

RESEARCH AND EXPERIMENTAL DEVELOPMENT

AUSTRALIA

HIGHER EDUCATION ORGANISATIONS

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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

RESEARCH AND 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). These guidelines state that the expenditure on R&D should include both direct expenditure and an estimate for indirect (overhead) expenditure in support of R&D.

For the ABS R&D survey of the Higher education sector, only universities are surveyed. Other institutions (e.g. Technical and Further Education colleges) are excluded because it is considered that their contribution to total R&D activity would be minimal.



ABBREVIATIONS

\$'000	thousand dollars
\$m	million dollars
ABS	Australian Bureau of Statistics
ACT	Australian Capital Territory
Aust.	Australia
GDP	gross domestic product
HERD	higher education 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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Australian Statistician

MAIN FEATURES

EXPENDITURE ON R&D

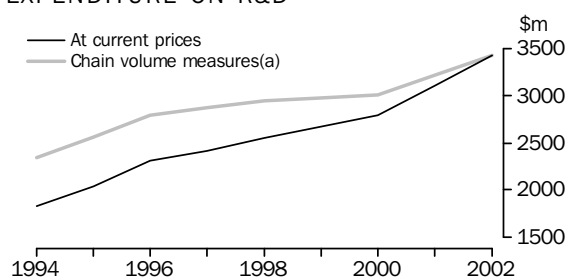
Higher education expenditure on R&D (HERD) in Australia in 2002 was estimated to be \$3,430m at current prices. This represented an increase of 22.9% over 2000.

In volume terms, with the effect of changes in prices and wages and salaries removed, R&D expenditure increased by 14.0% compared with 2000.

HERD has steadily increased since 1994 with an average annual rate of growth over this period of 8.2% in current price terms and 4.9% in chain volume measures.

HERD as a percentage of Gross Domestic product (GDP) in current prices has increased from 0.42% in 2000 to 0.45% in 2002.

EXPENDITURE ON R&D



(a) The reference year for chain volume measures is 2002. See paragraph 15 of the Explanatory Notes for details.

HUMAN RESOURCES DEVOTED TO R&D

Human resources devoted to R&D in Australia in 2002 by higher education organisations was estimated to be 49,612 person years. This represented an increase of 7.2% over 2000 and an average annual rate of growth of 2.7% since 1994.

RESOURCES DEVOTED TO R&D

	1994	1995	1996	1998	2000	2002
Expenditure						
At current prices (\$m)	1 830	2 039	2 308	2 555	r2 790	3 430
Chain volume measures (\$m)(a)	2 344	2 557	2 797	2 943	3 008	3 430
Human resources (person years)	40 096	na	42 739	45 502	46 287	49 612

na not available

r revised

(a) The reference year for chain volume measures is 2002. See paragraph 15 of the Explanatory Notes for details.

PURPOSE OF RESEARCH

Most R&D expenditure by higher education organisations was directed towards Society (\$1,474m or 43.0%) and Economic Development (\$992m or 28.9%).

RESEARCH FIELDS

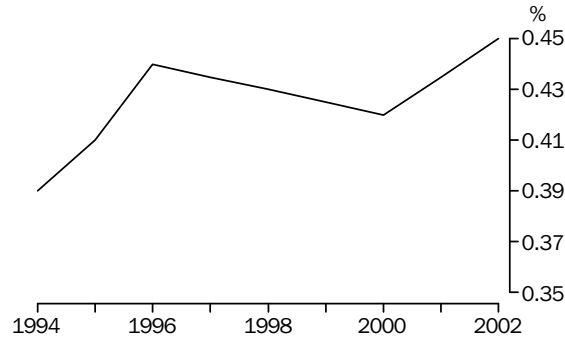
Medical and health sciences (\$864m or 25.2%), Biological sciences (\$410m or 12.0%), Engineering and technology (\$375m or 10.9%) and Agricultural, veterinary and environmental sciences (\$235m or 6.9%) were major fields of research by higher education organisations.

COMPARISON WITH GDP

HERD AS A PERCENTAGE OF GDP

HERD as a percentage of GDP increased from 0.42% in 2000 to 0.45% in 2002.

HERD AS A PERCENTAGE OF GDP



Australia's HERD/GDP ratio for 2002 is of a similar magnitude to those available for other comparable OECD countries, being higher than those for Germany, the United States of America and France.

HERD/GDP RATIOS OF OECD COUNTRIES

	2000	2002
	%	%
Finland	0.61	na
Canada	0.55	0.61
Iceland	0.45	0.50
Australia	0.42	0.45
Japan	0.43	na
France	0.41	0.43
Germany	0.40	0.43
United States of America	0.37	0.42
United Kingdom	0.38	na
Portugal	0.30	0.33
Hungary	0.19	0.25
Czech Republic	0.19	0.20
Slovak Republic	0.06	0.05

na not available

RESOURCES DEVOTED TO R&D

TYPE OF EXPENDITURE	Current expenditure accounted for 91.0% of higher education R&D expenditure, with capital expenditure accounting for the remaining 9.0%. Direct labour costs accounted for 41.9% of total expenditure.
PURPOSE OF RESEARCH	<p>The socioeconomic objectives within the Society division accounted for the majority of expenditure on higher education R&D in 2002 with 43.0% of total expenditure. The major subdivision within Society was Health with 28.3% of total R&D expenditure.</p> <p>The socioeconomic objectives within the Economic development division accounted for 28.9% of total R&D expenditure. The major subdivision within Economic development was Manufacturing.</p>
RESEARCH FIELDS	<p>The major research fields in which higher education R&D expenditure occurred in 2002 were:</p> <ul style="list-style-type: none">■ Medical and health sciences (\$864m, 25.2%)■ Biological sciences (\$410m, 12.0%)■ Engineering and technology (\$375m, 10.9%)■ Agricultural, veterinary and environmental sciences (\$235m, 6.9%).
TYPE OF ACTIVITY	The proportion of R&D expenditure directed towards Pure basic research and Strategic basic research has decreased slightly since 2000 (down from 30.0% to 28.4% and 23.9% to 23.4% respectively). Applied research has increased from 38.5% to 40.6% while Experimental development has remained fairly steady, falling from 7.7% to 7.6%.
SOURCE OF FUNDS	<p>General university funds were the source of funding for 59.3% (\$2,033m) of higher education R&D expenditure in 2002. National Competitive Research Grants provided 15.2% (\$520m), of which \$507m came from Commonwealth Schemes. Other funding from the Commonwealth government provided a further 11.6% (\$397m). State and local government provided 3.0% (\$104m) while businesses provided 5.1% (\$174m).</p> <p>Approximately 41.3% of funding from General university funds was spent on Society, 29.1% on Economic development and 23.5% on Non-oriented research. There was a similar pattern to spending from National Competitive Research Grants, with 43.1% of funding spent on Society, 27.5% on Economic development and 22.5% on Non-oriented research. The predominant objective on which state and local government funds were spent was Society (55.9%).</p> <p>Funding from businesses was mainly spent on Society (41.7%) and Economic development (37.4%).</p> <p>Medical and health sciences was the predominant research field in which funds were spent for all of the sources of funds.</p>
STATE COMPARISONS	The leading states in terms of location of higher education R&D expenditure in 2002 were New South Wales with \$992m and Victoria with \$863m, accounting for 28.9% and 25.2% of total expenditure respectively. Next in order were Queensland (16.7%), the Australian Capital Territory (10.2%), Western Australia (8.6%), South Australia (7.5%), Tasmania (2.0%) and the Northern Territory (0.8%).

RESOURCES DEVOTED TO R&D *continued*

STATE COMPARISONS

continued

The main socioeconomic objective division in most states and territories was Society with Tasmania and the Northern Territory being the exceptions. Economic development was the main division in Tasmania while Environment was the main division in the Northern Territory.

In New South Wales, Victoria, South Australia and Western Australia the predominant research field was Medical and health sciences. The predominant research field in Queensland and the Australian Capital Territory was Biological sciences.

TYPE OF R&D STAFF

Human resources devoted to R&D in Australia in 2002 by higher education organisations was estimated to be 49,612 person years, a 7.2% increase on the 2000 estimate. Researchers comprised 42,780 person years of this effort (8.3% more than in 2000), whereas supporting staff comprised 6,832 person years effort (less than 1% more than in 2000).

The socioeconomic objective of Society accounted for 44.4% of total research effort (person years) in the higher education sector in 2002. Economic development accounted for a further 28.8%.

Major fields in terms of research effort (person years) in the higher education sector in 2002 included Medical and health sciences (19.0%), Engineering and technology (10.4%) and Biological sciences (9.6%).

EXPENDITURE, By socioeconomic objective(a)—By type of expenditure

	Total	Land and buildings	Other capital expenditure	Direct labour costs (b)	Scholarships (c)	Other current expenditure
<i>Socioeconomic objective</i>	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000
<i>Defence</i>	10 942	39	1 468	4 306	590	4 540
<i>Economic development</i>						
Plant—production and primary products	115 780	1 086	5 534	47 875	8 237	53 048
Animal—production and primary products	76 649	1 496	4 227	32 688	5 981	32 256
Mineral resources (excl. energy)	58 824	384	3 682	24 014	3 481	27 263
Energy resources	35 032	805	3 603	14 018	2 247	14 360
Energy supply	40 567	748	3 510	15 773	3 520	17 017
Manufacturing	200 628	6 726	17 613	78 808	17 285	80 197
Construction	62 132	1 370	4 756	24 809	5 850	25 347
Transport	28 538	534	1 284	11 941	1 938	12 842
Information and communication services	161 797	2 071	11 086	70 947	11 883	65 810
Commercial services and tourism	42 586	1 037	1 491	21 255	2 349	16 454
Economic framework	169 314	3 222	4 432	79 261	9 227	73 172
<i>Total economic development</i>	991 845	19 479	61 218	421 388	71 996	417 765
<i>Society</i>						
Health	970 399	27 036	42 072	398 450	49 246	453 594
Education and training	160 840	3 389	4 529	71 053	15 350	66 520
Social development and community services	342 985	11 872	8 215	159 692	32 306	130 902
<i>Total society</i>	1 474 224	42 298	54 816	629 194	96 901	651 015
<i>Environment</i>						
Environmental policy frameworks and other aspects	34 343	640	1 411	15 145	3 217	13 931
Environmental management	186 730	4 225	10 720	77 081	15 492	79 213
<i>Total environment</i>	221 074	4 866	12 131	92 226	18 708	93 143
<i>Non-oriented research</i>	731 512	64 539	47 065	289 665	49 091	281 153
Total	3 429 597	131 220	176 696	1 436 779	237 286	1 447 615

(a) See paragraph 10 of the Explanatory Notes.

(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.

(c) For research higher degrees.

EXPENDITURE, By research field(a)—By type of expenditure

<i>Research field</i>	<i>Total</i>	<i>Land and buildings</i>	<i>Other capital expenditure</i>	<i>Direct labour costs (b)</i>	<i>Scholarships (c)</i>	<i>Other current expenditure</i>
	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000
Mathematical sciences	64 002	929	2 530	30 393	4 100	26 051
Physical sciences	129 350	963	11 051	57 425	6 649	53 262
Chemical sciences	155 227	18 492	11 077	57 254	12 279	56 125
Earth sciences	114 108	1 050	11 220	47 420	7 726	46 692
Biological sciences	410 155	56 243	21 473	146 386	26 100	159 953
Information, computing and communication sciences	144 133	2 021	11 239	62 293	11 113	57 467
Engineering and technology	374 546	6 604	28 719	150 327	30 728	158 169
Agricultural, veterinary and environmental sciences	235 190	3 674	10 989	99 934	17 984	102 609
Medical and health sciences	863 816	16 024	44 004	353 064	41 170	409 554
Education	128 358	3 008	3 272	57 987	11 230	52 862
Economics	83 788	1 658	1 663	38 802	4 302	37 363
Commerce, management, tourism and services	137 227	3 290	4 005	65 406	7 293	57 233
Studies in human society	111 448	1 885	2 599	48 917	9 935	48 112
Behavioural and cognitive sciences	113 275	2 729	4 356	51 213	10 510	44 467
Other research fields	364 975	12 650	8 502	169 959	36 168	137 696
Total	3 429 597	131 220	176 696	1 436 779	237 286	1 447 615

(a) See paragraph 10 of the Explanatory Notes.

(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.

(c) For research higher degrees.

EXPENDITURE, By socioeconomic objective(a)—By type of activity(b)

	Total	Pure basic research	Strategic basic research	Applied research	Experimental development
<i>Socioeconomic objective</i>	\$'000	\$'000	\$'000	\$'000	\$'000
<i>Defence</i>	10 942	2 570	3 412	4 163	797
<i>Economic development</i>					
Plant—production and primary products	115 780	17 629	32 155	55 045	10 951
Animal—production and primary products	76 649	10 170	15 839	43 296	7 344
Mineral resources (excl. energy)	58 824	9 004	14 741	31 844	3 234
Energy resources	35 032	4 858	10 061	17 826	2 286
Energy supply	40 567	6 755	8 122	18 188	7 503
Manufacturing	200 628	33 440	57 372	87 470	22 346
Construction	62 132	8 290	15 229	33 355	5 257
Transport	28 538	2 271	4 969	19 819	1 480
Information and communication services	161 797	28 907	40 728	73 524	18 637
Commercial services and tourism	42 586	5 675	9 241	26 286	1 384
Economic framework	169 314	29 857	35 617	97 156	6 684
<i>Total economic development</i>	<i>991 845</i>	<i>156 856</i>	<i>244 075</i>	<i>503 810</i>	<i>87 104</i>
<i>Society</i>					
Health	970 399	204 017	246 316	438 591	81 475
Education and training	160 840	28 543	27 158	89 956	15 183
Social development and community services	342 985	159 986	64 859	106 039	12 101
<i>Total society</i>	<i>1 474 224</i>	<i>392 547</i>	<i>338 333</i>	<i>634 586</i>	<i>108 759</i>
<i>Environment</i>					
Environmental policy frameworks and other aspects	34 343	7 777	7 677	16 748	2 141
Environmental management	186 730	41 093	45 024	89 992	10 622
<i>Total environment</i>	<i>221 074</i>	<i>48 870</i>	<i>52 700</i>	<i>106 740</i>	<i>12 763</i>
<i>Non-oriented research</i>	<i>731 512</i>	<i>374 443</i>	<i>164 361</i>	<i>141 407</i>	<i>51 301</i>
Total	3 429 597	975 286	802 881	1 390 706	260 725

(a) See paragraph 10 of the Explanatory Notes.

(b) See paragraph 6 of the Explanatory Notes.

EXPENDITURE, By research field(a)—By type of activity(b)

<i>Research field</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
Mathematical sciences	64 002	36 404	10 042	13 745	3 811
Physical sciences	129 350	75 327	19 365	22 482	12 176
Chemical sciences	155 227	55 988	45 004	41 825	12 411
Earth sciences	114 108	37 143	30 484	38 900	7 581
Biological sciences	410 155	151 731	129 979	101 054	27 390
Information, computing and communication sciences	144 133	24 506	39 000	66 236	14 391
Engineering and technology	374 546	57 543	83 754	191 789	41 461
Agricultural, veterinary and environmental sciences	235 190	32 044	55 406	128 657	19 083
Medical and health sciences	863 816	166 334	215 934	405 234	76 314
Education	128 358	16 388	18 058	81 083	12 830
Economics	83 788	16 350	18 217	44 983	4 239
Commerce, management, tourism and services	137 227	20 341	27 280	85 826	3 779
Studies in human society	111 448	48 752	20 724	38 365	3 607
Behavioural and cognitive sciences	113 275	35 378	28 595	40 713	8 589
Other research fields, courses and disciplines	364 975	201 060	61 039	89 814	13 063
Total	3 429 597	975 286	802 881	1 390 706	260 725

(a) See paragraph 10 of the Explanatory Notes.

(b) See paragraph 6 of the Explanatory Notes.

EXPENDITURE, By socioeconomic objective(a)—By source of funds

	Total	NATIONAL COMPETITIVE RESEARCH GRANTS		OTHER					
		Commonwealth schemes	Other schemes	State and local government	Other Commonwealth government	Business	General university funds (GUF)	Other Australian	Overseas
<i>Socioeconomic objective</i>	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000
<i>Defence</i>	10 942	817	41	83	3 073	632	5 785	104	407
<i>Economic development</i>									
Plant—production and primary products	115 780	30 868	332	4 205	17 976	7 934	49 011	3 962	1 492
Animal—production and primary products	76 649	17 771	596	4 454	13 605	4 735	31 519	2 538	1 431
Mineral resources (excl. energy)	58 824	7 615	27	1 218	5 727	7 330	31 679	4 013	1 216
Energy resources	35 032	4 376	179	845	2 728	2 813	18 578	4 439	1 074
Energy supply	40 567	5 763	2	698	2 962	3 805	25 182	949	1 207
Manufacturing	200 628	31 388	1 144	4 484	23 280	18 930	108 146	6 271	6 986
Construction	62 132	7 404	37	2 183	4 082	3 547	43 718	823	338
Transport	28 538	2 696	10	1 977	3 401	2 164	13 933	3 946	412
Information and communication services	161 797	18 737	233	2 747	17 101	6 151	108 040	5 449	3 338
Commercial services and tourism	42 586	2 503	41	476	3 455	1 562	33 849	356	344
Economic framework	169 314	10 910	143	2 855	17 120	6 143	128 614	1 494	2 034
<i>Total economic development</i>	991 845	140 029	2 744	26 141	111 436	65 114	592 268	34 241	19 871
<i>Society</i>									
Health	970 399	177 437	7 369	42 462	96 292	59 674	485 098	31 243	70 825
Education and training	160 840	12 399	152	7 355	23 075	6 593	106 997	2 864	1 406
Social development and community services	342 985	26 463	441	8 570	44 364	6 259	248 206	3 339	5 344
<i>Total society</i>	1 474 224	216 299	7 962	58 386	163 732	72 525	840 301	37 445	77 575
<i>Environment</i>									
Environmental policy frameworks and other aspects	34 343	4 165	105	1 660	4 847	1 720	20 630	400	816
Environmental management	186 730	30 361	539	10 876	28 080	13 957	95 958	3 732	3 228
<i>Total environment</i>	221 074	34 526	644	12 536	32 928	15 677	116 588	4 133	4 044
<i>Non-oriented research</i>	731 512	115 735	1 124	7 347	86 001	20 144	478 378	10 051	12 732
Total	3 429 597	507 405	12 514	104 494	397 169	174 093	2 033 319	85 974	114 629

(a) See paragraph 10 of the Explanatory Notes.

EXPENDITURE, By research field(a)—By source of funds

<i>Research field</i>	<i>Total</i>	NATIONAL COMPETITIVE RESEARCH GRANTS		OTHER					
		<i>Commonwealth schemes</i>	<i>Other schemes</i>	<i>State and local government</i>	<i>Other Commonwealth government</i>	<i>Business</i>	<i>General university funds (GUF)</i>	<i>Other Australian</i>	<i>Overseas</i>
	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000
Mathematical sciences	64 002	10 169	7	1 127	5 464	1 421	44 810	322	683
Physical sciences	129 350	22 674	199	2 073	20 684	2 647	75 729	3 122	2 222
Chemical sciences	155 227	24 086	125	1 202	20 219	8 428	97 151	1 776	2 241
Earth sciences	114 108	22 835	43	2 329	15 490	6 316	61 711	3 439	1 944
Biological sciences	410 155	79 631	1 697	8 751	59 848	22 089	220 925	7 255	9 959
Information, computing and communication sciences	144 133	15 299	223	3 626	13 237	5 444	98 137	5 329	2 839
Engineering and technology	374 546	49 893	1 255	8 935	35 733	30 189	225 840	13 603	9 099
Agricultural, veterinary and environmental sciences	235 190	51 000	1 018	13 732	34 646	16 874	105 720	7 811	4 389
Medical and health sciences	863 816	156 887	6 442	39 475	78 275	57 590	425 755	29 421	69 972
Education	128 358	9 552	194	6 660	17 827	5 743	85 131	2 451	800
Economics	83 788	7 207	164	1 782	13 277	3 532	55 643	799	1 385
Commerce, management, tourism and services	137 227	6 448	63	1 866	8 347	4 113	110 854	4 564	973
Studies in human society	111 448	10 169	272	3 852	17 245	3 067	73 257	1 268	2 318
Behavioural and cognitive sciences	113 275	13 883	451	4 230	15 092	1 928	74 398	1 626	1 667
Other research fields	364 975	27 674	362	4 853	41 786	4 711	278 260	3 189	4 140
Total	3 429 597	507 405	12 514	104 494	397 169	174 093	2 033 319	85 974	114 629

(a) See paragraph 10 of the Explanatory Notes.

EXPENDITURE, By socioeconomic objective(a)—By location

	Aust.	NSW(b)	Vic.	Qld	SA	WA	Tas.	NT	ACT(c)
<i>Socioeconomic objective</i>	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000
<i>Defence</i>	10 942	873	3 527	113	1 154	1 303	69	—	3 904
<i>Economic development</i>									
Plant—production and primary products	115 780	23 747	11 084	19 905	24 358	23 662	6 346	119	6 559
Animal—production and primary products	76 649	23 588	19 366	10 580	3 796	9 018	9 635	283	384
Mineral resources (excl. energy)	58 824	8 100	3 114	20 306	5 220	15 000	2 624	—	4 460
Energy resources	35 032	8 610	11 234	2 525	2 949	9 100	131	—	483
Energy supply	40 567	14 327	7 480	4 724	2 767	2 752	586	3 403	4 528
Manufacturing	200 628	62 434	67 175	31 570	11 010	12 907	1 957	4	13 573
Construction	62 132	24 698	18 379	12 581	2 174	3 019	466	82	733
Transport	28 538	2 884	10 000	9 966	2 395	754	909	28	1 602
Information and communication services	161 797	43 490	45 682	30 139	10 794	15 285	1 006	584	14 817
Commercial services and tourism	42 586	16 510	12 872	5 944	533	2 684	390	616	3 037
Economic framework	169 314	51 391	52 674	22 972	11 055	10 135	1 633	220	19 233
<i>Total economic development</i>	<i>991 845</i>	<i>279 779</i>	<i>259 060</i>	<i>171 212</i>	<i>77 051</i>	<i>104 316</i>	<i>25 681</i>	<i>5 339</i>	<i>69 408</i>
<i>Society</i>									
Health	970 399	282 282	295 738	134 341	90 918	84 058	11 820	2 449	68 794
Education and training	160 840	50 768	38 397	19 698	18 066	14 940	4 029	2 469	12 474
Social development and community services	342 985	121 719	65 010	43 730	22 411	17 039	6 443	4 046	62 587
<i>Total society</i>	<i>1 474 224</i>	<i>454 769</i>	<i>399 145</i>	<i>197 769</i>	<i>131 395</i>	<i>116 037</i>	<i>22 292</i>	<i>8 963</i>	<i>143 855</i>
<i>Environment</i>									
Environmental policy frameworks and other aspects	34 343	10 360	6 807	4 284	588	3 291	1 085	305	7 623
Environmental management	186 730	47 492	23 413	39 360	15 568	20 289	10 751	10 747	19 111
<i>Total environment</i>	<i>221 074</i>	<i>57 852</i>	<i>30 220</i>	<i>43 644</i>	<i>16 156</i>	<i>23 579</i>	<i>11 835</i>	<i>11 053</i>	<i>26 735</i>
<i>Non-oriented research</i>	<i>731 512</i>	<i>198 612</i>	<i>171 222</i>	<i>161 548</i>	<i>32 201</i>	<i>50 881</i>	<i>7 838</i>	<i>1 974</i>	<i>107 236</i>
Total	3 429 597	991 884	863 174	574 285	257 957	296 117	67 714	27 329	351 136

— nil or rounded to zero (including null cells)

(b) Includes Australian Catholic University.

(a) See paragraph 10 of the Explanatory Notes.

(c) Includes Australian Defence Force Academy.

EXPENDITURE, By research field(a)—By location

	<i>Aust.</i>	<i>NSW(b)</i>	<i>Vic.</i>	<i>Qld</i>	<i>SA</i>	<i>WA</i>	<i>Tas.</i>	<i>NT</i>	<i>ACT(c)</i>
<i>Research field</i>	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000
Mathematical sciences	64 002	22 472	17 049	7 457	3 215	2 488	349	—	10 972
Physical sciences	129 350	35 561	24 138	8 117	6 098	9 678	1 009	1 274	43 477
Chemical sciences	155 227	38 902	33 327	34 736	13 574	11 013	2 109	770	20 797
Earth sciences	114 108	24 878	21 640	14 500	6 609	16 325	6 521	95	23 539
Biological sciences	410 155	82 117	69 397	126 938	38 797	30 915	9 642	839	51 509
Information, computing and communication sciences	144 133	38 509	44 414	27 297	6 217	15 298	1 566	363	10 469
Engineering and technology	374 546	119 984	104 915	67 553	18 694	42 087	3 383	2 427	15 503
Agricultural, veterinary and environmental sciences	235 190	58 766	45 351	38 615	24 381	33 788	16 635	10 493	7 161
Medical and health sciences	863 816	261 520	276 278	116 188	74 504	74 778	10 781	2 920	46 847
Education	128 358	43 892	32 246	20 314	12 801	11 272	3 251	2 195	2 387
Economics	83 788	20 200	23 747	8 340	2 356	6 900	710	340	21 195
Commerce, management, tourism and services	137 227	46 159	39 801	25 997	7 913	9 019	1 229	1 512	5 597
Studies in human society	111 448	31 308	24 593	19 776	7 512	5 514	1 555	1 261	19 929
Behavioural and cognitive sciences	113 275	41 340	26 820	17 041	11 203	8 259	1 233	491	6 888
Other research fields	364 975	126 276	79 459	41 419	24 082	18 782	7 741	2 352	64 865
Total	3 429 597	991 884	863 174	574 285	257 957	296 117	67 714	27 329	351 136

— nil or rounded to zero (including null cells)

(b) Includes Australian Catholic University.

(a) See paragraph 10 of the Explanatory Notes.

(c) Includes Australian Defence Force Academy.

HUMAN RESOURCES DEVOTED TO R&D, By socioeconomic objective(a)—By type of employee

<i>Socioeconomic objective</i>	RESEARCHERS			
	<i>Total</i>	<i>Academics</i>	<i>Postgraduates</i>	<i>Supporting staff</i>
	person years	person years	person years	person years
<i>Defence</i>	123	34	64	25
Economic development				
Plant—production and primary products	1 497	373	821	304
Animal—production and primary products	1 006	277	576	154
Mineral resources (excl. energy)	703	198	382	124
Energy resources	480	155	272	54
Energy supply	542	136	336	70
Manufacturing	2 700	707	1 590	403
Construction	1 086	231	740	114
Transport	346	114	179	52
Information and communication services	2 447	627	1 495	325
Commercial services and tourism	708	226	397	85
Economic framework	2 759	793	1 714	253
<i>Total economic development</i>	14 274	3 836	8 501	1 937
Society				
Health	11 192	3 339	5 703	2 150
Education and training	3 544	652	2 609	283
Social development and community services	7 282	1 506	5 223	553
<i>Total society</i>	22 018	5 497	13 535	2 986
Environment				
Environmental policy frameworks and other aspects	535	134	331	70
Environmental management	2 876	719	1 746	411
<i>Total environment</i>	3 411	853	2 077	482
<i>Non-oriented research</i>	9 786	2 598	5 787	1 402
Total	49 612	12 817	29 963	6 832

(a) See paragraph 10 of the Explanatory Notes.

<i>Research field</i>	RESEARCHERS			
	<i>Total</i>	<i>Academics</i>	<i>Postgraduates</i>	<i>Supporting staff</i>
	person years	person years	person years	person years
Mathematical sciences	800	303	416	81
Physical sciences	1 385	447	607	332
Chemical sciences	1 854	495	1 073	287
Earth sciences	1 549	460	851	238
Biological sciences	4 785	1 272	2 666	847
Information, computing and communication sciences	2 168	563	1 319	286
Engineering and technology	5 177	1 367	3 110	699
Agricultural, veterinary and environmental sciences	3 115	801	1 756	558
Medical and health sciences	9 441	2 934	4 570	1 938
Education	3 084	550	2 324	210
Economics	1 176	374	657	146
Commerce, management, tourism and services	2 461	677	1 580	204
Studies in human society	2 310	455	1 626	229
Behavioural and cognitive sciences	2 207	456	1 522	229
Other research fields	8 100	1 665	5 887	548
Total	49 612	12 817	29 963	6 832

(a) See paragraph 10 of the Explanatory Notes.

EXPLANATORY NOTES

- INTRODUCTION**
- 1** This publication presents estimates of expenditure and human resources devoted to R&D carried out by organisations in the Higher education sector during 2002.
 - 2** For details of R&D statistics available for the Business, Government and Private nonprofit sectors see paragraph 18.
- DATA SOURCES**
- 3** The 2002 statistics presented in this publication have been compiled from data collected from universities in the ABS Survey of Research and Experimental Development in respect of the year ended 31 December 2002.
 - 4** The GDP figures used to derive higher education expenditure on R&D/GDP ratios are current at the time of manuscript finalisation (*National Income, Expenditure and Product, December Quarter 2003* (cat. no. 5206.0) — and, at current prices, are as follows: \$471,348m (1994–95); \$502,828m (1995–96); \$529,886m (1996–97); \$591,917m (1998–99); \$671,120m (2000–01) and \$754,291m (2002–03). The available higher education expenditure on R&D/GDP ratios for other OECD countries are current at the time of manuscript finalisation and are sourced from *Main Science and Technology Indicators, 2003/2*, OECD, Paris, 2003.
- 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 these data 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 AND COVERAGE**
- 8** The Higher education sector is defined by the OECD as including all universities and other institutions of post-secondary education whatever their source of finance or legal status.
 - 9** For the ABS R&D surveys of this sector, only universities are surveyed. The universities are asked to include R&D carried out by them as participants in unincorporated Cooperative Research Centres, but to exclude any R&D for incorporated Cooperative Research Centres as they are included in the Business sector. Other institutions (e.g. Technical and Further Education colleges) are excluded because it is considered that their contribution to total R&D activity would be minimal.
- SOCIOECONOMIC OBJECTIVE AND RESEARCH FIELDS, COURSES AND DISCIPLINES CLASSIFICATIONS**
- 10** R&D statistics classified by Socioeconomic objective (purpose of the research) and Research fields, courses and disciplines (fields in which the research was undertaken) have been collected and presented in this publication. 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).

EXPLANATORY NOTES *continued*

METHODOLOGY FOR DERIVING UNIVERSITY R&D EXPENDITURE ESTIMATES

- 12** Universities were asked to provide the ABS with the following data:
- direct staff inputs into R&D (i.e. personnel resources expended in undertaking R&D projects)
 - other staff resources directly supporting R&D by providing direct services to the researchers but not undertaking research in their own right
 - direct expenditure on R&D (i.e. the expenses directly attributable to research projects).

13 An estimate for indirect (overhead) expenditure was then added to the direct expenditure on R&D to obtain an estimate of the total cost of the R&D undertaken.

14 The following approach to estimating overhead R&D expenditure was used in the 2002 data collection:

- In cases where an allowance for overheads had already been included in the data reported by a university, no adjustments were made to the data.
- Where an allowance had not been included, either:
 - the university identified overhead costs and estimated the R&D part to be apportioned across relevant projects, etc.; or
 - the ABS estimated the overhead costs using a methodology agreed to by the universities and the Australian Vice-Chancellors' Committee. For more information on the methodology contact the ABS.

CHAIN VOLUME MEASURES

15 The chain volume measures appearing in this publication are annually reweighted chain Laspeyres indexes referenced to the current price values in a chosen reference year (currently 2002). They can be thought of as current price values re-expressed in (i.e. based on) the prices of the previous year and linked together to form continuous time series. They are formed in a multistage process of which the major steps are described in Section 15 of the information paper *Introduction of Chain Volume Measures in the Australian National Accounts* (cat. no. 5248.0).

RELIABILITY OF STATISTICS

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

- Many data providers had to make estimates because their accounts do 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.
- 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.
- The estimation of overhead R&D expenditure varied across universities (see paragraph 14).
- For the 2002 data collection, some universities improved the methodology used to collect data on their R&D activity.

ABS DATA AVAILABLE ON REQUEST

17 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 135 070.

RELATED PUBLICATIONS

18 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 2002, *Research and Experimental Development, All Sector Summary, Australia, 2000–01*, cat. no. 8112.0, ABS, Canberra
Australian Bureau of Statistics 2003, *Research and Experimental Development, Businesses, Australia, 2001–02*, cat. no. 8104.0, ABS, Canberra

EXPLANATORY NOTES *continued*

RELATED PUBLICATIONS *continued*

Australian Bureau of Statistics 2002, *Research and Experimental Development, Government and Private Non-Profit Organisations, Australia, 2000–01*, cat. no. 8109.0, ABS, Canberra

Organisation for Economic Co-operation and Development 2003, *Main Science and Technology Indicators 2003/2*, 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.

19 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

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

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 specified broad areas in the expectation of useful discoveries. It provides the broad base of knowledge for the solution of recognised practical problems.
Capital expenditure	Expenditure on the acquisition of fixed tangible assets such as land, buildings, vehicles, plant, machinery and equipment attributable to R&D activity.
Chain volume measures	Annually reweighted chain Laspeyres indexes referenced to the current price values in a chosen reference year (currently 2002). They can be thought of as current price values re-expressed in (i.e. based on) the prices of the previous year and linked together to form continuous time series.
Current expenditure	Expenditure on direct labour costs, scholarships, 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.
Direct labour costs	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.
Experimental development	Systematic work, using existing knowledge gained from research or practical experience for the purpose of creating new or improved products/processes.
Human resources devoted to R&D	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.
Other capital expenditure	Expenditure on the acquisition of vehicles, plant, machinery and equipment attributable to R&D activity.
Other current expenditure	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.
R&D activity	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.
Research field	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.
Socioeconomic objective	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).
Supporting staff	Technicians, skilled and unskilled craftpersons, secretarial and clerical staff directly associated with R&D activity.

GLOSSARY *continued*

Type of R&D activity Comprises basic research, applied research and experimental development.

FOR MORE INFORMATION . . .

- INTERNET* **www.abs.gov.au** the ABS web site is the best place to start for access to summary data from our latest publications, information about the ABS, advice about upcoming releases, our catalogue, and Australia Now—a statistical profile.
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