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Australian Bureau of Statistics

RESEARCH AND EXPERIMENTAL DEVELOPMENT

HIGHER EDUCATION ORGANISATIONS AUSTRALIA

EMBARGO: 11.30AM (CANBERRA TIME) FRI 12 APR 2002

CONTENTS

■ 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.

COMPARABILITY

Note that the research classifications used in this publication differ from those used in earlier years. See paragraph 11 of the Explanatory Notes.

ABBREVIATIONS

ABS	Australian Bureau of Statistics
GDP	Gross Domestic Product
HERD	Higher education expenditure on R&D
OECD	Organisation for Economic Co-operation and Development
R&D	Research and experimental development

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MAIN FEATURES

EXPENDITURE ON R&D

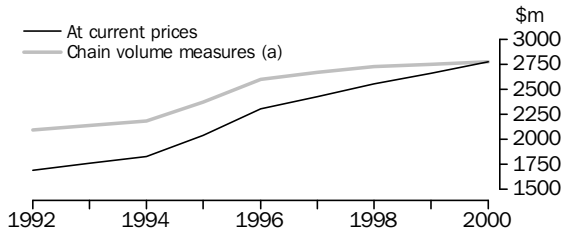
Higher education expenditure on R&D (HERD) in Australia in 2000 was estimated to be $2,775m at current prices. This represented an increase of 9% over 1998.

In volume terms, with the effect of changes in prices and wages and salaries removed, R&D expenditure increased by 2% compared with 1998.

HERD has steadily increased since 1992. The average annual rate of growth over this period has been 6.4% in current price terms and 3.6% in chain volume measures.

HERD as a percentage of Gross Domestic Product (GDP) has decreased from 0.43% in 1998 to 0.41% in 2000.

EXPENDITURE ON R&D



(a) The reference year for chain volume measures is 2000. See paragraph 15 of the Explanatory Notes for details.

HUMAN RESOURCES DEVOTED TO R&D

Human resources devoted to R&D in Australia in 2000 by higher education organisations was estimated to be 46,287 person years. This represented an increase of 2% over 1998 and an average annual rate of growth of 3.4% since 1992.

RESOURCES DEVOTED TO R&D

	1992	*1994*	*1995*	*1996*	*1998*	*2000*
Expenditure						
At current prices *($m)*	1 695.2	1 829.6	2 039.1	2 307.6	r2 555.1	2 774.6
Chain volume measures(a) *($m)*	2 095.8	2 186.5	2 377.1	2 604.7	2 728.5	2 774.6
Human resources *(person years)*	35 418	40 096	na	42 739	45 502	46 287

r revised
na not available
(a) The reference year for chain volume measures is 2000. See paragraph 15 of the Explanatory Notes for details.

PURPOSE OF RESEARCH

Most R&D expenditure by higher education organisations was directed towards Society ($1,123m or 40%) and Economic development ($795m or 29%).

RESEARCH FIELDS

Medical and health sciences ($668m or 24%), Biological sciences ($325m or 12%), Engineering and technology ($309m or 11%) and Agricultural, veterinary and environmental sciences ($205m or 7%) were major fields of research by higher education organisations.

HERD AS A PERCENTAGE OF GDP

HERD as a percentage of GDP fell from 0.43% in 1998 to 0.41% in 2000.

HERD AS A PERCENTAGE OF GDP

Australia's HERD/GDP ratio for 2000 compares favourably with those available for other OECD countries, being higher than those for Germany, the United States of America and France.

HERD/GDP RATIOS OF OECD COUNTRIES

	1998	*2000*
	%	%
Canada	0.49	0.60
Finland	0.57	0.59
Netherlands	0.53	na
Iceland	0.51	na
Japan	0.44	na
Australia	**0.43**	**0.41**
Denmark	0.41	na
Germany	0.40	0.40
United States of America	0.37	0.37
France	0.38	0.36
United Kingdom	0.36	na
Spain	0.27	0.27
Ireland	0.26	na
Italy	0.25	na
Poland	0.20	0.22
Hungary	0.17	0.20
Czech Republic	0.12	0.19

na not available

RESOURCES DEVOTED TO R&D

TYPE OF EXPENDITURE

Current expenditure accounted for 92% of higher education R&D expenditure, with capital expenditure accounting for the remaining 8%. The major component was direct labour costs which accounted for 44% of total expenditure.

PURPOSE OF RESEARCH

Note that data for some categories may not be comparable with those for earlier years as the research classifications have been revised (see paragraph 11 of the Explanatory Notes).

The Socio-economic objectives within the Society division accounted for the majority of expenditure on higher education R&D in 2000 with 40% of total expenditure. The major subdivision within Society was Health with 27% of total R&D expenditure.

The Socio-economic objectives within the Economic development division accounted for 29% of R&D expenditure.

RESEARCH FIELDS

The major research fields in which higher education R&D occurred in 2000 were: Medical and health sciences ($668m); Biological sciences ($325m); Engineering and technology ($309m); and Agricultural, veterinary and environmental sciences ($205m).

TYPE OF ACTIVITY

The proportion of R&D expenditure directed towards Pure basic research and Strategic basic research has decreased slightly since 1998 (down from 34% to 31% and 25% to 24% respectively). Applied research and Experimental development have increased from 35% to 38% and 6% to 8% respectively.

SOURCE OF FUNDS

General university funds were the source of funding for 63% ($1,746m) of higher education R&D expenditure in 2000. National Competitive Research Grants provided 18% ($495m), of which $483m came from Commonwealth Schemes. Other funding from the Commonwealth Government provided a further 6% ($167m). State and local government provided 3% ($88m) while Businesses provided 5% ($136m).

Approximately 40% of funding from General university funds was spent on Society, 28% on Economic development and 27% on Non-oriented research. There was a similar pattern to spending from National Competitive Research Grants, with 40% of funding spent on Society, 27% on Economic development and 27% on Non-oriented research.

The predominant objective on which State and local government funds were spent was Society (48%), while 44% of funds from Business were spent on Economic development.

Medical and health sciences was the predominant research field in which funds were spent for all of the sources of funds. General university funds were directed towards Medical and health sciences (21%), Biological sciences (11%) and Engineering and technology (10%). National Competitive Research Grants were directed towards the same fields as general university funds; Medical and health sciences (28%), Biological sciences (16%) and Engineering and technology (11%).

STATE COMPARISONS

The leading States in terms of location of higher education R&D expenditure in 2000 were New South Wales at $811m and Victoria at $631m, accounting for 29% and 23% of total expenditure respectively. Next in order were Queensland (17%), the Australian Capital Territory (11%), Western Australia (9%), South Australia (8%), Tasmania (3%) and the Northern Territory (1%).

STATE COMPARISONS *continued*

The main Socio-economic objective division in most State and Territories was Society with the Australian Capital Territory and Tasmania being the exceptions. Non-oriented research was the main Socio-economic objective division in the Australian Capital Territory while Economic development was the main division in Tasmania.

In New South Wales, Victoria, Queensland, South Australia and Western Australia the predominant research field was Medical and health sciences.

TYPE OF R&D STAFF

The percentage distribution by type of R&D employee in 2000 changed slightly when compared to 1998. Researchers increased as a percentage of total human resource effort at the expense of Supporting staff. Supporting staff decreased by 8% compared with a 4% increase in Researchers.

There was also a change in the composition of the research effort by Researchers. Academics accounted for 30% of effort by Researchers, a decrease of 1%, while Postgraduates increased to 70% of Researchers' effort.

The Socio-economic objective of Society accounted for 41% of total research effort (person years) in the higher education sector in 2000. Economic development accounted for a further 27%.

Major fields in terms of research effort (person years) in the higher education sector in 2000 included Medical and health sciences (19%), Engineering and technology (11%) and Biological sciences (10%).

1 EXPENDITURE, By socio-economic objective(a)—By type of expenditure

Socio-economic objective	Total	Land and buildings	Other capital expenditure	Direct Labour costs(b)	Scholarships(c)	Other current expenditure
	$'000	$'000	$'000	$'000	$'000	$'000
Defence	*4 361*	*107*	*179*	*1 844*	*237*	*1 996*
Economic development						
Plant — production and primary products	108 583	1 509	4 632	45 855	8 298	48 290
Animal — production and primary products	64 496	1 048	2 804	26 807	4 353	29 485
Mineral resources (excl. energy)	42 091	859	2 654	14 919	3 050	20 610
Energy resources	32 438	684	2 850	14 001	2 044	12 859
Energy supply	31 083	988	2 647	12 325	3 089	12 035
Manufacturing	140 674	2 046	15 870	58 100	10 871	53 787
Construction	54 128	915	2 976	23 315	4 697	22 225
Transport	22 783	647	1 310	10 088	1 718	9 021
Information and communication services	127 698	2 054	8 276	56 711	9 463	51 195
Commercial services and tourism	40 442	701	1 732	20 598	1 804	15 609
Economic framework	130 927	1 630	4 021	64 824	6 766	53 685
Total economic development	*795 346*	*13 079*	*49 772*	*347 542*	*56 152*	*328 801*
Society						
Health	744 298	10 563	35 571	332 994	38 397	326 773
Education and training	109 980	2 362	3 996	51 838	6 955	44 829
Social development and community services	268 738	6 829	8 872	124 479	22 563	105 995
Total society	*1 123 015*	*19 753*	*48 439*	*509 312*	*67 914*	*477 597*
Environment						
Environmental policy frameworks and other aspects	25 211	749	1 123	11 098	1 706	10 535
Environmental management	134 909	2 657	7 583	54 588	10 376	59 707
Total environment	*160 120*	*3 406*	*8 706*	*65 685*	*12 082*	*70 242*
Non-oriented research	*691 722*	*12 227*	*58 182*	*289 617*	*46 856*	*284 840*
Total	**2 774 564**	**48 571**	**165 277**	**1 214 000**	**183 241**	**1 163 476**

(a) The research classifications used in this publication differ from those used in earlier years. See paragraph 11 of the Explanatory Notes.

(b) Includes wages and salaries, payroll tax, payments to contract staff on the payroll, fringe benefits tax, workers compensation insurance, overtime earnings, shift allowances, penalty rates, bonuses, commission payments, holiday pay, long service leave payments, sick pay, employer contributions to superannuation and pension schemes.

(c) For research higher degrees.

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

Research field	Total	Land and buildings	Other capital expenditure	Direct Labour costs(b)	Scholarships(c)	Other current expenditure
	$'000	$'000	$'000	$'000	$'000	$'000
Mathematical sciences	59 393	278	2 559	29 473	3 258	23 825
Physical sciences	112 025	1 991	12 831	46 725	4 849	45 628
Chemical sciences	127 196	2 110	15 380	49 965	8 986	50 755
Earth sciences	94 619	1 170	7 589	38 826	6 852	40 183
Biological sciences	324 509	9 451	24 777	132 312	19 131	138 838
Information, computing and communication sciences	113 136	2 096	6 849	51 450	8 544	44 198
Engineering and technology	309 070	5 206	25 928	123 741	25 133	129 062
Agricultural, veterinary and environmental sciences	204 513	2 775	8 713	85 580	14 961	92 484
Medical and health sciences	667 716	7 249	34 742	299 639	33 208	292 877
Education	86 649	2 038	2 821	41 472	6 020	34 300
Economics	66 842	660	2 520	31 460	3 376	28 826
Commerce, management, tourism and services	110 954	1 848	3 564	55 834	5 561	44 147
Studies in human society	93 672	1 528	2 796	41 716	6 840	40 792
Behavioural and cognitive sciences	87 751	2 328	4 168	39 212	6 836	35 206
Other research fields	316 520	7 842	10 039	146 596	29 687	122 356
Total	**2 774 564**	**48 571**	**165 277**	**1 214 000**	**183 241**	**1 163 476**

(a) The research classifications used in this publication differ from those used in earlier years. See paragraph 11 of the Explanatory Notes.

(b) Includes wages and salaries, payroll tax, payments to contract staff on the payroll, fringe benefits tax, workers compensation insurance, overtime earnings, shift allowances, penalty rates, bonuses, commission payments, holiday pay, long service leave payments, sick pay, employer contributions to superannuation and pension schemes.

(c) For research higher degrees.

3 EXPENDITURE, By socio-economic objective(a)—By type of activity(b)

Socio-economic objective	Total	Pure basic research	Strategic basic research	Applied research	Experimental development
	$'000	$'000	$'000	$'000	$'000
Defence	*4 361*	*688*	*848*	*2 139*	*686*
Economic development					
Plant — production and primary products	108 583	11 704	30 614	57 310	8 956
Animal — production and primary products	64 496	9 610	15 305	33 492	6 090
Mineral resources (excl. energy)	42 091	6 882	9 932	23 649	1 629
Energy resources	32 438	4 191	11 028	14 152	3 068
Energy supply	31 083	3 617	5 984	14 053	7 430
Manufacturing	140 674	26 696	43 237	53 711	17 031
Construction	54 128	9 976	11 838	27 349	4 964
Transport	22 783	2 697	4 824	13 304	1 959
Information and communication services	127 698	27 419	27 211	56 658	16 411
Commercial services and tourism	40 442	6 009	9 199	23 229	2 006
Economic framework	130 927	23 406	27 306	75 766	4 450
Total economic development	*795 346*	*132 205*	*196 478*	*392 670*	*73 993*
Society					
Health	744 298	163 491	216 414	295 385	69 008
Education and training	109 980	28 264	19 599	54 493	7 624
Social development and community services	268 738	143 956	41 045	71 521	12 216
Total society	*1 123 015*	*335 711*	*277 058*	*421 398*	*88 848*
Environment					
Environmental policy frameworks and other aspects	25 211	5 200	5 510	12 842	1 659
Environmental management	134 909	30 259	38 539	57 113	8 998
Total environment	*160 120*	*35 459*	*44 049*	*69 955*	*10 657*
Non-oriented research	*691 722*	*343 295*	*147 336*	*161 579*	*39 512*
Total	**2 774 564**	**847 358**	**665 769**	**1 047 741**	**213 696**

(a) The research classifications used in this publication differ from those used in earlier years. See paragraph 11 of the Explanatory Notes.

(b) See paragraph 6 of the Explanatory Notes.

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

Research field	Total	Pure basic research	Strategic basic research	Applied research	Experimental development
	$'000	$'000	$'000	$'000	$'000
Mathematical sciences	59 393	31 471	11 369	13 707	2 846
Physical sciences	112 025	66 965	15 772	18 478	10 809
Chemical sciences	127 196	52 054	33 685	29 404	12 053
Earth sciences	94 619	33 364	30 283	25 794	5 179
Biological sciences	324 509	118 815	101 343	87 890	16 462
Information, computing and communication sciences	113 136	23 436	25 662	50 992	13 047
Engineering and technology	309 070	44 142	65 856	162 274	36 798
Agricultural, veterinary and environmental sciences	204 513	25 535	48 228	112 004	18 747
Medical and health sciences	667 716	138 830	199 043	266 802	63 041
Education	86 649	21 235	15 582	45 128	4 705
Economics	66 842	14 011	14 794	36 160	1 877
Commerce, management, tourism and services	110 954	18 580	22 376	65 990	4 008
Studies in human society	93 672	41 434	14 937	34 656	2 645
Behavioural and cognitive sciences	87 751	31 628	21 275	28 541	6 308
Other research fields	316 520	185 860	45 564	69 922	15 174
Total	**2 774 564**	**847 358**	**665 769**	**1 047 741**	**213 696**

(a) The research classifications used in this publication differ from those used in earlier years. See paragraph 11 of the Explanatory Notes.

(b) See paragraph 6 of the Explanatory Notes.

5 EXPENDITURE, By socio-economic objective(a)—By source of funds

Socio-economic objective	Total	NATIONAL COMPETITIVE RESEARCH GRANTS		OTHER					
		Common-wealth schemes	*Other schemes*	*State and local government*	*Other Common-wealth government*	*Business*	*General university funds (GUF)*	*Other Australian*	*Overseas*
	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000
Defence	*4 361*	*382*	—	*55*	*821*	*280*	*2 600*	*24*	*199*
Economic development									
Plant — production and primary products	108 583	31 825	150	4 774	9 693	5 623	51 789	3 012	1 717
Animal — production and primary products	64 496	16 721	263	4 797	5 065	4 002	30 401	2 288	960
Mineral resources (excl. energy)	42 091	5 792	32	539	3 605	8 121	22 232	401	1 369
Energy resources	32 438	7 322	1 166	1 060	2 077	3 507	15 782	445	1 079
Energy supply	31 083	4 335	60	1 534	2 663	4 135	16 835	812	710
Manufacturing	140 674	24 452	211	3 169	8 127	16 698	78 969	3 987	5 061
Construction	54 128	8 348	294	1 771	2 736	3 786	35 365	1 110	718
Transport	22 783	3 112	49	3 001	1 186	1 862	11 035	2 068	471
Information and communication services	127 698	15 421	72	2 869	7 888	6 968	86 955	3 975	3 550
Commercial services and tourism	40 442	2 902	2	1 256	1 908	1 443	32 032	646	254
Economic framework	130 927	10 506	16	2 032	5 889	4 168	106 716	1 070	531
Total economic development	*795 346*	*130 736*	*2 316*	*26 800*	*50 838*	*60 314*	*488 110*	*19 812*	*16 420*
Society									
Health	744 298	150 479	7 282	30 987	44 427	36 151	410 252	39 484	25 235
Education and training	109 980	12 102	428	5 591	6 394	2 891	78 911	2 424	1 238
Social development and community services	268 738	28 300	141	5 408	14 821	4 514	209 331	4 335	1 889
Total society	*1 123 015*	*190 881*	*7 851*	*41 986*	*65 642*	*43 556*	*698 494*	*46 243*	*28 362*
Environment									
Environmental policy frameworks and other aspects	25 211	3 171	5	1 232	2 552	761	16 590	502	397
Environmental management	134 909	23 581	591	9 046	11 761	9 251	74 150	3 696	2 834
Total environment	*160 120*	*26 752*	*596*	*10 278*	*14 312*	*10 012*	*90 739*	*4 199*	*3 232*
Non-oriented research	*691 722*	*134 665*	*1 302*	*8 741*	*34 891*	*22 059*	*465 749*	*11 876*	*12 439*
Total	**2 774 564**	**483 416**	**12 065**	**87 859**	**166 504**	**136 221**	**1 745 693**	**82 154**	**60 652**

— nil or rounded to zero (including null cells)

(a) The research classifications used in this publication differ from those used in earlier years. See paragraph 11 of the Explanatory Notes.

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

Research field	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*
	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000
Mathematical sciences	59 393	11 692	23	850	2 238	1 702	41 769	363	755
Physical sciences	112 025	22 745	54	454	7 895	2 022	75 334	1 537	1 983
Chemical sciences	127 196	23 651	1 398	2 465	6 873	7 928	81 317	2 493	1 072
Earth sciences	94 619	20 080	115	1 992	6 124	5 274	58 392	1 221	1 421
Biological sciences	324 509	77 787	940	10 610	16 903	16 971	186 213	6 565	8 519
Information, computing and communication sciences	113 136	12 003	10	1 487	6 250	5 494	81 502	3 739	2 652
Engineering and technology	309 070	52 939	1 659	10 749	21 588	31 631	172 621	7 437	10 445
Agricultural, veterinary and environmental sciences	204 513	48 358	736	13 337	18 934	11 853	101 357	7 208	2 730
Medical and health sciences	667 716	130 499	6 777	27 820	39 573	37 918	360 414	38 652	26 064
Education	86 649	8 766	13	5 079	4 878	1 591	64 694	796	833
Economics	66 842	7 340	23	1 063	5 927	2 634	48 301	1 084	470
Commerce, management, tourism and services	110 954	6 472	5	1 618	3 280	3 516	94 478	1 273	312
Studies in human society	93 672	10 208	70	2 660	6 603	1 696	70 061	1 481	893
Behavioural and cognitive sciences	87 751	16 733	112	3 874	4 417	1 527	57 534	3 137	418
Other research fields	316 520	34 141	131	3 802	15 023	4 464	251 706	5 168	2 085
Total	**2 774 564**	**483 416**	**12 065**	**87 859**	**166 504**	**136 221**	**1 745 693**	**82 154**	**60 652**

(a) The research classifications used in this publication differ from those used in earlier years. See paragraph 11 of the Explanatory Notes.

7 EXPENDITURE, By socio-economic objective(a)—By location

Socio-economic objective	Aust. $'000	NSW(b) $'000	Vic. $'000	Qld $'000	SA $'000	WA $'000	Tas. $'000	NT $'000	ACT(c) $'000
Defence	*4 361*	*329*	*330*	*73*	*1 569*	*1 495*	*13*	—	*554*
Economic development									
Plant — production and primary products	108 583	22 281	8 515	20 380	22 088	21 523	7 567	522	5 709
Animal — production and primary products	64 496	19 033	15 094	12 371	2 673	5 743	8 712	336	536
Mineral resources (excl. energy)	42 091	2 895	1 331	13 315	2 607	14 383	3 022	—	4 540
Energy resources	32 438	9 171	7 982	4 577	3 226	6 725	22	—	736
Energy supply	31 083	16 405	3 478	2 386	1 361	2 038	191	1 489	3 737
Manufacturing	140 674	36 103	43 910	28 960	8 261	6 469	1 472	162	15 336
Construction	54 128	26 153	14 379	7 013	1 739	2 979	942	—	923
Transport	22 783	3 274	7 874	6 047	3 111	626	853	9	989
Information and communication services	127 698	34 914	34 214	19 839	8 980	11 417	1 367	118	16 850
Commercial services and tourism	40 442	18 097	9 352	6 456	955	2 866	426	875	1 415
Economic framework	130 927	45 925	33 543	19 580	7 883	7 090	3 196	439	13 271
Total economic development	*795 346*	*234 250*	*179 670*	*140 924*	*62 884*	*81 858*	*27 768*	*3 950*	*64 041*
Society									
Health	744 298	212 193	203 645	111 416	83 390	72 930	9 589	1 872	49 262
Education and training	109 980	35 118	30 316	21 128	6 513	7 827	3 534	747	4 796
Social development and community services	268 738	86 542	55 036	32 610	13 596	12 474	6 993	2 891	58 596
Total society	*1 123 015*	*333 853*	*288 997*	*165 155*	*103 500*	*93 231*	*20 116*	*5 511*	*112 654*
Environment									
Environmental policy frameworks and other aspects	25 211	4 955	4 978	3 414	1 201	2 447	1 167	542	6 508
Environmental management	134 909	32 192	16 501	33 482	11 767	14 232	11 586	4 617	10 533
Total environment	*160 120*	*37 148*	*21 478*	*36 896*	*12 968*	*16 679*	*12 753*	*5 159*	*17 041*
Non-oriented research	*691 722*	*205 329*	*140 433*	*120 512*	*42 235*	*51 738*	*13 806*	*3 714*	*113 955*
Total	**2 774 564**	**810 908**	**630 908**	**463 559**	**223 155**	**245 000**	**74 456**	**18 333**	**308 244**

— nil or rounded to zero (including null cells)

(a) The research classifications used in this publication differ from those used in earlier years. See paragraph 11 of the Explanatory Notes.

(b) Includes Australian Catholic University.

(c) Includes Australian Defence Force Academy.

8 EXPENDITURE, By research field(a)—By location

Research field	Aust. $'000	NSW(b) $'000	Vic. $'000	Qld $'000	SA $'000	WA $'000	Tas. $'000	NT $'000	ACT(c) $'000
Mathematical sciences	59 393	23 271	13 667	5 834	4 416	2 113	443	—	9 649
Physical sciences	112 025	30 413	19 126	7 417	7 329	9 494	535	650	37 061
Chemical sciences	127 196	30 198	28 716	27 351	13 034	5 995	2 690	481	18 731
Earth sciences	94 619	18 359	15 849	12 112	5 801	10 675	10 010	28	21 788
Biological sciences	324 509	68 363	58 077	75 552	29 804	34 258	7 633	3 615	47 207
Information, computing and communication sciences	113 136	27 353	27 853	19 374	7 013	11 740	1 604	229	17 970
Engineering and technology	309 070	108 143	68 895	59 262	20 982	33 151	2 313	1 813	14 511
Agricultural, veterinary and environmental sciences	204 513	47 852	39 368	39 096	21 238	27 201	20 518	4 051	5 189
Medical and health sciences	667 716	203 093	180 946	99 251	71 902	65 687	9 750	1 863	35 225
Education	86 649	30 558	23 292	16 617	5 495	6 282	3 073	692	640
Economics	66 842	17 119	15 131	6 105	2 974	6 333	2 111	209	16 861
Commerce, management, tourism and services	110 954	46 204	26 791	20 498	5 261	7 001	1 732	1 046	2 420
Studies in human society	93 672	26 975	17 475	14 953	7 491	4 236	1 655	1 779	19 109
Behavioural and cognitive sciences	87 751	31 417	22 971	17 326	4 016	5 011	1 232	125	5 653
Other research fields	316 520	101 590	72 752	42 812	16 401	15 825	9 156	1 752	56 232
Total	**2 774 564**	**810 908**	**630 908**	**463 559**	**223 155**	**245 000**	**74 456**	**18 333**	**308 244**

— nil or rounded to zero (including null cells)

(a) The research classifications used in this publication differ from those used in earlier years. See paragraph 11 of the Explanatory Notes.

(b) Includes Australian Catholic University.

(c) Includes Australian Defence Force Academy.

9 EXPENDITURE, By socio-economic objective(a)—By type of employee

Socio-economic objective	Total	RESEARCHERS . . . Academics	Postgraduates	Supporting staff
	person years	person years	person years	person years
Defence	*68*	*16*	*47*	*5*
Economic development				
Plant — production and primary products	1 638	362	901	375
Animal — production and primary products	944	231	487	227
Mineral resources (excl. energy)	549	152	298	100
Energy resources	439	133	243	64
Energy supply	475	107	278	90
Manufacturing	2 128	574	1 176	378
Construction	1 097	255	702	141
Transport	391	103	235	53
Information and communication services	1 976	566	1 167	243
Commercial services and tourism	623	208	335	80
Economic framework	2 392	716	1 418	258
Total economic development	*12 652*	*3 404*	*7 239*	*2 008*
Society				
Health	10 171	3 016	5 197	1 959
Education and training	2 741	563	1 936	242
Social development and community services	6 055	1 322	4 212	522
Total society	*18 967*	*4 900*	*11 344*	*2 723*
Environment				
Environmental policy frameworks and other aspects	391	102	228	60
Environmental management	2 386	561	1 438	388
Total environment	*2 777*	*663*	*1 666*	*448*
Non-oriented research	*11 824*	*2 869*	*7 358*	*1 597*
Total	**46 287**	**11 854**	**27 654**	**6 780**

(a) The research classifications used in this publication differ from those used in earlier years. See paragraph 11 of the Explanatory Notes.

10 HUMAN RESOURCES DEVOTED TO R&D, By research field(a)—By type of employee

Research field	Total	RESEARCHERS . . . . Academics	Postgraduates	Supporting staff
	person years	person years	person years	person years
Mathematical sciences	844	317	446	81
Physical sciences	1 265	414	573	279
Chemical sciences	1 729	480	986	263
Earth sciences	1 565	350	942	273
Biological sciences	4 680	1 251	2 476	953
Information, computing and communication sciences	1 813	508	1 093	213
Engineering and technology	4 961	1 316	2 869	776
Agricultural, veterinary and environmental sciences	3 137	733	1 753	651
Medical and health sciences	8 770	2 641	4 336	1 793
Education	2 429	449	1 800	180
Economics	1 059	321	600	139
Commerce, management, tourism and services	2 110	629	1 285	196
Studies in human society	2 037	408	1 406	224
Behavioural and cognitive sciences	1 994	406	1 379	209
Other research fields	7 894	1 635	5 710	549
Total	**46 287**	**11 854**	**27 654**	**6 780**

(a) The research classifications used in this publication differ from those used in earlier years. See paragraph 11 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 2000.

2 For details of R&D statistics available for the Business enterprise and General government and Private non-profit sectors see paragraph 18.

DATA SOURCES

3 The 2000 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 2000.

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 2001* (Cat. no. 5206.0)) and, at current prices, are as follows: $425,707m (1992–93); $471,348m (1994–95); $502,828m (1995–96); $529,886m (1996–97); $591,592m (1998–99); and $672,046m (2000–01). The available higher education expenditure on R&D/GDP ratios for other OECD countries are current at time of manuscript finalisation and are sourced from *Main Science and Technology Indicators, 2001-2*, OECD, Paris, 2001.

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 respondents at the time of reporting, using OECD/ABS definitions. The ABS makes every effort to ensure correct and consistent interpretation and reporting of this 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, contact the ABS or refer to the OECD publication *The Measurement of Scientific and Technological Activities ('Frascati Manual' 1993)*, OECD, Paris 1994.

SCOPE AND COVERAGE

8 The Higher education sector is defined by 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 (CRCs), but to exclude any R&D for incorporated CRCs as they are included in the Business enterprise 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.

SOCIO-ECONOMIC OBJECTIVE AND RESEARCH FIELDS, COURSES AND DISCIPLINES CLASSIFICATIONS

10 The statistics in this publication are classified by Socio-economic objective and Research fields, courses and disciplines. For more information on these classifications see the *Australian Standard Research Classification, 1998* (Cat. no. 1297.0).

COMPARABILITY WITH PREVIOUS STATISTICS

11 The research classifications used in this publication differ from those used in earlier years. The classifications used in this publication were from the 1998

COMPARABILITY WITH PREVIOUS STATISTICS *continued*

edition of the Australian Standard Research Classification whereas the 1993 edition was used for previous publications.

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; and
- 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 2000 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; and
- 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 applied agreed factors to the reported data.

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 2000). 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 multi-stage 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 Socio-economic ojectives, Research fields, courses and disciplines and Type of R&D activity. The data presented under these classifications therefore reflect a degree of subjectivity.
- The estimation of overhead R&D expenditure was subjective and varied across universities.

UNPUBLISHED STATISTICS

17 Limited additional detailed R&D statistics are available at a charge from the ABS.

RELATED PUBLICATIONS

18 Users may also wish to refer to the following publications:

Australian Standard Research Classification (ASRC), 1998 (Cat. no. 1297.0)

Main Science and Technology Indicators 2001-2, OECD, Paris, 2001

Research and Experimental Development, All Sector Summary, Australia, 1998–99 (Cat. no. 8112.0)

Research and Experimental Development, Business Enterprises, Australia, 1999–2000 (Cat. no. 8104.0)

RELATED PUBLICATIONS *continued*

Research and Experimental Development, General Government and Private Non-profit Organisations, Australia, 1998–99 (Cat. no. 8109.0)

The Measurement of Scientific and Technological Activities ('Frascati Manual' 1993) OECD, Paris, 1994

19 Current publications issued by the ABS are listed in the *Catalogue of Publications and Products* (Cat. no. 1101.0). The ABS also issues, on Tuesdays and Fridays, a *Release Advice* (Cat. no. 1105.0) which lists publications to be released in the next few days. The Catalogue and Release Advice are available from any ABS office.

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 2000). 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.
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 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 fields, courses and disciplines	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.
Socio-economic objective	The area of expected national benefit rather than the immediate objectives of the researcher. The Socio-economic 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.
Type of R&D activity	Comprises basic research, applied research and experimental development.

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