



2002-03

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RESEARCH AND EXPERIMENTAL DEVELOPMENT

# ALL SECTOR SUMMARY

AUSTRALIA

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## INQUIRIES

- For further information about these and related statistics, contact the National Information and Referral Service on 1300 135 070 or Derek Byars on Canberra (02) 6252 5627.

# NOTES

## INTRODUCTION

This publication presents summary statistics of expenditure and human resources devoted to research and experimental development (R&D) carried out in Australia by organisations within the Business, Government and Private non-profit sectors during 2002-03 and the Higher education sector during the 2002 calendar year.

The statistics presented in this publication have previously been published (at a more detailed level) on an individual sector basis (see paragraph 14 of the Explanatory Notes).

## RESEARCH AND EXPERIMENTAL DEVELOPMENT (R&D) GUIDELINES

Australian Bureau of Statistics (ABS) surveys of R&D are conducted in accordance with standard guidelines promulgated by the Organisation for Economic Co-operation and Development (OECD). It should be noted that R&D performed overseas by Australian organisations is included in the data in this publication. The extent to which this impacts on international comparisons is being investigated.

## REVISIONS

It should be noted that data presented in this publication may subsequently be revised. These revisions are generally small and do not impact significantly on the period to period movements. Where revisions have been applied, the estimate is annotated with an 'r'.

## ABBREVIATIONS

.....

\$'000	thousand dollars
\$m	million dollars
ABS	Australian Bureau of Statistics
ACT	Australian Capital Territory
ANZSIC	Australian and New Zealand Standard Industrial Classification
GDP	gross domestic product
GERD	gross expenditure on R&D
NSW	New South Wales
NT	Northern Territory
OECD	Organisation for Economic Co-operation and Development
Qld	Queensland
R&D	research and experimental development
SA	South Australia
Tas.	Tasmania
Vic.	Victoria
WA	Western Australia

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## MAIN FEATURES

### EXPENDITURE ON R&D

Gross expenditure on R&D (GERD) in Australia in 2002-03 was estimated to be \$12,250m at current prices, 17.6% higher than that recorded in 2000-01. With the exception of the state/territory government which remained steady, all sectors showed an increase in R&D expenditure compared with 2000-01.

### EXPENDITURE ON R&D



### GROSS EXPENDITURE ON R&D

	1996-97	1998-99	2000-01	2002-03
<i>Sector</i>	\$m	\$m	\$m	\$m
Business	4 234.7	r4 094.7	r4 982.6	5 978.6
Government				
Commonwealth	1 266.6	r1 179.4	r1 404.8	1 531.3
State/territory	797.7	r863.6	r951.0	950.9
Higher education	2 307.6	2 555.1	r2 789.8	3 429.6
Private non-profit	185.8	r225.3	r289.0	359.5
<b>Total</b>	<b>8 792.4</b>	<b>r8 918.1</b>	<b>r10 417.1</b>	<b>12 249.9</b>

r revised

In 2002-03, the sectors accounted for the following proportions of GERD:

- Business 48.8%
- Higher education 28.0%
- Government 20.3%
- Private non-profit 2.9%.

By comparison, in 2000-01, the sectors had the following proportions:

- Business 47.8%
- Higher education 26.8%
- Government 22.6%
- Private non-profit 2.8%.

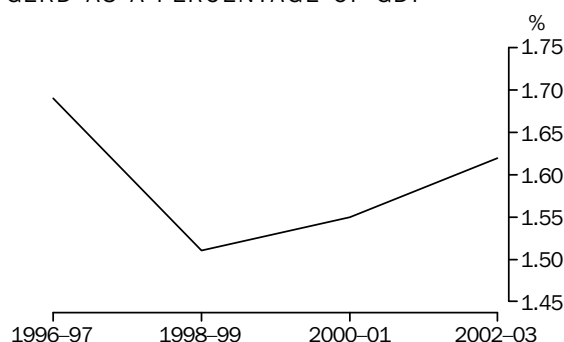
### GERD AS A PERCENTAGE OF GDP

GERD as a percentage of GDP has risen from 1.55% in 2000-01 to 1.62% in 2002-03.

## MAIN FEATURES *continued*

GERD AS A PERCENTAGE  
OF GDP *continued*

GERD AS A PERCENTAGE OF GDP



Australia's GERD/GDP ratio is low compared with other OECD countries. Australia is ranked below countries such as Finland, Japan, United States of America, Germany and France. Australia's overall ranking reflects the low R&D expenditure to GDP ratio of the Business sector, despite the Government and Higher education sectors having comparatively high ratios.

### GERD/GDP RATIOS OF OECD COUNTRIES

	2000-01	2002-03
<i>Country</i>	%	%
Finland	3.40	3.46
Japan	2.99	3.12
Iceland	2.75	3.09
Korea	2.65	2.91
United States of America	2.72	2.67
Germany	2.49	2.52
Denmark	na	2.52
France	2.18	2.20
Austria	1.86	1.93
Canada	1.92	1.91
United Kingdom	1.84	1.88
Norway	na	1.67
<b>Australia</b>	<b>1.55</b>	<b>1.62</b>
Czech Republic	1.33	1.30
Spain	0.94	1.03
Hungary	0.80	1.02
Portugal	0.80	0.93
Poland	0.66	0.59
Slovak Republic	0.65	0.58

na not available

HUMAN RESOURCES  
DEVOTED TO R&D

In 2002-03, 104,252 person years were devoted to R&D, up 9.0% from 2000-01. The majority of human resources devoted to R&D were by Higher education organisations (47.6%), Businesses (31.6%) and Government organisations (17.8%). In the period 1996-97 to 2002-03, human resources devoted to R&D increased by 15.0% or 13,560 person years. Over this period, person years of human resources devoted to R&D increased steadily in the Higher education and Private non-profit sectors. In the Business sector, human resources fell between 1996-97 and 1998-99 and then increased in 2000-01

## MAIN FEATURES *continued*

### HUMAN RESOURCES DEVOTED TO R&D *continued*

and again in 2002-03. In the Government sector, human resources fell between 1996-97 and 2000-01 and then increased in 2002-03.

#### HUMAN RESOURCES DEVOTED TO R&D

	1996-97	1998-99	2000-01	2002-03
Sector	person years	person years	person years	person years
Business	26 412	r25 109	r28 391	32 982
Government				
Commonwealth	10 377	r9 353	r9 565	10 185
State/territory	8 813	r9 069	r8 587	8 357
Higher education	42 739	45 502	46 287	49 612
Private non-profit	2 351	r2 551	r2 791	3 117
<b>Total</b>	<b>90 692</b>	<b>r91 583</b>	<b>r95 621</b>	<b>104 252</b>

r revised

### TYPE OF EXPENDITURE

Current expenditure accounted for 91.6% of gross R&D expenditure, with capital expenditure accounting for the remaining 8.4%. Labour costs accounted for 45.1% of total expenditure.

Other current expenditure was the main component (48.4%) of total R&D expenditure by the Business sector, up from 47.2% in 2000-01. Labour costs accounted for 43.9% of Business R&D expenditure, the same as in 2000-01.

Labour costs continued to be the main component of Government R&D expenditure (51.9%), up from 50.6% in 2000-01. Capital expenditure accounted for 8.8%, down from 9.0% in 2000-01.

Current expenditure accounted for 91.0%, down from 92.3% in 2000-01, of Higher education R&D expenditure. Labour costs accounted for 41.9% of total Higher education R&D expenditure in 2002-03.

### SOURCE OF FUNDS

The major sources of funds for R&D expenditure in Australia in 2002-03 were Business 46.4% (\$5,688m), up slightly from 46.3% in 2000-01, and Commonwealth government 37.6% (\$4,612m). State/territory/local government as a source of funds provided 6.7% in 2002-03, down from 7.8% in 2000-01. Other Australian sources provided 4.9% in 2002-03, up from 4.7% in 2000-01 while Overseas provided 4.3% of funds in 2002-03, up from 3.5% in 2000-01.

### TYPE OF ACTIVITY

Experimental development remained the predominant activity for GERD, accounting for 38.6% (\$4,727m) although this proportion was down from 39.5% in 2000-01. The proportions of GERD on the other activities were:

- Applied research 35.7% (\$4,379m), up from 34.7% in 2000-01
- Strategic basic research 15.5% (\$1,904m), virtually unchanged from 15.6% in 2000-01
- Pure basic research 10.1% (\$1,240m), virtually unchanged from 10.2% in 2000-01.

## MAIN FEATURES *continued*

TYPE OF ACTIVITY <i>continued</i>	<p>In 2002-03, the Higher education sector accounted for 78.6% (\$975m) of expenditure on Pure basic research and 42.2% (\$803m) of expenditure on Strategic basic research and was the main contributor to each of these activities. The Business sector accounted for 35.2% (\$1,540m) of expenditure on Applied research and 85.5% (\$4,040m) of expenditure on Experimental development activity and was the main contributor to each of these activities.</p>
LOCATION OF EXPENDITURE	<p>The leading states in terms of location of gross R&amp;D expenditure in 2002-03 were New South Wales with \$3,745m and Victoria with \$3,547m, accounting for 30.6% and 29.0% respectively.</p>
EXPENDITURE BY SOCIOECONOMIC OBJECTIVE	<p>In 2002-03, 63.1% (\$7,726m) of R&amp;D expenditure was directed towards Economic development. Society accounted for a further 20.7% of R&amp;D expenditure, followed by Environment (6.5%), Non-oriented research (6.4%) and Defence (3.3%). Manufacturing accounted for 38.6% (\$2,981m) of R&amp;D expenditure directed towards Economic development.</p> <p>The majority of expenditure on R&amp;D by the Business sector was on Economic development (90.0%) and by the Commonwealth government sector with 54.6% and by the State/territory government sector with 53.1%.</p> <p>The main purpose of R&amp;D expenditure in the Higher education and the Private non-profit sectors was Society, 43.0% and 96.2% respectively.</p>
EXPENDITURE BY RESEARCH FIELD	<p>The bulk of the Business sector's R&amp;D expenditure was in Engineering and technology (54.4%) and Information, computing and communication sciences (24.1%).</p> <p>The research fields in which most Commonwealth government expenditure on R&amp;D occurred were Engineering and technology (25.7%), Agricultural, veterinary and environmental sciences (15.9%), Earth sciences (13.3%) and Information, computing and communication sciences (10.8%).</p> <p>State/territory government R&amp;D expenditure was mainly in Agricultural, veterinary and environmental sciences (54.5%), Medical and health sciences (18.1%) and Biological sciences (10.7%).</p> <p>The research fields in which significant Higher education R&amp;D expenditure occurred were Other research fields (27.4%), primarily the Social sciences and Humanities, Medical and health sciences (25.2%), Biological sciences (12.0%) and Engineering and technology (10.9%).</p> <p>The majority of the Private non-profit sector's R&amp;D expenditure was in Medical and health sciences (61.4%) and Biological sciences (29.1%).</p>
TYPE OF EMPLOYEE	<p>Total person years of effort for 2002-03 for R&amp;D was 104,252, an increase of 8,631 person years on 2000-01. The effort by Researchers increased by 8.5% from 66,002 to 71,613 person years. R&amp;D effort by Technicians and Other supporting staff increased by 10.2% from 29,619 to 32,639 person years.</p>

## MAIN FEATURES *continued*

### TYPE OF EMPLOYEE

*continued*

Researchers were the predominant type of employee in total person years for all sectors, other than the Commonwealth government, accounting for 86.2% of Higher education person years, 57.3% of Business person years, 51.4% of State/territory government person years and 61.1% of Private non-profit person years of effort.

### HUMAN RESOURCES BY SOCIOECONOMIC OBJECTIVE

Of the total person years on R&D, Economic development accounted for 51.2% and Society for 29.2%. These proportions are noticeably different to those for expenditure reflecting the fact that average R&D expenditure per person year of effort differs across the sectors. In particular, it is considerably lower for the Higher education sector because a major part of the R&D is carried out by postgraduates and the research is generally directed towards more labour intensive objectives.

### HUMAN RESOURCES BY RESEARCH FIELD

The bulk of the Business sector's human resource effort was in Engineering and technology (51.2%) and Information, computing and communication sciences (29.3%).

The main research fields that the Commonwealth government sector's human resource effort was directed towards included Engineering and technology (27.9%) and Agricultural, veterinary and environmental sciences (16.9%).

State/territory government human resource effort was predominantly expended in Agricultural, veterinary and environmental sciences (49.4%) and Medical and health sciences (24.3%).

The research fields in which Higher education human resource efforts were mainly expended were Other research fields (39.0%), primarily the Social sciences and Humanities, Medical and health sciences (19.0%), Engineering and technology (10.4%) and Biological sciences (9.6%).

The majority of the Private non-profit sector's human resource effort was directed towards Medical and health sciences (62.4%) and Biological sciences (31.0%).

## EXPENDITURE, by sector, by type of expenditure

<i>Sector</i>	<i>Total</i>	<i>Land and buildings</i>	<i>Other capital expenditure</i>	<i>Labour costs(a)</i>	<i>Other current expenditure(b)</i>
	\$'000	\$'000	\$'000	\$'000	\$'000
2000-01					
Business	r4 982 558	r41 563	r400 042	r2 188 860	r2 352 093
Government					
Commonwealth	r1 404 831	75 059	58 150	r717 641	r553 982
State/territory	r950 966	53 253	r25 676	r474 081	r397 957
Higher education	r2 789 753	48 571	165 277	1 214 000	r1 361 905
Private non-profit	r289 038	25 845	r17 277	r136 168	r109 749
<b>Total</b>	<b>r10 417 146</b>	<b>r244 290</b>	<b>r666 422</b>	<b>r4 730 749</b>	<b>r4 775 685</b>
2002-03					
Business	5 978 614	95 070	362 738	2 626 497	2 894 309
Government					
Commonwealth	1 531 310	88 206	92 531	785 516	565 057
State/territory	950 852	11 934	24 983	501 811	412 124
Higher education	3 429 597	131 220	176 696	1 436 779	1 684 902
Private non-profit	359 548	13 739	27 480	178 757	139 572
<b>Total</b>	<b>12 249 921</b>	<b>340 169</b>	<b>684 427</b>	<b>5 529 360</b>	<b>5 695 964</b>

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(a) See Glossary for definition of labour costs.

(b) For the Higher education sector, includes scholarships for research higher degrees.



## EXPENDITURE, by sector, by source of funds

Sector	Total \$'000	Commonwealth government \$'000	State and local government \$'000	Business \$'000	Other Australian(a) \$'000	Overseas \$'000
2000-01						
Business	r4 982 558	r179 237	r8 428	r4 533 921	r28 127	r232 844
Government						
Commonwealth	r1 404 831	r1 193 214	27 491	76 922	73 011	34 194
State/territory	r950 966	r72 938	r657 439	r54 543	r158 707	r7 339
Higher education	r2 789 753	r(b)2 410 802	87 859	136 221	94 219	60 652
Private non-profit	r289 038	r73 682	r29 876	r19 507	r139 327	r26 647
<b>Total</b>	<b>r10 417 146</b>	<b>r3 929 873</b>	<b>r811 094</b>	<b>r4 821 114</b>	<b>r493 391</b>	<b>r361 675</b>

2002-03						
Business	5 978 614	246 831	11 474	5 354 090	42 838	323 381
Government						
Commonwealth	1 531 310	1 255 884	39 624	78 044	123 709	34 048
State/territory	950 852	67 373	630 271	50 256	189 266	13 686
Higher education	3 429 597	(c)2 937 893	104 494	174 093	98 488	114 629
Private non-profit	359 548	103 939	39 821	31 594	147 300	36 894
<b>Total</b>	<b>12 249 921</b>	<b>4 611 921</b>	<b>825 684</b>	<b>5 688 077</b>	<b>601 601</b>	<b>522 639</b>

r revised

(a) Includes funds provided via government levies.

(b) Includes \$1,761m of General University funds (GUF), the majority of which is funding from the Commonwealth government.

(c) Includes \$2,033m of General University funds (GUF), the majority of which is funding from the Commonwealth government.

## EXPENDITURE, by sector, by type of activity(a)

<i>Sector</i>	<i>Total</i>	<i>Pure basic research</i>	<i>Strategic basic research</i>	<i>Applied research</i>	<i>Experimental development</i>
	\$'000	\$'000	\$'000	\$'000	\$'000
2000-01					
Business	r4 982 558	r38 227	r288 247	r1 187 419	r3 468 665
Government					
Commonwealth	r1 404 831	r71 166	r429 039	r604 288	r300 340
State/territory	r950 966	r38 164	r121 858	r679 077	r111 866
Higher education	r2 789 753	r837 370	r666 144	r1 072 762	r213 477
Private non-profit	r289 038	r74 178	r124 456	r67 658	r22 745
<b>Total</b>	<b>r10 417 146</b>	<b>r1 059 105</b>	<b>r1 629 744</b>	<b>r3 611 204</b>	<b>r4 117 094</b>
2002-03					
Business	5 978 614	49 857	348 544	1 540 457	4 039 756
Government					
Commonwealth	1 531 310	99 014	471 025	689 375	271 895
State/territory	950 852	53 213	131 482	648 877	117 281
Higher education	3 429 597	975 286	802 881	1 390 706	260 725
Private non-profit	359 548	62 692	150 155	109 485	37 216
<b>Total</b>	<b>12 249 921</b>	<b>1 240 062</b>	<b>1 904 087</b>	<b>4 378 899</b>	<b>4 726 873</b>

r revised

(a) See paragraph 6 of the Explanatory Notes.

## EXPENDITURE, by sector, by location

	<i>Total</i>	<i>NSW</i>	<i>Vic.</i>	<i>Qld</i>	<i>SA</i>	<i>WA</i>	<i>Tas.</i>	<i>NT</i>	<i>ACT and ext. terr.</i>	<i>Overseas</i>
<i>Sector</i>	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000
2000-01										
Business	r4 982 558	r1 737 401	r1 740 979	r531 753	r331 154	r477 865	48 850	r12 291	r38 478	r63 788
Government										
Commonwealth	r1 404 831	r246 466	r345 925	r119 741	r192 401	r74 596	91 813	r13 558	r315 250	r5 082
State/territory	r950 966	r273 992	r190 375	r241 046	95 538	105 480	6 471	r32 957	2 270	r2 836
Higher education	r2 789 753	810 908	630 908	r478 748	223 155	245 000	74 456	18 333	308 244	—
Private non-profit	r289 038	r60 203	r193 117	r6 487	4 184	16 734	np	4 351	np	r1 002
<b>Total</b>	<b>r10 417 146</b>	<b>r3 128 970</b>	<b>r3 101 304</b>	<b>r1 377 775</b>	<b>r846 433</b>	<b>r919 675</b>	np	<b>r81 490</b>	np	<b>r72 708</b>

2002-03										
Business	5 978 614	2 138 858	1 906 622	660 548	527 092	513 062	61 526	30 409	42 214	98 284
Government										
Commonwealth	1 531 310	267 382	374 969	147 701	225 466	89 099	109 668	20 622	294 932	1 472
State/territory	950 852	270 693	170 277	255 288	96 617	108 114	8 801	29 439	7 092	4 531
Higher education	3 429 597	991 884	863 174	574 285	257 957	296 117	67 714	27 329	351 136	—
Private non-profit	359 548	76 168	231 474	9 647	6 135	22 388	235	np	np	3 528
<b>Total</b>	<b>12 249 921</b>	<b>3 744 986</b>	<b>3 546 515</b>	<b>1 647 470</b>	<b>1 113 266</b>	<b>1 028 779</b>	<b>247 945</b>	np	np	<b>107 815</b>

— nil or rounded to zero (including null cells)

r revised

np not available for publication but included in totals where applicable, unless otherwise indicated

## EXPENDITURE, by socioeconomic objective, by sector(a)

<i>Socioeconomic objective</i>	GOVERNMENT					
	<i>Total</i>	<i>Business</i>	<i>Common -wealth</i>	<i>State/territory</i>	<i>Higher education</i>	<i>Private non -profit</i>
	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000
<i>Defence</i>	402 842	108 046	283 854	—	10 942	—
<i>Economic development</i>						
Plant - production and primary products	np	75 907	125 260	252 100	115 780	np
Animal - production and primary products	np	61 761	96 072	181 488	76 649	np
Mineral resources (excl. energy)	592 604	436 129	90 091	7 561	58 824	—
Energy resources	271 666	177 661	56 506	2 468	35 032	—
Energy supply	np	154 610	26 345	37	40 567	np
Manufacturing	2 980 546	2 541 322	209 542	23 899	200 628	5 155
Construction	252 740	152 107	34 554	3 894	62 132	53
Transport	np	136 310	3 759	11 527	28 538	np
Information and communication services	np	1 290 962	49 750	3 140	161 797	np
Commercial services and tourism	411 414	341 766	12 987	14 072	42 586	4
Economic framework	318 512	13 385	131 286	4 372	169 314	155
<i>Total economic development</i>	<i>7 725 684</i>	<i>5 381 919</i>	<i>836 152</i>	<i>504 557</i>	<i>991 845</i>	<i>11 211</i>
<i>Society</i>						
Health	1 898 695	376 351	24 943	203 046	970 399	323 956
Education and training	206 001	13 346	1 946	9 775	160 840	20 094
Social development and community services	430 945	26 185	30 939	28 981	342 985	1 855
<i>Total society</i>	<i>2 535 641</i>	<i>415 882</i>	<i>57 828</i>	<i>241 802</i>	<i>1 474 224</i>	<i>345 905</i>
<i>Environment</i>						
Environmental policy frameworks and other aspects	np	10 305	17 592	18 060	34 343	np
Environmental management	np	56 731	302 997	170 082	186 730	np
<i>Total environment</i>	<i>798 517</i>	<i>67 036</i>	<i>320 589</i>	<i>188 142</i>	<i>221 074</i>	<i>1 676</i>
<i>Non-oriented research</i>	<i>787 237</i>	<i>5 731</i>	<i>32 886</i>	<i>16 351</i>	<i>731 512</i>	<i>756</i>
<b>Total</b>	<b>12 249 921</b>	<b>5 978 614</b>	<b>1 531 310</b>	<b>950 852</b>	<b>3 429 597</b>	<b>359 548</b>

— nil or rounded to zero (including null cells)

(a) See paragraph 10 of the Explanatory Notes.

np not available for publication but included in totals where applicable, unless otherwise indicated

## EXPENDITURE, by research field, by sector(a)

<i>Research field</i>	GOVERNMENT					
	<i>Total</i>	<i>Business</i>	<i>Common -wealth</i>	<i>State/territory</i>	<i>Higher education</i>	<i>Private non -profit</i>
	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000
Mathematical sciences	np	30 405	27 233	8 864	64 002	np
Physical sciences	np	45 386	119 213	424	129 350	np
Chemical sciences	484 938	203 889	104 910	16 867	155 227	4 045
Earth sciences	470 770	114 203	203 871	38 588	114 108	—
Biological sciences	988 451	210 318	161 720	101 699	410 155	104 560
Information, computing and communication sciences	1 770 590	1 439 926	165 024	16 663	144 133	4 844
Engineering and technology	4 051 961	3 251 506	393 069	31 374	374 546	1 465
Agricultural, veterinary and environmental sciences	1 198 519	199 937	243 508	517 798	235 190	2 087
Medical and health sciences	1 674 984	391 961	25 964	172 448	863 816	220 796
Other research fields	1 182 461	91 084	86 799	46 127	939 070	19 380
<b>Total</b>	<b>12 249 921</b>	<b>5 978 614</b>	<b>1 531 310</b>	<b>950 852</b>	<b>3 429 597</b>	<b>359 548</b>

— nil or rounded to zero (including null cells)

np not available for publication but included in totals where applicable, unless otherwise indicated

(a) See paragraph 10 of the Explanatory Notes.

## HUMAN RESOURCES, by sector, by type of employee

Sector	Total	Researchers	Technicians	Other supporting staff
	person years	person years	person years	person years
2000-01				
Business	28 391	16 221	8 132	4 038
Government				
Commonwealth	9 565	4 418	3 299	1 847
State/territory	8 587	4 306	3 183	1 097
Higher education	46 287	39 507	(a)na	(a)6 780
Private non-profit	2 791	1 549	949	294
<b>Total</b>	<b>95 621</b>	<b>66 002</b>	<b>15 563</b>	<b>14 056</b>
2002-03				
Business	32 982	18 891	9 725	4 367
Government				
Commonwealth	10 185	3 739	4 235	2 210
State/territory	8 357	4 297	2 863	1 197
Higher education	49 612	42 780	(a)na	(a)6 832
Private non-profit	3 117	1 906	885	325
<b>Total</b>	<b>104 252</b>	<b>71 613</b>	<b>17 708</b>	<b>14 931</b>

na not available

(a) For the Higher education sector, technicians are not separately identified. They are included in other supporting staff.

## GOVERNMENT

<i>Socioeconomic objective</i>	<i>Total</i>	<i>Business</i>	<i>Common -wealth</i>	<i>State/territory</i>	<i>Higher education</i>	<i>Private non -profit</i>
	person years	person years	person years	person years	person years	person years
<i>Defence</i>	3 124	636	2 366	—	123	—
<i>Economic development</i>						
Plant - production and primary products	np	507	963	1 976	1 497	np
Animal - production and primary products	3 483	293	723	1 451	1 006	10
Mineral resources (excl. energy)	2 129	888	492	46	703	—
Energy resources	1 121	307	319	15	480	—
Energy supply	np	652	163	—	542	np
Manufacturing	19 315	14 968	1 404	219	2 700	24
Construction	2 103	777	211	29	1 086	—
Transport	np	1 088	26	59	346	np
Information and communication services	np	8 306	343	19	2 447	np
Commercial services and tourism	2 611	1 692	85	125	708	—
Economic framework	3 620	125	698	36	2 759	2
<i>Total economic development</i>	53 345	29 603	5 427	3 976	14 274	65
<i>Society</i>						
Health	18 519	1 938	171	2 335	11 192	2 882
Education and training	3 935	160	20	93	3 544	119
Social development and community services	8 032	233	241	255	7 282	20
<i>Total society</i>	30 485	2 331	433	2 683	22 018	3 021
<i>Environment</i>						
Environmental policy frameworks and other aspects	np	97	106	155	535	np
Environmental management	np	271	1 631	1 400	2 876	np
<i>Total environment</i>	7 092	368	1 737	1 555	3 411	21
<i>Non-oriented research</i>	10 205	44	223	143	9 786	10
<b>Total</b>	<b>104 252</b>	<b>32 982</b>	<b>10 185</b>	<b>8 357</b>	<b>49 612</b>	<b>3 117</b>

— nil or rounded to zero (including null cells)

(a) See paragraph 10 of the Explanatory Notes.

np not available for publication but included in totals where applicable, unless otherwise indicated

## HUMAN RESOURCES, by research field, by sector(a)

<i>Research field</i>	GOVERNMENT					
	<i>Total</i>	<i>Business</i>	<i>Common -wealth</i>	<i>State/territory</i>	<i>Higher education</i>	<i>Private non -profit</i>
	person years	person years	person years	person years	person years	person years
Mathematical sciences	np	156	225	63	800	np
Physical sciences	np	291	842	5	1 385	np
Chemical sciences	3 983	1 304	688	123	1 854	15
Earth sciences	3 023	187	970	317	1 549	—
Biological sciences	8 748	1 013	1 054	930	4 785	966
Information, computing and communication sciences	12 949	9 673	968	108	2 168	32
Engineering and technology	25 152	16 874	2 844	244	5 177	12
Agricultural, veterinary and environmental sciences	10 096	1 112	1 725	4 126	3 115	18
Medical and health sciences	15 491	1 891	182	2 033	9 441	1 945
Other research fields	21 030	481	686	409	19 338	116
<b>Total</b>	<b>104 252</b>	<b>32 982</b>	<b>10 185</b>	<b>8 357</b>	<b>49 612</b>	<b>3 117</b>

— nil or rounded to zero (including null cells)

np not available for publication but included in totals where applicable, unless otherwise indicated

(a) See paragraph 10 of the Explanatory Notes.



## EXPLANATORY NOTES

### INTRODUCTION

**1** This publication presents summary statistics of expenditure and human resources devoted to R&D carried out in Australia by organisations within the Business, Government and Private non-profit sectors during 2002–03 and the Higher education sector during the calendar year 2002.

**2** The statistics presented in this publication have previously been published (at a more detailed level) on an individual sector basis (see paragraph 14).

### DATA SOURCES

**3** Information relating to data sources is as follows:

- Business – the statistics presented in this publication have been compiled from data collected from businesses in the Survey of Research and Experimental Development in respect of the year ended 30 June 2003. This survey was based on a complete enumeration of businesses identified by the Australian Bureau of Statistics (ABS) as likely R&D performers (businesses mainly engaged in Agriculture, forestry and fishing were excluded). The survey was conducted by mail questionnaires and an 85% response was obtained. For businesses that did not respond to the current survey and had reported R&D activity in the previous survey, data were imputed based on the expected expenditures for 2002–03 reported previously.
- Government and Private non-profit – the statistics have been compiled from data collected from Government and Private non-profit organisations in the Survey of Research and Experimental Development in respect of the year ended 30 June 2003. This survey was based on a complete enumeration of Government and Private non-profit organisations identified by the Australian Bureau of Statistics (ABS) as likely R&D performers. The survey was conducted by mail questionnaires and a 97% response rate was obtained.
- Higher education – the statistics have been compiled from data collected from universities in the Survey of Research and Experimental Development in respect of the year ended 31 December 2002.

**4** The GDP figures used to derive GERD/GDP ratios are current at the time of manuscript finalisation – *Australian National Accounts: National Income, Expenditure and Product, June quarter 2004* (cat. no. 5206.0) – and, at current prices, are as follows: \$529,886m (1996–97); \$591,917m (1998–99); \$671,120m (2000–01); and \$756,170m (2002–03). The available GERD/GDP ratios for other OECD countries are current at the time of manuscript finalisation and are sourced from *Main Science and Technology Indicators, 2004/1*, OECD, Paris, 2004.

### DEFINITIONS

**5** R&D is defined in accordance with the OECD standard as comprising '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 this stock of knowledge to devise new applications'.

**6** Type of R&D activity comprises pure basic research, strategic basic research, applied research and experimental development. Data in this classification are subjectively allocated by data providers at the time of reporting, using OECD/ABS definitions. The ABS makes every effort to ensure correct and consistent interpretation and reporting of these data and applies consistent processing methodologies. Analysts using this classification should bear the original subjectivity in mind.

**7** For a more comprehensive interpretation of the definition of R&D activity, see the *Australian Standard Research Classification (ASRC), 1998* (cat. no. 1297.0) or refer to the OECD publication *Proposed Standard Practice for Surveys on Research and Experimental Development ('Frascati Manual' 2002)*, OECD, Paris, 2003.

### SCOPE

**8** The sector classification used in the compilation of these statistics is adapted from the guidelines specified by the OECD for use in the conduct of R&D surveys.

**9** Four sectors are recognised:

## EXPLANATORY NOTES *continued*

### SCOPE *continued*

- Business – includes all businesses whose primary activity is the production of goods or services for sale to the general public at a price intended to cover at least the cost of production, and the private non-profit institutions mainly serving them.
  - The Business sector for the R&D survey excludes businesses mainly engaged in Agriculture, forestry and fishing (i.e. industries in Division A of the *Australian and New Zealand Standard Industrial Classification (ANZSIC), 1993* (cat. no. 1292.0), partly because of collection difficulties and partly because such businesses are believed to have very low R&D activity (agricultural R&D activity is generally carried out by specialised research institutes not included in ANZSIC Division A).
- Government – includes all Commonwealth, state and local government departments and authorities.
  - The Government sector for the R&D survey excludes local government organisations because it is considered that their contribution to total R&D activity would be minimal. Public sector organisations mainly engaged in higher education (e.g. universities) are included in the Higher education sector whilst those mainly engaged in trading or financial activities are included in the Business sector.
- Higher education – includes all universities and other institutions of post-secondary education whatever their source of finance or legal status.
  - The Higher education sector for the R&D survey excludes non-university post-secondary education institutions (e.g. Technical and Further Education colleges) because it is considered that their contribution to total R&D activity would be minimal.
- Private non-profit – includes private or semi-public incorporated organisations which are established with the intention of not making a profit.

### SOCIOECONOMIC OBJECTIVE AND RESEARCH FIELDS, COURSES AND DISCIPLINES CLASSIFICATIONS

**10** The statistics in this publication are classified by Socioeconomic objective (purpose of the research) and Research fields, courses and disciplines (fields in which the research was undertaken). Data were subjectively allocated by data providers at the time of reporting, using OECD/ABS definitions. The ABS makes every effort to ensure correct and consistent interpretation and reporting of these data and applies consistent processing methodologies. Analysts using these data should bear the original subjectivity in mind.

**11** For more information on these classifications see the *Australian Standard Research Classification (ASRC), 1998* (cat. no. 1297.0).

### RELIABILITY OF STATISTICS

**12** The statistics in this publication should be used with caution for the following reasons:

- Many data providers made estimates because their accounts did not separately record data on R&D activity.
- The OECD standard definition of R&D used in this survey differs in some respects from what data providers may regard as R&D activity. This is because the definitions used within the grants for industry R&D schemes (for the allocation of grants) and the R&D Tax Concession scheme (for tax deductibility for specific R&D activities) are slightly different from the international standard.
- Some data providers had difficulties describing their R&D programs in terms of socioeconomic objectives, research fields and types of activity. The data presented under these classifications therefore reflect a degree of subjectivity.

### ABS DATA AVAILABLE ON REQUEST

**13** As well as the statistics included in this and related publications, the ABS may have other relevant data available on request. Inquiries should be made to the National Information and Referral Service on 1300 135070.

## EXPLANATORY NOTES *continued*

### RELATED PUBLICATIONS

- 14** Users may also wish to refer to the following publications:
- Australian Bureau of Statistics 1998, *Australian Standard Research Classification (ASRC)*, cat. no. 1297.0, ABS, Canberra
- Australian Bureau of Statistics 2004, *Research and Experimental Development, Businesses, Australia, 2002–03*, cat. no. 8104.0, ABS, Canberra
- Australian Bureau of Statistics 2004, *Research and Experimental Development, Government and Private Non-Profit Organisations, Australia, 2002–03*, cat. no. 8109.0, ABS, Canberra
- Australian Bureau of Statistics 2004, *Research and Experimental Development, Higher Education Organisations, Australia, 2002*, cat. no. 8111.0, ABS, Canberra
- Organisation for Economic Co-operation and Development 2004, *Main Science and technology Indicators 2004/1*, OECD, Paris
- Organisation for Economic Co-operation and Development 2003, *Proposed Standard Practice for Surveys on Research and Experimental Development ('Frascati Manual' 2002)*, OECD, Paris.

**15** Current publications and other products released by the ABS are listed in the Catalogue of Publications and Products cat. no. 1101.0. The catalogue is available from any ABS office or the ABS web site <<http://www.abs.gov.au>>. The ABS also issues a daily Release Advice on the web site which details products to be released in the week ahead.

### ROUNDING

**16** Where figures have been rounded, discrepancies may occur between sums of the component items and totals.

## GLOSSARY

<b>Applied research</b>	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.
<b>Basic research</b>	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 specified broad areas in the expectation of useful discoveries. It provides the broad base of knowledge for the solution of recognised practical problems.
<b>Capital expenditure</b>	Expenditure on the acquisition of fixed tangible assets such as land, buildings, vehicles, plant, machinery and equipment attributable to R&D activity.
<b>Current expenditure</b>	Expenditure on direct labour costs, materials, fuels, rent and hiring, repairs and maintenance, data processing etc. and the proportion of expenditure on general services and overheads which is attributable to R&D activity.
<b>Experimental development</b>	Systematic work, using existing knowledge gained from research or practical experience, for the purpose of creating new or improved products/processes.
<b>Human resources devoted to R&amp;D</b>	The effort of 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.
<b>Labour costs</b>	Wages and salaries, overtime allowances, penalty rates, leave loadings, bonuses, commission payments, all paid leave, employer contributions to superannuation and pension schemes, payroll tax, fringe benefits tax, payments to contract staff on the payroll, severance, termination and redundancy payments and workers' compensation insurance.
<b>Other current expenditure</b>	Expenditure on materials, fuels, rent and hiring, repairs and maintenance, data processing etc. and the proportion of expenditure on general services and overheads which is attributable to R&D activity.
<b>Other supporting staff</b>	Skilled and unskilled craftpersons, secretarial and clerical staff directly associated with R&D activity.
<b>R&amp;D activity</b>	Systematic investigation or experimentation involving innovation or technical risk, the outcome of which is new knowledge, with or without a specific practical application, or new or improved products, processes, materials, devices or services. R&D activity extends to modifications to existing products/processes. R&D activity ceases and pre-production begins when work is no longer experimental.
<b>Research field</b>	Field in which the R&D activity was performed. The Research fields, courses and disciplines classification is primarily structured around disciplines or activities. It describes what research is being performed.
<b>Researchers</b>	Those involved with the conception and/or development of new products/processes (e.g. executives and directors involved in the planning or management of scientific and technical aspects of R&D projects, and software developers/programmers). They exclude executives and directors concerned primarily with budgets and human resources rather than project content.
<b>Socioeconomic objective</b>	The area of expected national benefit rather than the immediate objectives of the researcher. The Socioeconomic objective classification defines the main areas of Australian economic and social activity to which the results of research programs are applied. It describes the purpose of the research (i.e. why the research is being performed).

## GLOSSARY *continued*

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<b>Technicians</b>	Those performing technical tasks in support of R&D activity, normally under the direction and supervision of a researcher. These tasks include preparation of experiments, taking records, preparation of charts and graphs and coding computer programs.
<b>Type of R&amp;D activity</b>	Comprises basic research, applied research and experimental development.





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