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Department of Education, Science and Training

Australian Science and Technology at a glance 2005

DECEMBER

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FOREWORD

A strong science and innovation system contributes to Australia's future prosperity through economic growth, social well-being and environmental sustainability. In the modern global economy, Australia's international trade competitiveness depends increasingly on our skills, knowledge and innovation. Therefore it is important to know how well Australia's science and innovation system is performing relative to other countries, so that we can regularly review and adjust our policies to meet new challenges.

Australian Science and Technology at a Glance 2005 is a handy reference source that presents a balanced range of indicators showing the overall structure, trends and performance of the Australian science and innovation system. The indicators cover measures such as expenditure on research and development, patents, research publications and human resources. They also extend to broader issues such as Australia's performance in technology- and knowledge-intensive industries. The indicators are drawn from a range of sources, including the Australian Bureau of Statistics and the Organisation for Economic Cooperation and Development.

Further statistical information that supplements this pocket-sized reference is available on my Department's website at http://www.dest.gov.au/scienceinnovationanalysis/.

The Hon Dr Brendan Nelson MP
Minister for Education, Science and Training

November 2005

TECHNICAL NOTES

The science and innovation system encompasses people, activities, institutions, processes, infrastructure, linkages and collaborations involved in the generation, diffusion and absorption of scientific and technological knowledge. The capability and performance of the Australian science and innovation system is crucial to advancing Australia's future economic prosperity, social development and high-standard quality of life.

Australian Science and Technology at a Glance is an annual publication dedicated to monitoring and evaluating inputs, processes, outputs and impacts of Australia's science and innovation system, tracking its structural shifts and recent trends and measuring its performance in comparison to other countries. In so doing, the 2005 version presents a balanced selection of science and innovation indicators under the following eight themes:

1. National investment in science and innovation
2. Government support for science and innovation
3. R&D performance
4. R&D financing
5. Human resources in science and technology
6. Scientific and technological output
7. Innovation and technological diffusion
8. Impact on economic competitiveness and quality of life

This publication has drawn heavily on a number of data sources including Australian Bureau of Statistics (ABS) data on Research and Experimental Development, the OECD Main Science and Technology Indicators database, Australian Government Science and Innovation Budget Statements, the OECD *Science, Technology and Industry Scoreboard*, the Thomson ISI database on National Science Indicators, ABS data on Innovation in Australian Businesses, ABS data on Human Resources in Selected Qualifications and Occupations, and many others. In addition, ABS and OECD background economic data relating to GDP, implicit price indices, exchange rates, purchasing power parities, employment, labour force and population have been extensively used for time series and international comparisons.

The data have been presented as consistently as possible in line with the standard OECD methodology entitled *The Measurement of Scientific and Technological Activities: Proposed Standard Practice for Surveys of Research and Experimental Development* - Frascati Manual 2002 for R&D statistics, with *Measurement of Scientific and Technological Activities: Proposed Guidelines for Collecting and Interpreting Innovation Data* – Oslo Manual 2005 for innovation statistics, and with *The Measurement of Scientific and Technological Activities: Manual on the Measurement of Human Resources Devoted to S&T* – Canberra Manual 1995 for the statistics on human resources in science and technology. The national standard classifications relevant to science and innovation have also been applied including *Australian Standard Research Classification (ASRC, 1998), Australian Standard Classification of Education* (ASCED), *Australian Standard Classification of Occupations* (ASCO, second edition), and *the Australian and New Zealand Standard Industrial Classification* (ANZSIC, 1993).

Users who need more statistical information on funding, resources and performance of Australia's science and innovation system may wish to refer to our 2005 edition of *Australian Science and Innovation System – a Statistical Snapshot*. In addition, the document *Definitions and Methodological Notes – Statistics on Science and Innovation* has been updated and expanded to provide comprehensive information on data definitions, coverage and methodologies commonly used in science and innovation statistics in Australia and internationally. The 2005 edition is specifically prepared to assist users in understanding and interpreting the statistics presented in this publication. Both documents are available from our web site http://www.dest.gov.au/scienceinnovationanalysis/.

I would like to acknowledge the outstanding effort of Dr Yanfei Shi in the production of this publication. Inquiries relating to these statistical publications should be directed to the Science and Innovation Analysis Section, Department of Education, Science and Training, phone (02) 6240 9672 or email yanfei.shi@dest.gov.au.

Tony Brown
Director, Science and Innovation Analysis Section,
Department of Education, Science and Training

November 2005

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Australian Science and Technology at a glance 2005

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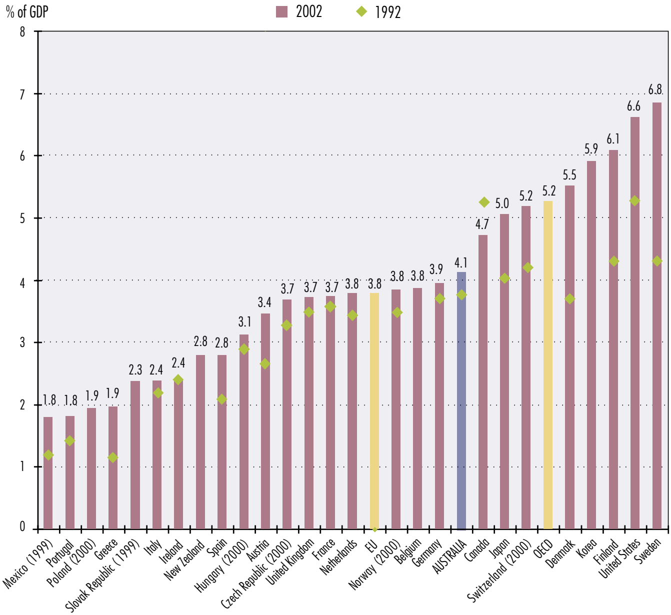
National Investment in Science and Innovation

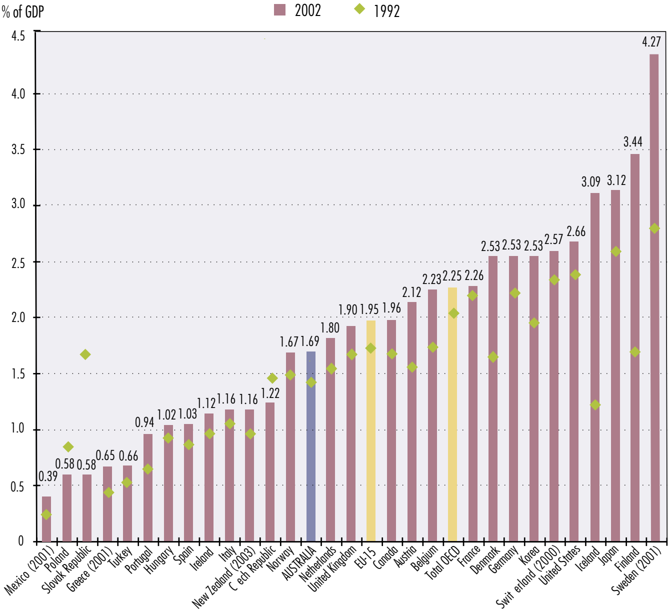
Chart 1 Investment in knowledge as a percentage of GDP – by OECD country, 1992 and 2002



Investment in knowledge is a synthetic indicator designed to compare OECD member countries' expenditures on their "knowledge base" which is critical for economic growth, job creation and improved living standards. It is calculated as the sum of expenditure on R&D, expenditure on higher education and expenditure on software. Australia's investment in knowledge accounted for 4.1% of GDP in 2002, compared to 5.2% for the OECD as a whole and 3.8% for the EU. Over the period 1992 to 2002, Australia's investment in knowledge increased by 0.25 percentage points.

Sources: OECD, *Science, Technology and Industry Scoreboard 2005*; OECD, *Factbook 2005.*

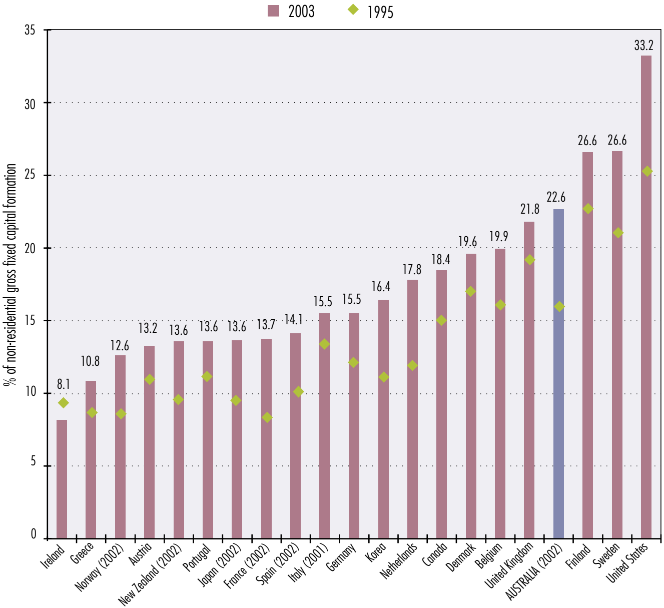
Chart 2 Gross domestic expenditure on R&D (GERD) as a percentage of GDP – by OECD country, 1992 and 2002



Gross domestic expenditure on R&D (GERD) is a key indicator of government and private sector efforts to obtain competitive advantage in science and technology. Australia spent around 1.69% of GDP on R&D in 2002, below the averages of 2.25% for the OECD as a whole and 1.95% for the EU15. Sweden, Finland, Japan and Iceland had GERD exceeding 3% of GDP. Over the period 1992-2002, Australia increased its GERD measured as a share of GDP by 0.17 percentage points, compared to 0.08 percentage points for the OECD as a whole and the EU15.

Sources: ABS, unpublished R&D data, September 2005; OECD, Main Science and Technology Indicators database, 2005/1.

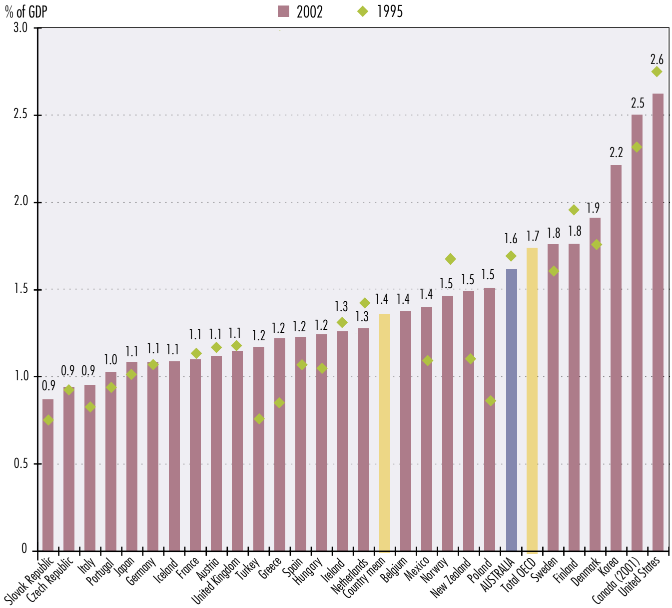
Chart 3 Investment in ICT as a share of non-residential gross fixed capital formation – by OECD country, 1995 and 2003



Investment in physical capital, in particular in information and communication technology (ICT), is important for economic growth and performance. It is a way to expand and renew the capital stock and enable new technologies to enter the production process. Australia's investment in ICT accounted for 22.6% of non-residential gross fixed capital formation in 2003, ranked 4th out of the 21 OECD countries for which data are available. Over the period 1995-2003, Australia's investment in ICT as a share of non-residential gross fixed capital formation grew faster than the OECD countries for which data are available, except the United States and France.

Source: OECD, *Science, Technology and Industry Scoreboard 2005.*

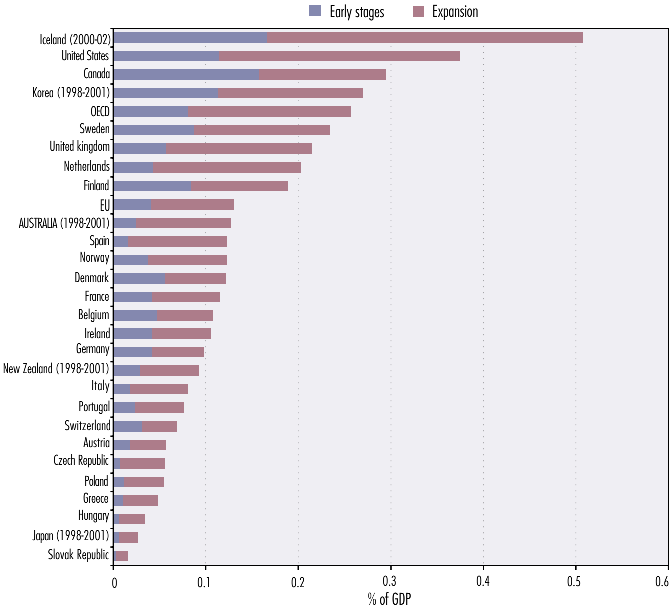
Chart 4 Expenditure on tertiary educational institutions as a percentage of GDP – by OECD country, 1995 and 2002



Expenditure on tertiary education is an investment that can help to foster economic growth and enhance productivity through the development of human capital. Australia spent about 1.6% of GDP on tertiary educational institutions in 2002, a slight fall from 1.7% of GDP in 1995. However, Australia's expenditure on tertiary educational institutions relative to GDP remained high among the OECD countries. In 2002, only six OECD countries had a level higher than Australia, namely the United States (2.6%), Canada (2.5%), Korea (2.2%), Denmark (1.9%), Finland (1.8%) and Sweden (1.8%).

Source: OECD, *Education at a Glance: OECD Indicators 2005.*

Chart 5 Investment in venture capital as a percentage of GDP – by OECD country, 2000-03



The size of investment in venture capital indicates the availability of investment capital to finance new technology-based businesses, which offer the prospects of above average returns for investors. Australia invested 0.127% of GDP in venture capital over the period 1998-2001, including 0.025% of GDP for early stages investment (seed capital and start-up financing) and 0.102% of GDP for expansion financing. Australia's ratio of venture capital investment to GDP was relatively high as compared with the ratios for other OECD countries in 2000-03, close to the EU average of 0.130%.

Source: OECD, *Science, Technology and Industry Scoreboard 2005.*

Government Support for Science and Innovation

Chart 6 Overview of Australian Government support for science and innovation – at current prices, 1996-97 to 2005-06

	Cash Outlays			Accrual Expenses						
ACTUAL COST INCURRED IN YEAR ($M)	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	est. actual 2004-05	budget est. 2005-06
INTRAMURAL EXPENDITURE ON SCIENCE & INNOVATION										
Major Australian Government Research Agencies										
Defence Science & Technology Organisation	254.9	212.1	221.3	237.6	261.0	275.0	283.4	293.9	314.4	329.7
CSIRO	444.5	466.8	475.4	500.0	496.7	509.6	532.1	568.6	577.1	593.9
Other R&D Agencies	279.8	256.4	244.2	272.5	338.3	385.9	402.7	441.5	399.2	400.1
SUB-TOTAL	**979.2**	**935.3**	**940.9**	**1,010.1**	**1,096.0**	**1,170.5**	**1,218.1**	**1,304.1**	**1,290.7**	**1,323.7**
EXTRAMURAL EXPENDITURE ON SCIENCE & INNOVATION										
Business R&D and Innovation										
Industry R&D Tax Concession	525.0	420.0	370.0	460.0	510.0	370.0	416.0	406.0	456.0	491.0
Other R&D Support	58.2	20.0	60.1	176.9	176.8	237.9	158.6	230.8	62.6	87.4
Other Innovation Support	69.6	120.4	166.6	112.0	124.7	284.3	244.4	216.3	358.8	396.3
SUB-TOTAL	**652.8**	**560.4**	**596.7**	**748.9**	**811.5**	**892.2**	**818.9**	**853.1**	**877.4**	**974.7**
Higher Education Research and Research Training										
Australian Research Council	-	-	-	-	247.8	265.8	298.3	394.4	481.4	556.5
Performance Based Block Funding	-	-	-	-	942.5	1,012.5	1,086.5	1,172.2	1,179.0	1,251.3
R&D Support under Former Funding Framework	1,610.5	1,675.4	1,737.2	1,775.9	-	-	-	-	-	-
Other R&D Support	2.7	2.5	2.5	15.7	614.0	598.9	588.0	594.8	589.1	449.5
SUB-TOTAL	**1,613.2**	**1,677.9**	**1,739.7**	**1,791.6**	**1,804.3**	**1,877.2**	**1,972.8**	**2,161.4**	**2,249.5**	**2,257.3**

Continued next page

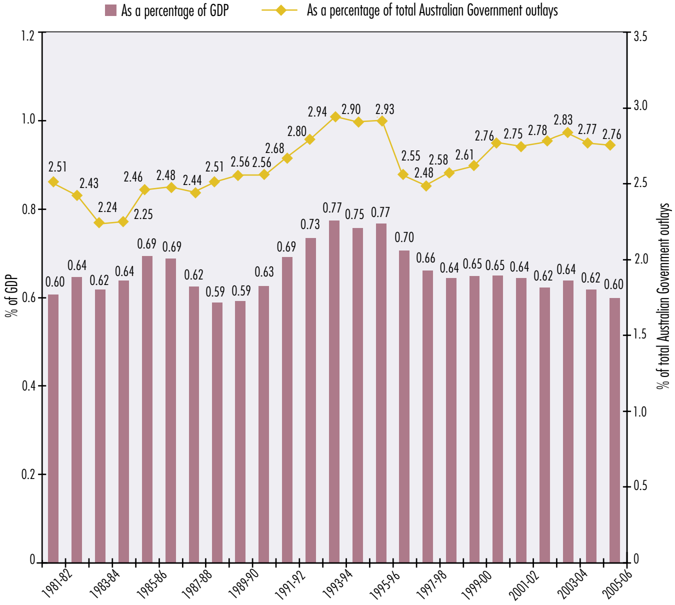
Chart 6 Overview of Australian Government support for science and innovation – at current prices, 1996-97 to 2005-06 cont

	Cash Outlays					Accrual Expenses				
ACTUAL COST INCURRED IN YEAR ($M)	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	est. actual 2004-05	budget est. 2005-06
Science and Technology programmes										
NHMRC and Other Health	167.0	174.5	194.6	186.5	309.7	248.3	273.7	369.0	419.5	431.9
Cooperative Research Centres	142.3	144.3	142.3	137.5	139.7	145.3	148.6	201.1	194.0	208.2
Rural	126.0	140.5	150.2	138.2	141.3	197.5	204.3	210.7	193.7	207.2
Energy and the Environment	11.4	25.2	8.9	11.8	20.9	33.6	29.1	35.8	43.4	63.7
Other Science Support	24.7	28.7	12.1	7.0	6.7	12.5	38.4	49.3	54.9	71.4
SUB-TOTAL	**471.4**	**513.2**	**508.1**	**481.0**	**618.3**	**637.2**	**694.1**	**866.0**	**905.4**	**982.4**
TOTAL AUSTRALIAN GOVERNMENT SUPPORT	**3,716.6**	**3,686.8**	**3,785.4**	**4,031.6**	**4,330.1**	**4,577.1**	**4,704.0**	**5,184.5**	**5,323.0**	**5,538.1**

Source: DEST, *Science and Innovation Budget Tables 2005-06.*

Information on Australian Government support for science and innovation at current prices (nominal terms) over the period 1996-97 to 2005-06 is presented in detail on this chart. Australian Government support for science and innovation refers to the total Australian Government funding for science and innovation through the budget and special appropriations. This includes funds for major Australian Government research agencies, business R&D and innovation, higher education research and research training, and other science and technology programmes that have as their immediate and direct objective the enhancement of Australia's science and innovation performance and capability, in particular those that provide a flow of funding to support science and innovation. For more information on Australian Government support for science and innovation, see Science and Innovation Budget Tables 2005-06, available at http://www.dest.gov.au/scienceinnovationanalysis/.

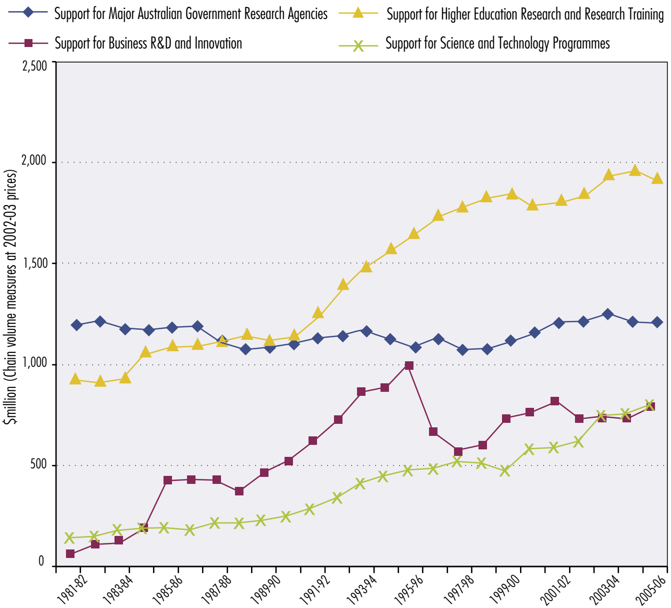
Chart 7 Australian Government support for science and innovation as a percentage of GDP and total Australian Government outlays, 1981-82 to 2005-06



This chart tracks Australian Government support for science and innovation, expressed both as a percentage of Australian Government outlays (as shown in the line) and as a percentage of GDP (as shown in the bars). Relative to Australian Government outlays, Australian Government support for science and innovation shows a fluctuating but upward trend, rising from 2.51% in 1981-82 to 2.76% in 2005-06, after hitting a high point of 2.94% in 1993-94. Australian Government support for science and innovation relative to GDP has also fluctuated, starting at 0.60% in 1981-82, rising to a peak of 0.77% in 1993-94 and 1995-96, and finishing at 0.60% in 2005-06.

Source: DEST, derived from *Science and Innovation Budget Information* (1981-82 to 2005-06).

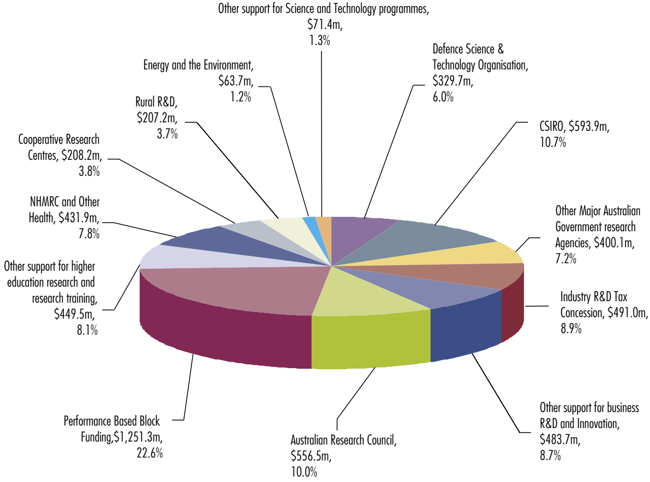
Chart 8 Australian Government support for science and innovation in chain volume measures – by main component, 1981-82 to 2005-06



This chart shows the trend of the main components of Australian Government support for science and innovation in real terms (at 2002-03 prices). Australian Government support for higher education research and research training has become the largest component since the mid 1980s and has more than doubled in real terms over the period 1981-82 to 2005-06. Australian Government support to major Australian Government research agencies has been relatively stable over the last quarter of a century, being the second largest component in 2005-06. Both the support for business R&D and innovation and the support for science and technology programmes have experienced a significant increase over the period, starting from a low base in 1981-82.

Source: DEST, derived from *Science and Innovation Budget Information* (1981-82 to 2005-06).

Chart 9 Distribution of Australian Government support for science and innovation – by major programme or programme category, 2005-06

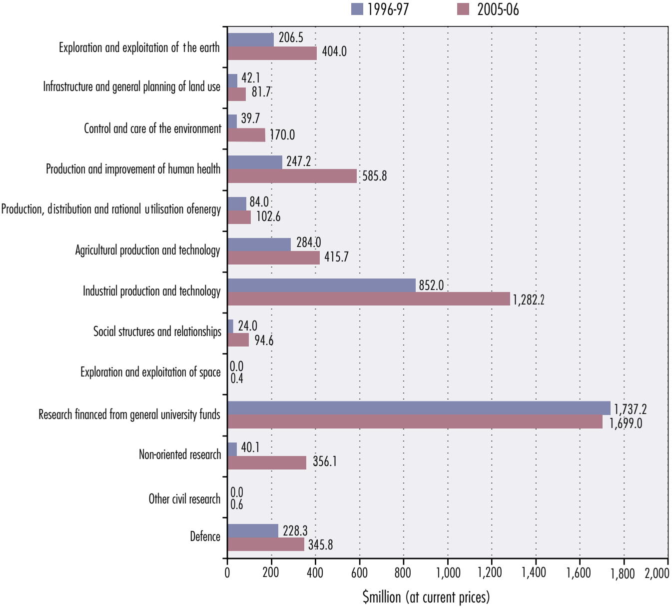


T al Australian Government support for science and innovation = $5,538.1 million

The major components of Australian Government support for science and innovation are presented in the chart as percentages of the total support ($5,538.1m). The largest component is performance based block funding for higher education research and research training (22.6%). CSIRO receives the second largest component (10.7%). Two Australian Government research-funding agencies – the Australian Research Council (ARC) and the National Health and Medical Research Council (NHMRC) –also receive 10.0% and 7.8% respectively. The Industry R&D tax concession accounts for 8.9% of the total support.

Source: DEST, *Science and Innovation Budget Tables 2005-06.*

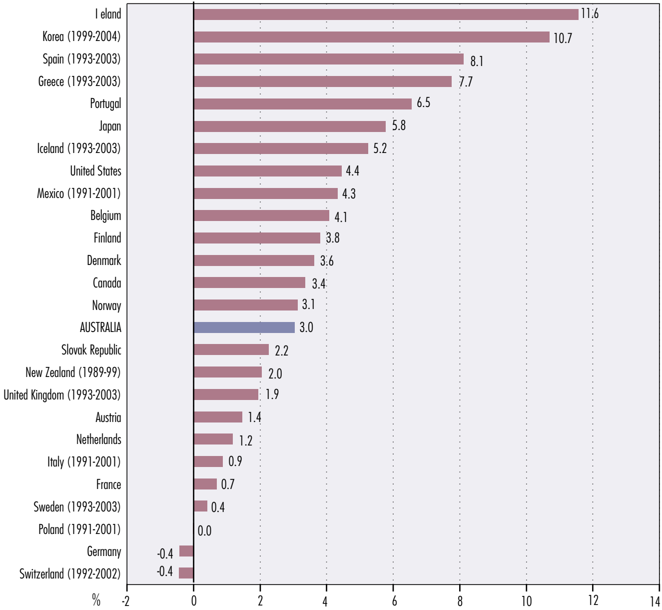
Chart 10 Australian Government support for science and innovation – by socio-economic objective, 1996-97 and 2005-06



The chart indicates how Australian Government support on science and innovation is distributed by socio-economic objective. In 2005-06 Australian Government funding for science and innovation is mainly directed to Research financed by general university funds ($1,699m) including performance based block funding for higher education research and research training ($1,251.3m), Industrial production and technology ($1,282.2m), Protection and improvement of human health ($585.8m) and Agricultural production and technology ($415.7m). Australian Government funding for Non-oriented research, Social structures and relationships, and Control and care of the environment recorded a higher growth rate over the decade to 2005-06, starting from a relatively small base.

Source: DEST, *Science and Innovation Budget Tables 2005-06.*

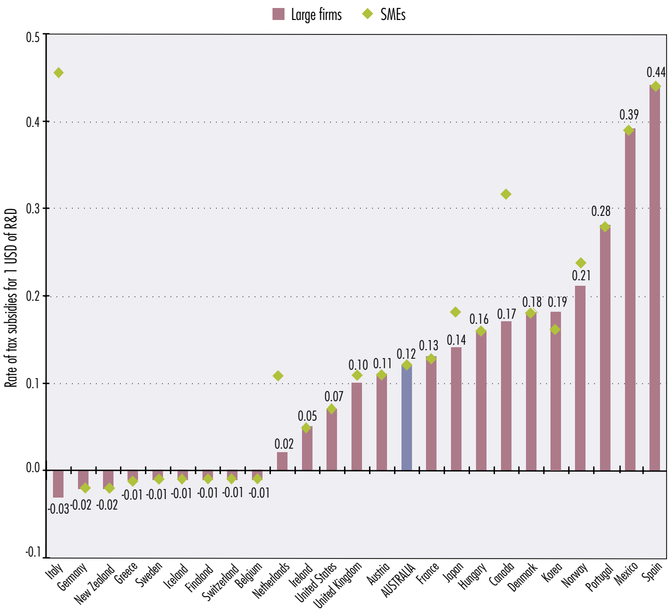
Chart 11 Average annual real growth rate of government budget appropriations or outlays for R&D – by OECD country, 1994-2004



Government budget appropriations or outlays for R&D (GBAORD) are the amount of funds that a country's central or federal governments allocate or appropriate for R&D spending every year. This chart ranks OECD countries by the average annual real growth rate of GBAORD between 1994 and 2004. Australia recorded a growth rate of 3.0% over the period. Countries with the highest growth rate were Ireland (11.6%), Korea (10.7%) and Spain (8.1%) while a fairly low growth rate was experienced in the United Kingdom (1.9%), the Netherlands (1.2%), France (0.69%) and Sweden (0.39%), and a negative growth rate in Germany and Switzerland (-0.4% each).

Source: OECD, *Science, Technology and Industry Scoreboard 2005.*

Chart 12 Rates of tax subsidies for R&D – by OECD country, 2004



Most OECD countries have special tax treatment for business R&D expenditure, such as immediate write-off of current R&D expenditures and various types of tax relief including tax credits or allowances against taxable income. These R&D tax concessions are used as an indirect way of encouraging business R&D expenditure. The OECD has developed an index to compare the generosity of the tax treatment of business R&D in different countries. As shown in the chart, Australia had a relatively favourable tax treatment of business R&D in 2004, ranked eleventh out of the 25 OECD nations for large firms and twelfth for small to medium sized firms. Direct subsidies (Chart 41) are the other main form of government support for business R&D.

Source: OECD, *Science, Technology and Industry Scoreboard 2005.*

Note: Tax subsidies are calculated as 1 minus the B index. In Australia, 1 unit of R&D expenditure by large firms results in 0.12 unit of tax relief.

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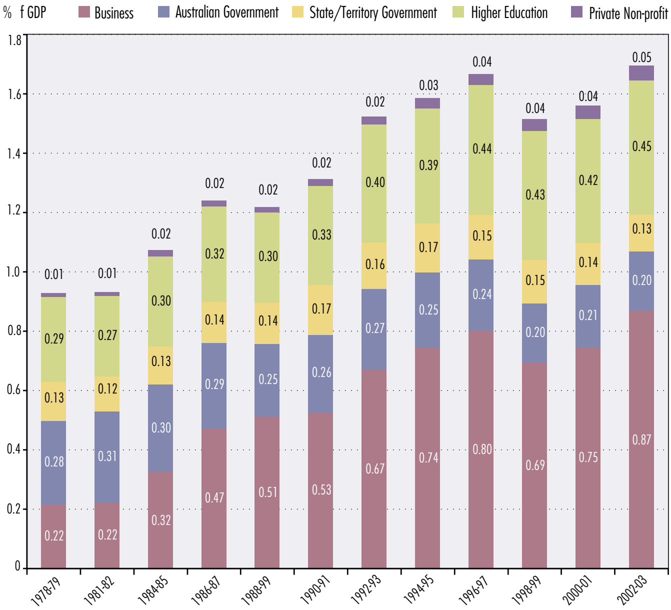
R & D Performance

Chart 13 Overview of Australia's gross domestic expenditure on R&D (GERD) – by sector of performance, 1978-79 to 2002-03

Sector of performance	1978-79	1981-82	1984-85	1986-87	1988-89	1990-91	1992-93	1994-95	1996-97	1998-99	2000-01	2002-03
Current Prices ($million)												
Business	245.8	373.7	731.1	1,288.6	1,798.3	2,099.8	2,861.9	3,508.3	4,234.7	4,094.7	4,982.6	6,571.4
Government	469.9	714.7	955.3	1,154.9	1,352.3	1,704.0	1,823.9	1,976.1	2,064.3	2,043.0	2,355.8	2,482.2
Australian Gov.	321.2	514.8	669.4	786.5	869.6	1,034.0	1,155.4	1,193.3	1,266.6	1,179.4	1,404.8	1,531.3
State/Territory Gov.	148.7	199.9	285.9	368.4	482.7	670.0	668.5	782.8	797.7	863.6	951.0	950.9
Higher Education	325.5	452.5	685.7	881.7	1,072.9	1,332.8	1,695.2	1,829.6	2,307.6	2,555.1	2,789.8	3,429.6
Private Non-profit	12.6	20.9	43.5	49.1	53.3	85.4	101.9	152.7	185.8	225.3	289.0	359.5
Total	1,053.8	1,561.8	2,415.6	3,374.3	4,276.8	5,222.0	6,482.9	7,466.7	8,792.4	8,918.1	10,417.1	12,842.7
Chain Volume Measures ($million at 2002-03 prices)												
Business	-	-	-	2,275.1	2,836.4	2,918.0	3,784.6	4,481.2	5,141.1	4,762.9	5,291.1	6,571.4
Government	-	-	-	1,897.6	2,006.7	2,303.6	2,327.6	2,437.5	2,430.3	2,318.4	2,487.9	2,482.2
Australian Gov.	-	-	-	1,292.3	1,290.4	1,397.9	1,474.5	1,471.9	1,491.2	1,338.4	1,483.6	1,531.3
State/Territory Gov.	-	-	-	605.3	716.3	905.8	853.1	965.6	939.1	980.0	1,004.3	950.9
Higher Education	-	-	-	1,529.1	1,696.8	1,894.3	2,251.6	2,344.4	2,796.4	2,942.6	3,007.9	3,429.6
Private Non-profit	-	-	-	89.7	85.5	120.6	136.4	197.4	226.2	259.0	306.9	359.5
Total	-	-	-	5,791.5	6,625.4	7,236.5	8,500.1	9,460.6	10,594.0	10,283.0	11,093.7	12,842.7

Source: DEST, based on ABS unpublished R&D data provided in September 2005.

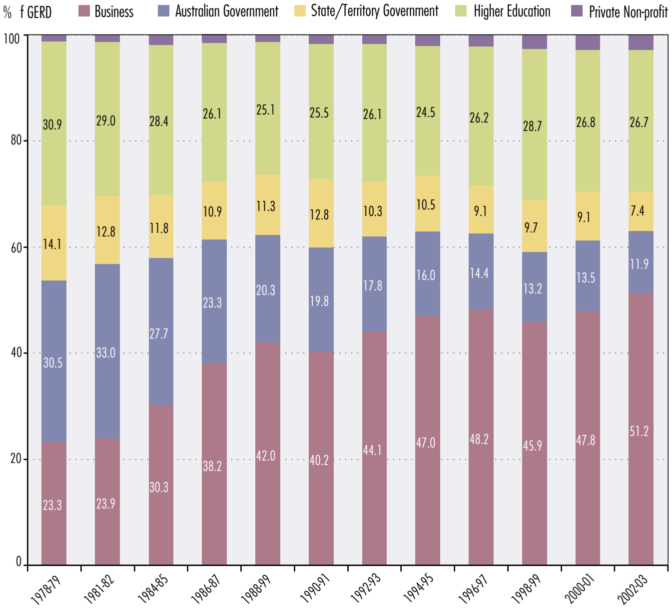
Chart 14 GERD as a percentage of GDP – by sector of performance, 1978-79 to 2002-03



Australia's gross domestic expenditure on R&D (GERD) comprises R&D spending in four performing sectors – business enterprises, government laboratories, universities and private non-profit organisations. In the financial year 2002-03, business expenditure on R&D (BERD) accounted for 0.87% of GDP, followed by 0.45% for higher education expenditure on R&D (HERD), 0.33% for government expenditure on R&D (GOVERD), and 0.05% for private non-profit organisation expenditure on R&D (PNPERD). Between 1978-79 and 2002-03 business R&D grew to exceed government and higher education R&D combined, from an initial level smaller than each of government and higher education R&D.

Source: DEST, based on ABS unpublished R&D data provided in September 2005.

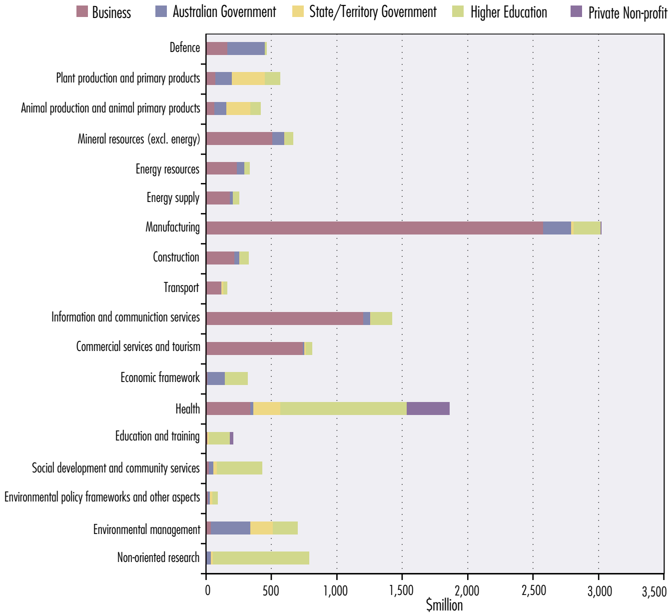
Chart 15 Proportion of GERD – by sector of performance, 1978-79 to 2002-03



By tracking the proportion of R&D expenditure carried out by the business, government, higher education and private non-profit sectors between 1978-79 and 2002-03, the chart reveals a marked shift in the composition of national investment in R&D. The business sector has conducted an increasing share of R&D activity over the twenty-four year period since 1978-79. It carried out 23.3% in 1978-79 but by 2002-03 that percentage had risen to 51.2%. In contrast, the government sector's share of R&D activity fell from 44.6% to 19.3% over the same period. The share for the higher education sector fluctuated within a range of 24.5% to 30.9%. The private non-profit sector is relatively small, but it has increased its share from 1.2% to 2.8% over the period.

Source: DEST, based on ABS unpublished R&D data provided in September 2005.

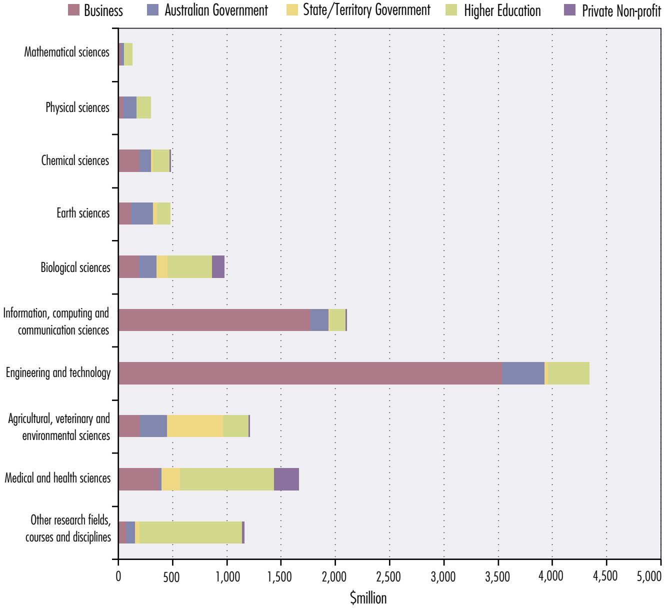
Chart 16 GERD by sector of performance – by socio-economic objective, 2002-03



The chart shows GERD broken down by socio-economic objective in 2002-03. Australia's highest R&D spending was directed towards Manufacturing ($3,023.4m), followed by Health ($1,863.9m) and Information and communication services ($1,422.7m). Business R&D concentrated on Manufacturing and Information and communication services while most of Health R&D and Non-oriented research was undertaken in the higher education sector. Environment management, Defence and Manufacturing were the principal objectives for Australian Government research institutes. In contrast, Health, Plant production and plant primary products, and Animal production and animal primary products were the key objectives for state and territory government agencies. Private non-profit organisations devoted most of their R&D resources to Health.

Source: ABS, unpublished R&D data provided in September 2005.

Chart 17 GERD by sector of performance – by field of research, 2002-03



The chart shows GERD broken down by field of research in 2002-03. Australia's highest R&D spending was in the fields of Engineering and technology ($4,339.4m), followed by Information, computing and communication services ($2,103.3m) and Medical and health sciences ($1,660.7m). Business R&D dominated the fields of Engineering and technology ($3,538.9m) and Information, computing and communication sciences ($1,772.6m). Universities were the largest spenders in Medical and health sciences ($863.8m) and Other research fields, courses and disciplines ($939.1m). Australian Government research agencies showed a greater spread across fields of research than state and territory government agencies. Private non-profit organisations focused on Biological sciences and Medical and health sciences.

Source: ABS, unpublished R&D data provided in September 2005.

Chart 18 R&D in Australia – by sector of performance and location, 2002-03

	Business			Australian Government			State/Territory Government			Higher Education			Private Non-profit			Gross Domestic R&D Expenditure		
Location	Current Prices $million	Per capita $	% of GSP (%)	Current Prices $million	Per capita $	% of GSP (%)	Current Prices $million	Per capita $	% of GSP (%)	Current Prices $million	Per capita $	% of GSP (%)	Current Prices $million	Per capita $	% of GSP (%)	Current Prices $million	Per capita $	% of GSP (%)
NSW	2,557.1	382.7	0.96	267.4	40.0	0.10	270.7	40.5	0.10	991.9	148.4	0.37	76.2	11.4	0.03	4,163.3	623.1	1.57
Vic.	1,968.9	400.9	1.02	375.0	76.3	0.19	170.3	34.7	0.09	863.2	175.7	0.45	231.5	47.1	0.12	3,608.8	734.8	1.88
Qld.	683.6	179.9	0.54	147.7	38.9	0.12	255.3	67.2	0.20	574.3	151.1	0.45	9.6	2.5	0.01	1,670.5	439.5	1.32
SA	533.8	349.8	1.09	225.5	147.7	0.46	96.6	63.3	0.20	258.0	169.0	0.53	6.1	4.0	0.01	1,120.0	733.8	2.29
WA	605.1	310.3	0.73	89.1	45.7	0.11	108.1	55.4	0.13	296.1	151.9	0.36	22.4	11.5	0.03	1,120.9	574.8	1.36
Tas.	60.9	127.5	0.48	109.7	229.8	0.86	8.8	18.4	0.07	67.7	141.9	0.53	0.2	0.5	0.00	247.3	518.1	1.93
NT	39.7	199.9	0.44	20.6	103.9	0.23	29.4	148.3	0.32	27.3	137.6	0.30	1.3	6.7	0.01	118.4	596.4	1.31
ACT & Ext Terr.	43.1	133.2	0.28	294.9	912.1	1.95	7.1	21.9	0.05	351.1	1085.9	2.32	8.6	26.7	0.06	704.9	2179.8	4.66
Overseas	79.2	n.a.	n.a.	1.5	n.a.	n.a.	4.5	n.a.	n.a.	n.a.	n.a.	n.a.	3.5	n.a.	n.a.	88.7	n.a.	n.a.
Total	**6,571.4**	**330.7**	**0.87**	**1,531.3**	**77.1**	**0.20**	**950.9**	**47.8**	**0.13**	**3,429.6**	**172.6**	**0.45**	**346.1**	**17.4**	**0.05**	**12,842.7**	**646.3**	**1.69**

Source: DEST, based on ABS unpublished R&D data provided in September 2005.

Chart 19 Overview of international R&D performance – by OECD member and non-member economy, 2002

OECD member and non-member economies	GERD (million current PPP $)	GERD per capita (current PPP$)	GERD as a percentage of GDP (%)	BERD as a percentage of GDP (%)	HERD as a percentage of GDP (%)	GOVERD as a percentage of GDP (%)	Basic research expenditure as a percentage of GDP (%)	Average annual real growth rate of GERD in 1992-2002 (%)
Total OECD	**657226.6**	**573.0**	**2.25**	**1.53**	**0.41**	**0.25**	**-**	**3.29**
United States	277099.9	961.4	2.66	1.87	0.42	0.23	0.49	3.33
EU-15	**198686.4**	**521.0**	**1.95**	**1.25**	**0.43**	**0.25**	**-**	**2.61**
Japan	108248.1	849.4	3.12	2.32	0.43	0.30	0.39	1.80
Germany	55673.5	675.0	2.53	1.75	0.43	0.35	-	1.84
France	38360.0	626.4	2.26	1.43	0.43	0.37	0.53	1.44
United Kingdom	32481.4	547.5	1.90	1.26	0.42	0.17	-	2.29
Korea	22246.6	467.0	2.53	1.90	0.26	0.34	0.35	8.47
Canada	18202.9	580.4	1.96	1.09	0.65	0.22	-	5.43
Italy	17698.6	305.2	1.16	0.56	0.38	0.20	-	1.38
Sweden (2001)	10364.0	1165.0	4.27	3.31	0.83	0.12	-	6.90
Spain	9684.4	238.9	1.03	0.56	0.31	0.16	0.16	4.48
AUSTRALIA	**9608.6**	**486.3**	**1.69**	**0.87**	**0.45**	**0.33**	**0.42**	**4.99**
Netherlands	8707.4	539.3	1.80	1.02	0.52	0.25	-	2.14
Belgium	6584.5	637.4	2.23	1.63	0.43	0.14	-	4.92
Switzerland (2000)	5627.0	780.6	2.57	1.90	0.64	0.03	0.72	1.30
Austria	5137.7	635.6	2.12	1.42	0.57	0.12	-	6.34
Finland	4997.0	960.8	3.44	2.41	0.66	0.36	-	8.36
Denmark	4086.8	760.2	2.53	1.75	0.58	0.19	-	6.71
Mexico (2001)	3623.7	36.2	0.39	0.12	0.12	0.15	0.12	10.89

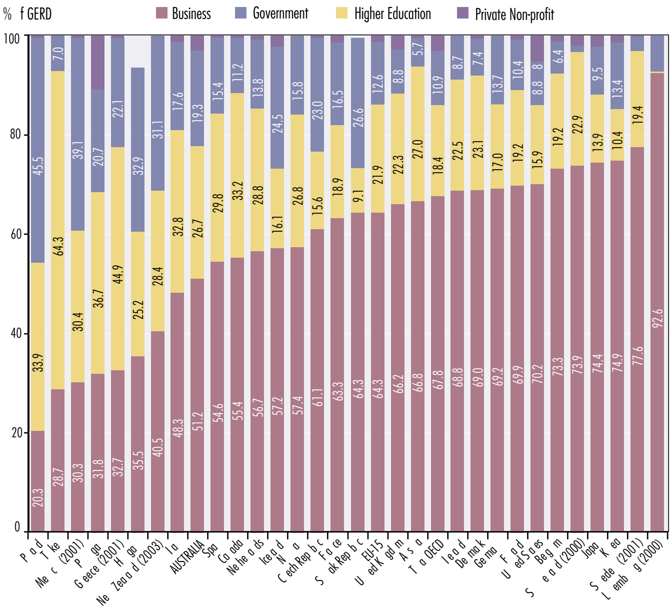
Continued next page

Chart 19 Overview of international R&D performance – by OECD member and non-member economy, 2002 cont

OECD member and non-member economies	GERD (million current PPP $)	GERD per capita (current PPP$)	GERD as a percentage of GDP (%)	BERD as a percentage of GDP (%)	HERD as a percentage of GDP (%)	GOVERD as a percentage of GDP (%)	Basic research expenditure as a percentage of GDP (%)	Average annual real growth rate of GERD in 1992-2002 (%)
Turkey	3014.5	43.3	0.66	0.19	0.43	0.05	-	6.04
Norway	2782.7	613.1	1.67	0.96	0.45	0.26	0.28	4.10
Poland	2477.5	64.8	0.58	0.12	0.20	0.26	0.19	1.35
Czech Republic	2070.6	203.0	1.22	0.75	0.19	0.28	0.30	-0.87
Portugal	1827.1	176.2	0.94	0.30	0.34	0.19	0.19	6.93
Hungary	1494.7	147.1	1.02	0.36	0.26	0.34	0.25	2.93
Ireland	1433.0	365.0	1.12	0.77	0.25	0.10	-	8.76
Greece (2001)	1226.8	112.0	0.65	0.21	0.29	0.14	-	8.62
New Zealand (2003)	1090.0	269.8	1.16	0.47	0.33	0.36	0.41	5.08
Slovak Republic	390.8	72.5	0.58	0.37	0.05	0.15	0.15	-7.05
Luxembourg (2000)	368.3	840.0	1.71	1.58	0.00	0.17	-	-
Iceland	261.4	909.1	3.09	1.77	0.50	0.76	0.49	12.08
China	71339.5	55.5	1.22	0.75	0.12	0.35	0.07	14.95
India (2000)	20782.7	20.5	0.85	-	-	-	-	-
Russian Federation	14916.5	103.5	1.25	0.87	0.07	0.31	0.17	3.56
Chinese Taipei	12240.0	543.5	2.31	1.43	0.28	0.57	0.25	8.32
Israel	6569.9	1000.0	5.05	3.79	0.82	0.27	0.90	11.05
Singapore	2153.7	516.3	2.15	1.32	0.55	0.28	0.33	-

Source: DEST, based on ABS unpublished R&D data provided in September 2005 and the OECD Main Science and Technology Indicators database, 2005/1.

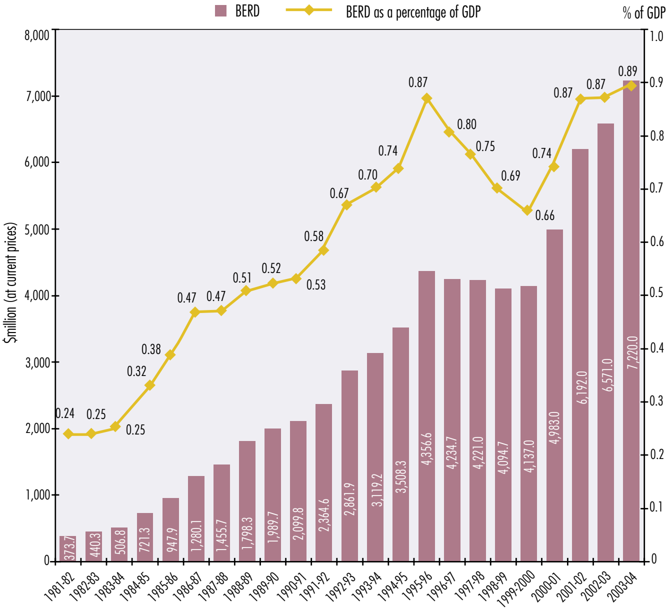
Chart 20 Proportion of GERD by sector of performance – by OECD country, 2002



The chart compares Australia with other OECD countries in terms of the distribution of domestic R&D in the four performing sectors. In 2002, the business sector accounted for 51.2% of gross domestic R&D expenditure (GERD) in Australia, significantly less than the OECD average (67.8%) and the EU15 average (64.3%). In comparison with other highly-developed OECD economies, Australia had higher proportions of domestic R&D performed by the government and higher education sectors, at 19.3% and 26.7% respectively. The OCED as a whole undertook around 10.9% of total R&D activity in the government sector and 18.4% in the higher education sector.

Sources: ABS, unpublished R&D data, September 2005; OECD Main Science and Technology Indicators database, 2005/1.

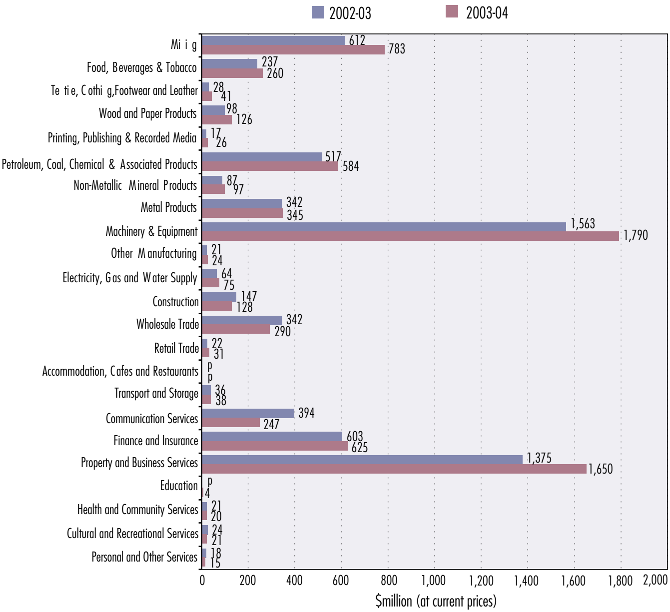
Chart 21 Business expenditure on R&D (BERD) at current prices and as a percentage of GDP, 1981-82 to 2003-04



This chart tracks Australia's business R&D expenditure (BERD) over the period 1981-82 to 2003-04. BERD recorded a rapid growth at current prices throughout the whole of the 1980s and the first half of the 1990s, followed by a standstill over the second half of the 1990s. It has picked up again since the end of the 1990s and reached an all-time high of $7,220 million in 2003-04. Australia's business R&D intensity (BERD as a share of GDP) had a relatively steep upward trend in the period to 1994-95, with the intensity subsequently dipping and then recovering to 0.89% in 2003-04, the highest level ever recorded.

Source: DEST, based on ABS unpublished R&D data provided in September 2005.

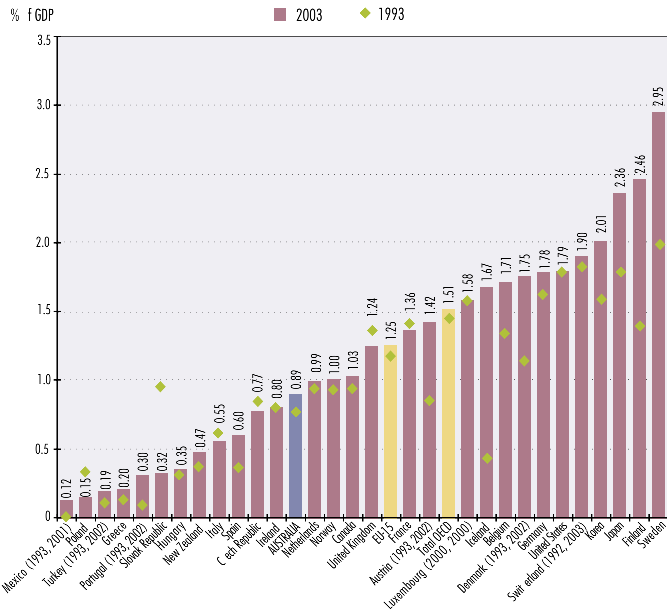
Chart 22 BERD – by industry, 2002-03 and 2003-04



Business R&D expenditure by industry for the financial years 2002-03 and 2003-04 is shown in this chart. In 2003-04, business enterprises in the Machinery and equipment industries spent $1,790m on R&D, an increase of 14.5% over the level of 2002-03. Business R&D expenditure in Property and business services amounted to $1,650m in 2003-04, an increase of 20% over the previous year. Mining also recorded a rise of 27.9%, to $783m in 2003-04. In contrast, Wholesale trade and Communication services reported decreases of 15.2% and 37.3%, to $290m and $247m respectively in 2003-04.

Source: ABS, unpublished R&D data, September 2005.

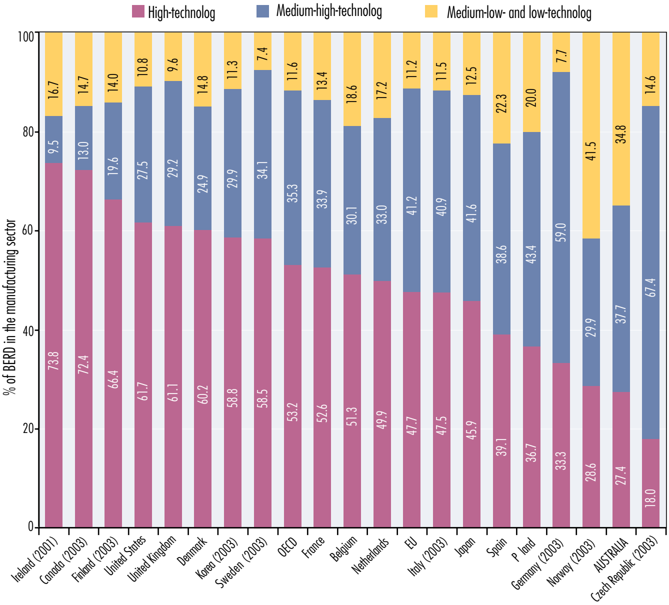
Chart 23 BERD as a percentage of GDP – by OECD country, 1993 and 2003



In 2003, Australia's business expenditure on R&D (BERD) stood at 0.89% of GDP, well below the OECD as a whole (1.51%) and the EU15 (1.25%). The highest business R&D intensity among OECD countries was exhibited by Sweden (2.95%), Finland (2.46%), Japan (2.36%) and Korea (2.01%) with the lowest being displayed by Mexico (0.12%), Poland (0.15%) and Turkey (0.19%). Over the period 1993-2003, Australia's business R&D intensity increased by 0.19 percentage points, compared to 0.09 percentage points for both the OECD as a whole and the EU15.

Sources: ABS, unpublished R&D data, September 2005; OECD Main Science and Technology Indicators database, 2005/1.

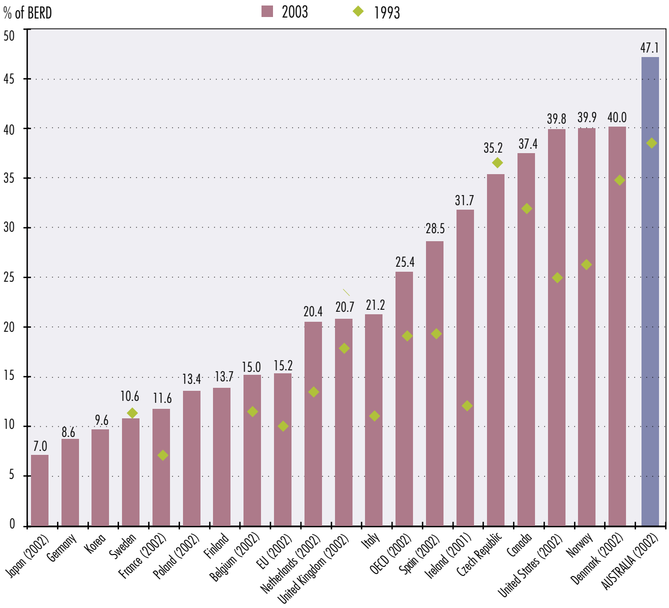
Chart 24 Share of BERD in the manufacturing sector by technology intensity – by OECD country, 2002



Manufacturing industries are grouped into four categories according to their R&D intensity: High, Medium-high, Medium-low and Low technology. In 2002, high-technology industries in Australia accounted for 27.4% of total manufacturing R&D expenditure, compared to more than 53.2% in the OECD as a whole and 47.7% in the EU. Manufacturing R&D is skewed towards Medium-low- and Low-technology industries in Australia, which accounted for over 34.8% of total manufacturing R&D expenditure, second only to Norway (41.5%) out of the 19 OECD countries for which data are available.

Source: OECD, *Science, Technology and Industry Scoreboard 2005.*

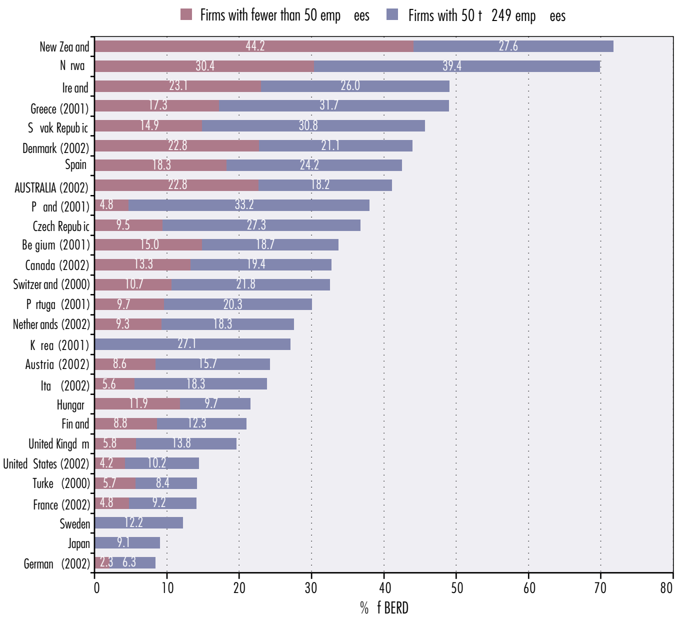
Chart 25 Share of services in BERD – by OECD country, 1993 and 2003



In 2003, the services sector carried out around 47.1% of total business R&D in Australia, the highest of the 19 OECD countries listed in the chart, followed by Denmark (40.0%), Norway (39.9%), the United States (39.8%) and Canada (37.4%). In the OECD as a whole, the services sector accounted for more than one-quarter of total business expenditure on R&D, much higher than in the EU15 (15.2%). Less than 10% of business R&D was carried out in the services sector in Japan (7.0%), Germany (8.6%) and Korea (9.6%). Over the period 1993-2003, the share of the services sector in R&D increased faster in Australia than in most OECD countries.

Source: OECD, *Science, Technology and Industry Scoreboard 2005.*

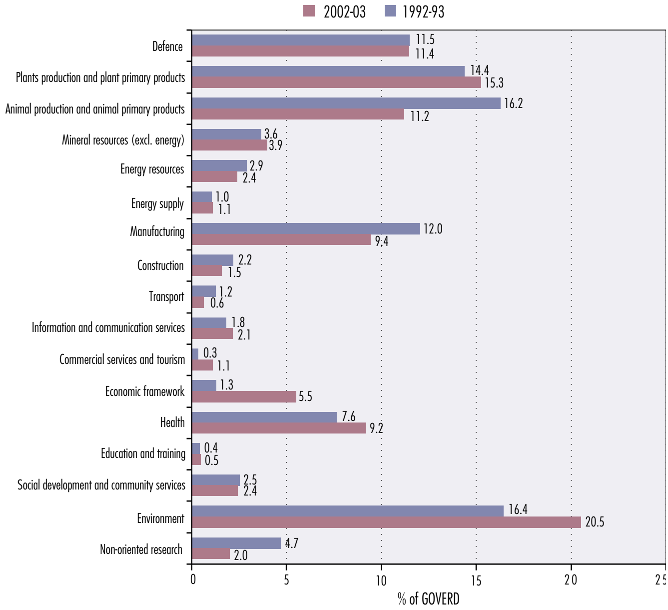
Chart 26 Share of BERD by size of firm – by OECD country, 2003



In 2002, firms with fewer than 250 employees performed around 41% of business R&D in Australia. Only seven OECD countries had a higher proportion: New Zealand (72%), Norway (70%), Ireland and Greece (49%), the Slovak Republic (46%), Denmark (44%) and Spain (43%). In the larger EU countries, the United States and Japan, the share was less than one-fifth. Firms with fewer than 50 employees accounted for almost one-fifth of business R&D (23%) in Australia, equivalent to Denmark and Ireland in the OECD countries. Only New Zealand (44%) and Norway (30%) had a higher proportion.

Source: OECD, *Science, Technology and Industry Scoreboard 2005.*

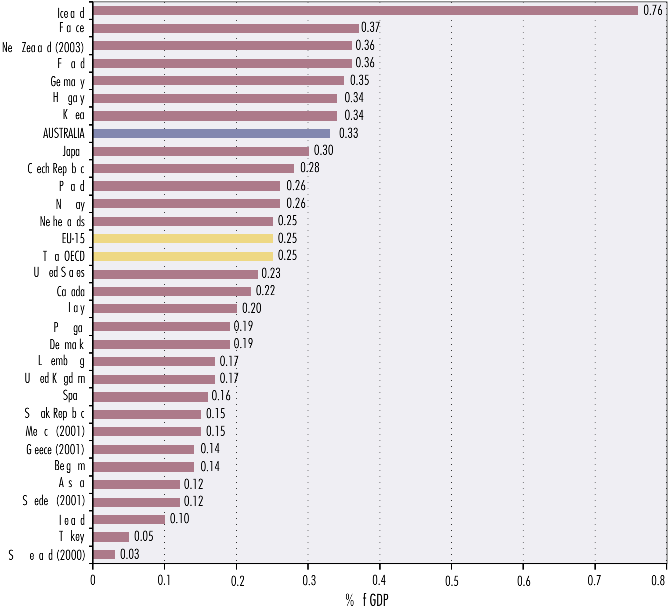
Chart 27 Distribution of government expenditure on R&D (GOVERD) – by socio-economic objective, 1992-93 and 2002-03



This chart shows expenditure on R&D by government research agencies (GOVERD) broken down by socio-economic objective. In 2002-03, Australia's government research agencies directed around 20.5% of total R&D spending towards the Environment objective, 15.2% towards Plant production and plant primary products, 11.4% towards Defence, 11.2% towards Animal production and animal primary products, 9.4% towards Manufacturing and 9.2% towards Health. Over the decade between 1992-93 and 2002-03, the proportion of R&D spending by government research agencies increased most in Economic framework (from 1.3% to 5.5%), Environment (from 16.4% to 20.5%) and Health (from 7.6% to 9.2%).

Source: ABS, unpublished R&D data, September 2005.

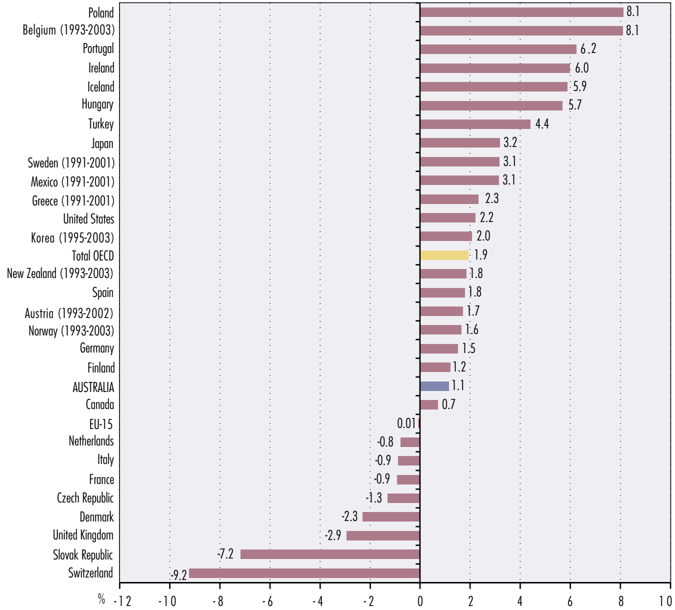
Chart 28 GOVERD as a percentage of GDP – by OECD country, 2002



In this chart, OECD countries are ranked by expenditure on R&D by government research agencies as a share of GDP in 2002. Australia ranked eighth among OECD countries with 0.33% of GDP spent on R&D in the government sector. This was significantly above the figure for the EU15 (0.25%) and the OECD as a whole (0.25%). At 0.76%, Iceland had more than twice the figure for France (0.37%), at second place. Other countries with strong R&D spending in the government sector were New Zealand (0.36%), Finland (0.36%), Germany (0.35%), Hungary (0.34%) and Korea (0.34%).

Sources: ABS, unpublished R&D data, September 2005; OECD Main Science and Technology Indicators database, 2005/1.

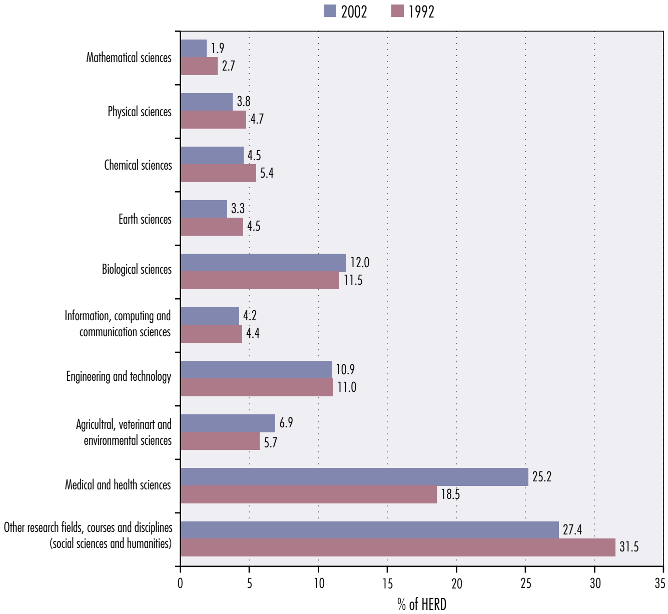
Chart 29 Average annual real growth rate of GOVERD – by OECD country, 1992-2002



Between 1992 and 2002, Australia's R&D expenditure in the government sector recorded an average annual growth rate of 1.1% in real dollar terms. This growth rate was relatively low compared with 1.9% for the OECD as a whole but was higher than that for the EU15 where R&D expenditure in the government sector remained almost unchanged in real terms. Over the period, the growth rate for government R&D expenditure was highest in the smaller OECD economies and amongst the countries with relatively low GOVERD to GDP ratios at the beginning of the period.

Sources: ABS, unpublished R&D data, September 2005; OECD Main Science and Technology Indicators database, 2005/1.

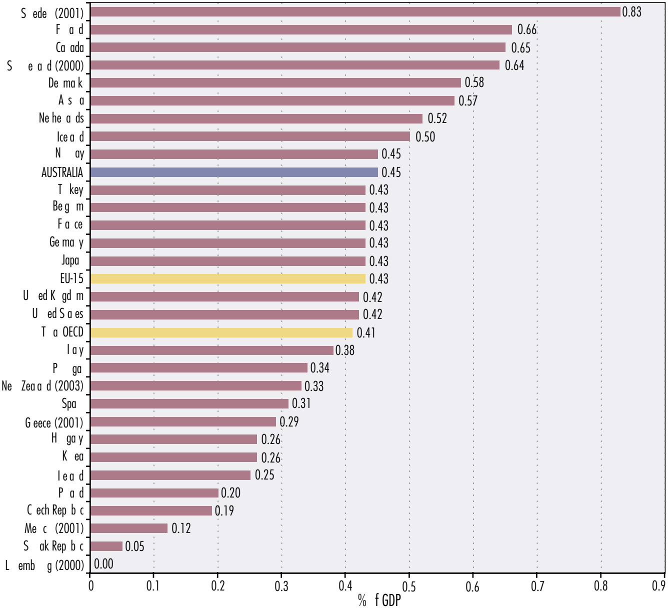
Chart 30 Distribution of higher education expenditure on R&D (HERD) – by field of research, 1992 and 2002



This chart presents a breakdown of higher education expenditure on R&D (HERD) by field of research. In 2002, more money was spent on the field of Medical and health sciences than on any other single research field. Medical and health science accounted for 25.2% of total university R&D spending, followed by Biological sciences (12.0%) and Engineering and technology (10.9%). Over the period 1992-2002, the proportion of R&D expenditure increased in the fields of Medical and health sciences (from 18.5% to 25.2%), Agricultural, veterinary and environmental sciences (from 5.7% to 6.9%) and Biological sciences (from 11.5% to 12.0%) while the proportions decreased in all other fields.

Source: ABS, unpublished R&D data, September 2005.

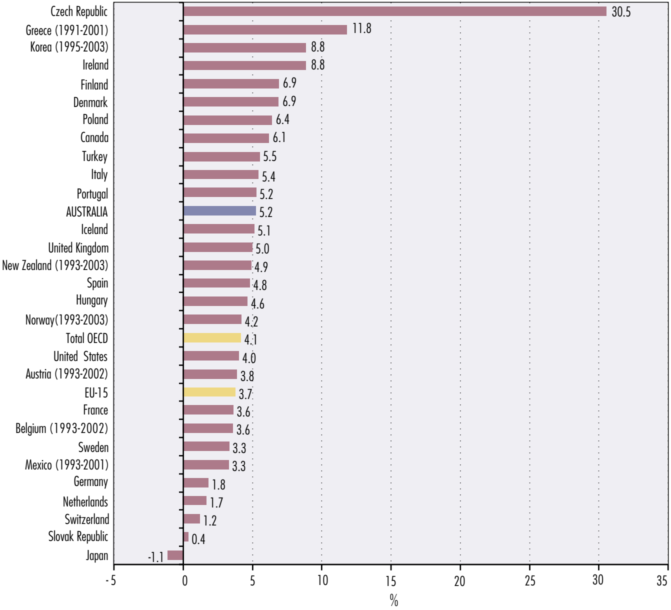
Chart 31 HERD as a percentage of GDP – by OECD country, 2002



During 2002, Australia ranked equal ninth with Norway amongst the OECD countries in terms of higher education R&D expenditure as a percentage of GDP, with 0.45% of GDP spent on R&D in the higher education sector. Sweden ranked highest among the OECD countries at 0.83%, significantly higher than second-placed Finland (0.66%) and third-placed Canada (0.65%). Relative to GDP, Australia's higher education R&D expenditure was ahead of France (0.43%), Germany (0.43%), Japan (0.43%), the United States (0.42%) and the United Kingdom (0.42%). It was also 0.02 percentage points more than the EU15 average (0.43%) and 0.04 percentage points higher than the OECD average (0.41%).

Source: OECD, Main Science and Technology Indicators database, 2005/1.

Chart 32 Average annual real growth rate of HERD – by OECD country, 1992-2002



Australia's R&D expenditure in the higher education sector grew on average by 5.2% per annum in real terms over the period between 1992 and 2002. This was relatively high by OECD standards, compared to 4.1% for the OECD as a whole and 3.7% for the EU15. The Czech Republic recorded the highest ranking, at 30.5%, followed by Greece (11.8%), Korea and Ireland (8.8% each), and Finland and Denmark (6.9% each). Japan was the only country reporting a negative growth rate (-1.1%) over the period.

Source: OECD, Main Science and Technology Indicators database, 2005/1.

Australian Science and Technology

at a glance

2005

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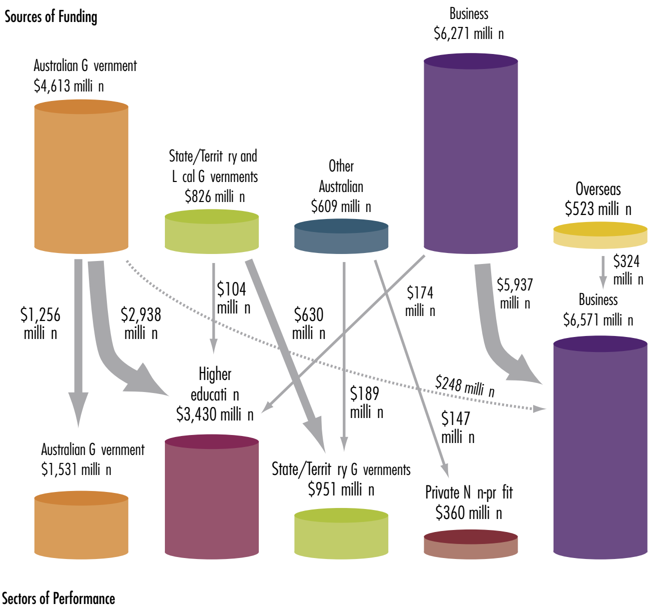
R & D Financing

Chart 33 Overview of Australia's gross domestic expenditure on R&D (GERD) – by source of funds, 1978-79 to 2002-03

Source of funds	1978-79	1981-82	1984-85	1986-87	1988-89	1990-91	1992-93	1994-95	1996-97	1998-99	2000-01	2002-03
Current Prices ($million)												
Business	217.5	319.5	674.3	1,251.8	1,781.5	2,148.2	2,851.9	3,451.0	4,203.9	4,091.6	4,821.1	6,270.9
Government	806.1	1,154.3	1,648.6	1,983.2	2,305.8	2,868.2	3,257.2	3,542.2	4,023.3	4,177.8	4,741.0	5,439.4
Australian Gov.	666.0	975.6	1,386.2	1,662.2	1,883.3	2,282.4	2,679.8	2,865.8	3,356.5	3,439.3	3,929.9	4,613.2
State/Territory Gov.	140.1	178.7	262.4	321.0	422.5	585.8	577.4	676.4	666.8	738.5	811.1	826.2
Other Australian	13.5	32.4	58.6	83.9	91.2	141.4	255.7	328.3	384.5	422.6	493.4	609.2
Overseas	16.8	16.1	26.0	29.0	57.0	64.2	118.1	145.2	180.6	226.1	361.7	523.2
Total	**1,053.8**	**1,522.2**	**2,407.5**	**3,347.9**	**4,235.5**	**5,222.0**	**6,482.9**	**7,466.7**	**8,792.4**	**8,918.1**	**10,417.1**	**12,842.7**
Chain Volume Measures ($million at 2002-03 prices)												
Business	-	-	-	2,210.1	2,809.9	2,985.3	3,771.4	4,408.0	5,103.7	4,759.3	5,119.6	6,270.9
Government	-	-	-	3,258.6	3,421.6	3,877.5	4,156.7	4,369.3	4,736.6	4,741.0	5,006.9	5,439.4
Australian Gov.	-	-	-	2,731.2	2,794.6	3,085.6	3,419.9	3,535.0	3,951.6	3,903.0	4,150.3	4,613.2
State/Territory Gov.	-	-	-	527.4	626.9	791.9	736.9	834.3	785.0	838.1	856.6	826.2
Other Australian	-	-	-	145.5	144.2	201.0	339.6	420.7	465.9	486.7	532.0	609.2
Overseas	-	-	-	51.2	89.9	89.2	156.2	185.5	219.3	263.0	384.1	523.2
Total	**-**	**-**	**-**	**5,665.4**	**6,465.7**	**7,153.0**	**8,423.9**	**9,383.4**	**10,525.5**	**10,250.1**	**11,042.5**	**12,842.7**

Source: DEST, based on ABS unpublished R&D data provided in September 2005.

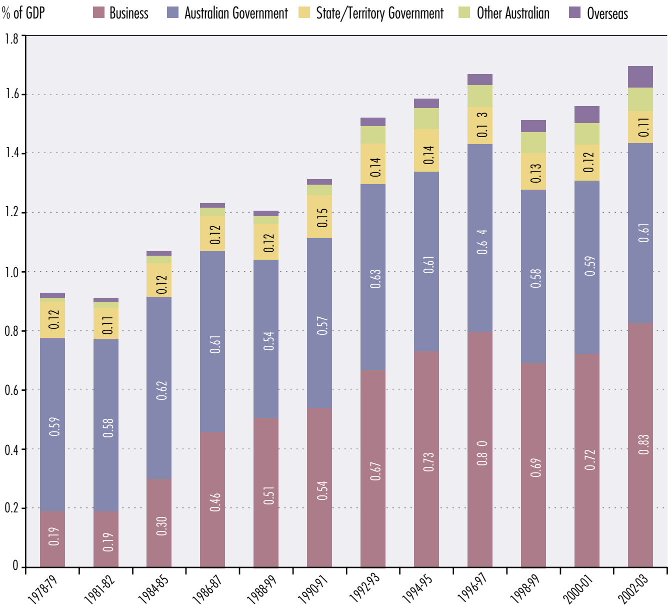
Chart 34 Major flows of funding for R&D in Australia, 2002-03



In the financial year 2002-03, business and higher education were the largest sectors of R&D performance in Australia, carrying out research and experimental development (R&D) activity worth $6,571m and $3,430m respectively. The majority of funding for R&D in the business sector came from the sector itself ($5,937m), with the second largest portion of funding for this sector coming from overseas ($324m). Higher education received most of its R&D funding from the Australian Government ($2,938m), with much of the remainder coming from business ($174m) and state, territory and local government ($104m).

Source: DEST, based on ABS unpublished R&D data provided in September 2005.

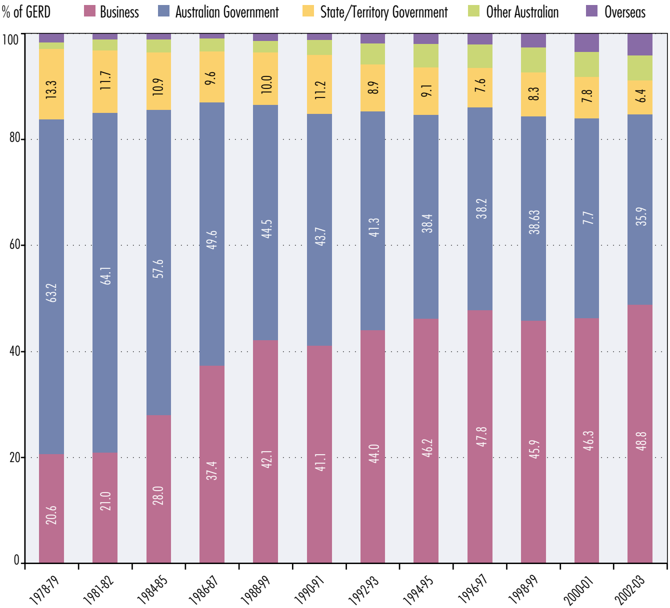
Chart 35 GERD as a percentage of GDP – by source of funds, 1978-79 to 2002-03



Business, Federal, State and Territory Governments, Other Australian and Overseas are the four funding sources which provide funds for R&D undertaken within Australia. In 2002-03, gross domestic expenditure on R&D (GERD) accounted for 1.69% of GDP in Australia, of which the bulk of funding came from business and government (both the Australian Government and state and territory governments), representing 0.83% of GDP and 0.72% of GDP respectively. Business-financed GERD relative to GDP rose significantly over the last quarter of a century (from 0.19% in 1978-79 to 0.83% in 2002-03) while GERD financed by government as a share of GDP remained almost unchanged over the period (from 0.71% to 0.72%).

Source: DEST, based on ABS unpublished R&D data provided in September 2005.

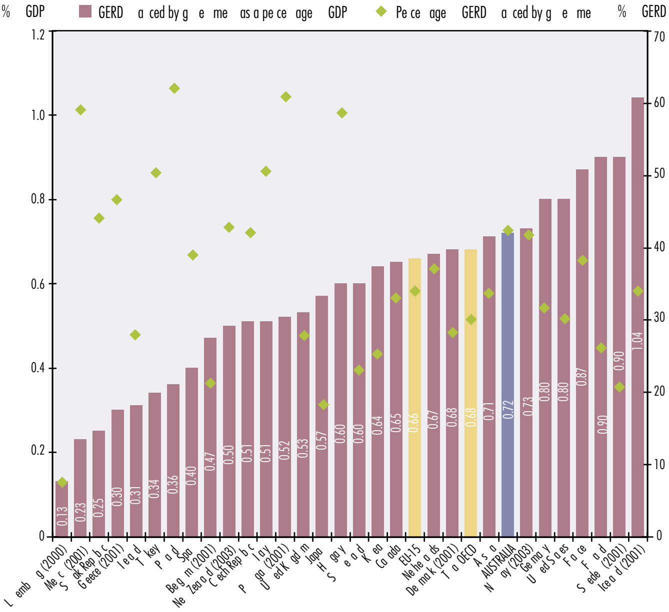
Chart 36 Proportion of GERD – by source of funds, 1978-79 to 2002-03



The chart tracks the proportion of GERD financed by Business, the Australian Government and State and Territory governments, Other Australian sources and Overseas sources over the period 1978-79 to 2002-03. It shows that there has been a considerable shift in the structure of R&D funding over the period. The contribution of Australian business to R&D funding has been on an upward trend, rising from 20.6% in 1978-79 to 48.8% in 2002-03. Governments have contributed a diminishing proportion of R&D funding with the percentage falling from 76.5% in 1978-79 to 42.3% in 2002-03. Overseas investors remain a minor contributor to Australian R&D funding but their role has shown a steady upward trend.

Source: DEST, based on ABS unpublished R&D data provided in September 2005.

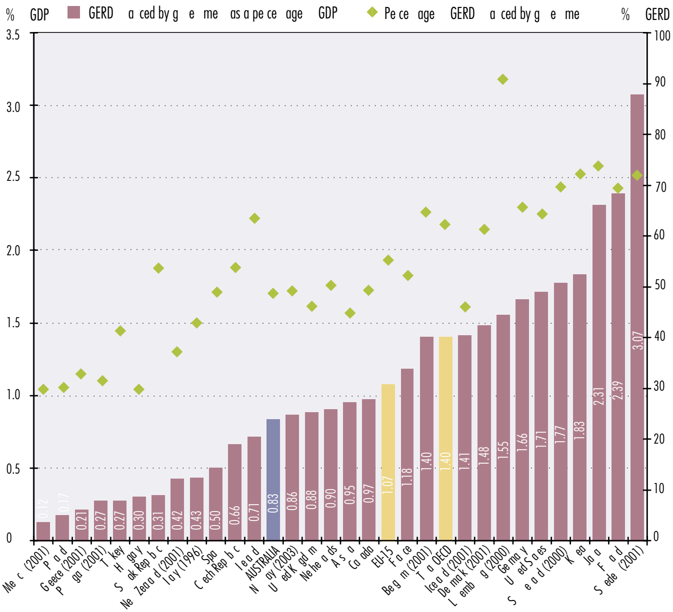
Chart 37 GERD financed by government – by OECD country, 2002



Governments in OECD countries provide direct funding for R&D at various levels. Australia's level of government-financed R&D was estimated at 0.72% of GDP in 2002, compared to the OECD average of 0.68% and the EU15 average of 0.66%. The share of government-financed GERD in Australia was about 42.4% of GERD in 2002, much higher than the OECD average of 30.1% and the EU15 average of 34.2%. Generally speaking in the larger OECD economies government-financed R&D accounts for a higher share of GDP but a relatively low share of GERD is financed by government owing to the strong contribution of business R&D.

Sources: ABS, unpublished R&D data, September 2005; OECD, Main Science and Technology Indicators database, 2005/1.

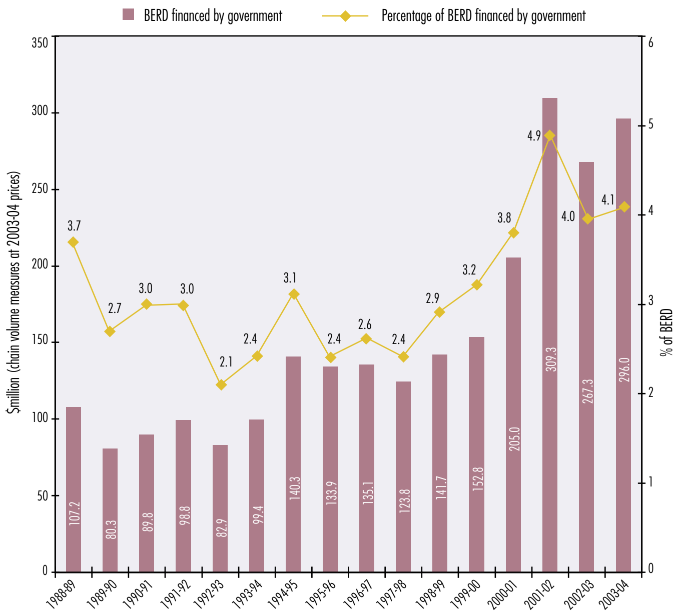
Chart 38 GERD financed by industry – by OECD country, 2002



Industry plays the most important role in financing R&D in the industrialised OECD countries. In 2002 Australia's industry financed R&D valued at 0.83% of GDP, below the OECD average of 1.40% and the EU15 average of 1.07%. In Sweden, Finland and Japan, industry-financed R&D exceeded 2% of GDP. The share of R&D financed by industry was also relatively low in Australia, at 48.8% of GERD in 2002, as compared to the OECD average of 62.1% and the EU15 average of 55.1%. Luxembourg, Japan, Korea and Sweden led other OECD countries with more than 70% of GERD financed by industry.

Sources: ABS, unpublished R&D data, September 2005; OECD, Main Science and Technology Indicators database, 2005/1.

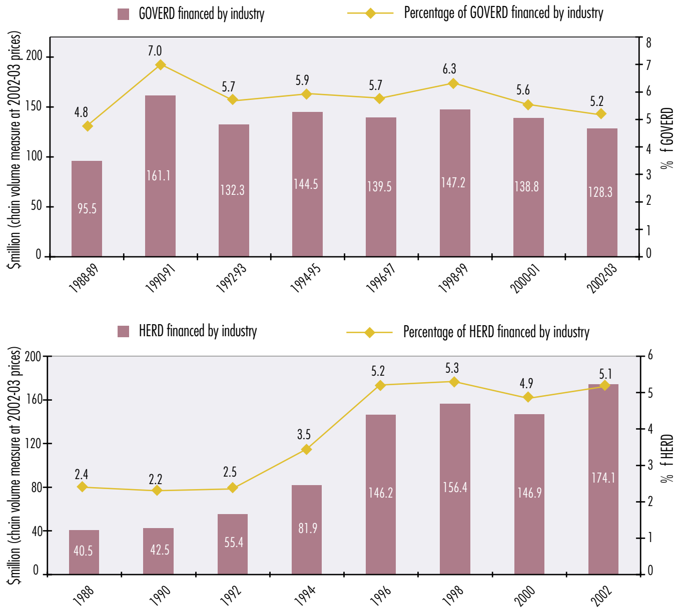
Chart 39 BERD financed by government, 1988-89 to 2003-04



This chart illustrates the trend in BERD financed by government (federal and state) in Australia over the period 1988-89 and 2003-04, expressed both in real terms (as shown in the bars) and as a percentage of total BERD (as shown in the line). The chart does not include revenue foregone through tax concessions for business R&D. Government contributed about $296m in direct funding for business R&D in 2003-04, the amount almost tripling in real terms over the fifteen years from 1988-89. Government financed approximately 4.1% of BERD in 2003-04. This was below the peak level of 4.9% reached in 2001-02 but higher than the levels recorded during the 1990s.

Source: ABS, unpublished R&D data, September 2005.

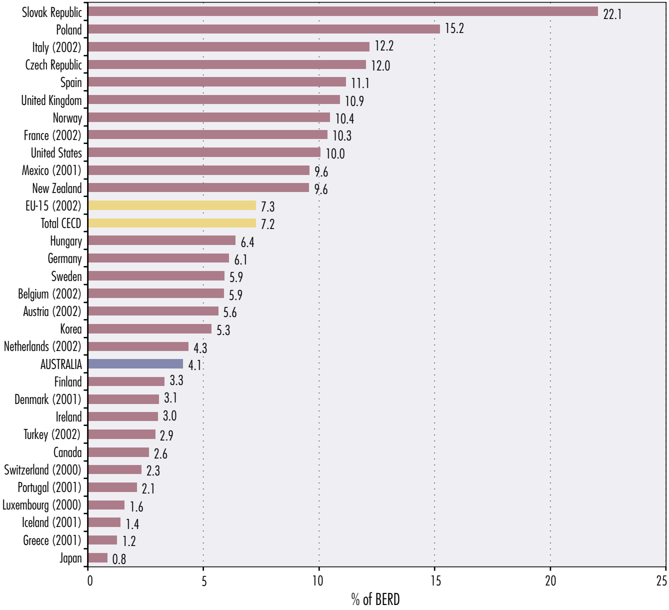
Chart 40 GOVERD and HERD financed by industry, 1988-89 to 2002-03



The funding of Higher Education R&D and Government R&D by the business enterprise sector is one indicator reflecting the extent of interaction between industry and publicly funded research organisations. This chart shows business financing of R&D expenditure in Australia's government research agencies and universities over the period between 1988-89 and 2002-03, both in real terms and as a share of total expenditure. The percentage of GOVERD financed by industry remained relatively stable over the period, with the highest recorded in 1990-91 and the lowest in 1988-89.
In contrast, the level of HERD financed by industry displayed continuous steady growth until 1996 when it reached a plateau around 5%.

Source: ABS, unpublished R&D data, September 2005.

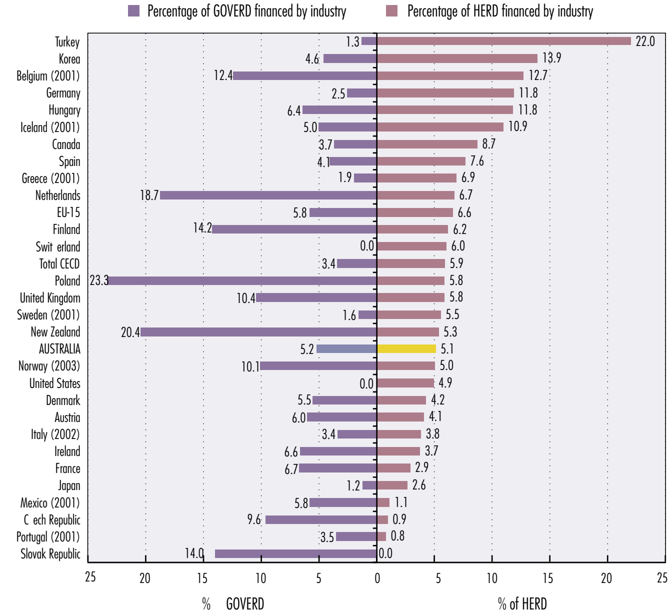
Chart 41 Percentage of BERD financed by government – by OECD country, 2003



Governments in most OECD countries provide direct financial support for businesses to invest and undertake R&D through subsidies, competitive grants, procurement and grants repayable in case of successful commercialisation. In 2003, governments in Australia financed 4.1% of business R&D, compared to 7.3% in the EU15 and 7.2% in the OECD as a whole. The share of government-financed BERD varied considerably across OECD countries, with nearly a third of countries attaining a level of more than 10% including the United Kingdom (10.9%), France (10.3%) and the United States (10.0%) and another third of countries recording a level of less than 4% including Canada (2.6%) and Japan (0.8%). Tax concessions (Chart 12) are the other main form of government support for business R&D.

Sources: ABS, unpublished R&D data, September 2005; OECD, Main Science and Technology Indicators database, 2005/1.

Chart 42 Percentage of GOVERD and HERD financed by industry – by OECD country, 2002



OECD countries are ranked in this chart in terms of the proportion of government expenditure on R&D (GOVERD) and higher education expenditure on R&D (HERD) that is financed by industry. Australia was around the middle of the range in its share of GOVERD financed by industry, standing at 5.2% in 2002 compared to the OECD average of 3.4% and the EU15 average of 5.8%. With 5.1% of HERD financed by industry in 2002, Australia was slightly below the OECD average of 5.9% and the EU15 average of 6.6%. In comparison with other OECD countries, Australia exhibited little difference between the government and higher education sectors in their proportions of industry-financed R&D.

Source: OECD, Main Science and Technology Indicators database, 2005/1.

Australian Science and Technology

at a glance

2005

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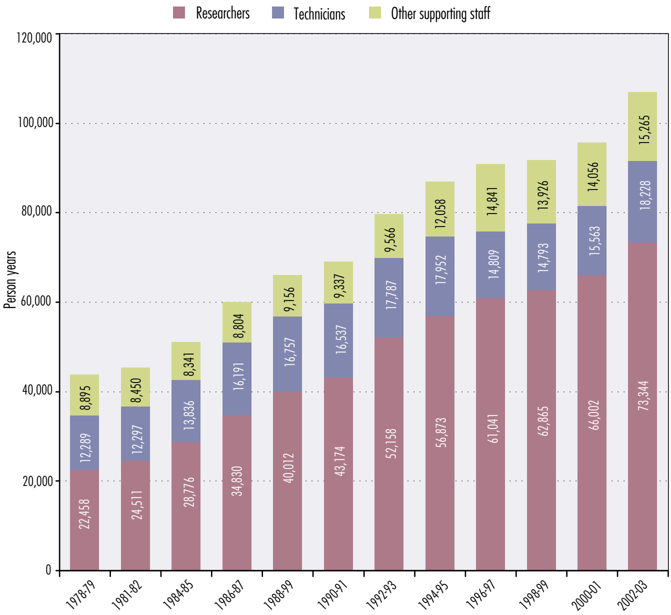
Human Resources in Science and Technology

Chart 43 Overview of human resources devoted to R&D – by sector of performance, 1978-79 to 2002-03

Sector of performance	1978-79	1981-82	1984-85	1986-87	1988-89	1990-91	1992-93	1994-95	1996-97	1998-99	2000-01	2002-03
Total human resources devoted to R&D (person years)												
Business	8,626	8,488	12,562	17,591	20,803	21,025	22,919	25,812	26,412	25,109	28,391	35,567
Government	17,424	17,792	17,137	18,325	19,198	19,660	19,804	19,309	19,190	18,422	18,152	18,542
Australian Gov.	11,318	11,412	11,119	11,529	10,863	10,670	11,019	10,660	10,377	9,353	9,565	10,185
State/Territory Gov.	6,106	6,380	6,018	6,796	8,335	8,990	8,785	8,649	8,813	9,069	8,587	8,357
Higher Education	17,047	18,241	20,844	23,219	24,902	27,081	35,418	40,096	42,739	45,502	46,287	49,612
Private Non-profit	546	688	712	945	1,023	1,282	1,369	1,666	2,351	2,551	2,791	3,117
Total	**43,643**	**45,211**	**51,255**	**60,080**	**65,926**	**69,048**	**79,510**	**86,883**	**90,692**	**91,584**	**95,621**	**106,838**
Researchers (person years)												
Business	3,649	3,472	5,889	9,106	11,873	12,604	13,943	14,903	15,259	14,772	16,221	20,622
Government	6,455	6,796	6,891	7,630	8,355	9,280	9,613	8,807	9,024	8,518	8,724	8,036
Australian Gov.	4,054	4,374	4,408	4,808	4,585	4,988	5,522	4,431	4,526	3,879	4,418	3,739
State/Territory Gov.	2,401	2,422	2,483	2,822	3,770	4,292	4,091	4,376	4,498	4,639	4,306	4,297
Higher Education	12,089	13,610	15,662	16,324	19,318	20,666	27,914	32,272	35,472	38,137	39,507	42,780
Private Non-profit	265	332	334	496	467	624	687	892	1,286	1,437	1,549	1,906
Total	**22,458**	**24,210**	**28,776**	**33,556**	**40,013**	**43,174**	**52,157**	**56,874**	**61,041**	**62,864**	**66,002**	**73,344**

Source: DEST, based on ABS unpublished R&D data provided in September 2005.

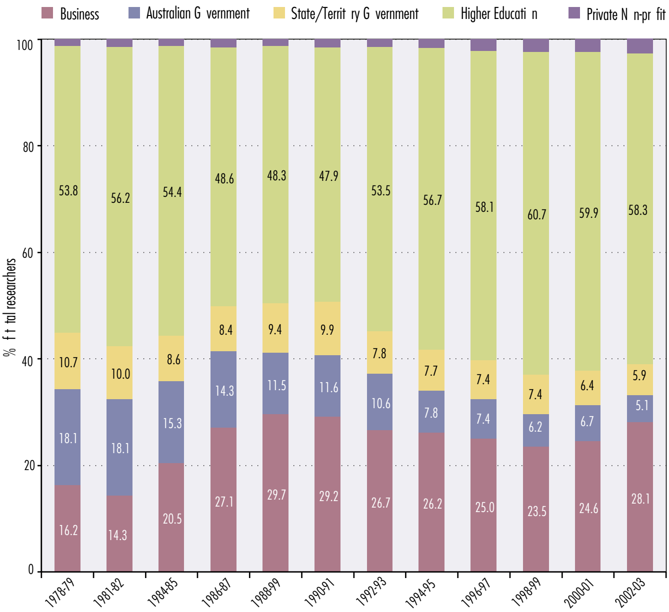
Chart 44 Total R&D personnel – by type of employee, 1978-79 to 2002-03



Total R&D personnel are defined as total human resources devoted to R&D including researchers, technicians and other supporting staff. Australia's R&D personnel reached 106,838 person years in 2002-03, of which 73,344 were employed as researchers, 18,228 as technicians, and 15,265 as other supporting staff. This was almost 2.5 times the level of 1978-79 and the highest level recorded since then. The proportion of researchers in total R&D personnel has increased over the last twenty-four years, from 51.5% in 1978-79 to 68.6% in 2002-03. In contrast, the proportions of technicians and other supporting staff have dropped from 28.2% to 17.1% and from 20.4% to 14.3% respectively over the period.

Source: DEST, based on ABS unpublished R&D data provided in September 2005.

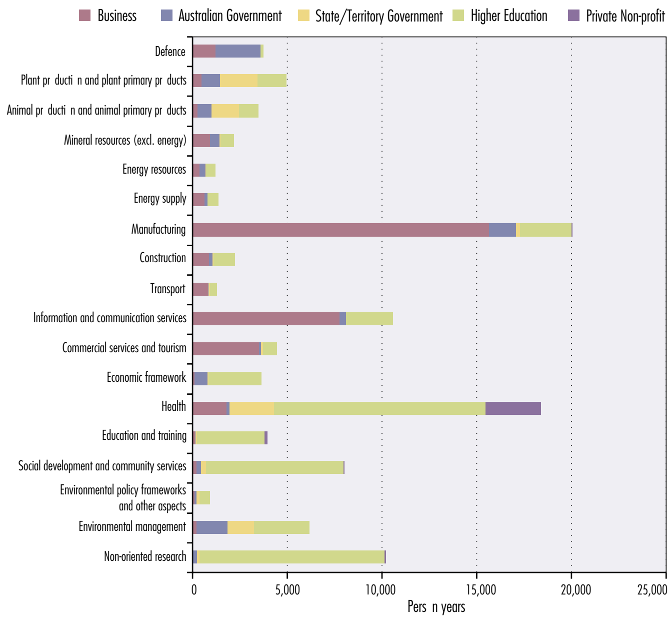
Chart 45 Distribution of total researchers – by sector of performance, 1978-79 to 2002-03



Researchers are mainly responsible both for producing and exploiting knowledge. The chart tracks the distribution of Australian researchers in the four R&D performing sectors over twenty-four years. Researchers employed in the higher education sector rose from 53.8% of total researchers in 1978-79 to 58.3% in 2002-03. The share of business researchers also increased from 16.2% in 1978-79 to 28.1% in 2002-03. In contrast, the proportion of researchers employed in the government sector declined over the period, from 18.1% to 5.1% for Australian Government and from 10.7% to 5.9% for state and territory governments. Private non-profit organisations accounted for a relatively small share, at 2.6% in 2002-03, but it recorded continuous growth over the period.

Source: DEST, based on ABS unpublished R&D data provided in September 2005.

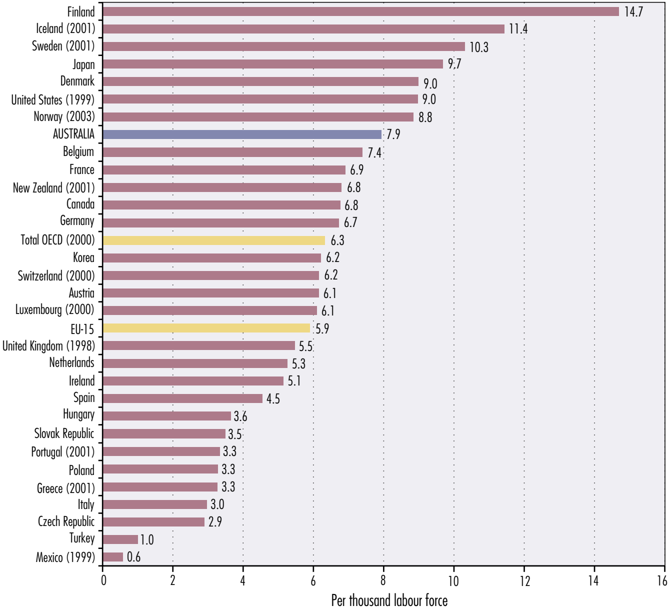
Chart 46 Total R&D personnel by sector of performance – by socio-economic objective, 2002-03



The distribution of total R&D personnel by socio-economic objective in the four performing sectors is shown in this chart. In 2002-03, the largest number of researchers was devoted to Manufacturing (20,040 person years), followed by Health (18,394 person years). Business R&D personnel dominated research in Manufacturing (15,693) and Information and communication services (7,782). Higher education R&D personnel focused more on Health (11,192), Non-oriented research (9,786) and Social development and community services (7,282). The Australian Government employed most R&D personnel in Defence R&D (2,366) and the majority of the R&D personnel in the private non-profit organisations were engaged in Health R&D.

Source: ABS unpublished R&D data September 2005.

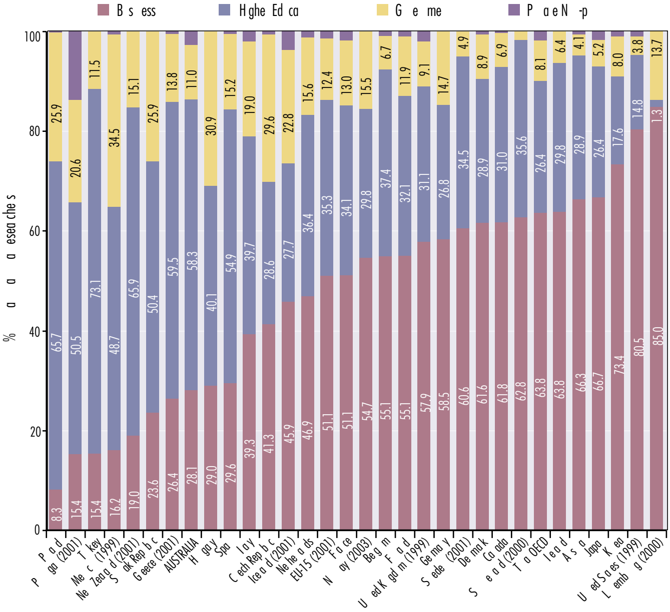
Chart 47 Total researchers per thousand labour force – by OECD country, 2002



The chart ranks OECD countries in terms of the proportion of researchers in the national labour force. Australia had around 7.9 person years per thousand labour force in 2002, above the 6.3% for the OECD as a whole and 5.9% for the EU15. Finland, Iceland, Sweden, Japan, Denmark and the United States had the highest proportions of researchers in their labour force, at 9.0 person years per thousand labour force or more. Italy, the Czech Republic, Turkey and Mexico had 3.0 person years or less per thousand labour force.

Sources: ABS, unpublished R&D data, September 2005; OECD, Main Science and Technology Indicators database, 2005/1.

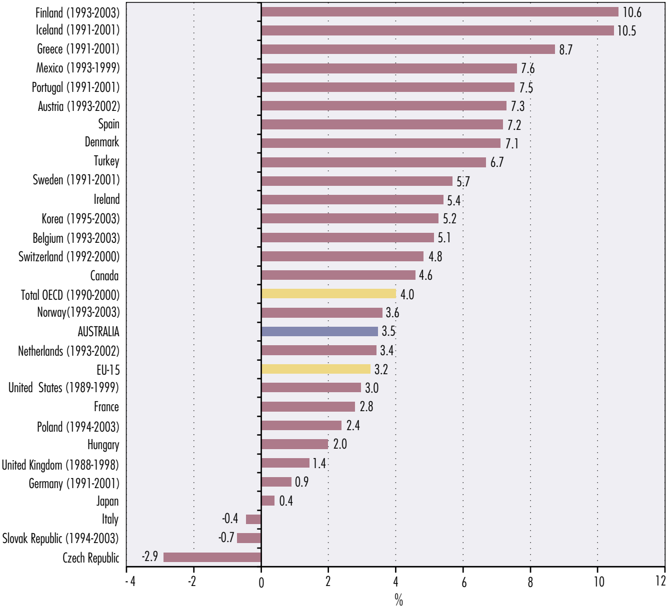
Chart 48 Distribution of total researchers by sector of performance – by OECD country, 2002



The chart compares Australia with other OECD countries in terms of the distribution of national researchers in the four performing sectors. In 2002, the business sector accounted for 28.1% of total researchers in Australia, significantly less than the OECD average (63.8%) and the EU15 average (51.1%). Australia had 58.3% of total researchers working in the higher education sector, ranked the third highest amongst OECD nations, well above the OECD average (26.4%) and the EU15 average (35.3%). Australia's government sector accounted for 11.0% of total researchers, slightly above 8.1% in the OECD as a whole but below 12.4% in the EU15.

Sources: ABS, unpublished R&D data, September 2005; OECD, Main Science and Technology Indicators database, 2005/1.

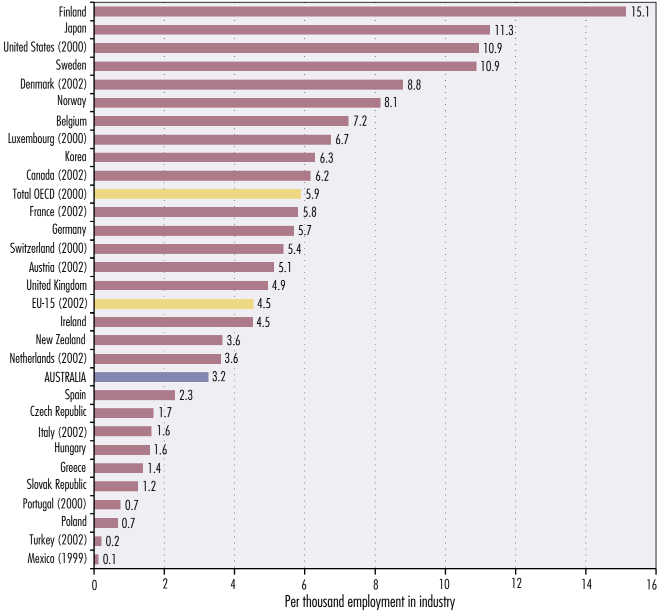
Chart 49 Growth of total researchers at average annual rate – by OECD country, 1992-2002



Growth rates of total researchers in OECD countries over the decade between 1992 and 2002 are compared in this chart. Australia's growth rate in total researchers amounted to 3.5% per annum. It was slightly above that of the EU15 (3.2%) but below the OECD as a whole (4.0%). Finland and Iceland led OECD countries with a growth rate more than 10% while Italy, the Slovak Republic and the Czech Republic reported a decline of total researchers over the period. The large OECD economies the United States (3.0%), France (2.8%), the United Kingdom (1.4%), Germany (0.9%) and Japan (0.4%) all recorded a growth rate lower than Australia.

Sources: ABS, unpublished R&D data, September 2005; OECD, Main Science and Technology Indicators database, 2005/1.

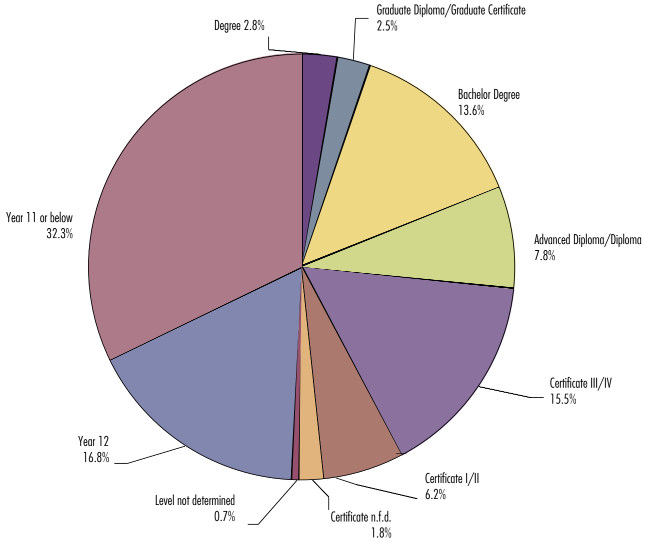
Chart 50 Total business enterprise researchers per thousand employment in industry – by OECD country, 2003



It is mainly through business researchers that firms can use knowledge to produce new innovative products and services. In 2003, Australia had around 3.2 business researchers (person years) per thousand employment in industry. This was relatively low compared with 5.9 business researchers for the OECD as a whole and 4.5 business researchers for the EU15. Finland sits at the top of the table with 15.1 business researchers per thousand employment in industry, almost five times that for Australia, followed by Japan (11.3), the United States and Sweden (10.9 each), Denmark (8.8) and Norway (8.1). Portugal, Poland, Turkey and Mexico recorded less than 1 business researcher per thousand employment in industry.

Sources: ABS, unpublished R&D data, September 2005; OECD, Main Science and Technology Indicators database, 2005/1.

Chart 51 All persons aged 15-64 years in Australia – by qualification, May 2004

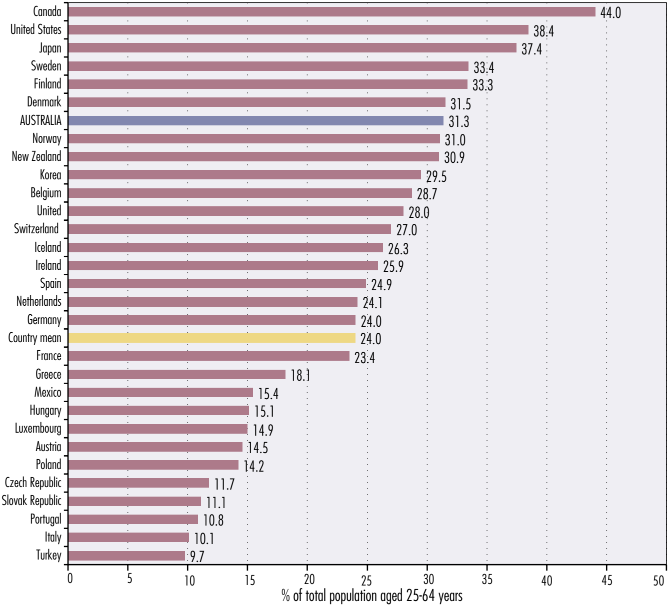


Total population aged 15-64 years = 13.17 million

The presence of highly educated people in the working age population can be considered as the most important resource in research, science and innovation. Australia's population aged 15-64 years stood at around 13.2 million in May 2004, 26.7% of which (3.5 million) had a qualification of Advanced Diploma/Diploma or higher. There were around 6.5 million people without non-school qualifications, representing 49.1% of total population aged 15-64 years, 16.8% with Year 12 and 32.3% with Year 11 or below.

Source: DEST, based on ABS Education and Work data, September 2005.

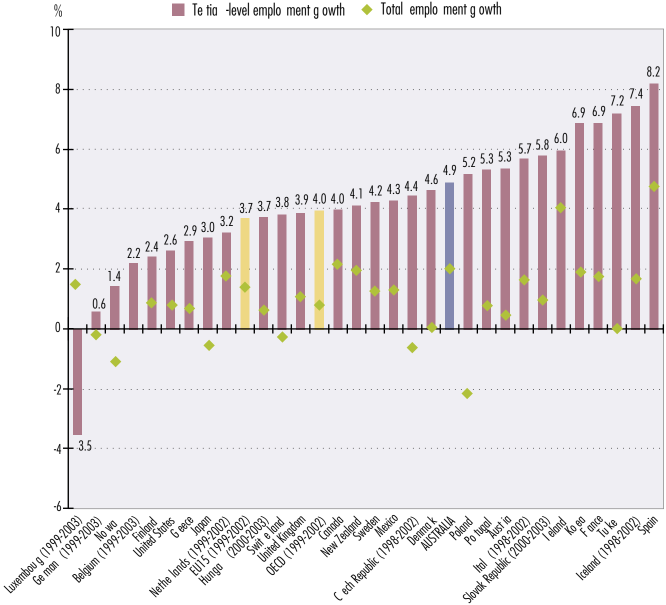
Chart 52 Human resources in science and technology by qualification (HRSTQ) as a percentage of total population aged 25-64 years – by OECD country, 2003



Human resources in science and technology by qualification (HRSTQ) refers to persons successfully completing tertiary education (as defined in the ISCED-1997) in an S&T field. In this definition, science and technology (S&T) is used in its broadest sense including the fields of social sciences, humanities, natural sciences and engineering. With HRSTQ accounting for 31.3% of total population aged 25-64 years, Australia ranked 7th out of the OECD countries, far higher than the OECD country mean of 24.0%. Amongst the highest countries were Canada (44.0%), the United States (38.4%), Japan (37.4%), Sweden (33.4%), Finland (33.3%) and Denmark (31.5%). The shares of HRSTQ in the population aged 25-64 years were below 15% in eight OECD countries including Portugal, Italy and Turkey.

Source: OECD, *Education at a Glance: OECD Indicators 2005.*

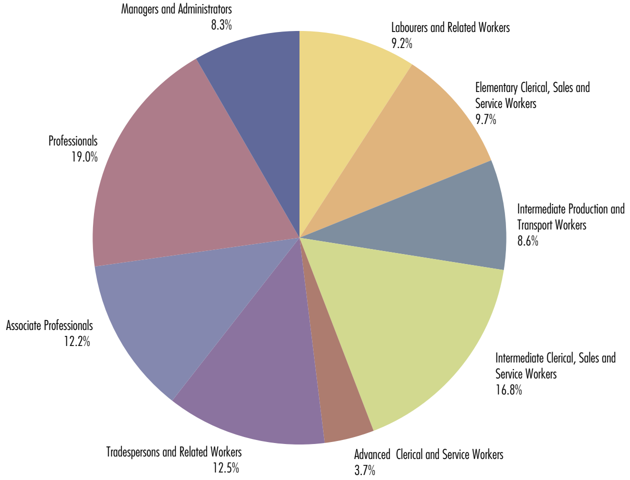
Chart 53 Employment growth of HRSTQ at average annual rate – by OECD country, 1998-2003



In Australia, the employment of HRSTQ (tertiary-level graduates) grew at 4.9% per annum over the five year period between 1998 and 2003. This growth rate was well above 4.0% per annum for OECD as a whole and 3.7% per annum for the EU15 over the period. Spain and Iceland recorded the highest growth rates at 8.2% and 7.4% respectively while Luxembourg experienced negative growth, at -3.5%. Across the OECD countries, the growth rates of employment of tertiary-level graduates were generally much higher than those of total employment with the exception of Luxembourg.

Source: OECD, Education Attainment database, May 2005.

Chart 54 Employed persons aged 15-64 years in Australia – by occupation, August 2004

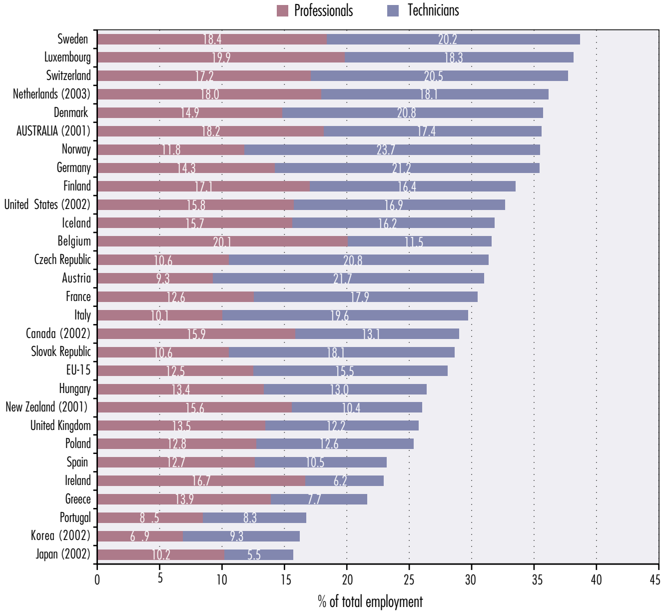


Total employed persons aged 15-64 years = 9.58 million

The availability of competent individuals for employment to a large extent determines the national capacity for research, science and innovation. In August 2004, about 3.8 million people were employed as Managers and administrators, Professionals and Associate professionals in Australia. This group of highly-skilled workers represented approximately 39.5% of total employed persons aged 15-64 years (9.6 million) in Australia. Tradespersons and related workers and Advanced clerical and service workers accounted for 12.5% and 3.7% of total employed persons aged 15-64 years respectively.

Source: DEST, based on ABS Labour Force data, September 2005.

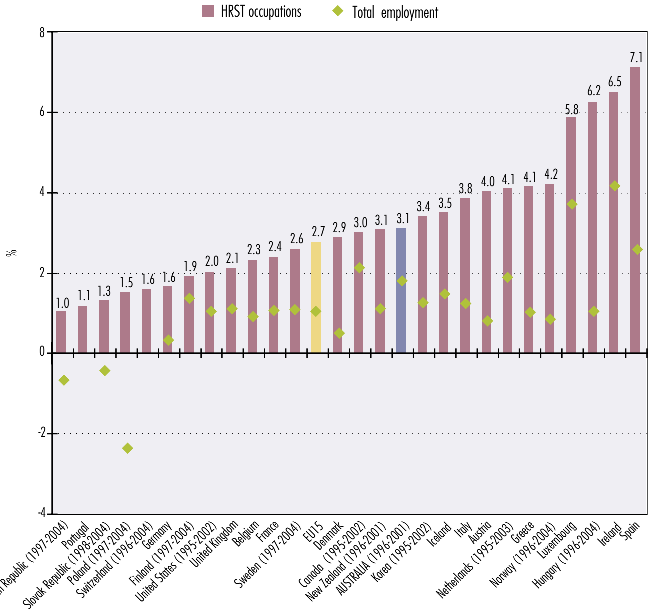
Chart 55 Human resources in science and technology by occupation (HRSTO) as a percentage of total employment – by OECD country, 2004



Human resources in science and technology by occupation (HRSTO) refers to persons employed in an S&T occupation where tertiary qualifications are normally required. This category of workers (so-called S&T workers) usually corresponds to professionals, technicians and certain managers (as defined in the ISCO-88). Australia's stock of HRSTO accounted for 35.6% of total employment in 2001 comprising professionals (18.2% of total employment) and technicians (17.4%). This represents one of the highest shares in OECD countries, significantly higher than the EU15 average of 28.0% in 2004.

Source: OECD, *Science, Technology and Industry Scoreboard 2005.*

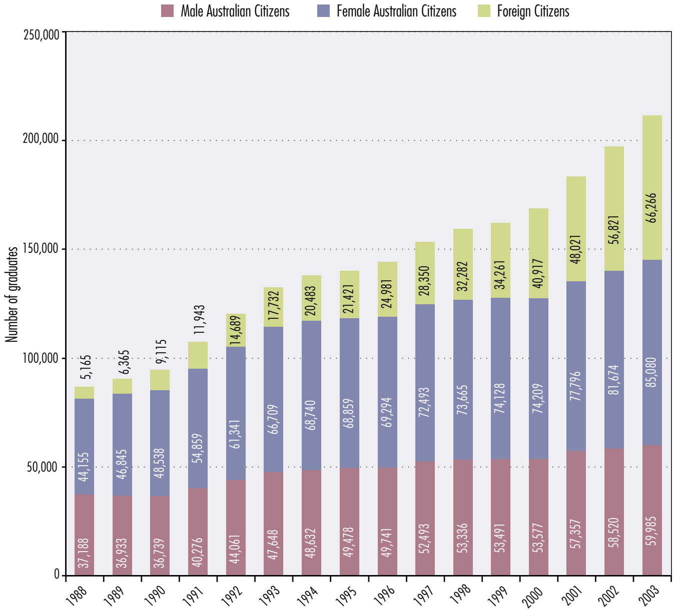
Chart 56 Employment growth of HRSTO at average annual rate – by OECD country, 1995-2004



The employment of HRSTO in Australia grew by 3.1% per annum over the period 1996-2001, much higher than the growth rate of 2.7% per annum for the EU15. The countries with the highest growth rates in HRSTO over the period 1995-2004 were Spain (7.1%), Ireland (6.5%) and Hungary (6.2%) while some countries experienced a relatively low growth rate including the Slovak Republic (1.3%), Portugal (1.1%) and the Czech Republic (1.0%). The growth rates in HRSTO were generally higher than that for total employment across OECD countries except Poland, the Czech Republic and Portugal.

Source: OECD, *Science, Technology and Industry Scoreboard 2005.*

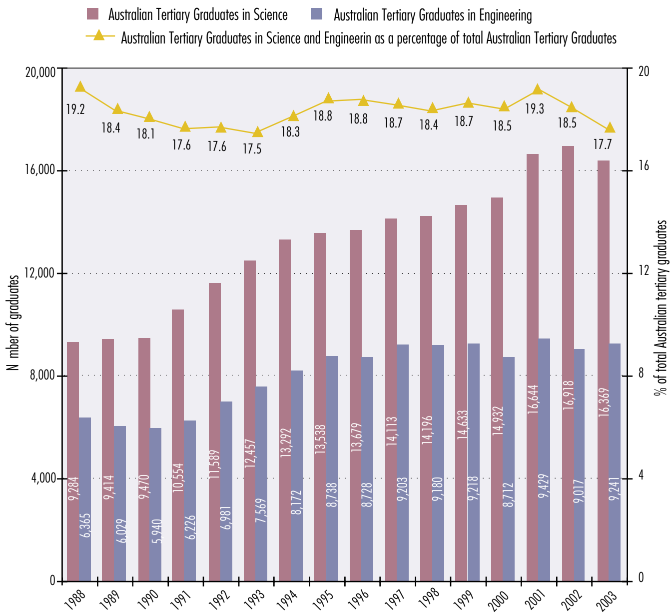
Chart 57 Tertiary graduates in Australia – by citizenship and gender, 1988 to 2003



The number of tertiary graduates in Australia experienced continuous growth over the period between 1988 and 2003. Foreign tertiary graduates grew more than ten-fold over the period, from 5,165 in 1988 to 66,266 in 2003 while Australian tertiary graduates (tertiary graduates with Australian citizenship) almost doubled from 81,343 in 1988 to 145,065 in 2003. As such, foreign graduates now account for nearly one third of total tertiary graduates in Australia (31.4% in 2003). The number of female Australian tertiary graduates was 18.7% higher than that of male Australian tertiary graduates in 1988 and this gender gap has been becoming wider, up to 41.8% in 2003.

Source: DEST, derived from unpublished data provided by the University Statistics Unit, DEST in July 2005.

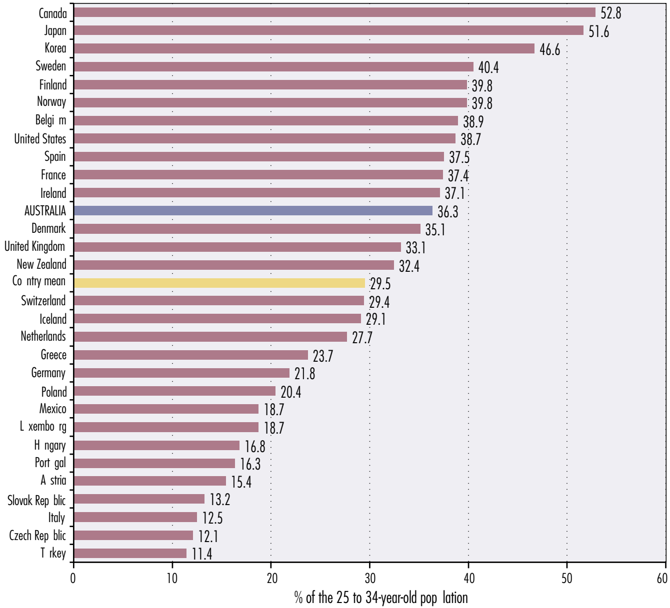
Chart 58 Australian tertiary graduates in science and engineering, 1988 to 2003



The bars and line in the chart track the number of Australian tertiary graduates (tertiary graduates with Australian citizenship) in science and engineering over the period 1988-2003 and the proportion they represent of total Australian tertiary graduates. In 2003 there were 16,369 science graduates, nearly twice as many as engineering graduates (9,241). The number of science graduates increased by 76.3% over the period, much higher than the 45.2% increase in the number of engineering graduates. Australian tertiary graduates in science and engineering as a whole accounted for approximately 17.7% of total Australian tertiary graduates in 2003. This proportion fluctuated over the period, reaching its peak level of 19.3% in 2001 and standing at 17.7% in 2003.

Source: DEST, derived from unpublished data provided by the University Statistics Unit, DEST in July 2005.

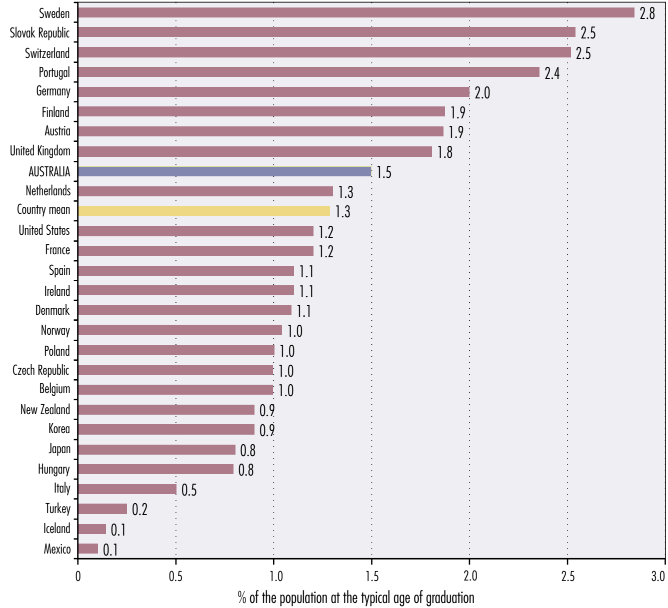
Chart 59 Percentage of the 15 to 34-year-old population with tertiary education – by OECD country, 2003



The proportion of tertiary-level graduates in the 25 to 34-year-old population is an indicator of the labour market's innovative potential and displays a general trend towards up-skilling. The chart ranks OECD countries in terms of the share of tertiary graduates in total employment in 2003. At 36.3%, Australia's share was significantly higher than the OECD country mean of 29.5%. Canada and Japan had significantly higher rankings than the other countries, with tertiary-level graduates accounting for more than half of the 25 to 34-year-old population. In the Slovak Republic, Turkey, the Czech Republic and Italy, tertiary-level graduates accounted for less than 15% of the 25 to 34-year-old population.

Source: OECD, *Education at a Glance: OECD Indicators 2005.*

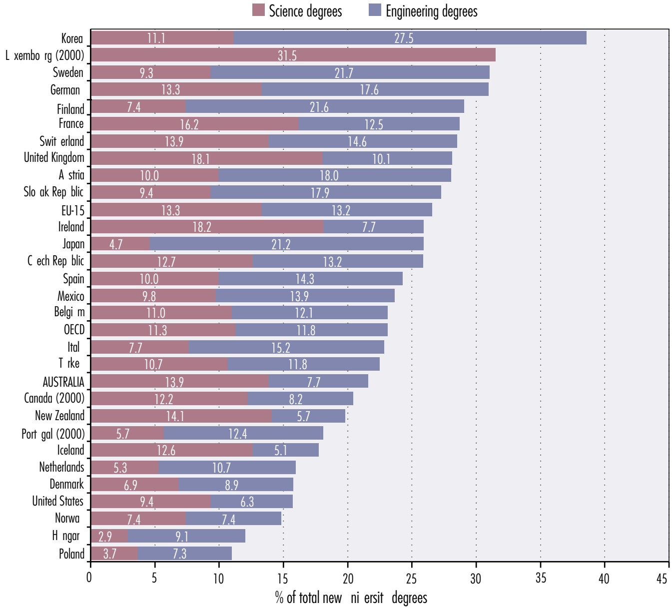
Chart 60 PhD graduates as a percentage of the population at the typical age of graduation – by OECD country, 2003



In Australia, PhD graduates accounted for 1.5% of the population at the typical age of graduation in 2003. This was slightly above the OECD country mean of 1.3% and at 9th place amongst OECD countries, between the United Kingdom (1.8%) and the Netherlands (1.3%). The leading countries on this indicator were Sweden (2.8%), the Slovak Republic (2.5%), Switzerland (2.5%), Portugal (2.4%), Germany (2.0%), Finland and Austria (1.9% each). Relative to the population at the typical age of graduation, Italy, Turkey, Iceland and Mexico had the least PhD graduates, at 0.5% or less.

Source: OECD, *Education at a Glance: OECD Indicators 2005.*

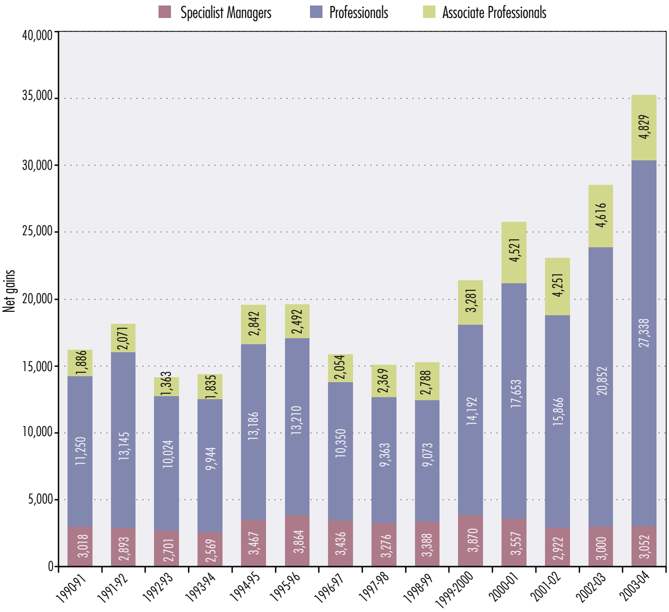
Chart 61 University science and engineering graduates as a percentage of total new university degrees – by OECD country, 2002



In 2002, 21.6% of total new university graduates in Australia received science and engineering degrees, compared to 26.5% in the EU15 and 23.1% in the OECD as a whole. 13.9% of new university graduates in Australia were awarded science degrees; this represents one of the highest proportions among OECD countries. However, the university graduates with engineering degrees accounted for only 7.7% of total new university graduates in Australia, much lower than 11.8% for the OECD as a whole and 13.2% for the EU15. More than one-fifth of total university graduates were awarded engineering degrees in Korea, Sweden, Finland and Japan.

Source: OECD, *Science, Technology and Industry Scoreboard 2005.*

Chart 62 Australia's net gains in highly skilled workers through migration, 1990-91 to 2003-04

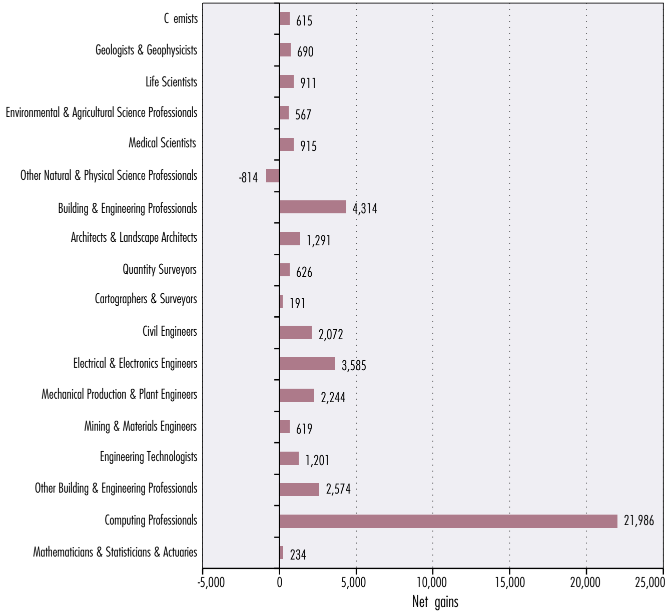


The bars in the chart show the trend in the Australia's net gains in highly skilled workers through migration. In the five year period to 2003-04, Australia's net gains of highly skilled workers increased markedly, reaching more than 35,000 persons in 2003-04, compared to the levels of approximately 15,000 recorded in most years of the 1990s. The net gains in the groups of Professionals and Associate professionals have accounted for almost all the increase over the fourteen year period, with the net gains in Specialist managers largely unchanged. In 2003-04, the largest net gains occurred mainly in the group of Professionals (27,338), followed by Associate professionals (4,829) and Specialist Managers (3,052).

Source: DEST, derived from unpublished data provided by DIMIA in June 2005.

Note: Figures under associate professionals from 1990-91 to 1996-97 are for para-professionals.

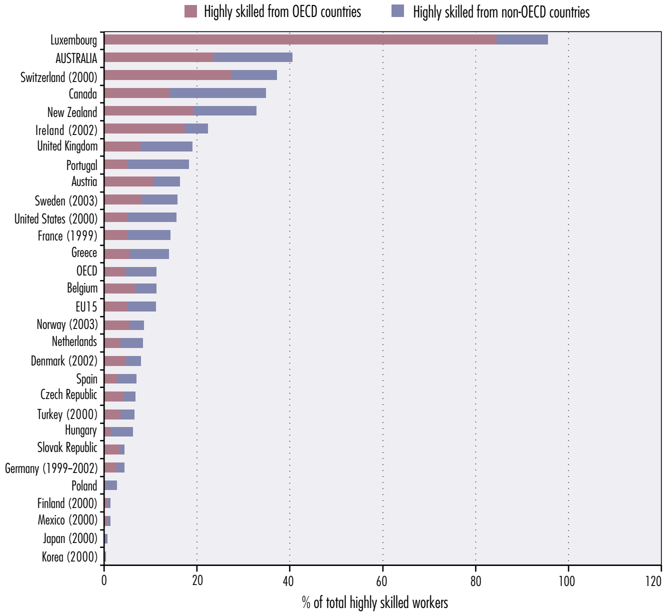
Chart 63 Net gains in scientists and engineers through migration – by selected occupation, 1999-2000 to 2003-04



In the five years to 2003-04, Australia experienced net gains in scientists and engineers through migration across almost all science and engineering occupations. By far the largest net gain came in the category of Computing professionals (21,986 persons). The second largest net gain was in the category of Building and engineering professionals and others including architects, surveyors, engineers and technologists (16,143 persons). Australia's net gain in the Natural and physical scientists was estimated at 2,884, which involved the net gains of 915 Medical scientists, 911 Life scientists, 690 Geologists and geophysicists, 615 Chemists, 567 Environmental and agricultural scientists, and the net loss of 814 people in the category of Other natural and physical science professionals.

Source: DEST, derived from unpublished data provided by DIMIA in June 2005.

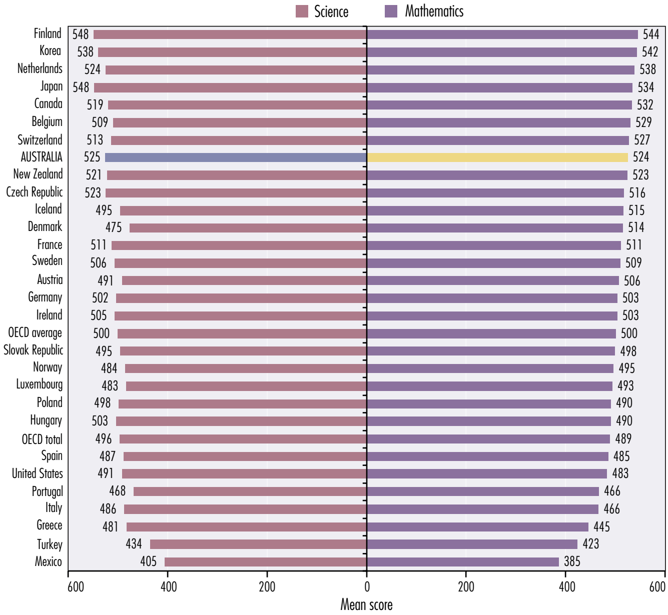
Chart 64 Highly skilled migrants as a percentage of total highly skilled workers – by OECD country, 2001



Modern economies compete in attracting highly skilled immigrants to feed the demand for human resources in science and technology. In 2001, Australia ranked as second in the OECD to Luxembourg in highly skilled migration, with the number of highly skilled migrants from both OECD and non-OECD countries corresponding to 40.4% of total highly skilled workers in Australia. Other countries which are major beneficiaries of highly skilled migration include Switzerland (37.1%), Canada (34.6%) and New Zealand (32.6%). Highly skilled migrants were estimated at less than 2% of total highly skilled workers in Korea, Japan, Mexico and Finland.

Source: OECD, Database on Immigrants and Expatriates, April 2005.

Chart 65 Mathematical and scientific literacy of 15-year-olds – by OECD country, 2003



The chart presents the mean mathematical and scientific literacy scores obtained by 15-year-old students amongst the OECD countries for the year 2003. As shown, both Australian mathematical and scientific literacy scores for this year were significantly greater than the average OECD scores. Australia's mean score amongst 15-year-olds for mathematics was 524 (compared to the OECD average score of 500), while Australian 15-year-olds displayed a mean score in science of 525 (compared to the OECD average score of 500). Finland ranked highest in literacy scores for both mathematics and science amongst 15-year-olds during 2003, with scores of 544 and 548 respectively.

Source: OECD, PISA database, 2003.

Australian Science and Technology

at a glance

2005

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Scientific and Technological Output

Chart 66 Australian Nobel Prize winners in science

WILLIAM BRAGG & LAWRENCE BRAGG
1915 PHYSICS
Study of X-ray crystallography

HOWARD FLOREY (SHARED)
1945 PHYSIOLOGY OR MEDICINE
Development of penicillin

MACFARLANE BURNET (SHARED)
1960 PHYSIOLOGY OR MEDICINE
Research on organ transplantation

JOHN ECCLES
1963 PHYSIOLOGY OR MEDICINE
Research on the transmission of nerve impulses

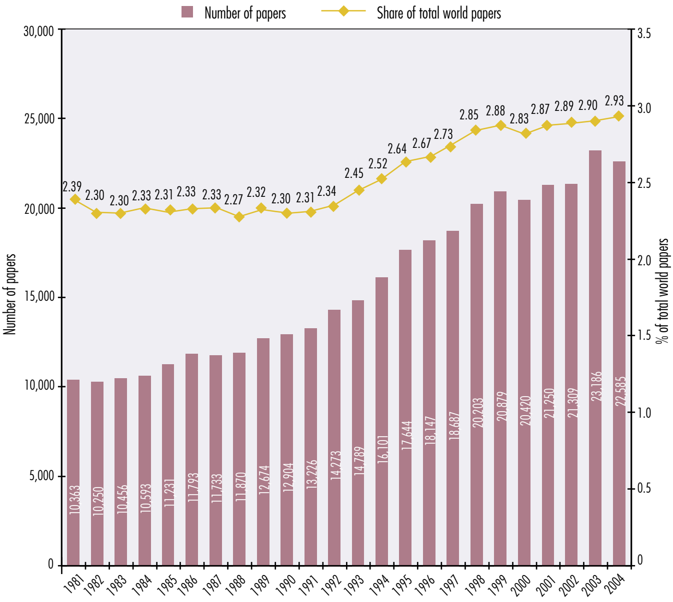
JOHN CORNFORTH (SHARED)
1975 CHEMISTRY
Pioneer of new branch of chemistry on the structure of living matter

PETER DOHERTY (SHARED)
1996 PHYSIOLOGY OR MEDICINE
Discoveries concerning the specificity of the cell mediated immune defence

BARRY MARSHALL & ROBIN WARREN
2005 PHYSIOLOGY OR MEDICINE
Discoveries concerning the bacterium causing stomach ulcers and gastritis

Barry Marshall and Robin Warren have won the 2005 Nobel Prize in Physiology or Medicine for their work identifying the bacterium Helicobacter pylori and its role in gastritis and peptic ulcers. As such, Australia has now had seven Nobel Prizes in science, with nine Australian scientists having received these Prizes. The Nobel Prize is the most prestigious international award for science.

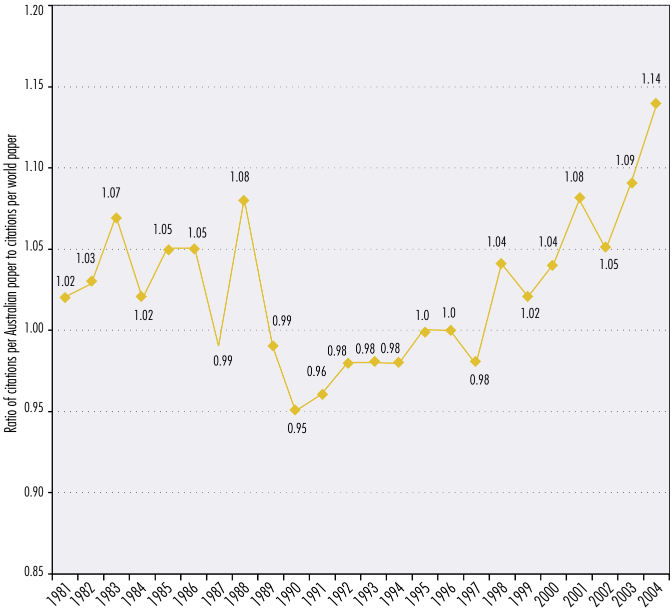
Chart 67 Australia's number and world share in scientific publications, 1981 to 2004



Scientific publications are used as a measure of scientific performance. The total number of Australian scientific publications rose fairly steadily from 10,363 in 1981 to 22,585 in 2004. The upward trend seemed to stall between 1999 and 2002 and experienced a slight drop in 2004 following the peak level reached in 2003. Australia's share of total world scientific publications stayed roughly steady until the early 1990s. The figure for 1981 was 2.39%, while the figure for 1992 was 2.34%. Since then there has been an upward trend, reaching an all-time high of 2.93% in 2004.

Source: Thomson ISI, National Science Indicators database, 2005.

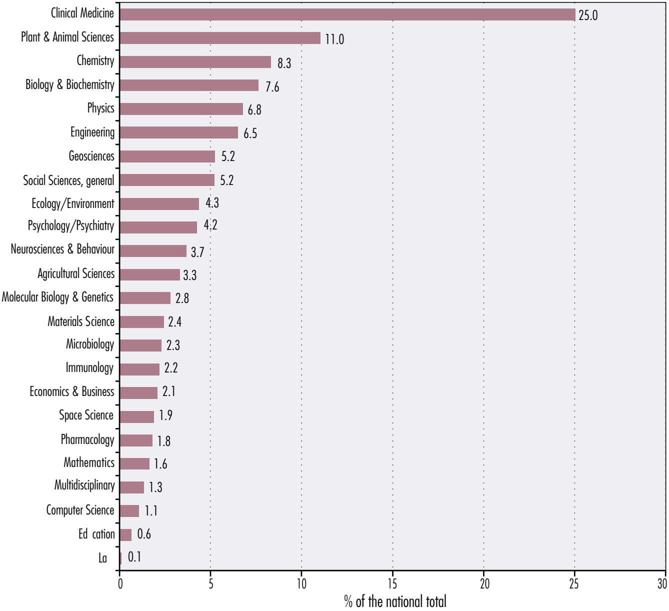
Chart 68 Impact of Australian scientific publications, 1981 to 2004



The number of citations a scientific publication receives is used as an indicator of its impact and is referred to as citation impact. This chart indexes the Australian citation impact against the worldwide average. For example, in 2004 Australia scored 1.14, which means that the Australian citation impact was 1.14 times the world average. From 1981 to 2004, Australian citation impact was generally above the world average; however it has dipped below that average on various occasions between 1987 and 1997. The ratio of Australian citation impact to the world average has trended generally upward since 1997 and increased sharply between 2002 and 2004.

Source: Thomson ISI, National Science Indicators database, 2005.

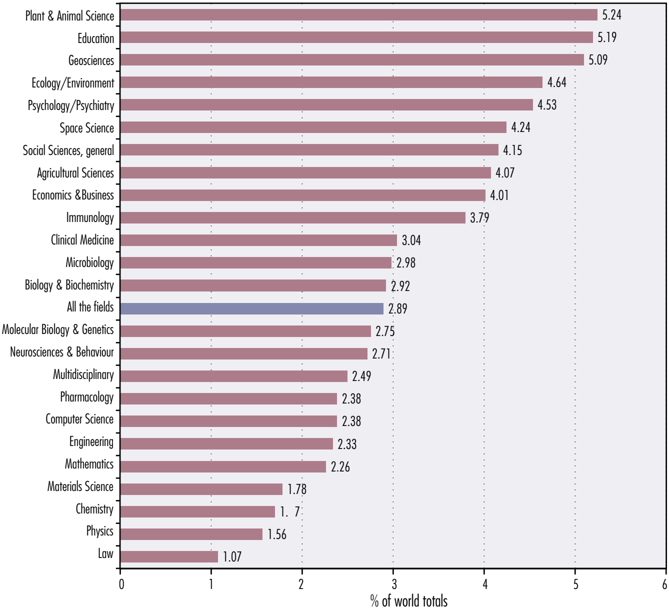
Chart 69 Distribution of Australian scientific publications – by field of research, 2000-04



This chart provides the distribution of Australian scientific publications amongst the fields of research (as defined by Institute for Scientific Information) over the period 2000-04. The largest percentage of scientific publications over the period was in the field of Clinical medicine (25.0%) followed by Plant and animal sciences (11.0%). Six other fields achieved a share greater than five percent: Chemistry (8.3%), Biology and biochemistry (7.6%), Physics (6.8%), Engineering (6.5%), Geosciences (5.2%) and Social sciences, general (5.2%). Mathematics accounted for 1.6% of the total Australian research papers published during the period.

Source: Thomson ISI, National Science Indicators database, 2005.

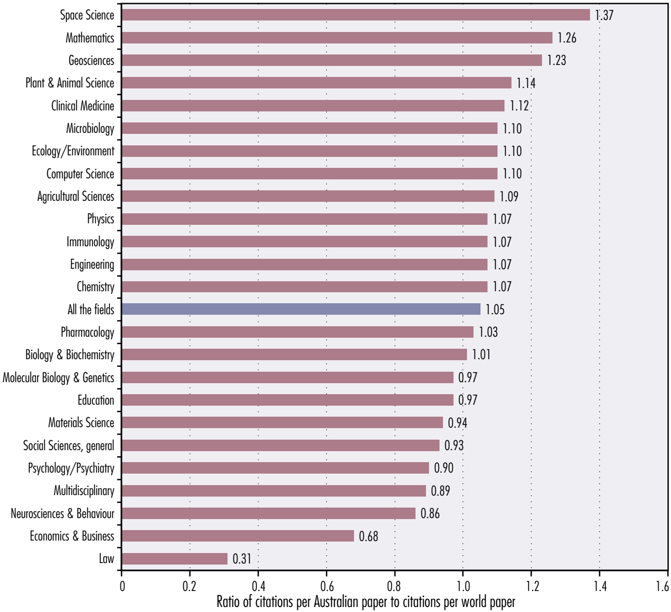
Chart 70 Australian scientific publications as a percentage of world totals – by field of research, 2000-04



This chart indicates that the number of Australian scientific publications amounted to 2.89% of the world total for the five-year period to 2004. It also shows that in 13 fields, Australian research achieved even better relative prominence. For instance, Australian scientific publications on Plant and animal sciences amounted to 5.24% of the world total in that field over the period. Australian scientific publications were also relatively numerous in the fields of Education (5.19%), Geosciences (5.09%), Ecology and environment (4.64%), Psychology and psychiatry (4.53%) and Space sciences (4.24%).

Source: Thomson ISI, National Science Indicators database, 2005.

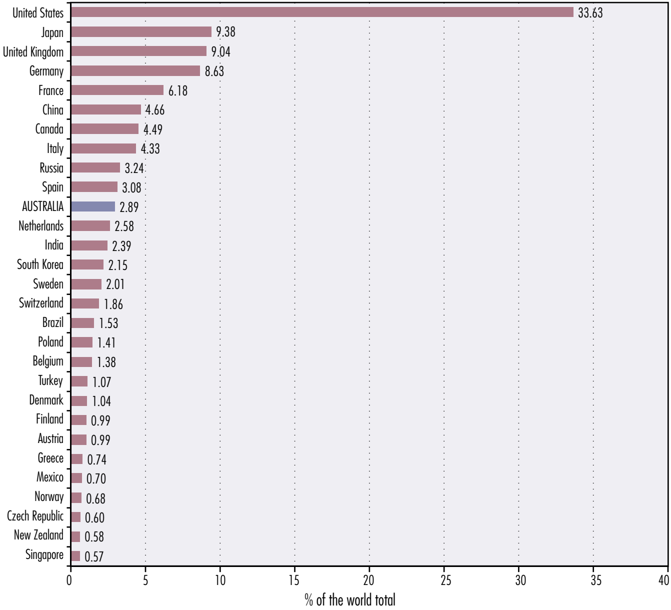
Chart 71 Impact of Australian scientific publications – by field of research, 2000-04



This chart ranks the relative citation impact of Australian scientific publications by field of research over the period 2000-04. At the head of the chart are scientific publications in the field of Space sciences, with an index of 1.37. This means that Australian scientific publications were cited at 1.37 times the world rate for papers in that field over the period. The chart also indicates that Australian scientific publications were generally well cited. During the five year period to 2004, Australia achieved citation impact at or above the world average in 15 out of the 24 fields.

Source: Thomson ISI, National Science Indicators database, 2005.

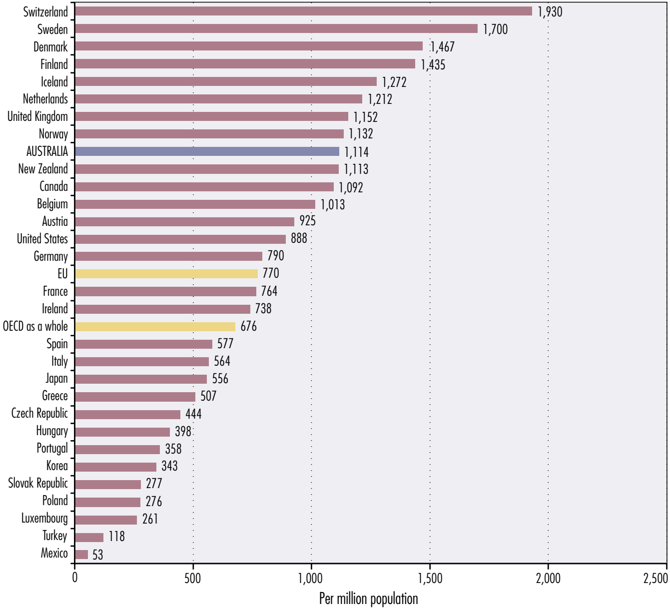
Chart 72 Share of world scientific publications – by world leading country, 2000-04



During the five year period to 2004, Australia accounted for 2.89% of the total world research papers published. Australia ranked 11th in the world and ninth among OECD countries. The United States was the largest producer of scientific literature. Its scientific publications made up 33.63% of the world total. The other countries ahead of Australia were Japan (9.38%), the United Kingdom (9.04%), Germany (8.63%), France (6.18%), China (4.66%), Canada (4.49%), Italy (4.33%), Russia (3.24%) and Spain (3.08%). Australia was immediately followed by the Netherlands (2.58%) and India (2.39%).

Source: Thomson ISI, National Science Indicators database, 2005.

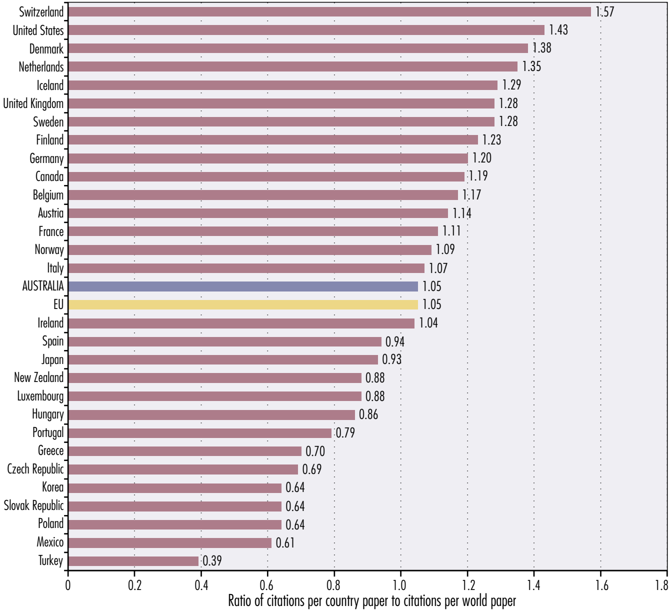
Chart 73 Number of scientific publications per million population – by OECD country, 2000-04



Australia ranked ninth among the OECD countries in terms of the number of scientific publications per capita over the period 2000-04. With 1,114 scientific publications per million population, Australia ranked close to the United Kingdom (1,152), Norway (1,132), New Zealand (1,113) and Canada (1,092) and well above the OECD average (676), the EU average (770), and the rate for the United States (888). Switzerland, Sweden, Denmark and Finland led the OECD countries with rates of 1,930, 1,700, 1,467 and 1,435 respectively.

Source: Thomson ISI, National Science Indicators database, 2005.

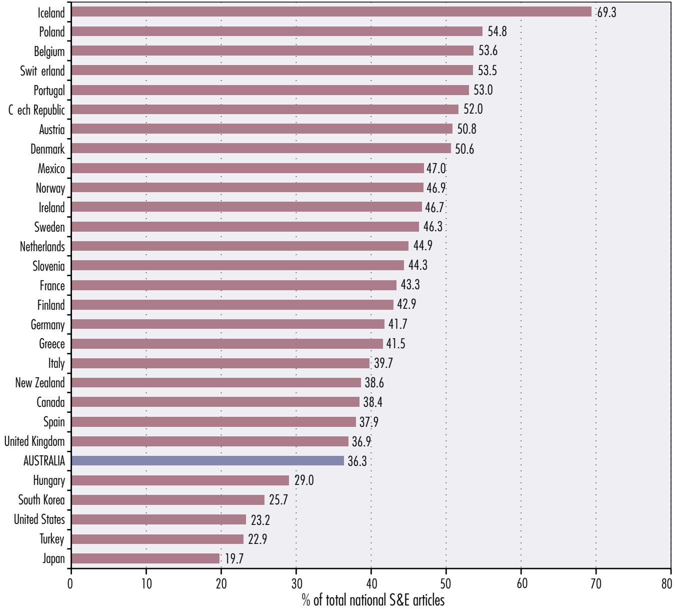
Chart 74 Impact of scientific publications – by OECD country, 2000-04



This chart ranks OECD countries in terms of the ratio of citation impact to the worldwide average. Over the period 2000-04 Australia scored 1.05, equivalent to the EU, which means that Australian citation impact, as well as that for the EU was 1.05 times the world average. Switzerland led OECD countries with a ratio of 1.57, followed by the United States (1.43), Denmark (1.38), the Netherlands (1.35), Iceland (1.29), the United Kingdom and Sweden (1.28 each). Scientific publications from the Slovak Republic, Poland, Mexico and Turkey received the lowest relative number of citations among OECD countries over the period.

Source: Thomson ISI, National Science Indicators database, 2005.

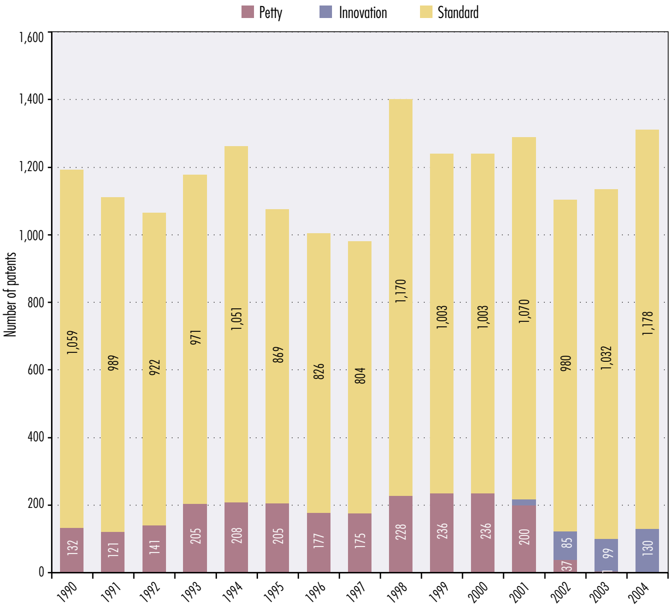
Chart 75 Share of internationally co-authored science and engineering (S&E) articles – by OECD country, 2001



OECD countries are ranked in terms of the share of internationally co-authored Scientific and Engineering (S&E) articles in total national S&E articles. Australia placed relatively low compared to other countries, with only 36.3% of Australian S&E articles having at least one co-author from other countries. The proportion of internationally-co-authored S&E articles was also rather low in Canada, the United Kingdom, the United States and Japan. Small European countries ranked high on this indicator, with internationally-co-authored S&E articles accounting for 69.3% of total S&E articles in Iceland, 53.6% in Belgium, and 53.5% in Switzerland.

Source: NSF, *Science and Engineering Indicators 2004.*

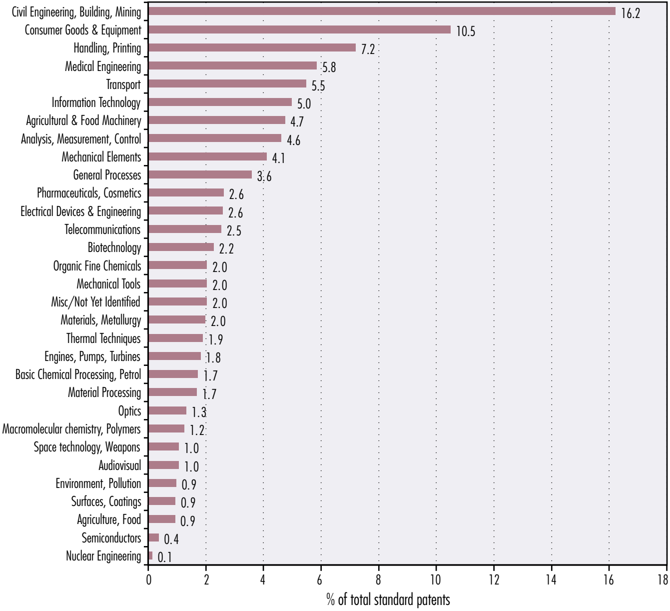
Chart 76 Number of patents granted to Australian residents by IP Australia, 1990 to 2004



The number of patents reflects the inventive performance of countries, regions and firms. IP Australia grants two types of patents: standard patents that give long-term protection and control over an invention for up to 20 years; and innovation patents that are a relatively fast, inexpensive protection option, lasting a maximum of 8 years. The innovation patent replaced the petty patent on 24 May 2001; however, the right of a petty patent previously granted is still enforceable until the term of the petty patent expires. The number of patents granted to Australian residents by IP Australia stood at 1,308 in 2004, the second highest level since 1990, slightly below the peak level of 1,398 recorded in 1998.

Source: IP Australia, Patent Statistics, September 2005.

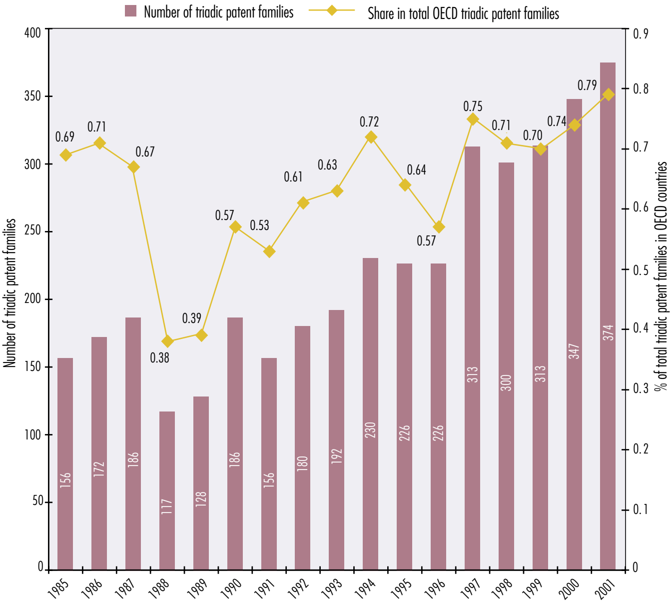
Chart 77 Share of standard patents granted to Australian residents by IP Australia – by technology group, 2000-04



The chart ranks 31 technology groups in terms of their shares in the total number of standard patents granted to Australian residents by IP Australia over the five years to 2004. The technology groups on the top of the list were Civil engineering, building and mining (16.2%), Consumer goods and equipment (10.5%), Handling and printing (7.2%), Medical engineering (5.8%), Transport (5.5%) and Information Technology (5.0%). Agriculture and food (0.9%), Semiconductors (0.4%) and Nuclear engineering (0.1%) accounted for the lowest shares amongst the technology groups.

Source: IP Australia, Patent Statistics, September 2005.

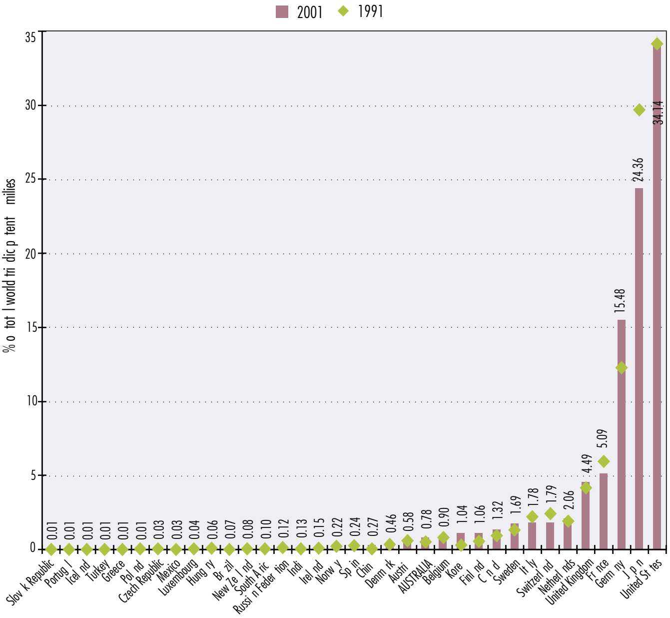
Chart 78 Australia's number and share in triadic patent families, priority year 1985 to 2001



"Triadic" patent families relate to patented inventions for which protection has been sought at the three major patent offices: the European Patent Office (EPO), the Japanese Patent Office (JPO) and the United States Patent and Trademark Office (USPTO). In Australia, the number of triadic patent families has trended generally upwards from 156 in 1985 to 374 in 2001. Australia's share in total OECD triadic patent families has fluctuated over the 15-year period. It started at 0.69% in 1985 but ended with an all time high of 0.79% in 2001.

Source: OECD, Main Science and Technology Indicators database, 2005/1.

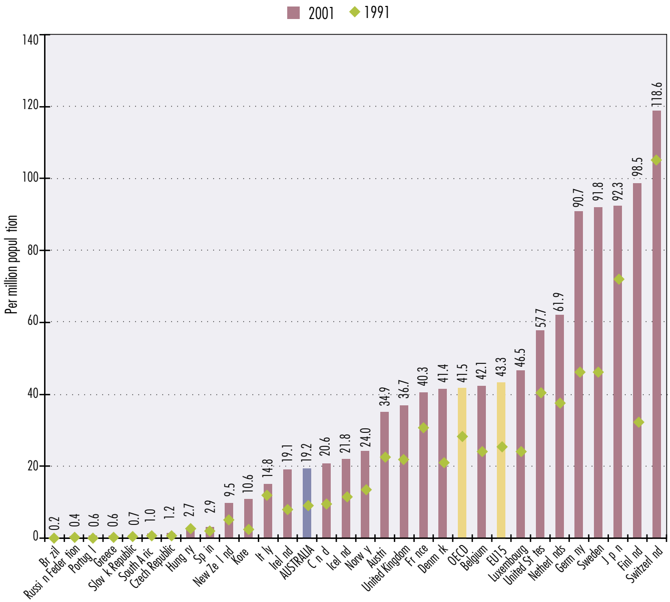
Chart 79 Share of countries in triadic patent families – by world leading country, priority year 1991 and 2001



Australia is compared in the chart with other OECD countries in terms of the share in the total world triadic patent families.
In 2001, Australia accounted for 0.78% of total world triadic patent families, ranked fourteenth in the world. The United States had more than one third of total world triadic patent families (34.14%), followed by Japan (24.36%), Germany (15.48%), France (5.09%) and the United Kingdom (4.49%). These countries accounted for more than 83.6% of total world triadic patent families. Between 1991 and 2001, Australia increased by 0.25 percentage points in its share of total world triadic patent families.

Source: OECD, *Science, Technology and Industry Scoreboard 2005.*

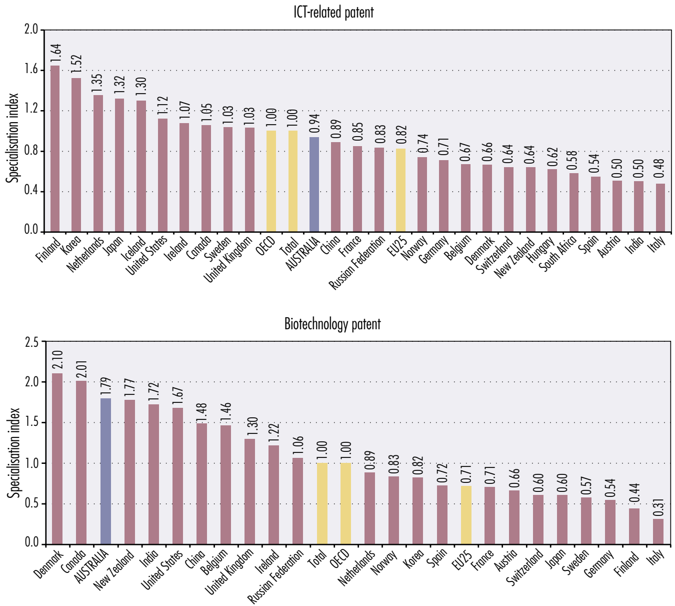
Chart 80 Number of triadic patent families per million population – by world leading country, priority year 1991 and 2001



To normalise patent counts for country size, triadic patent families are expressed relative to population. Australia had 19.2 triadic patent families per million population, less than half the OECD and EU15 averages (41.5 and 43.3 respectively). Switzerland led with a figure of 118.6, followed by Finland (98.5), Japan (92.3) Sweden (91.8), Germany (90.7) and the Netherlands (61.9) and the United States (57.7). Some OECD countries such as the Slovak Republic, Greece, Portugal, Poland, Mexico and Turkey had a low propensity to patent, with less than one triadic patent family per million population.

Source: OECD, *Science, Technology and Industry Scoreboard 2005*.

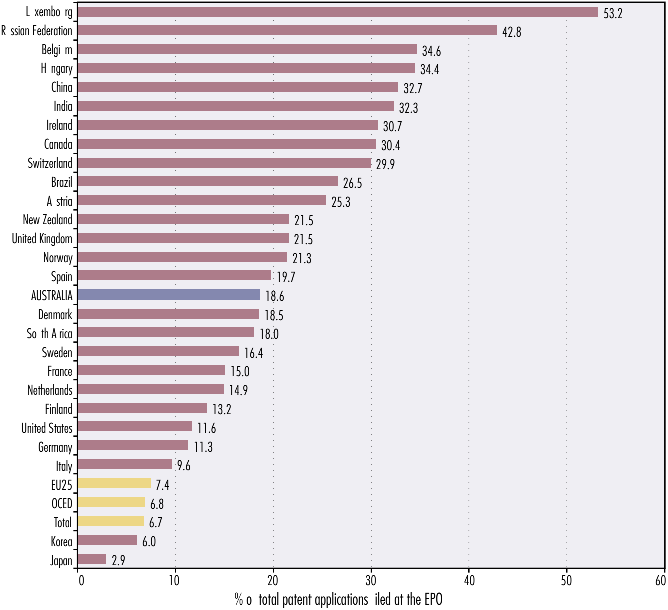
Chart 81 Specialisation index of ICT and biotechnology patents filed at the EPO – by OECD country, priority years 1996-2001



OECD countries are compared in terms of the level of specialisation in ICT and biotechnology patents. The specialisation index is calculated as the share of a country in a specific technology area divided by the share of the country in all technology areas based on its patent applications to the European Patent Office (EPO). Over the period 1996-2001, Australia was highly specialised in Biotechnology patents compared to other countries, only behind Denmark and Canada. In contrast, Australia's specialisation in ICT was just under the world as a whole and the OECD as a whole.

Source: OECD, *Science, Technology and Industry Scoreboard 2005.*

Chart 82 Share of patents with foreign co-inventors – by world leading country, priority years 1999-2001



The co-inventions of patents provide an indication of the level of internationalisation of scientific and technological activities. Over the period 1999-2001, the share of the patent applications to the European Patent Office (EPO) with foreign co-inventors amounted to 18.6% for Australia. The shares tend to be higher in smaller countries and large non-OECD member countries, such as Luxembourg (53.2%), the Russian Federation (42.8), Belgium (34.6%), Hungary (34.4%), China (32.7%) and India (32.3%). In contrast, countries with large number of patents (e.g. Germany, Japan, the United States, etc.) tend to have a low share of patents with foreign inventors except the United Kingdom (21.5%).

Source: OECD, *Science, Technology and Industry Scoreboard 2005.*

Australian Science and Technology

at a glance

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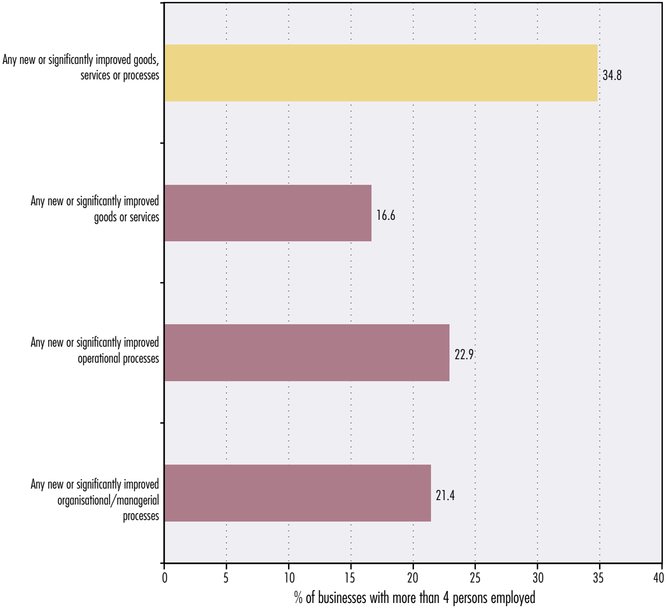
DECEMBER

Innovation and Technological Diffusion

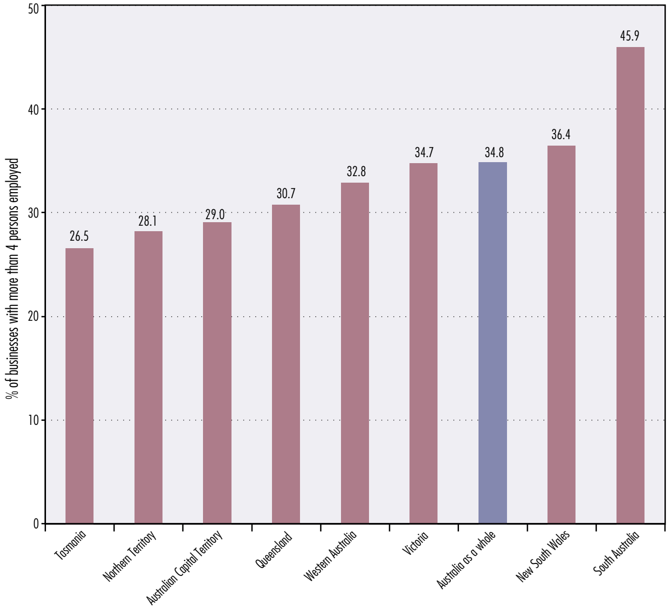
Chart 83 Innovation in Australian business, 2001-03



Innovation is seen as a key driver of economic growth. Innovation in business is characterised by the introduction of new or significantly improved goods or services and/or the implementation of new or significantly improved processes (which includes operational and organisational/managerial processes). During the three years ended December 2003, innovation was undertaken by 34.8% of businesses with more than 4 employees in Australia. Around 16.6% of businesses introduced new or significantly improved goods or services, 22.9% of the businesses implemented new or significantly improved operational processes, and 21.4% of businesses implemented new or significantly improved organisational/managerial processes.

Source: ABS, *Innovation in Australian Business, 2003.*

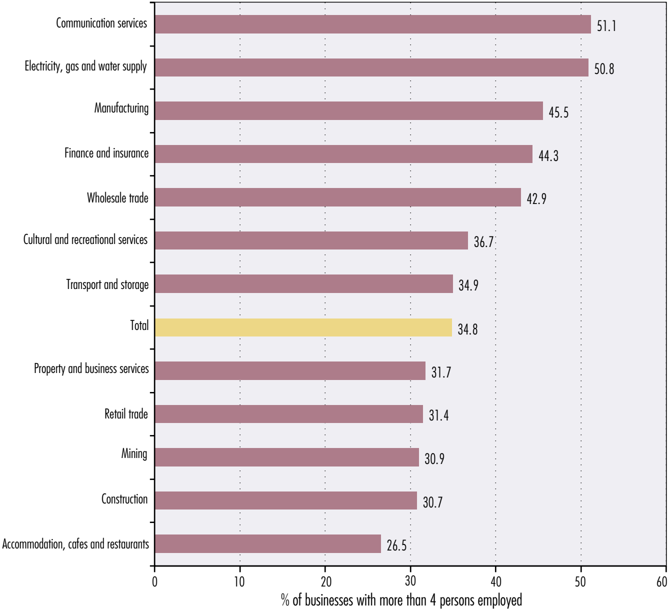
Chart 84 Proportion of businesses innovating – by State and Territory, 2001-03



The chart shows the proportion of businesses innovating by state and territory in Australia during the three years ended December 2003. South Australia had the highest proportion of businesses undertaking innovation (45.9%). The proportions of businesses innovating in New South Wales, Victoria, Queensland and Western Australia were similar at around 30-35%. In Tasmania, the Northern Territory and the Australian Capital Territory the proportion of businesses innovating was low.

Source: ABS, *Innovation in Australian Business, 2003.*

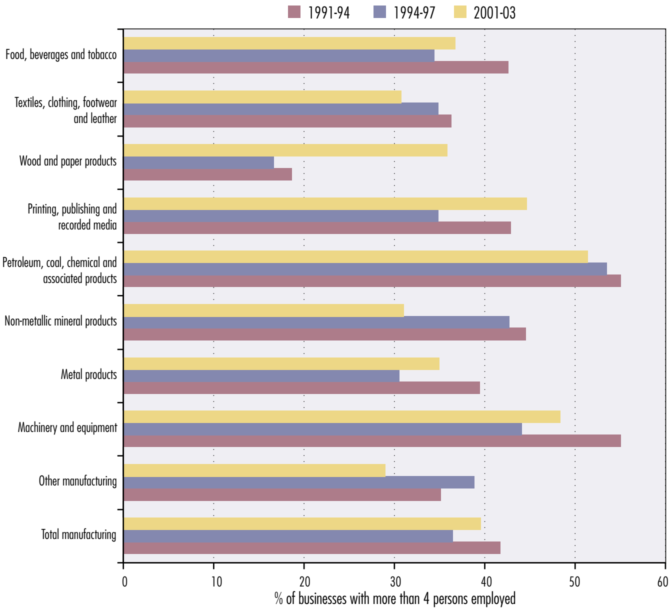
Chart 85 Proportion of businesses innovating – by industry, 2001-03



The chart presents the proportion of businesses innovating by industry in Australia during the three years ended December 2003. Just over half of the businesses in the Communication services (51.1%) and Electricity, gas and water supply (50.8%) industries undertook innovation. Innovators accounted for 45.5% of businesses in Manufacturing, 44.3% of businesses in Finance and insurance, 42.9% of businesses in Wholesale trade. Accommodation, cafes and restaurants (26.5%) and Construction industries (30.7%) had the lowest proportion of businesses innovating.

Source: ABS, *Innovation in Australian Business, 2003.*

Chart 86 Proportion of businesses innovating in manufacturing industry – by industry, 1991-94, 1994-97 and 2001-03

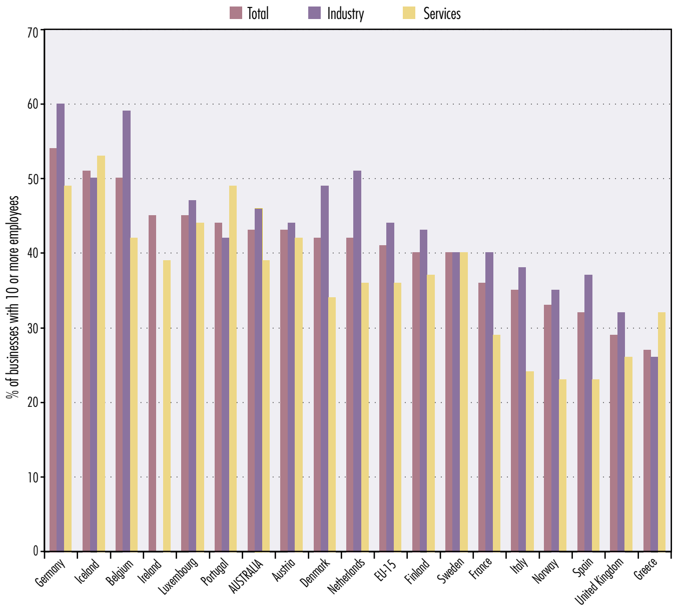


Data from the 2003 Innovation Survey are adjusted to be comparable to data from the 1993-94 and 1996-97 Innovation in Manufacturing surveys. The proportion of businesses innovating in the Manufacturing industry stood at 39.5% in 2001-03; this was slightly lower than that in 1991-94 (41.7%), but slightly higher than that in 1994-97 (36.4%). The Wood and paper products industry had the most noticeable change in the proportion of businesses innovating, increasing from 18.6% in 1991-94 to 35.8% in 2001-03. The largest decrease was in the Non-metallic mineral products industry, which dropped from 44.5% in 1991-94 to 31.0% in 2001-03. The Petroleum, coal, chemical and associated products industry has maintained a high proportion of businesses innovating during the three time periods.

Sources: ABS, *Innovation in Australian Business, 2003.*

Note: In this chart, data for 2001-03 excludes the implementation of new or significantly improved organisational/managerial processes.

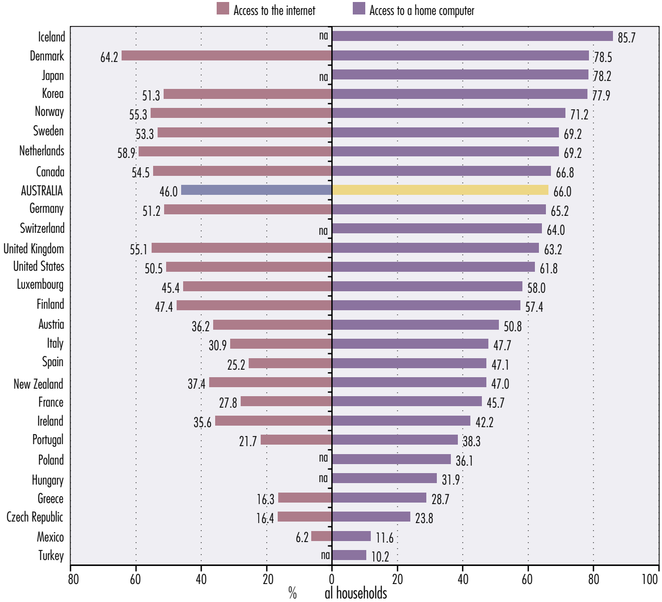
Chart 87 Total proportion of businesses innovating – in Australia, 2001-03 and the European Union, 1998-2001



Data from the 2003 Innovation Survey are adjusted to be comparable to data from the European Union Third Community Innovation Survey for 1998-2001. The total proportion of business innovating in Australia (43%) was slightly higher than that of the EU15 (41%). The proportion of Australian businesses innovating in the Industry Sector (46%) ranked seventh of the countries listed, while those in the Services Sector (39%) ranked ninth. Germany ranked highest while the United Kingdom fell behind most of the EU15 countries in terms of the proportion of businesses innovating.

Source: ABS, *Innovation in Australian Business, 2003.*

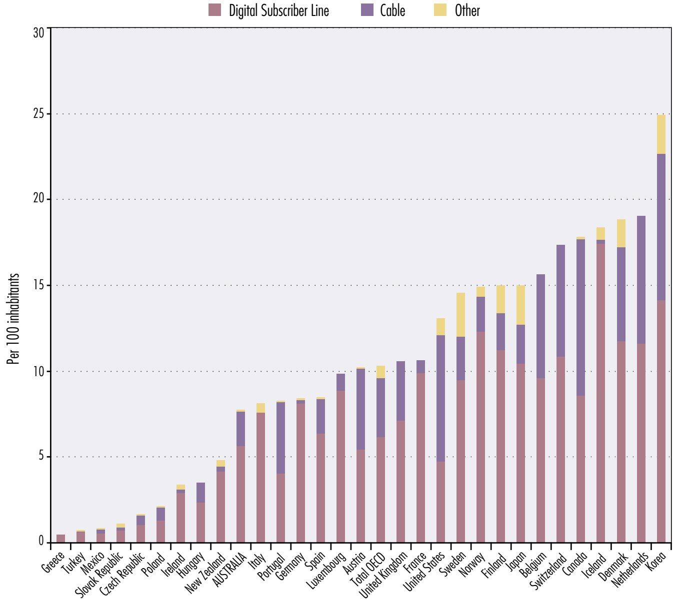
Chart 88 Households with access to a home computer and the Internet – by OECD country, 2003 or most recent year



In this chart, OECD countries are ranked in terms of the proportion of households with access to a home computer and the Internet in 2003. Australia had 66.0% of households with access to a home computer, ranked relatively high amongst OECD countries, above the 63.2% for the United Kingdom and the 61.8% for the United States. Approximately 46.0% of households in Australia had access to the Internet, below the 55.1% for the United Kingdom and 50.5% for the United States but still amongst the top half of OECD countries.

Source: OECD, *Key ICT Indicators*, December 2004.

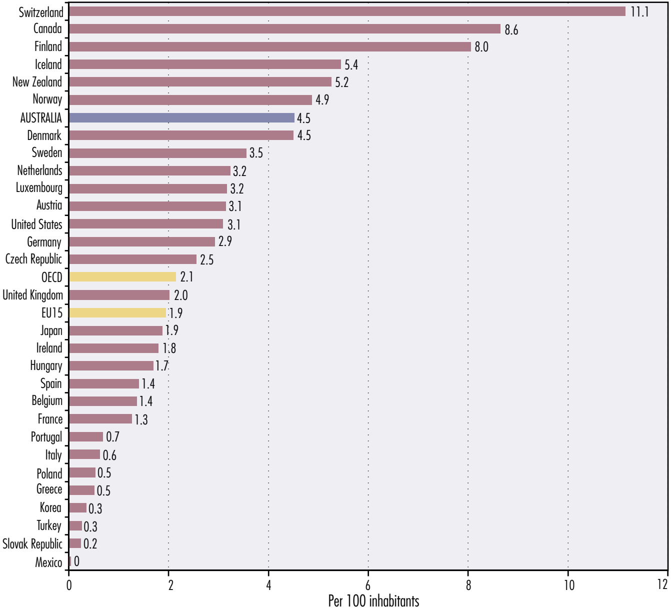
Chart 89 Broadband subscribers per 100 inhabitants – by OECD country, December 2004



The scope and quality of Internet access and the full adoption and integration of e-commerce depend upon bandwidth and "always on" access. Australia has a relatively low broadband connection rate with 7.7 broadband subscribers per 100 inhabitants in December 2004, compared to an OECD average of 10.2. With 24.9 broadband subscribers per 100 inhabitants, Korea led the OECD nations, followed by the Netherlands (19.0), Denmark (18.8), Iceland (18.3) and Canada (17.8). In contrast, Mexico, Turkey and Greece had less than 1 broadband subscriber per 100 inhabitants.

Source: OECD, Broadband Statistics, December 2004.

Chart 90 Secure servers per 100 inhabitants – by OECD country, September 2004



Secure servers represent one form of infrastructure used to conduct secure electronic transactions. Their use implies the provision of content for sale and/or the conduct of commercial transactions over the Internet. Countries that rank high on this indicator are likely to be the most active in e-commerce. Australia stood at 4.5 secure servers per 100 inhabitants in September 2004, ranked 7th in OECD countries, equivalent to that in Denmark. The figure for Australia was more than twice the OECD average (2.1) and the EU15 average (1.9). Switzerland, Canada and Finland recorded the highest levels at 11.1, 8.6 and 8.0 respectively.

Source: OECD, *Communications Outlook 2005*.

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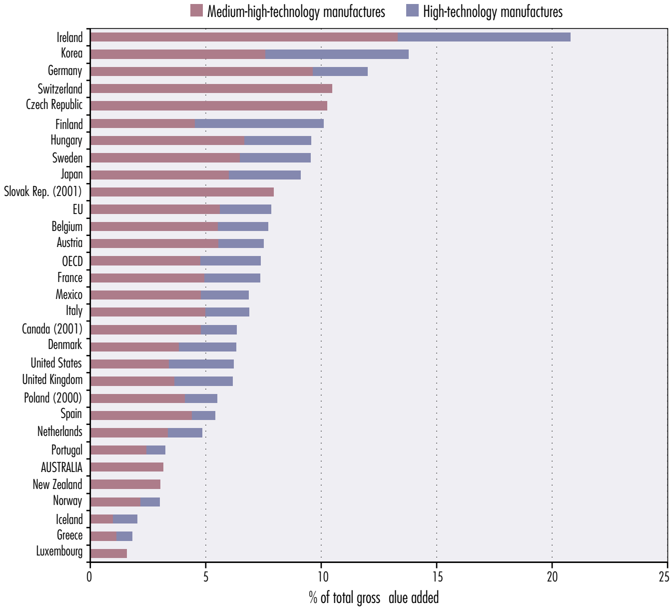
Impact on Economic Competitiveness and Quality of Life

Chart 91 Share of value-added by technology-intensive manufactures in total gross value added – by OECD country, 2002

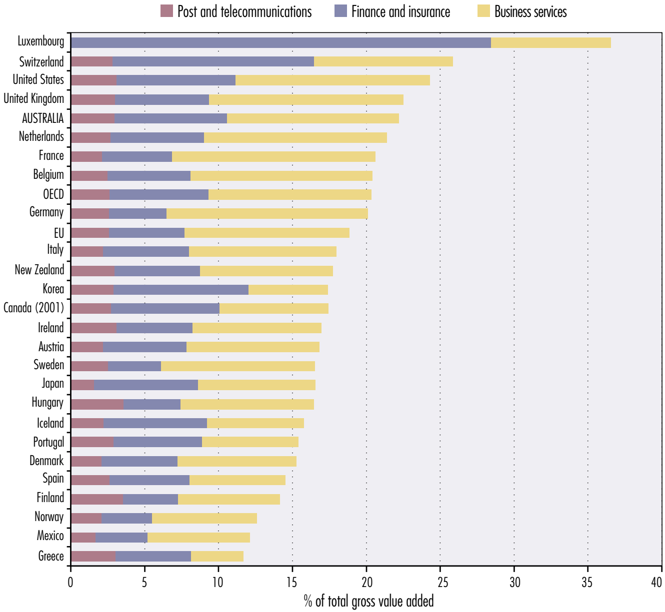


This chart ranks OECD countries by the relative contribution technology-intensive manufacturing industries make to total gross value added in the national economy. In 2002, high- and medium-high-technology manufacturing only accounted for 3.2% of total gross value added in Australia; this ranked Australia towards the bottom of the OECD countries listed on the chart. Australia's figure was less than half the EU average (7.8%) and the OECD average (7.4%). Ireland led the OECD countries with 20.8% of total gross value added contributed by technology-intensive manufactures, followed by Korea (13.8%), Germany (12.0%) and Switzerland (10.5%).

Source: OECD, *Science, Technology and Industry Scoreboard 2005*.

Note: Breakdown data for Australia, New Zealand, Switzerland, the Slovak Republic, the Czech Republic and Luxembourg are not available.

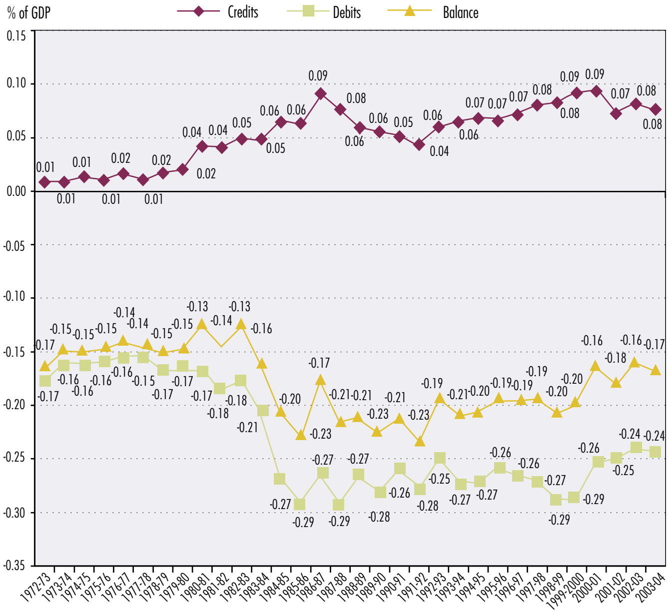
Chart 92 Share of value added by knowledge-intensive "market" services in total gross value added – by OECD country, 2002



OECD countries are ranked in the chart according to the relative contribution knowledge-intensive "market" service industries made to gross value added in the national economy in 2002. Australia ranked fifth with 22.2% contribution of these industries to total gross value added, just behind Luxembourg (36.5%, Switzerland (25.8%), the United States (24.3%) and the United Kingdom (22.5%). By sector, post and telecommunications accounted for 3.0% of Australia's total gross value added, finance and insurance 7.6% and business services 11.6%. In all sectors, the Australian figures were higher than the OECD averages (2.7%, 6.7% and 11.0% respectively) and the EU averages (2.6%, 5.1% and 11.1% respectively).

Source: OECD, *Science, Technology and Industry Scoreboard 2005.*

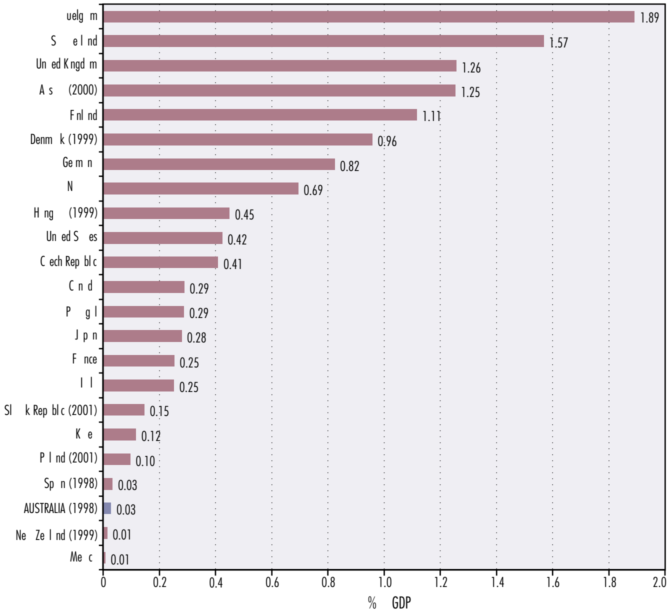
Chart 93 Australian royalties and licence fees balance of payments as a percentage of GDP, 1972-73 to 2003-04



Australian royalty and license credits relative to GDP exhibited steady growth from the early 1970s to the first half of the 1980s, followed by a drop in the second half of the 1980s. They rose again throughout the 1990s reaching the peak level of 0.09% in 2000, followed by a slight decline to 0.08% in 2004. Following the significant increase in the first half of the1980s, Australian royalty and license debits as a percentage of GDP has been reduced gradually since the middle 1980s, to 0.24% of GDP in 2004. Since the middle 1980s, the balance of Australian royalties and licence fees as a percentage of GDP has fluctuated around the -0.20% mark, increasing slightly to -0.17% in 2004.

Source: DEST, based on Balance of Payments data provided by ABS, September 2005.

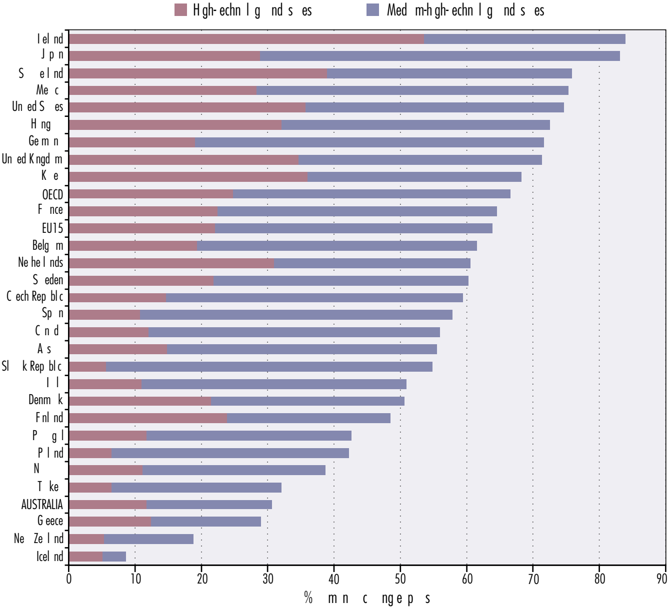
Chart 94 Technology balance of payments: receipts as a percentage of GDP – by OECD country, 2002



Technology balance of payments (TBP) registers the commercial transactions related to international technology transfers. TBP receipts relates to a country's exports of technology, which reflects its competitiveness in the international market for knowledge. As shown in this chart, Australia ranked towards the bottom of the OECD countries on this indicator. Australia's TBP receipts amounted to 0.03% of GDP, equivalent to that for Spain, only ahead of New Zealand and Mexico (0.01% each). Belgium led the other OECD countries, at a rate of 1.89% in 2002, followed by Switzerland (1.57%), the United Kingdom (1.26%) and Austria (1.25%).

Source: OECD, Main Science and Technology Indicators database, 2005/1.

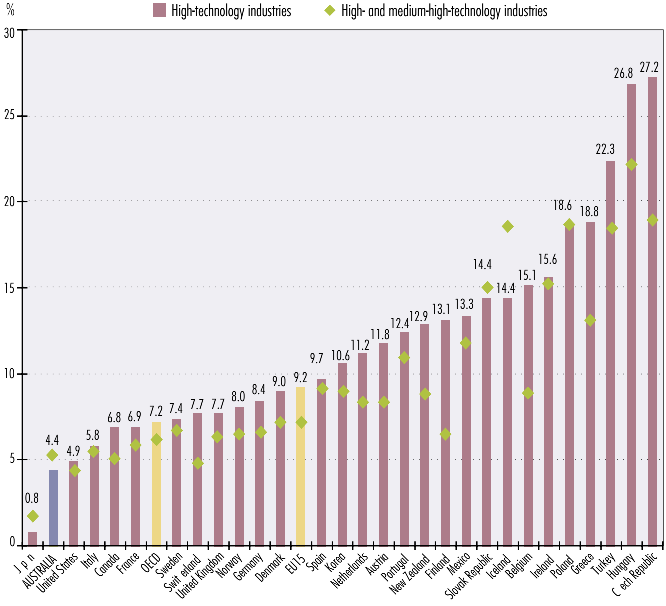
Chart 95 Share of high- and medium-high-technology industries in manufacturing exports – by OECD country, 2003



In this chart, OECD countries are ranked by the share of high- and medium-high- technology industries in manufacturing exports. In 2003, Australia's exports in high- and medium-high-technology industries accounted for 11.8% and 18.9% of total manufacturing exports, respectively. This represented less than half the OECD averages, 24.8% in high-technology industries and 41.8% in medium-high-technology industries, as well as the EU15 averages, 22.1% in high-technology industries and 41.8% in medium-high-technology industries. In Ireland, Japan and Switzerland, high- and medium-high-technology industries accounted for more than three quarters of the total manufacturing exports.

Source: OECD, STAN Indicators database, May 2005.

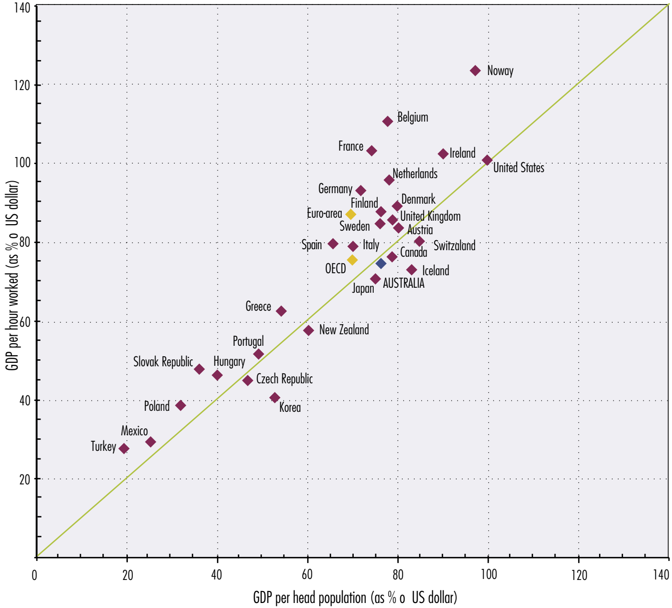
Chart 96 Growth of high- and medium-high-technology exports at average annual rate – by OECD country, 1994-2003



Australia recorded a growth rate of 4.4% per annum in high-technology exports over the period 1994-2003. This was a relatively low growth rate compared to 7.2% for the OECD as a whole and 9.2% for the EU15. For high- and medium-high-technology exports, Australia experienced a growth rate of 5.2% per annum. This was also relatively low, compared to 6.2% for the OECD as a whole and 7.2% for the EU15. The countries with a relatively small high technology sector at the beginning of the period achieved a higher growth rate, for example the Czech Republic, Hungary and Turkey, while growth rates for well-developed countries such as Japan, the United States, Canada and France were amongst the lowest in OECD countries.

Source: OECD, STAN Indicators database, May 2005.

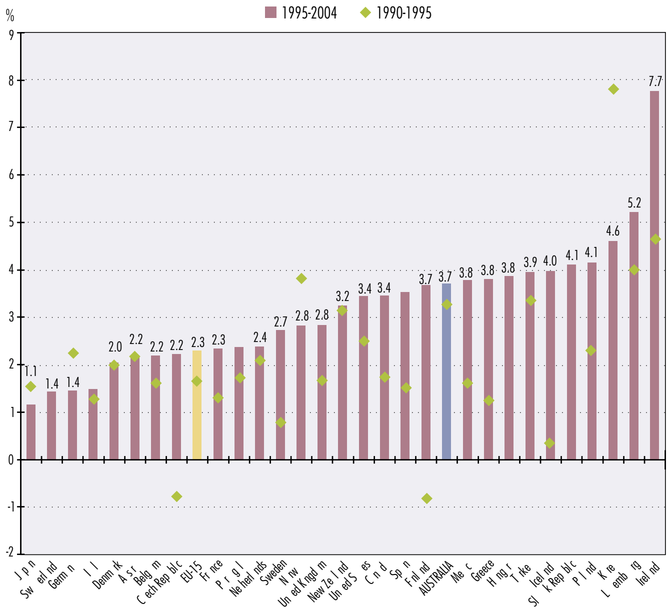
Chart 97 GDP per head of population and GDP per hour worked – by OECD country, 2004



Gross domestic product (GDP) is a broad measure of economic activity. The chart shows the difference in income (GDP per head of population) and labour productivity (GDP per hour worked) in OECD countries relative to the United States in 2004. Australia's GDP per head of population and GDP per hour worked were estimated to be around 76% and 75% respectively of those for the United States during that year. Australia's income level was higher than the OECD average and the Euro-area average; our level of labour productivity was equivalent to the OECD average but below the Euro-area average.

Source: OECD, Productivity database, July 2005.

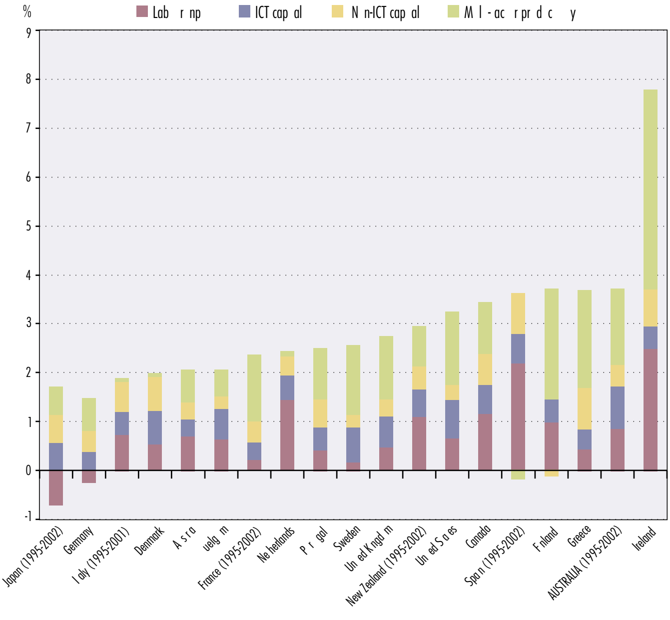
Chart 98 Growth of real GDP at average annual rate – by OECD country, 1990-95 and 1995-2004



Growth of real GDP is widely used to assess governments' performance in managing their economies. For the period 1995-2004, Australia had a relatively high GDP growth rate among OECD countries. We averaged 3.7% a year in real terms, being above the rate of 2.3% for the EU15 and the rates for the major economies such as Canada (3.4%), the United States (3.4%), the United Kingdom (2.8%), France (2.3%), Germany (1.4%) and Japan (1.1%). Australia experienced a stronger GDP growth rate during the period 1995-2004 than during the previous period 1990-95.

Source: OECD, Productivity database, July 2005.

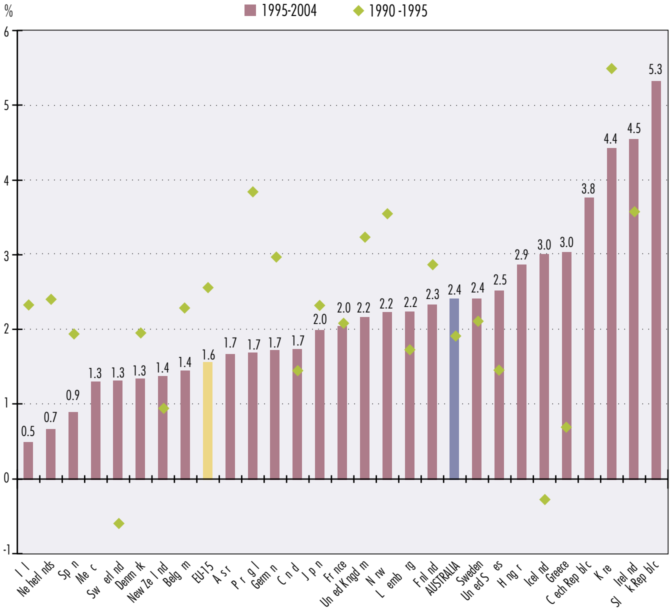
Chart 99 Contribution to GDP growth by factor – by OECD country, 1995-2003



Economic growth can be increased by increasing the amount and types of labour and capital used in production, such as higher labour utilisation, and capital deepening (for example investment in information and communications technology). It can also be increased by attaining greater overall efficiency in how these factors of production are used together, such as more rapid multi-factor productivity (MFP) growth. Over the period 1995-2002, Australia received one of the largest boosts from ICT capital in OECD countries and the contribution of its investment in ICT to GDP growth was estimated at 0.87 percentage points annually. In comparison with most other OECD countries, MFP growth was also a relatively important source of GDP growth in Australia, contributing 1.56 percentage points a year to GDP growth over the same period.

Source: OECD, *Science, Technology and Industry Scoreboard 2005.*

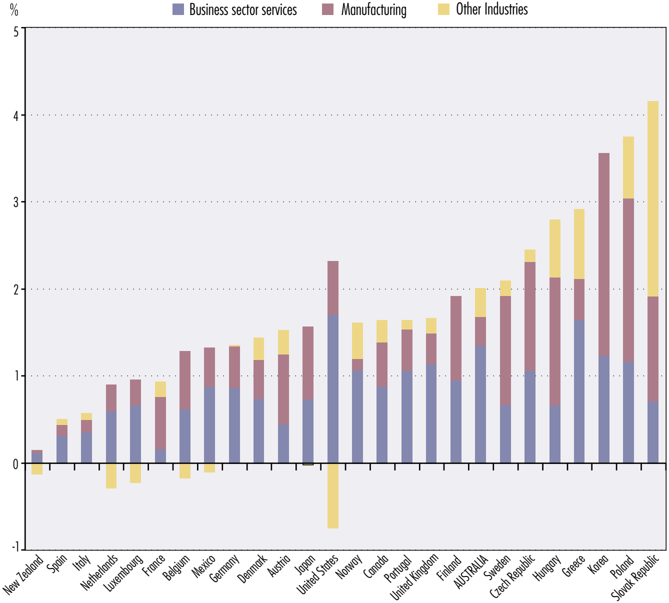
Chart 100 Growth of labour productivity at average annual rate – by OECD country, 1990-95 and 1995-2004



The growth of labour productivity is one of the main sources of the growth of GDP and also provides a broad indication of the scope for non-inflationary increases in wages and salaries. This chart compares Australia's annual growth rate of labour productivity (GDP per hour worked) with other OECD countries over the two periods 1990-95 and 1995-2004. Australia recorded an average annual rate of 2.4% in 1995-2004, higher than the United Kingdom (2.2%), Japan (2.0%), France (2.0%), Canada (1.7%) and Germany (1.7%). In comparison with the period 1990-95, Australia's growth rate and international ranking both increased.

Source: OECD, Productivity database, July 2005.

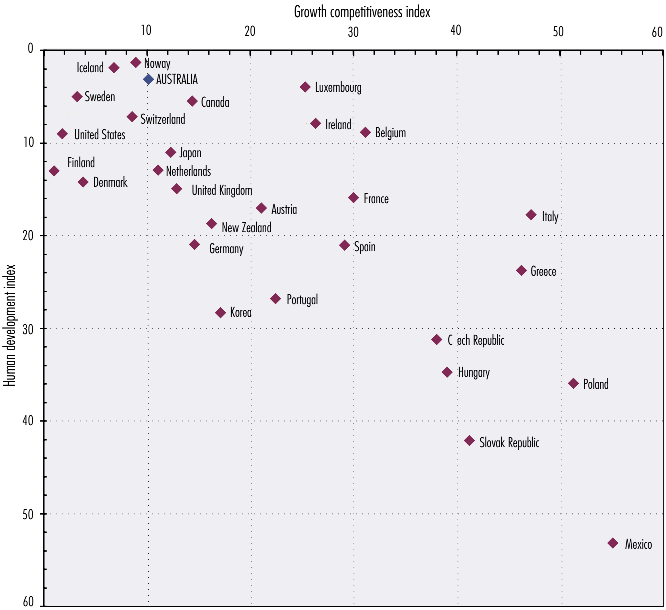
Chart 101 Contribution to labour productivity growth by industry – by OECD country, 1995-2003



A breakdown of productivity growth by activity can show which industries are particularly important for overall productivity performance. In Australia, business sector services accounted for the bulk of labour productivity growth over the period 1995-2003, at 1.4 percentage points annually. This represented one of the highest rankings amongst OECD countries, behind only the United States (1.7) and Greece (1.6). Manufacturing in Australia contributed only 0.3 percentage points annually to overall labour productivity growth over the same period, lower than most other OECD countries. Other industries in Australia also contributed 0.3 percentage points a year to overall labour productivity growth, relatively high by OECD standards.

Source: OECD, *Science, Technology and Industry Scoreboard 2005.*

Chart 102 Economic competitiveness and human development in OECD countries – by world ranking, 2005



Australia is one of the few OECD countries where economic competitiveness and human development are ranked amongst the highest in the world. According to the World Economic Forum's Global Competitiveness Index, Australia rated as the tenth most competitive economy in the world in 2005-06. In terms of the Human Development Index released by the United Nations' *Human Development Report*, Australia ranked the third best in the world in human development in 2005, behind only Norway and Iceland. The Growth Competitiveness Index (GCI) presents an estimate of underlying prospects of economic growth over the medium term. The human development index (HDI) evaluates environments in which people can develop their full potential and lead productive, creative lives in accord with their needs and interests.

Source: World Economic Forum, *The Global Competitiveness Report 2005-06*; The United Nations, *Human Development Report 2005*.

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Abbreviations

ABS	Australian Bureau of Statistics
ACT	Australian Capital Territory
ANZSIC	Australian and New Zealand Standard Industrial Classification
ARC	Australian Research Council
ASCED	Australian Standard Classification of Education
ASCO	Australian Standard Classification of Occupations
ASRC	Australian Standard Research Classification
BERD	Expenditure on R&D in the Business Enterprise Sector
CIS	Community Innovation Survey
CRC	Cooperative Research Centre
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEST	Australian Government Department of Education, Science and Training
DIMIA	Australian Government Department of Immigration, Multicultural and Indigenous Affairs
DSTO	Defence Science and Technology Organisation
EC	European Commission
EPO	European Patent Office
Est.	Estimated
EU	European Union
FTE	Full Time Equivalent
GBAORD	Government Budget Appropriations or Outlays for R&D
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on R&D
GOVERD	Government Intramural Expenditure on R&D or R&D Expenditure in the Government Sector
GSP	Gross State Product
HERD	Expenditure on R&D in the Higher Education Sector
HRST	Human Resources in Science and Technology
HRSTQ	Human Resources in Science and Technology – Qualification
HRSTO	Human Resources in Science and Technology – Occupation
ICT	Information and Communication Technologies
IP	Intellectual Property
ISCED	International Standard Classification of Education
ISCO	International Standard Classification of Occupation
ISI	Institute for Scientific Information, Philadelphia, USA
ISIC	International Standard Industrial Classification
MFP	Multifactor productivity
MSTI	Main Science and Technology Indicators
n.a.	Not available or not applicable.
n.e.c	Not elsewhere classified
NHMRC	National Health and Medical Research Council
n.f.d.	Not further defined
n.i.e	Not included elsewhere
n.p.	Not available for publication but included in totals where applicable, unless otherwise indicated
NSF	National Science Foundation, USA
OECD	Organisation for Economic Cooperation and Development
PhD	Doctor of Philosophy
PISA	Programme for International Student Assessment
PNPERD	Expenditure on R&D in the Private Non-Profit Sector
PPP	Purchasing Power Parities
R&D	Research and Experimental Development
S&E	Science and Engineering or Scientists and Engineers
SME	Small to medium enterprise
S&T	Science and Technology
STAN	Structural Analysis
TBP	Technology Balance of Payments
USPTO	United States Patent and Trademark Office
-	Nil or rounded to zero (including null cells)


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Glossary

Applied research – original work undertaken in order to acquire new knowledge with a specific application in view. It is undertaken either to determine possible uses for the findings of basic research or to determine new methods or ways of achieving some specific and predetermined objectives.

Basic research – experimental and theoretical work undertaken primarily to acquire new knowledge without a specific application in view. It consists of pure basic research and strategic basic research. Pure basic research is carried out without looking for long-term benefits other than the advancement of knowledge. Strategic basic research is directed into specific broad areas in the expectation of useful discoveries. It provides the broad base of knowledge for the solution of recognised practical problems.

B index – it is defined as the present value of before-tax income necessary to cover the initial cost of R&D investment and payment of corporate income tax that makes it profitable to perform research activities. Algebraically, the B index is equal to the after-tax cost of an expenditure of USD 1 on R&D divided by one minus the corporate income tax rate. The after-tax cost is the net cost of investing in R&D, taking into account all the available tax incentives (the index is rescaled so higher values equal higher incentives).

Business Enterprise Sector – it includes all firms, organisations and institutions whose primary activity is the market production of goods or services for sale to the general public at an economically significant price. Public enterprises are included in the business enterprise sector.

Chain volume measure – it is used to revalue expenditure on R&D in such a way as to remove the direct effects of changes in their prices over the period under review. It is calculated based on the implicit price deflators on R&D at a reference year of 2000-01 provided by the ABS.

Citation – a reference to a scientific or research paper by another such paper. The number of citations provides a proxy measure of the impact of the paper being so referenced.

Citation impact – number of citations received per paper published.

EU15 – it refers to the 15 members states of the European Union in the period prior to enlargement in 2004: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom.

EU25 – it refers to the European Union Member States including Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden and the United Kingdom.

Euro-area – it refers to the following countries: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain.

Expenditure on tertiary educational institutions – it represents direct public and private expenditure on tertiary educational institutions. It covers all expenditure on tertiary educational institutions including on ancillary services and expenditure on R&D.

Experimental development – systematic work, using existing knowledge gained from research or practical experience, for the purpose of creating new or improved products/processes.

Field of research – a classification of R&D complementary to socio-economic objective, which categorises R&D according to its nature. It is based on distinct academic disciplines and involved areas of study. Examples are physical sciences, biological sciences and humanities.

Full-time equivalent (FTE) – it corresponds to one year's work by one person. Thus, someone who normally devotes 50% of his/her time to R&D should be counted as 0.5 FTE.

Funding – it refers to the allocation of monies for expenditure on R&D.

Government Budget Appropriations or Outlays for R&D (GBAORD) – these data are based on all the budget items related to R&D, covering federal or central government only. It refers to budget provision, not to actual expenditure.

Government Sector – it covers all departments, offices and other bodies which furnish but normally do not sell to the community those common services, other than higher education, which can not otherwise be conveniently and economically provided and administer the state and the economic and social policy of the community, as well as private non-profit organisations controlled and mainly financed by government.

Gross expenditure on R&D – the sum of intramural R&D expenditures incurred by all organisations in the survey.

High- and medium-high-technology industries – it refers to industries classified as high technology industries and medium-high technology industries:

- high-technology industries include aircraft and spacecraft; pharmaceuticals; office, accounting and computing machinery; radio, TV and communications equipment; and medical, precision and optical instruments;
- medium-high-technology industries include electrical machinery and apparatus, not elsewhere classified; motor vehicles, trailers and semi-trailers; chemicals excluding pharmaceuticals; railroad equipment and transport equipment, not elsewhere classified; and machinery and equipment, not elsewhere classified.

Higher Education Sector – it is composed of all universities, colleges of technology and other institutes of post-secondary education, whatever their source of finance or legal status. It also includes all research institutions, experimental stations and clinics operating under the direct control of or administrated by or associated with higher education establishments.

Highly R&D-intensive industries – these industries include the aerospace industry, electronic industry, office machinery and computer industry, pharmaceutical industry and medical, precision and optical instruments, watches and clocks (instruments) industry.

Human resources devoted to R&D (or R&D personnel) – researchers, technicians and other staff directly involved with R&D activity. Overhead staff (e.g. administrative and general service employees such as personnel officers, janitors etc.) whose work indirectly supports R&D, are excluded.

Human resources in science and technology (HRST) – it is defined according to the Canberra Manual as people fulfilling one of the following conditions:

- successfully completed education at the third level in an S&T field of study (according to the Canberra Manual, the seven broad S&T fields of study are Natural Sciences, Engineering and technology, Medical Sciences, Agricultural Sciences, Social Sciences, Humanities and other fields);
- not formally qualified as above, but employed in an S&T occupation where the above qualifications are normally required.

Human resources in science and technology by qualification (HRSTQ) – these people hold education qualifications in categories 5b, 5a or 6 of the ISCED (1998). 5b refers to programmes which are practically oriented or occupationally specific and are mainly designed for participants to acquire the practical skills, and know-how needed for employment in a particular occupation or trade or class of occupations or trades – the successful completion of which usually provides the participants with a labour-market relevant qualification. 5a refers to programmes which are highly theoretically based/research preparatory or which provide access to professions with high skill requirements; 6 refers to programmes which lead directly to an advanced research qualification, such as a doctoral degree.

Human resources in science and technology by occupation (HRSTO) – these people are working in a S&T occupation as defined in (ISCO-88 COM codes 2 or 3. ISCO-88 COM code 2 is the major group 2 - professionals. Its principal subgroups are physical, mathematical and engineering science professionals; life science and health professionals; teaching professionals; and other professionals. ISCO-88 COM code 3 is the Major Group 3 – Technicians and associate professionals.

Innovating business – a business, in the ABS 2003 Innovation Survey, was classified as innovating if it undertook at least one of the following activities in the three years ending December 2003:

- the business introduced any new or significantly improved goods or services;
- the business implemented any new or significantly improved operational processes;
- the business implemented any new or significantly improved organisational/managerial processes.

Investment in ICT – it covers the acquisition of information technology equipment (computers and related hardware), communications equipment and software that is used in production for more than one year.

Investment in knowledge – it covers expenditure on R&D, education and software.

Investment in venture capital – venture capital is provided by specialised financial firms acting as intermediaries between primary sources of finance (such as pension funds or banks) and firms (formal venture capital). It is also provided by so-called 'business angels' (usually wealthy individuals experienced in business and finance who invest directly in firms). Data on investment in venture capital excludes venture capital provided by 'business angels'.

Knowledge-intensive "market" service industries – it refers to post and telecommunications; finance and insurance and business services (excluding property services) industries.

Labour productivity – it is defined as GDP per hour worked. It is a key economic indicator and is closely associated with standards of living.

Multifactor productivity (MFP) – it is the change in GDP that cannot be explained by changes in the quantities of capital and labour that are made available to generate the GDP.

Patent – a patent is a legal title of industrial property granting its owner the exclusive right to exploit an invention commercially for a limited area and time. In this publication, the year of a patent is based on priority year.

Patent families – a patent family is defined as a set of patents taken in various countries for protecting a single invention. The patent family in this publication refers to "triadic" families: i.e. a patent is a member of the patent families if and only if it is filed at the European Patent office (EPO), the Japanese Patent Office (JPO) and is granted by the US Patent & Trademark Office (USPTO).

Patent granted by IP Australia – IP Australia is the Australian Government agency responsible for granting rights in patents, trade marks and designs. IP Australia grants two types of patents:

- a standard patent gives long-term protection and control over an invention for up to 20 years;
- an innovation patent is a relatively fast, inexpensive protection option, lasting a maximum of 8 years. The innovation patent replaced the petty patent on 24 May 2001. However, the right of a petty patent previously granted is still enforceable until the term of the petty patent expires.

Patent granted at the USPTO – data on patents granted at the USPTO are based on the CHI's database on International Technological Indicators. It should be noted that these data refer to patents granted, and not to applications. Also, the reference year corresponds to the year of publication.

Performance – it refers to expenditure by organisations in carrying out R&D.

Performing sectors – domestic R&D (expenditure or human resources) is divided into four sectors of performance for the purpose of statistical collection: Business, Higher Education, Government and Private Non-profit Institutions.

Private Non-profit Sector – it comprises non-market, private non-profit institutions serving households (i.e. the general public) and private individuals or households.

Professionals – persons who perform analytical, conceptual and creative tasks through the application of theoretical knowledge and experience in the fields of science, engineering, business and information, health, education, social welfare and the arts.

Public expenditure on educational institutions – it includes public subsidies to households attributable for educational institutions and direct expenditure on educational institutions from international sources.

Purchasing Power Parities (PPP) – they are exchange rates adjusted to equivalent purchasing power.

Net gains through migration – net gains through migration are estimated based on the difference between long-term and permanent arrivals and long-term and permanent departures.

- long-term arrivals comprise overseas visitors who intend to stay in Australia for 12 months or more (but not permanently) and Australian residents returning after an absence of 12 months or more overseas.
- long-term departures comprise Australian residents who intend to stay abroad for 12 months or more (but not permanently) and overseas visitors departing who stayed 12 months or more in Australia.

Real terms – using a series of implicit price indices on R&D, a chain volume measure is estimated to enable real comparison of R&D funding and performing trends.

Research and Experimental Development (R&D) – it comprises creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of the stock of knowledge to devise new applications.

Researchers – those involved with the conception and/or development of new knowledge, products, processes, methods and systems, and in the management of the projects concerned.

Scientific publications – this provides an output indicator of a country's scientific activity. The ISI database contains bibliometric information that reflects research performance by over 170 countries. In this publication, the ISI data covers approximately 5,500 journals in the sciences, 1,800 in the social sciences and 1,200 in the arts and humanities. A paper is attributed to a country if the paper carried at least one author address of that country.

Science and engineering graduates – it refers to those who successfully completed education at ISCED 97 version levels 5a, 5b or 6 in the ISCED fields of education listed as life sciences, physical sciences, mathematics and statistics, computing, engineering and engineering trades, manufacturing and processing, architecture and building.

- science graduates are the graduates in the ISCED fields of life science, physical sciences, mathematics and statistics and computing; and
- engineering graduates are the graduates in the ISCED fields of engineering and engineering trades, manufacturing and processing, and architecture and building.

Scientists and Engineers (S&E) – it includes two sub-major groups of professionals – physical, mathematical and engineering science professionals, and life science and health professionals according to the International Standard Classification of Occupation (ISCO).

Socio-economic objective – it categorises R&D according to its purpose. This purpose consists of discrete economic, social, technological and scientific domains. Examples are defence, manufacturing, environment and the advancement of knowledge.

Sources of funding – R&D expenditure is subdivided into five sources of funding; from Business, from Government, from Higher Education, from PNPs and from abroad.

Specialisation index (SI) – it is calculated as the share of country A in a specific technology area (i.e. ICT-related patents) divided by the share of country A in all technology areas. When the SI of ICT-related patents is greater than 1, the country has a higher share in ICT-related patents than its share in all technology areas. Conversely, when the SI of ICT-related patents is below 1, the country has a lower share in ICT-related patents than its share in all technology.

Specialist managers – persons who coordinate the administration and operation of specialised functions or fields of activity within an organisation. Under the broad direction of the general manager, they plan, administer and review the financial, corporate, personnel, supply and distribution, information technology, sales and marketing, and other specialised activities of an organisation.

Tax subsidies for R&D – tax subsidies for R&D are extensively used by governments as an indirect way of encouraging business R&D expenditure, in contrast to direct financial support for business R&D. There are many forms of tax subsidies for R&D including write-off of current R&D expenditures and various types of tax relief such as tax credits or allowance against tax income.

Technicians – those performing technical tasks in support of R&D activity, normally under the direction and supervision of a researcher. These tasks include the preparation of experiments, the taking of records, the preparation of charts and graphs, and the coding of data.

Technical innovation – in the OECD Oslo manual (1997), technical innovation is defined to '. . .comprise implemented technologically new products and processes and significant technological improvements in products and processes. An innovation has been implemented if it has been introduced on the market (product innovation) or used within a production process (process innovation). Innovations therefore involve a series of scientific, technological, organisational, financial and commercial activities. An innovating business is one that has implemented technologically new or significantly technologically improved products or processes during the period under review'.

Technology Balance of Payments (TBP) – it measures the commercial transactions related to international technology transfers. It involves money paid or received for the acquisition and use of patents, licences, trademarks, designs, know-how and closely related technical services. It also includes money paid or received for industrial R&D carried out abroad.

Technology-intensive manufacturing industries – it refers to the industries classified as high technology industries and medium-high technology industries under the International Standard Industrial Classification (ISIC, rev.3).

Tertiary graduates in Australia – it refers to the graduates who successfully completed an award course from Australia's universities.

Trade balance – the difference in value between total imports and total exports.

Triadic patent families – see Patent families.

Type of R&D activity – it comprises basic research, applied research and experimental development.