to the nation's mineral and agricultural resources by advancing production techniques and downstream processing.

In the manufacturing sector, science and technology provide opportunities for developing a wide range of new industries and products and increasing efficiency in existing industries. In the services sector science and technology are of critical importance, particularly in developments such as information and communications technologies.

Australian medical researchers working in universities, research institutions and hospitals have won international acclaim and earned Australia a proud record for excellent research. Discoveries by Australian researchers have had a major impact on diagnosis and care.

In addition, Australian-made scientific and medical instruments have had considerable success, with some achieving significant market positions. For example, pacemakers manufactured by Nucleus have a significant share of the world market. There are numerous other examples.

Besides its intellectual capital, Australia's environment and natural resources are its most important assets. Knowledge of the environment and the impact of technologies are crucial to ensure an appropriate balance between environmental and economic objectives. We need, through science, to increase our understanding of Australia's unique plants, animals and ecosystems.

Australia's science and technology effort makes a major contribution to the nation's position as a responsible member of the international community. Australian scientists have a high profile in a number of global scientific endeavours including meteorology, radio astronomy, Antarctic research and international health programs. Within our region, Australian research and technical expertise play a vital role in cooperative activities in agriculture, resource management and environmental problems.

Australia's security also depends critically on using the most modern military equipment. Science and technology contributes to developing and utilising defence systems and to understanding how international developments in this area affect the strategic balance.

Since science and technology are potent factors in determining social change, there is a pressing need to raise awareness in the community of developments in this field, and to understand the impact these changes have on cultural attitudes.

It is important for the Government to look for the most appropriate ways to address these issues when it is formulating social policy. Informed public debate about science and its implications is the best way to form and communicate community attitudes toward science and its impact on society. But to enhance public debate on science, we must raise the level of scientific and technological literacy in our community.

The continuing need for change

While developments in science continually shape our society, prevailing cultural, social and economic conditions determine the direction, speed and the level of development of scientific knowledge. At present there are significant shifts in the demands which society is making on science. Society is looking increasingly to science and technology to provide knowledge and understanding to underpin economic development and to contribute solutions to new and pressing concerns.

When first coming to office the Government recognised that realisation of its vision of Australia's future required many fundamental changes to Australian attitudes and institutions.

The Government has, since coming to office, sought such change, taking direct action where it could and encouraging broad recognition of the need for change. This need for change in attitudes and institutions is no less evident in science and technology than in other spheres of Australian life.

The Government has sought to encourage major science and technology institutions to be more conscious of and responsive to society's needs and aspirations. Our most urgent concern has been to involve science and technology fully in improving Australia's economic performance. Although much remains to be done, this process is now well under way.

Change is never easy for those involved. Reorientation of funding for CSIRO, for example, has necessarily caused difficulties. Its direct budget allocations have been reduced in real terms both to reflect and encourage a move to greater external funding and industry linkages, and to contribute to the Government's general budget tightening. This has inevitably limited funds for some areas of research with some consequent effects on morale.

In a process of change there must be continuous monitoring. A number of reviews and investigations of science and technology capacity have recently provided government with advice and information. These have revealed concerns about employment conditions necessary to attract and retain high calibre scientists, technicians and engineers and the need to increase business and community awareness of science and technology's importance to the nation's well being, as well as the level of support for research infrastructure, linkages between various groups and individuals in the scientific community and industry, and increased participation in international research. Announcing the Government's response to these investigations presents an excellent opportunity to present in a single statement the diverse elements of our science policy.

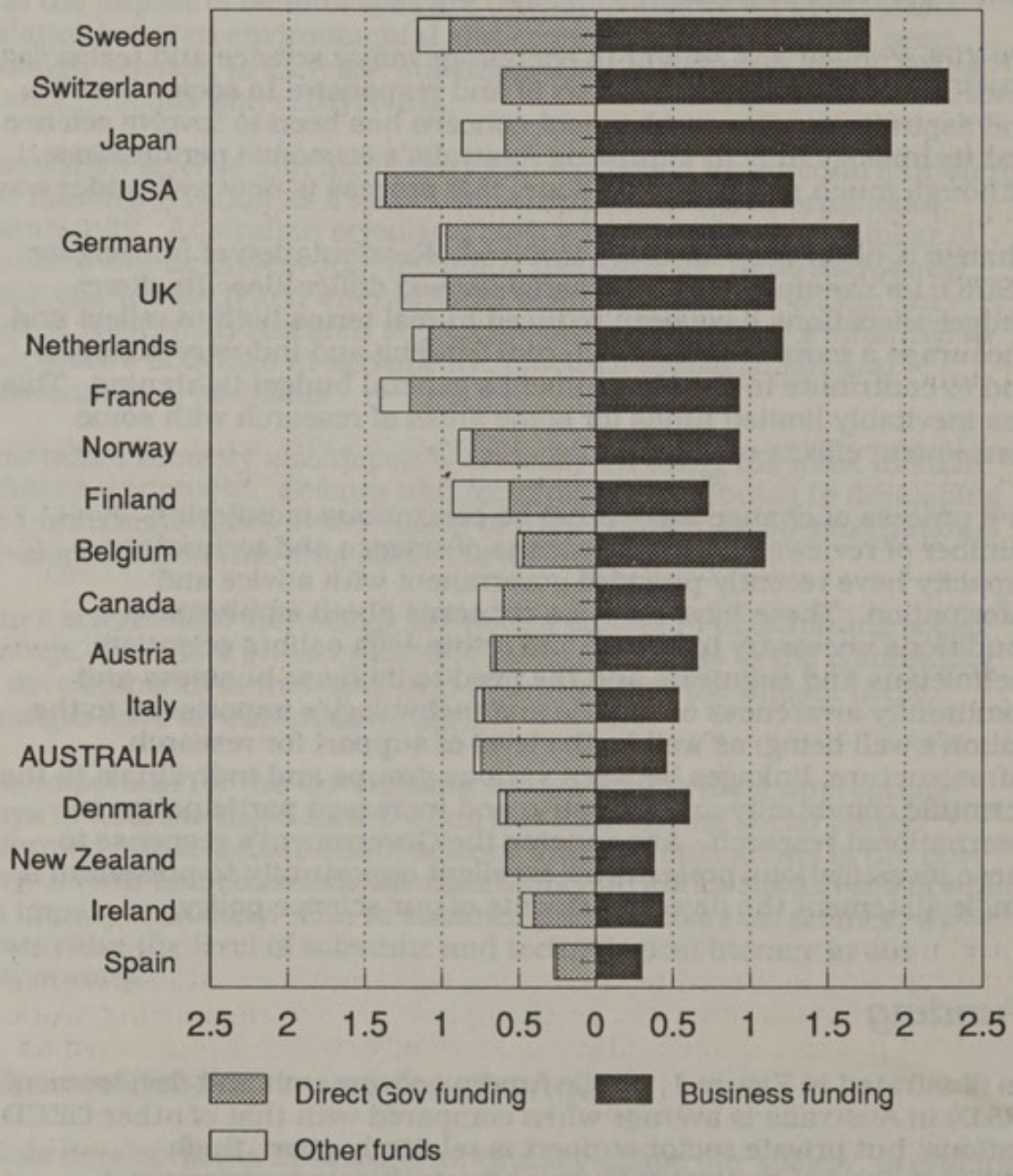
Funding

As illustrated in Figure 1, public funding of research and development (R&D) in Australia is average when compared with that of other OECD nations, but private sector support is relatively poor. Such comparisons are important because Australian industries must compete with those of other countries on world markets. In Sweden, Switzerland and the Netherlands, the proportion of industry investment in total R&D is 60 per cent, 79 per cent and 50 per cent respectively.

Figure 1

INTERNATIONAL COMPARISON OF LEVELS OF SUPPORT FOR R&D AS A PERCENTAGE OF GDP

(latest available year)



Public funding of R&D in Australia is average when compared with other OECD nations. Private sector support in this area, however, is relatively low.

Source: Science and Technology Indicators Section, Department of Industry, Technology and Commerce, from OECD and national data.

In 1978-79, Government contributed 79 cents in every research dollar, compared with industry's 21 cents. This ratio was quite unbalanced, reflecting in part the reluctance of a then closeted manufacturing sector to invest in indigenous R&D. This reluctance was particularly serious in 'development', where costs tend to be far higher and the process more protracted, than in 'research'. By 1986-87, the proportion was healthier, with the Government share being 63 cents in every research dollar, compared to industry's 37 cents. By the mid 1990s, we should aim for a more even balance of contribution to R&D investment.

Changing this balance in Australia's R&D spending is essential, and the trend is in the right direction. However, there are still problems with the overall amount of research funding which will require a concerted effort by both industry and government if we are to produce the critical mass of activity which will make Australia a significant contributor to, and beneficiary of, world science and technology in the 21st Century. For many countries R&D amounting to 2 per cent of Gross Domestic Product (GDP) has been seen as a minimum critical mass. For Australia to achieve a similar figure with balanced contributions from government and industry, industry would need to more than double its R&D funding as a proportion of GDP.

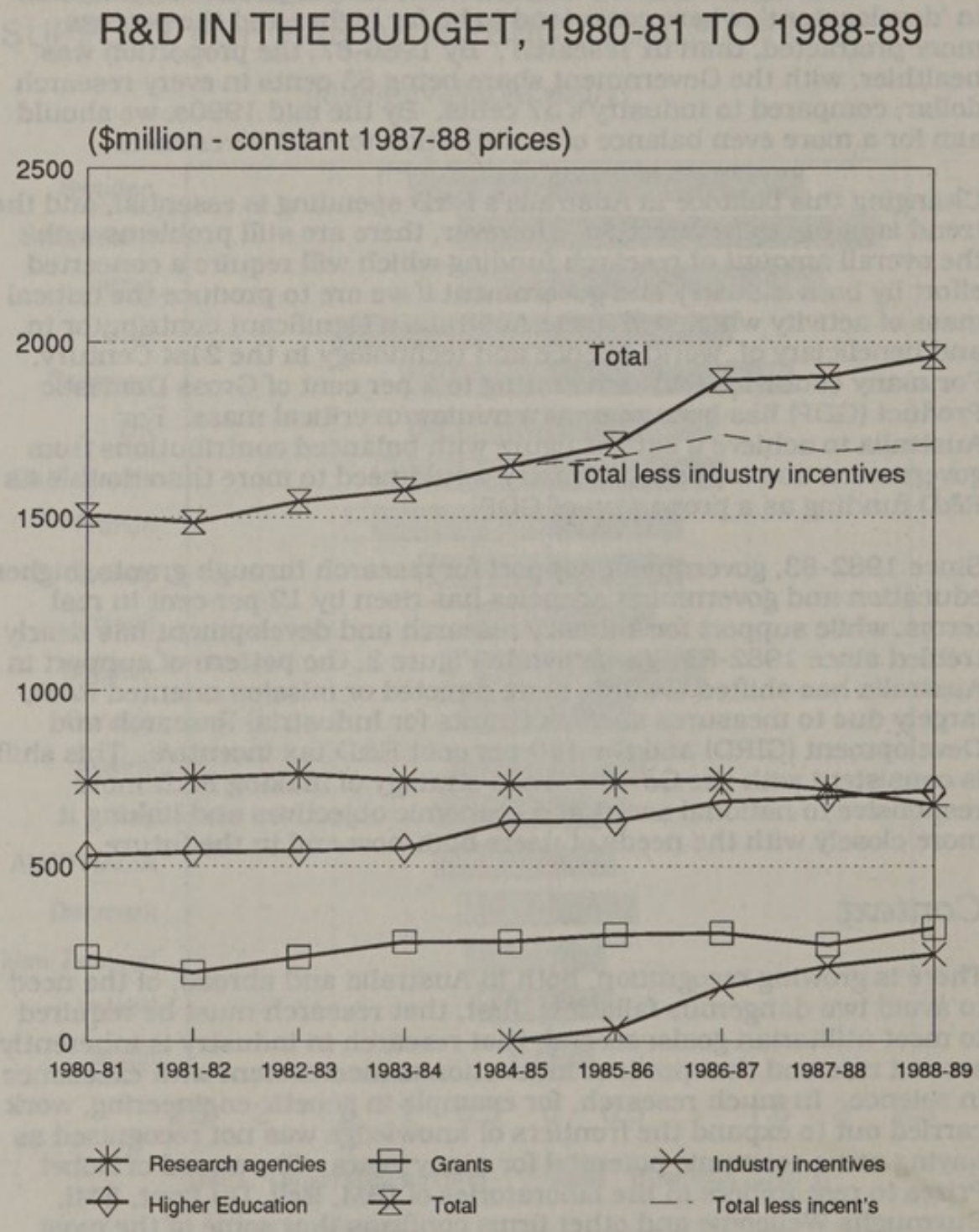
Since 1982-83, government support for research through grants, higher education and government agencies has risen by 12 per cent in real terms, while support for industry research and development has nearly trebled since 1982-83. As shown in Figure 2, the pattern of support in Australia has shifted towards more directed or mission oriented R&D, largely due to measures such as Grants for Industrial Research and Development (GIRD) and the 150 per cent R&D tax incentive. This shift is consistent with the Government's strategy of making R&D more responsive to national social and economic objectives and linking it more closely with the needs of users both now and in the future.

Context

There is growing recognition, both in Australia and abroad, of the need to avoid two dangerous fallacies: first, that research must be required to meet utilitarian goals; second, that research in industry is inherently second rate and that product innovation is inconsistent with excellence in science. In much research, for example in genetic engineering, work carried out to expand the frontiers of knowledge was not recognised as having some economic potential for many years. The award of Nobel Prizes to researchers in the laboratories of IBM, Bell, Du Pont, EMI, Burroughs Wellcome and other firms confirms that some of the most intellectually challenging work anywhere is being carried out in industry.

The pursuit of curiosity-driven, basic research is essential to the survival of rich and lively science and technology in Australia. It provides the best training ground to stimulate and enthuse young

Figure 2



While the Government's total support for R&D has increased significantly in real terms since its election, the balance of support has shifted.

Source: Science and Technology Indicators Section, DITAC, from Budget papers and related sources.

scientists. However, the relationship between science and technology is very complex. Science provides the foundation of knowledge and skill formation which makes technology possible - it provides a context of continuity with past experience and future capability. Investment in science helps to provide the core capacity which is an essential precondition to the next stage of development in technology. If science is long-term and cumulative, technology is immediate and perishable in a context of market volatility, and frequent incremental change.

The distinction between 'fundamental' (or basic), 'strategic' and 'applied' research, while convenient, is increasingly blurred in practice because the categories overlap: they are indeed part of a continuum. The labels 'long-term research' and 'short-term research' may be more appropriate. The concept of 'relevance' in research is also increasingly dubious. When the frontiers of knowledge are pushed forward rapidly, areas which seemed remote or irrelevant a few years ago are now at the forefront of research by universities and corporations - for example, work on AIDS, superconductivity and the greenhouse/ozone phenomena.

There is a complex and unpredictable interaction between long-term and short-term research. In addition, there can be important synergistic effects between research projects which are advancing the frontiers of knowledge in different disciplines. For example, interdisciplinary cancer research - including physics, chemistry, biology and computer modelling - appears to have been even more productive than narrowly focussed biological or physiological approaches.

Funds are limited and we need to make hard choices about priorities. We must be prepared to recognise and support excellence and contribute to world science as we have, for example, in medical research. We need far more research-industry interaction, but it must be a two-way process.

In research institutions generally, there must be flexibility and a capacity for redeployment as new areas of interest emerge (eg AIDS) and other areas become of declining interest (eg smallpox). Nevertheless, to attract and retain the best people, it is essential to have a reasonably long term security about the environment in which research decisions are made.

We need to clarify the issue of who pays for what. As the work in R&D is advanced toward *production*, it becomes clearly the responsibility of industry. Government should provide the national contribution to long-term research, while recognising that government research organisations (and higher education institutions) ought to be increasingly involved as a resource in industry collaboration, at industry's expense. In the United Kingdom and Canada there has been an increasing emphasis on ensuring that government expenditure is directed towards long-term generic research which contributes to the knowledge base and is generally available, while industry should be

taking up and funding near-market research. However, in the United States, Europe and Japan, many major corporations are now undertaking much fundamental long term research in new areas, long in advance of the identification of products or processes.

Increasingly, the economic performance of modern nations is judged on the basis of their ability to exploit new developments in technology - to capitalise upon brain power and scientific expertise. To secure maximum benefit for the community the importance of linkages between the development of new knowledge and the ways in which such knowledge can be used must be recognised. Innovation is the means by which we capture the benefits which science and technology may yield. The generation of new products and processes requires that research and development activities be fully integrated into the innovation processes of individual companies.

Australia has a record of failing to recognise the significance of discoveries in Australian laboratories: witness our rejection of the "black box" flight recorder, computing and transistors in the 1950s which set us back 30 years in electronics. We need widespread changes in attitude to turn this pattern around.

Throughout its term in office, the Government has been guided by the recognition that successful research depends on highly motivated and thoughtfully directed effort by individuals and groups. The Government sees its task as the provision of an environment which will encourage such creativity, while at the same time ensuring that these talents are used in a manner which will bring maximum benefit to the nation. There needs to be sufficient skilled scientists and technologists working in adequately equipped facilities.

SECTION 2:
THE GOVERNMENT'S STRATEGY

Science and technology encompass a wide range of activities and involve a corresponding wide range of portfolios, programs and policies. Over the last six years there have been strong themes running through all aspects of government science and technology policy which reflect the strategic decisions that have been made about the best approach to managing Australia's science and technology effort. This strategy is not hierarchical, driven by a simple, single objective, but recognises the richness of the range of activities comprising science and technology. The Government's strategy can be presented under four broad headings:

- Central role of science and technology in achieving national objectives
    - government recognition of the essential role of science and technology in a diverse range of activities
- Management strategy
    - promoting links between research and users
    - pursuit of excellence
    - increase in overall funding of research and development
    - responsibilities of research managers
- Human resources strategy
    - creativity
    - training
- Science and technology and the wider community

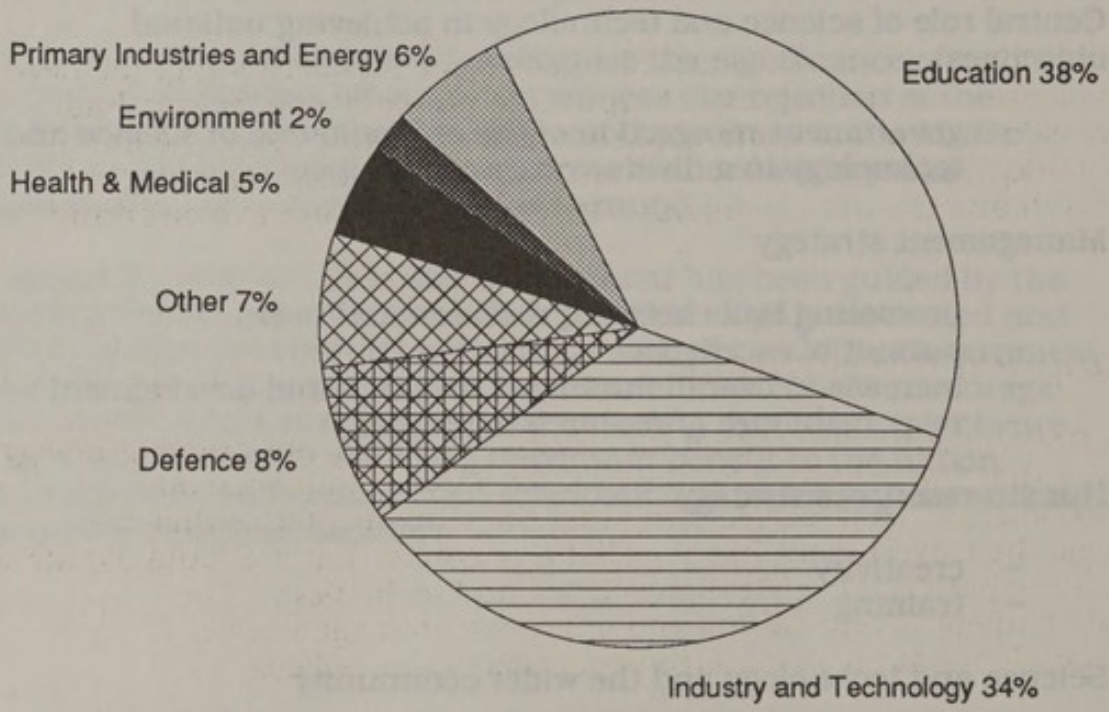
Central role of science and technology

The recognition that science and technology play a central role in achieving national objectives is fundamental. It is from this recognition that the attention given by government flows. At its most general this involves acknowledging that economic and social development in the modern world is dominated by science and technology and its approach to problems, and no government can afford to do other than give it a central place. The vitality and strength of science and technology in Australia will be key determinants of the success of the Government in achieving a broad range of policy objectives.

Recognition of this can be seen in the range of government portfolios with a strong interest in science and technology: particularly the Industry, Technology and Commerce Portfolio; Education, Employment

Figure 3

ESTIMATED COMMONWEALTH SUPPORT FOR R&D - 1987-88



R&D TOTAL $1840m

Commonwealth portfolios fund R&D within their areas of responsibility. This figure is based on estimates for 1987-88. It includes indirect expenditure by DEET of about $490 million (the estimated R&D component of higher education funding) and revenue foregone through DITAC of about $150 million (the estimated cost of the industrial R&D tax incentive).

Source: Science and Technology Statement 1987-88.

and Training; Community Services and Health; Primary Industries and Energy; Arts, Sport, the Environment, Tourism and Territories and Defence. In the Prime Minister's portfolio the Australian Science and Technology Council (ASTEC) provides independent analysis of a range of science and technology matters.

Crucial elements of science and technology across a wide range of research activities are supported from public funds totalling nearly $2 billion. The main features are shown in Figure 3. This public support is important for at least two reasons: to allow a range of basic research activities, fundamental to the growth of knowledge in science; and to support research which may not lead to direct commercial applications for a number of years, or which may have diffuse benefits. Such research is seldom conducted by private firms because of the commercial risks involved.

In addition to these well established cases for public funding, the need for scientific and technological input into public policy making has increased dramatically and is likely to continue to do so. The moral and ethical issues raised by certain kinds of medical and biological research and the management of the environment are two clear and important examples.

Management strategy

The Government accepts that its central role in science and technology means that the decisions it takes will be a major influence on developments. However, in accepting the responsibilities this role brings, the Government has rejected any notion that it should dictate in detail the pattern of Australian science and technology. The establishment within CSIRO and other research agencies of independent boards of management reflects this policy.

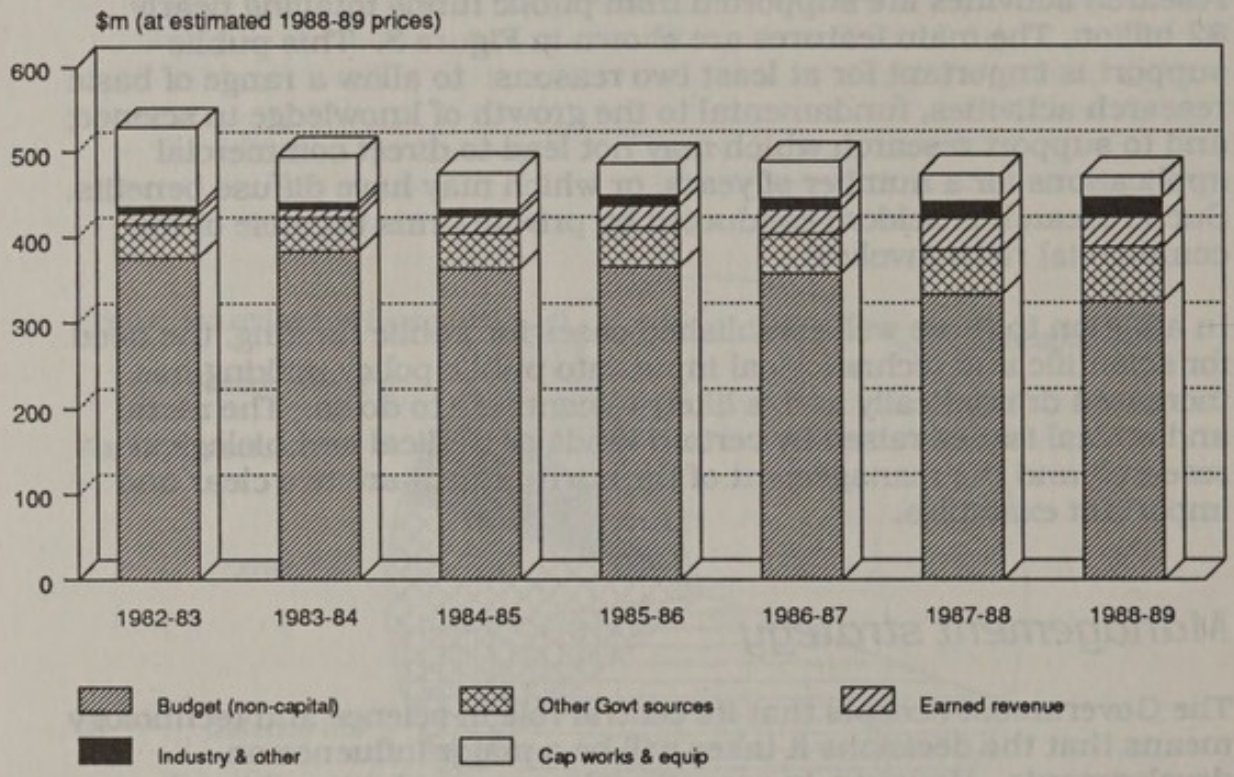
In this regard two important objectives have been addressed: the pursuit of excellence and the encouragement of closer cooperation between researchers and users of that research.

The first is driven by the constraints imposed by scarcity of resources, a recognition that skilled people and excellent work are valuable in their own right, and that an explicit policy of rewarding excellence will provide an incentive and a benefit to the science and technology community.

The pursuit of excellence has been encouraged by an increasing reliance on competitive funding programs such as those for industry R&D (GIRD), energy research (NERDDC), medical research (NHMRC), rural research (RIRFs) and, most importantly, by the creation of the Australian Research Council (ARC) which supports research in the higher education sector. The ARC recommends research grants to

Figure 4

CSIRO FUNDING



Details of CSIRO's total expenditure, including that from non-government sources of funds.

Source: Science and Technology Indicators Section, Department of Industry, Technology and Commerce, from CSIRO and Department of Finance data.

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individuals and groups of academics selected on a competitive basis for resources additional to the resources available through their own institutions. While the Government recognises that much basic research requires public funding on a long term basis it believes that competition for grants ensures that the best researchers are funded. The Government believes that this approach to funding enhances the overall benefits flowing from effective government support of science and technology.

One recent initiative to ensure that scientists are adequately rewarded for outstanding research is CSIRO's introduction of a cash bonus scheme to pay a substantial proportion of royalties earned on CSIRO's projects to individual research scientists and teams for excellent

research. The full bonuses under this scheme, which became effective from July 1988, will be paid to CSIRO scientists in July-August this year.

Efforts to encourage closer cooperation between researchers and users of research have taken place on two complementary fronts. Perhaps most contentiously, the Government is encouraging publicly funded research bodies to link research activities more closely to the needs of users and to seek increased funding from them. In some cases, for example in CSIRO, this has involved internal reorientation (see Figure 4) which has not been achieved without effort. The incentive to seek new sources of funds outside government encourages those working in science and technology to seek and be receptive to offers of partnership with industry. The Government acknowledges the efforts that have been made by these bodies, and firmly believes that substantial long-term benefits will accrue to the nation as a result.

An approach complementary to this has been the increase in funding provided through government programs, through programs funded jointly by government and the private sector, and, most important of all, through the substantial increase in private sector activity in research and development stimulated by the generous 150 per cent tax incentive for industry R&D.

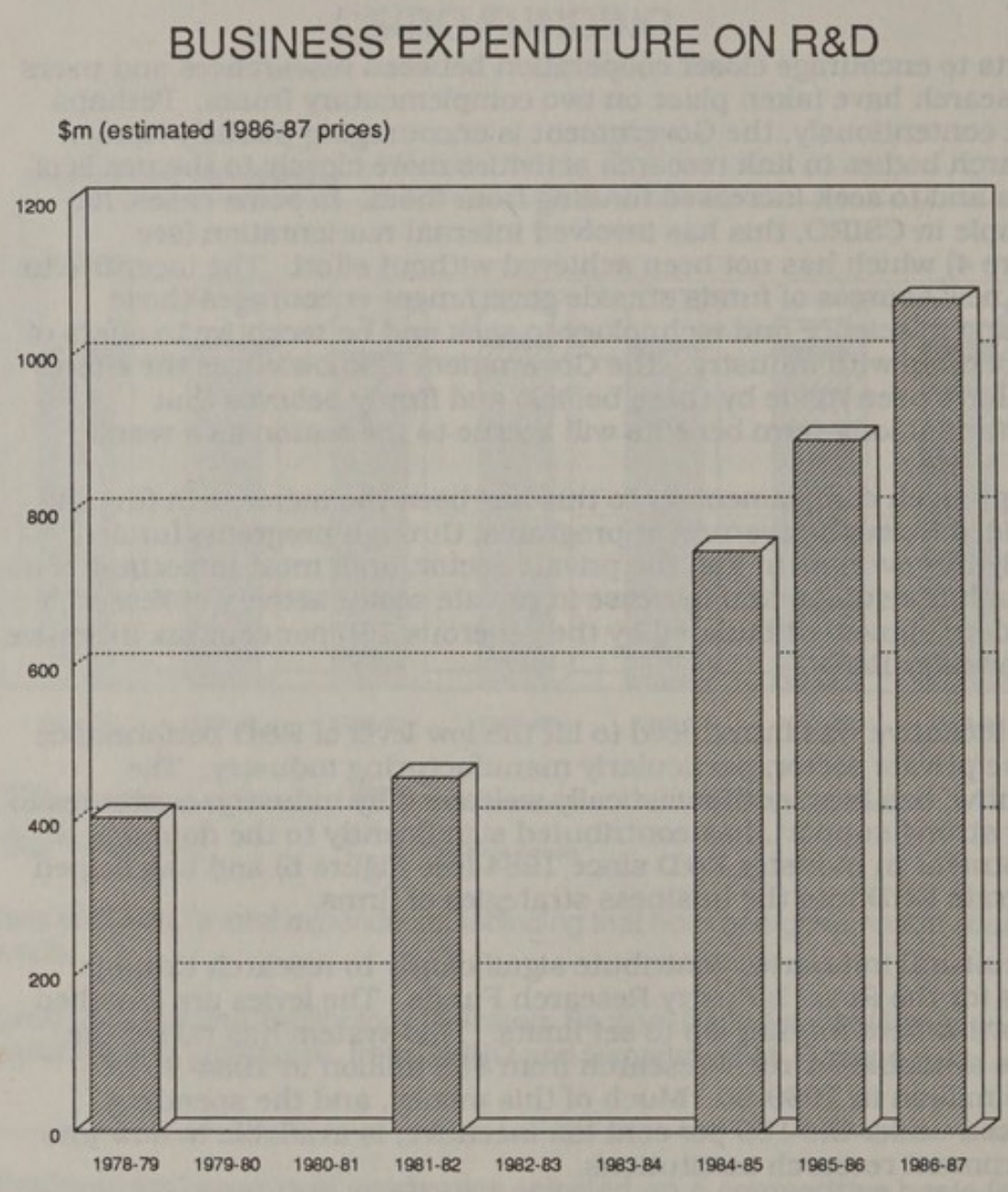
This incentive was introduced to lift the low level of R&D performance by the private sector, particularly manufacturing industry. The incentive has been enthusiastically welcomed by industry, continues to draw strong support, has contributed significantly to the doubling of investment in industry R&D since 1984 (see Figure 5) and has helped integrate R&D into the business strategies of firms.

Agricultural industries contribute significantly to research through levies for the Rural Industry Research Funds. The levies are matched by government funding up to set limits. This system has raised the funds available for rural research from $59 million in 1984-85 to $145 million in 1989-90. Much of this money, and the spending induced under the 150 per cent tax incentive, is available to flow into government research institutions.

The Government has aimed to have decisions taken by those best qualified to make the complex judgements required: research managers, researchers themselves and users of research.

To provide a pattern of incentive and motivation capable of eliciting the best from those involved it is appropriate that they bear the responsibility for the consequences of their decisions, including, of course, reaping any rewards. This has not been commonplace in Australia, and therefore requires a period of adjustment and acclimatisation. But it is essential if research management expertise, including in priority setting and research evaluation, is to be developed.

Figure 5



In recent years there has been a substantial increase in business investment in R&D, but from a low base of about 0.23 per cent of GDP in 1978-79. This had doubled to 0.46 per cent of GDP by 1986-87.

Source: Science and Technology Indicators Section, Department of Industry, Technology and Commerce, from ABS Catalogue No. 8104.

The Government is keenly aware that the scientific community is capable of offering useful advice and many worthwhile ideas. There are a variety of forums for this purpose including ASTEC, the Boards of government research establishments, the ARC and its associated committees and the learned academies. Ultimately, the kinds of efforts required if science and technology are to play the role envisaged for them by government are only likely to be made by people deeply committed to the enterprises in which they are engaged.

Human resources strategy

Science and technology depend on the creativity of individuals and groups of individuals. Such creativity is the well-spring. Without such creativity no amount of money will produce results. If science and technology is to flourish in Australia, first class minds must be attracted to its pursuit, and they must be offered the chance for intellectual development and a supportive work environment.

The Government is mindful of its role in educating and training suitably skilled people to contribute to national development. In this context, the Government has pursued a cohesive strategy of:

- greatly expanding the numbers of participants in higher education
- facilitating the links between skills and knowledge development
- encouraging a balance of skills to reflect the greater need for scientific and technical competence in the coming decades, and
- including capacity for individuals to use skills flexibly in changing economic and social environments.

A range of initiatives has been taken to encourage students to remain in education and training, particularly in science and related courses. For example, the Commonwealth Government in cooperation with the States is promoting curriculum development in mathematics and science on a national basis. Specific strategies have been put in place to encourage more women to take mathematics and science at senior secondary level. The Government is undertaking a detailed review of the education of mathematics and science teachers.

At a more general level, enhanced income support and other measures have encouraged a massive lift in the proportion of students completing a full twelve years of schooling - from 38 per cent in 1982 to 58 per cent last year.

The management strategy outlined earlier aims to create an environment for science and technology which is more competitive and performance oriented. Individual researchers and institutions must

now win a portion of their funding by competing with others against a variety of standards some involving peer review and others commercial criteria.

The best Australian research can now obtain increased support. Rather than threaten the future of Australian science and technology, the Government believes that this kind of environment will both stimulate and reward it so as to enliven and enhance it. Such a system recognises the reality of scarce resources and makes allocations which are, in the long term, in the best interests of the nation.

Science and technology in the wider community

If it is to enrich society, science and technology must be integrated into the broader community. This requires science and technology to be understood by the community, and the research community to have an understanding of society's needs and aspirations.

In recent years in Australia, the strongest case for enhancement of national well-being through increased involvement of science and technology has been in economic restructuring. One of the problems of Australian manufacturing industry has been the undervaluing of indigenous science and technology.

Only in our export-oriented primary sector, used to competing on world markets, is there a tradition of partnership with science and technology to develop a capacity to remain competitive. Through a range of policies including the 150 per cent tax concession, GIRD, tariff reform, the National Industry Extension Service and the Teaching Companies Scheme, the Government has attempted to change the attitudes of Australian industry.

Because the impact of science and technology is so pervasive, informed discussion of a whole range of social and political problems is only possible with a degree of scientific literacy. Examples include AIDS, genetic engineering, nuclear energy, and environmental issues.

To an increasing extent all groups in the community are seeking scientific information and questioning conventional wisdom. The Government also has made increasing demands on scientific advice to fulfil its complex role in areas such as defence, environment, and natural disasters. Agencies such as ASTEC, CSIRO and the Bureau of Meteorology have played a role here, as well as newly established ones like the Commission for the Future and the National Science and Technology Centre.

The attitude of the community to science and technology will feed back, enhancing or undermining the contribution it can make to society generally. The attitude of young people to the prospect of a career in

science and technology is a powerful example. The Government accepts that its own attitude exerts a strong influence on such community perceptions.

Because it is usually performed in large scale high risk projects over several years, precompetitive research often involves a number of countries. Exclusion from such international efforts will see Australia denied timely access to developments at the leading edge. Consequently, technology-based industries are under increasing pressure to cooperate across national boundaries in their research.

In recent years there has been a significant increase in large cooperative international research programs, covering such important areas as information technology and new materials science. Some notable examples include ESPRIT, BRITE, RACE and the Human Frontiers Science Program in which Australia is outstandingly well qualified to collaborate. Another example is the recent commitment between the Australian and Japanese Governments to investigate the concept of a Multi-function Polis in Australia.

SECTION 3: ENHANCING SCIENCE AND TECHNOLOGY CAPACITY

As part of its continuing monitoring of major policy settings, the Government has commissioned reviews of various aspects of science and technology policy. The Smith and Wilson Committees have been examining aspects of higher education. The McKinnon Committee recently completed a review of marine science. The Minister for Primary Industries and Energy has commissioned a thorough review of all aspects of research and development in the portfolio. Cabinet established a Group of Officials to identify the particular difficulties being experienced in science and technology. ASTEC has also just completed a major review of the core capacity of Australian science and technology. These reports contain an enormous amount of useful, detailed information which cannot properly be summarised here. These reports, however, contain a number of themes of general concern.

Among the scientific community there is some apprehension brought about by the changes occurring within science and technology. Although there is broad agreement with the general policy directions, some scientists fear that the Government's commitment is lessening and others that their sectoral interests may be damaged. This is related to a general concern about the perceived lack of a clear statement of the Government's science and technology strategy and adequate mechanisms to coordinate and consult on science and technology policy.

It is a general view that decades of neglect and insufficient funding have led to a rundown in science and technology infrastructure. Human resources are also of concern with difficulties in attracting young people to a scientific career.

Redistribution of funding, particularly in respect of CSIRO and the universities following the creation of the ARC, have raised some concerns. Some institute managers feel they now lack flexibility to respond to the requirement to re-evaluate their priorities.

Frustration continues to be evident from both researchers and research users over the difficulties of cooperating productively. Research users complain that researchers are not interested in addressing their needs. Researchers complain that commerce is not interested in funding research nor in becoming innovative.

The Government takes these expressions of concern seriously and has attempted to provide a response through the measures now announced. Policy development in science and technology is a continuing process

and the Government will be monitoring the response carefully, including by means of the new mechanisms described below.

Advice and coordination

Government's responsibilities in science and technology include parts of the higher education system, government research organisations, and a variety of research programs. Activity occurs in many portfolios because of the diversity and extent of Government involvement in science and technology (see Figure 6).

A major new national forum for consideration of science and technology issues will be created through the formation of the Prime Minister's Science Council. The Council, to be chaired by the Prime Minister, will include other senior Ministers with strong portfolio interests in science and technology, representatives from the scientific community and leading executives from industry.

Others with a particular interest in or ability to contribute to issues before the Council will be coopted for those items. The Council will meet at least twice a year to consider issues of national significance in science and technology.

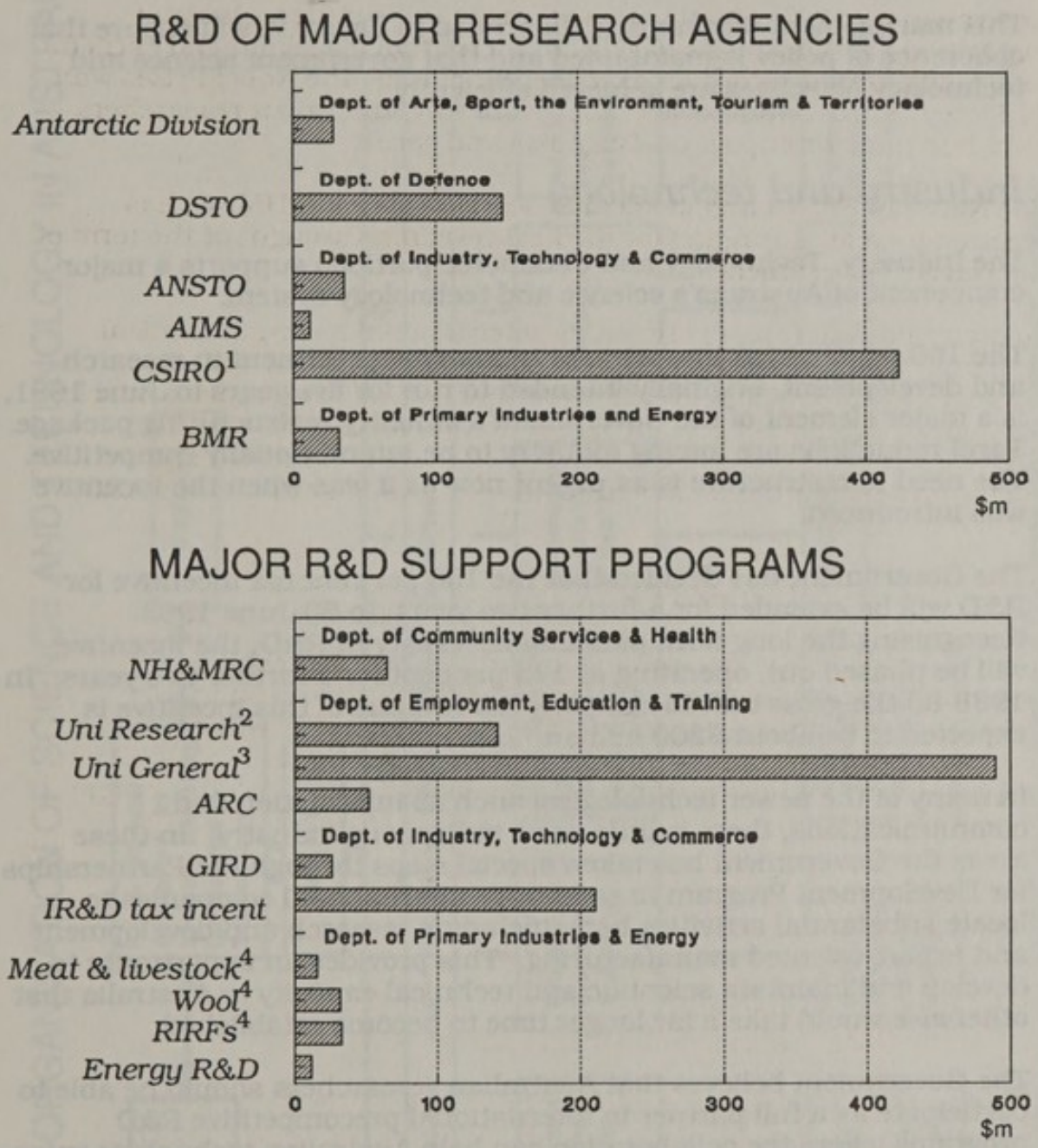
In science and technology matters in general and in the business of the Council in particular, the Prime Minister will be assisted by the Minister for Science, Customs and Small Business who also becomes the Minister Assisting the Prime Minister for Science and Technology. The Minister Assisting will be deputy chair of the Council.

A new position of Chief Scientist will be created within the Prime Minister's portfolio to provide advice to the Prime Minister and the Minister Assisting for Science and Technology. The Chief Scientist will serve on the Prime Minister's Council and act as its Executive Officer, responsible for coordinating the business of the Council.

The capacity of the Australian Science and Technology Council (ASTEC) to provide comprehensive analysis of issues in science and technology combined with its range of contacts with the science and technology community place it in a strong position to contribute to the work of the new Council as well as continue its advisory role. Accordingly, ASTEC's Chairman will be a member of the Prime Minister's Council.

At the officials level and complementing the work of the Prime Minister's Council, the Coordination Committee on Science and Technology will be chaired by the Chief Scientist with the Chief Science Adviser in the Industry, Technology and Commerce portfolio as deputy chair. This Committee will bring together senior officers from all departments with an interest in science and technology to share

Figure 6



These data indicate the relative scale of support for R&D through larger agencies and programs. In some portfolios there are smaller programs, not shown in the figure, which aggregate to significant size. Commonwealth business enterprises such as Telecom Australia (estimated $56 million R&D in 1987-88) are also omitted.

(1) Includes non-government funds and funding from some programs below. (2) Identifiable research funding of universities. (3) Estimated research component of general university funding (GUF). (4) Includes funding from industry levies.

Source: Science and Technology Indicators Section, DITAC, based on estimated 1987-88 data from Science and Technology Statement 1987-88.

information about their programs and policies, problems and opportunities.

This management mechanism, illustrated in Figure 7, will ensure that coherence of policy is maintained and that government science and technology objectives are achieved efficiently.

Industry and technology

The Industry, Technology and Commerce portfolio supports a major component of Australia's science and technology system.

The 150 per cent tax incentive for industry's investment in research and development, originally intended to run for five years to June 1991, is a major element of the Government's industry restructuring package. Tariff reductions are forcing industry to be internationally competitive. The need to restructure is as urgent now as it was when the incentive was introduced.

The Government has decided that the 150 per cent tax incentive for R&D will be extended for a further two years, to 30 June 1993. Recognising the long term planning necessary in R&D, the incentive will be phased out, operating at 125 per cent for a further two years. In 1988-89 the gross cost to company tax revenue of this incentive is expected to be about $200 million.

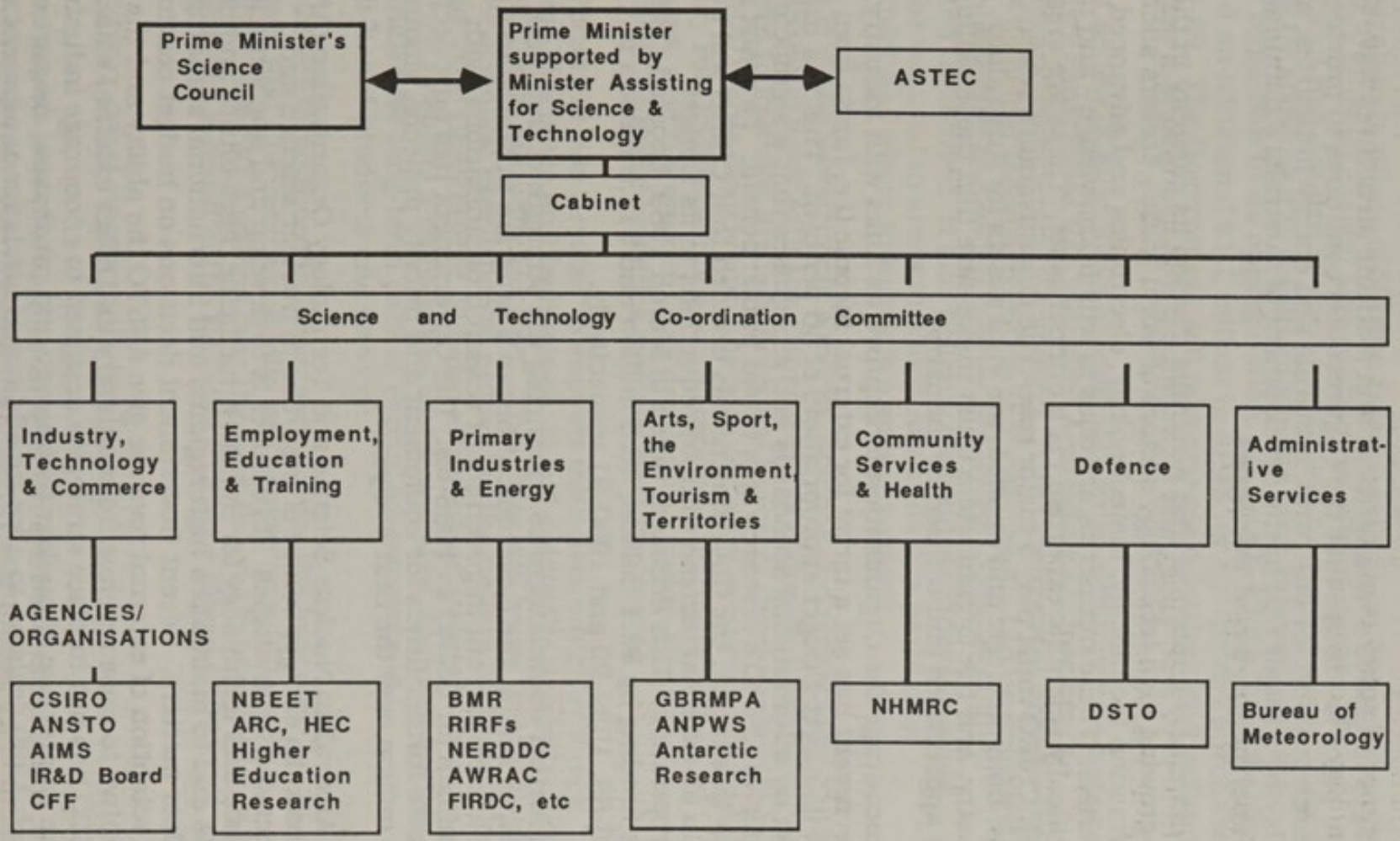
In many of the newer technologies, such as information and communications, there is little or no indigenous industry. In these areas the Government has taken special steps through the Partnerships for Development Program to encourage international companies to locate substantial activities here, including research and development and export-oriented manufacturing. This provides an opportunity to develop and maintain scientific and technical capacity in Australia that otherwise would take a far longer time to become established.

The Government believes that Australian researchers should be able to participate as a full partner in international precompetitive R&D programs where the collaboration can help Australian technology enter world markets. The Government has therefore decided to increase funding for international science and technology by $17.5 million over the next five years, including additional support for Bilateral Science and Technology Cooperation programs.

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) is an independent statutory authority and one of the world's largest and most diverse scientific research organisations. It is a leader in Australia's expanded science and technology effort, and has an excellent track record in strategic and applied research particularly in the agricultural and mining sectors. Industries in these sectors have

Figure 7

COMMONWEALTH ORGANISATION OF SCIENCE AND TECHNOLOGY IN AUSTRALIA



Science and technology is an essential part of a number of Commonwealth Government portfolios

been responsible for the creation of much of Australia's wealth and have had a continuous focus on world markets, with all the opportunities and pressures which that implies.

Changes in CSIRO's management and institute structures have been put in place to ensure that the Organisation continues to provide vital research support for our rural, minerals and energy industries, as well as playing a major role in the development of Australia's manufacturing and information-based industries.

It is extremely important that Australia develop its capacity in the fast-growing high technology sectors of world trade - sectors such as information technology, biotechnology, electronics and advanced materials. These industries are ones in which knowledge - and more specifically scientific expertise - is a critical asset. These are areas in which CSIRO must play a major role. The Organisation's research skills, both strategic and applied, are vital assets for Australian industry, and the Organisation must make sure that these skills are fully appreciated and utilised by industry.

To encourage the Organisation to improve its links with industry, the Government has set a target for external income (i.e. funds from other than its direct Budget appropriation) of 30 per cent. This is a modest target by international standards and recognises that a significant portion of CSIRO's research is of broad public benefit. To assist it to reach this target, the Government has decided that CSIRO will now retain all external income without reductions in its Budget appropriation. This decision, taken in March 1989, boosted CSIRO's base funding by $2.1 million, $6.6 million and $11.6 million in 1988-89, 1989-90 and 1990-91 respectively.

As a further commitment to enhancing the strength of the 1989 public research sector, the Government began a program in March to update obsolete equipment in government research organisations, with $5 million for CSIRO in 1988-89. The Government has now decided to allocate further funds for equipment and priority projects, amounting to $90 million over the next five years.

The Australian Nuclear Science and Technology Organisation (ANSTO) is Australia's major centre of expertise in nuclear science and associated technologies. Its charter is to develop and apply nuclear science and technology for industry, medicine, agriculture and other fields and to maintain a high regional and international standing in nuclear matters. Recent Government decisions on budget continuity and retention of external revenue give ANSTO the ability and the incentive to raise revenue from industry and other external sources. ANSTO has put in place strategies designed to encourage industry to make greater use of nuclear technology and processes. As part of the March 1989 decision to allocate additional funds for equipment in government laboratories, ANSTO received $0.5 million towards the cost

of a tandem accelerator. The Government has now decided to allocate a further $2.5 million over the next five years for new equipment.

The Australian Institute of Marine Science (AIMS) conducts research in Australia's tropical coastal and continental shelf regions. The Government has decided to encourage AIMS to develop closer links with industry by allowing it to retain all income from external sources without reduction in its appropriation. In March 1989, the Government allocated an additional $1.1 million to AIMS for equipment purchased in 1988-89. The Government will now provide a further $2.5 million for equipment and new research over the next five years.

A recent review of Australia's marine industries and marine science and technology capabilities has identified Australia's achievements, strengths and commercial advantages. The Government accepts the Report's principal recommendation that policies should be prepared and implemented to develop further our marine resources and associated industries. It also believes that industry development should be targeted to areas in which Australia has particular opportunity and where industry is a willing partner.

The heads of the Government's marine science and technology agencies will be asked to work with the Department of Industry, Technology and Commerce to examine areas of potential industry development, to bring marine R&D more closely into line with industry requirements and to play a key role in international cooperation in marine science and technology. The Government has decided to provide an extra $3.9 million for these activities over the next five years.

The Government has decided to support initiatives which enhance awareness of science and technology. It will create the Australia Prize, worth $250 000 annually tax free. This Prize will be an international award for scientific excellence in promoting the welfare of the peoples of the world. The Government will also establish an Industry-Science Foundation to create a mechanism which will alert business leaders to opportunities for long-term patient capital investments in research-based products and services.

The initiatives announced in this statement for the Industry, Technology and Commerce portfolio will involve an additional expenditure of $120.4 million over the next five years in addition to the tax foregone as a result of the R&D tax incentive beyond 1991.

Education and research training

The Government has allocated additional resources to expand the higher education system. During the 1989-91 triennium, an additional $843 million (in December 1987 dollars) will be provided to create 49 000 new places in higher education. Growth will be directed

primarily towards priority fields such as engineering, computing, business and management studies. Funds of $430 million will be provided during the triennium to meet capital requirements. In addition a one-off special injection of $19 million has been provided in 1989 for urgent renovation needs.

Further to this expansion of our education system, the Government now intends to increase the resources available for allocation to higher education institutions and researchers on the advice of the ARC. These resources will be allocated to areas where they will be of greatest benefit to the nation. Support must be provided for outstanding researchers and those best able to confront the problems and opportunities facing us.

A total of $977.9 million will be allocated through the ARC over the next five years, an increase of $466.4 million over 1989 funding levels. This will be achieved by a major injection of new funds and by continuing the transfer of funds from institutional operating grants to the ARC. New funds will total $254.4 million over the next five years with $56.9 million going to increase support for postgraduate research students and the remaining $197.5 million to develop the capacity of higher education institutions to support high quality research.

The funds will be allocated on advice from the ARC, in consultation with the Higher Education Council (HEC).

To allow better forward planning the Government will introduce full triennial funding for the ARC, in line with funding arrangements for higher education institutions.

The Government recognises that adequate support for research training is essential to ensure that Australia obtains the numbers of skilled and innovative researchers it will need. It will therefore provide additional funds of $56.9 million over the next five years to upgrade dramatically the Commonwealth Postgraduate Awards Scheme. In 1990 the government will make available $31.8 million sufficient to provide for 1450 continuing research scholarships and 900 new research scholarships. From 1990 all Commonwealth Postgraduate Research Awards will be provided tax-free at a minimum level of $12 734, equivalent to a taxable level of $15 000, compared to the current level of $10 415. Institutions will have the flexibility to set stipends above this level up to $16 433 (equal to $20 000 taxed) according to their own research priorities and local needs.

In addition, 30 new industry research scholarships will be available each year to link directly with industry. They will assist in opening up joint industry higher education research training opportunities, and so lead to closer interaction between the two sectors. It is intended that by 1992 there will be a pool of about 80 or 90 of these awards.

Primary industries and energy

The role of the Primary Industries and Energy portfolio is to foster efficient, innovative and adaptable primary and energy industries. Economic and scientific research in the Department complements its policy advice and administration. Research is carried out through three government bodies: the Australian Bureau of Agricultural and Resource Economics (ABARE), the Bureau of Mineral Resources, Geology and Geophysics (BMR) and the Bureau of Rural Resources (BRR). These together provide independent advice and assist in Government policy development and decision making.

Besides maintaining its internal research work, the Department has concentrated on establishing industry research programs and building industry awareness of the importance of science and technology. For agricultural industries this has been done through the formation of fifteen research councils and three R&D corporations, all of which allocate funds for R&D on a competitive basis. The funds for them derive from industry levies together with Government contributions.

The Department is also responsible for three energy-related R&D programs under the National Energy Research, Development and Demonstration Program, and research programs for fisheries, afforestation, soil conservation and water.

The Government has recognised the need for a more integrated approach to research policy across primary and energy industries. Its statement, *Research, Innovation and Competitiveness*, deals with its research and development arrangements, how they can be made more efficient and effective and continue to produce results that are relevant to industry needs. The changes fall into several areas: funding, coordination and evaluation of research efforts.

The Government has introduced a number of initiatives to improve the funding of R&D in the Primary Industries and Energy portfolio. It has encouraged agricultural industries to increase their levy contributions to at least 0.5 per cent of the gross value of production and will match contributions to that level.

The Government will continue to fund soil and water R&D but will encourage beneficiaries of the research to make a contribution to the cost and will hold discussions with the relevant industries and State governments on this matter.

R&D corporations have proved an attractive model for administering portfolio research programs as they have been more forward-looking about R&D. New corporations will be established for grains and dairy research and the Government will reconstitute the Wool Research and Development Council as a subsidiary R&D corporation under the Australian Wool Corporation. A Natural Resources Research and

Development Corporation will be created. The new Corporation will allocate existing water and soil conservation R&D funds to natural resource management R&D projects. Its charter will also encompass research into the environmental aspects of forestry management.

A new Rural Industries Research and Development Corporation will be established to administer funds under the Australian Rural Research Funds and those existing Rural Industry Research Funds (RIRFs) where it is not practicable to establish separate R&D coprorations or where the industry concerned wishes its RIRF to come under the new Corporation.

To draw together the research which is being carried out among the various research bodies funded by the portfolio, a Primary Industries and Energy Research Council will be created to provide high level representation for R&D in the portfolio and to establish a consultative link with other major science and technology bodies and forums.

The Australian Bureau of Agricultural and Resource Economics is to undertake a number of studies to evaluate the benefits that can be obtained by research.

These changes will guide primary and energy industries' research and development policies over the next three to five years and are expected to have a significant impact on priorities and directions determined for that research and development.

Environment

The Government has already announced support for a national greenhouse research program so we can better understand and respond to climate change. It will provide $7.8 million during 1988-89 and 1989-90 for research and policy support including:

- research by CSIRO and the Bureau of Meteorology on climatic modelling;
- support for the World Climate Impact Studies Program of the United Nations Environment Program; and
- funds for the Academy of Science to participate in the International Geosphere - Biosphere Program.

A National Greenhouse Advisory Committee, comprising eminent Australian scientists, will be established to advise the Government on greenhouse research issues, including details of a greenhouse research grant scheme to begin in 1990-91. The Government is also considering the establishment of a comprehensive national climate program (including enhanced research) linked to the World Meteorological

Organisation's World Climate Program and Second World Climate Conference in 1990.

Decisions on natural resource issues require an adequate scientific base. The Government is further considering the development of environmental databases and ASTEC will undertake a study on the state of Australian environmental research. Government decisions on marine science and technology, referred to earlier, will help support research on our near shore marine ecosystems.

Health and medical research

The National Health and Medical Research Council (NHMRC) has received increased funding for medical research throughout the term of the Hawke Government. The NHMRC has recently established a Public Health Research and Development Committee to foster research into public health issues, such as Aboriginal health, and to train public health researchers.

The Government will further strengthen Australia's health and medical research workforce by attracting and retaining bright young researchers through a program of priming grants to assist the transition from understudy to fully-fledged independent scientist. A senior medical research fellowships and awards program will help attract to Australia eminent medical researchers in high priority areas. In addition, the postgraduate research awards granted by the NHMRC will be increased in number and value at a cost of $5.7 million over five years.

In seeking to maintain Australia's strong international record in medical research, the Government will also provide the NHMRC with additional funding to upgrade and replace obsolete biomedical equipment. The NHMRC will now also allocate a proportion of the funds which have been transferred from higher education operating grants to the ARC.

A unit for research on possible health effects of chemicals used in agriculture, industry and the home is to be established. Priority funding will also be available for research into areas promoting good health such as studies into the effects of lifestyle on hypertension, and for research into the health needs of women and of disadvantaged groups. The Government will address research into AIDS in its forthcoming White Paper on the National AIDS Strategy.

The total increase in funding for medical research through the NHMRC over the five year period to 1993-94 is $45.5 million. This represents a real increase of 18.7 per cent over the period.

Defence

The Defence Science and Technology Organisation (DSTO) is the principal R&D body within the Defence portfolio, and Australia's second largest R&D organisation. DSTO's mission and objectives were revised recently to allow it to provide greater support to Australia's policy of defence self-reliance, chiefly through the establishment of closer links between DSTO and Australian industry.

DSTO is investigating ways to foster key defence technologies, and is responding to the need for a stronger Australian defence industry by involving industry at the earliest possible stage in its R&D activities and by passing full scale engineering development activities to industry.

DSTO is actively pursuing mechanisms, such as contract and collaborative research projects, to improve its interaction with higher education institutions, and is developing a memorandum of understanding with CSIRO to enhance research cooperation between the two organisations.

An Industry Consultative Group has also been proposed to help DSTO identify new defence technologies in which Australian industry can play a major role.

SECTION 4: CONCLUSION

Since science and technology have a central role to play in the nation's future, the Government has moved to integrate these activities fully with other elements of Government policy.

Important initiatives, particularly the formation of the Prime Minister's Science Council, have now been taken to coordinate Government policy in this area.

The decisions to increase expenditure substantially on science and technology by $390 million over five years and to forego significant revenue, at a time of fiscal restraint, show the depth of the Government's commitment. The decisions announced today are summarised in Table 1.

The Government's policy is firmly based on increasing the pool of funds available for science and technology, while achieving a better balance between government and business enterprise funding. Incentives to industry are already encouraging greater use of Australia's scientific and technological capacity.

Government policy will increasingly emphasise the need for high quality, long-term research to provide new ideas and foster a strong core capacity to underpin new and developing technologies.

The strategic approach outlined in this statement has been followed by the Government since it come to office in 1983. The basic approach remains valid. The extensive reviews which have now been completed have highlighted areas where there was scope for improving implementation. The measures announced here address those. The Government will continue to monitor and fine-tune policy as the need arises.

In this statement, the Government has made a commitment to improving Australia's scientific and technological base. Successful implementation of these strategies will need an equally vigorous commitment by researchers, research institutions, higher education and industry.

TABLE 1

ADDITIONAL SUPPORT FOR SCIENCE AND TECHNOLOGY [1]

	1989-90	1990-91	1991-92 to 1993-94 [2]	Five Year Total
	$m	$m	$m	$m
CAREER ISSUES				
Commonwealth postgraduate awards	2.70	8.40	11.40	45.30
NHMRC postgraduate awards	0.80	1.00	1.30	5.70
INFRASTRUCTURE/PRIORITY PROJECTS				
Higher education	10.00	30.00	45.00	175.00
DPIE review of R&D effectiveness; equipment (BMR)	1.30	1.30	0.30	3.50
DCSH training; equipment; new research	4.40	8.10	9.10	39.80
CSIRO equipment; new research	14.00	19.00	19.00	90.00
ANSTO equipment	0.50	0.50	0.50	2.50
AIMS equipment	0.50	0.50	0.50	2.50
Marine science and technology	0.70	0.80	0.80	3.90
PUBLIC AWARENESS				
Prime Minister's Science Council	0.20	0.20	0.20	1.00
Australia Prize	0.25	0.25	0.25	1.25
Special projects	0.55	0.55	0.55	2.75
INTERNATIONAL SCIENCE AND TECHNOLOGY				
Bilateral S&T agreements; precompetitive R&D; Human Frontiers Science Program	3.10	3.60	3.60	17.50
R&D FUNDING				
Continuation of R&D tax incentive [3]				
TOTAL	39.00	74.20	92.50	390.70

(1) All amounts are in 1989-90 dollars. (2) The figures in this column apply in each of the years 1991-92, 1992-93 and 1993-94. (3) To give an indication of the gross cost to company tax revenue of this decision, the amount foregone in 1988-89 is expected to be about $200 million.

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