Australian Bureau of Statistics

2003–04

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RESEARCH AND EXPERIMENTAL DEVELOPMENT, BUSINESSES AUSTRALIA

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CONTENTS

INQUIRIES

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100 years of STATISTICS

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NOTES

RESEARCH AND EXPERIMENTAL DEVELOPMENT (R&D) GUIDELINES

The Australian Bureau of Statistics (ABS) Survey of R&D in the business sector is conducted in accordance with standard guidelines promulgated by the Organisation for Economic Co-operation and Development (OECD).

The survey is a complete enumeration of businesses identified by the ABS as likely R&D performers. Businesses mainly engaged in Agriculture, Forestry and Fishing (i.e. Division A of the Australian and New Zealand Standard Industrial Classification (ANZSIC)) are excluded 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 Division A).

DATA QUALITY

When interpreting the results in this publication it is important to take into account factors that may affect the reliability of estimates. These factors are described in the Non-sampling error section in the Technical Note.

Data presented in this publication may subsequently be revised. See the Revisions section of the Technical Note for further detail.

ABBREVIATIONS

$'000	thousand dollars
$m	million dollars
ABS	Australian Bureau of Statistics
ACT	Australian Capital Territory
ANZSIC	Australian and New Zealand Standard Industrial Classification
BERD	business expenditure on R&D
GDP	gross domestic product
GSP	gross state product
n.e.c.	not elsewhere classified
no.	number
NSW	New South Wales
NT	Northern Territory
OECD	Organisation for Economic Co-operation and Development
PYE	person years of effort
Qld	Queensland
R&D	research and experimental development
RFCD	research fields, courses and disciplines
SA	South Australia
SEO	socio-economic objective
Tas.	Tasmania
Vic.	Victoria
WA	Western Australia

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CHAPTER 1 BUSINESS R&D

RESOURCES DEVOTED TO R&D

Business expenditure on R&D (BERD) in Australia in 2003–04 was estimated to be $7,220m at current prices, 10% higher than that recorded in 2002–03. This is the highest level recorded and is the fourth successive year of increase following the declines from 1995–96 to 1998–99 and the levelling off between 1998–99 and 1999–2000.

The change in BERD between 2002–03 and 2003–04 resulted from:

- 3,536 businesses performing R&D in both years, incurring $6,088m of R&D expenditure in 2002–03 and $6,295m in 2003–04, an increase of 3%. Of these continuing R&D performers, 44.4% recorded increases in expenditure of 10% or more, while 35.0% recorded decreases of 10% or more.
- 743 businesses which recorded $484m of R&D expenditure in 2002–03 and did not report R&D activity in 2003–04.
- 1,580 businesses who did not report R&D activity in 2002–03, but recorded $925m of R&D expenditure in 2003–04.

Human resources devoted to R&D in 2003–04 totalled 38,093 person years, 7% higher than in 2002–03.

1.1 RESOURCES DEVOTED TO R&D

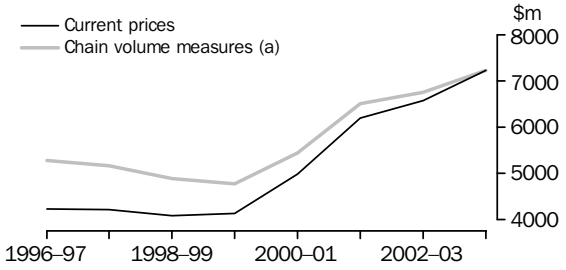
		1996-97	*1997-98*	*1998-99*	*1999-2000*	*2000-01*	*2001-02*	*2002-03*	*2003-04*
Expenditure on R&D									
At current prices	$m	4 235	4 221	4 095	4 137	4 983	r6 192	r6 571	7 220
Chain volume measures(a)	$m	5 276	5 158	4 896	4 776	5 442	r6 508	r6 754	7 220
Human resources devoted to R&D	PYE	26 412	24 769	25 109	26 507	28 391	r32 209	r35 567	38 093

r revised

(a) The reference year for chain volume measures is 2003-04. See paragraph 20 of the Explanatory Notes.

In volume terms, with the effect of changes in prices and wages and salaries removed, R&D expenditure increased by 6.9% from 2002–03 to 2003–04.

EXPENDITURE ON R&D

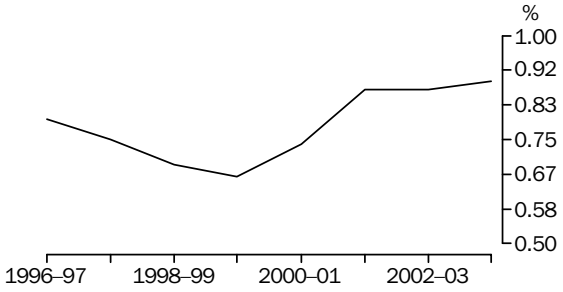


(a) Reference year for chain volume measures is 2003–04. See paragraph 20 of the Explanatory Notes for details.

BERD AS A PERCENTAGE OF GDP

Australia's BERD as a percentage of Gross Domestic Product (GDP) increased to 0.89% in 2003–04, subsequent to a levelling off in 2002–03.

BERD AS A PERCENTAGE OF GDP (a)



(a) At current prices. See paragraph 2 of the Explanatory Notes.

The table below shows Australia's BERD/GDP ratio as compared to all OECD countries for which comparable data is available.

1.2 BERD/GDP RATIOS OF OECD COUNTRIES(a)

	2000-01	*2001-02*	*2002-03*	*2003-04*
	%	%	%	%
Sweden	na	3.31	na	2.95
Finland	2.41	2.42	2.41	2.46
Japan	2.12	2.26	2.32	2.36
Korea	1.77	1.97	1.90	2.01
United States of America	2.04	2.00	1.87	1.79
Denmark	na	1.65	1.75	na
Germany	1.75	1.75	1.75	1.73
Belgium	1.48	1.60	1.63	1.71
Iceland	1.55	1.80	1.77	1.67
France	1.36	1.41	1.43	1.36
United Kingdom	1.21	1.24	1.26	1.24
Canada	1.15	1.27	1.09	1.03
Norway	na	0.96	0.96	1.00
Netherlands	1.11	1.10	1.02	0.99
Australia	**0.74**	r**0.87**	r**0.87**	**0.89**
Ireland	0.82	0.78	0.77	0.80
Czech Republic	0.74	0.74	0.75	0.77
Spain	0.50	0.50	0.56	0.60
Italy	0.53	0.55	0.56	0.55
New Zealand	na	0.42	na	0.47
Slovak Republic	0.43	0.43	0.37	0.32
Hungary	0.35	0.38	0.36	0.35
Portugal	0.22	0.27	0.30	na
Turkey	0.21	0.24	0.19	na
Poland	0.24	0.23	0.12	0.15

na not available
r revised
(a) See paragraph 2 of the Explanatory Notes.

EXPENDITURE ON R&D

The Manufacturing industry was the largest contributor (46%) to total BERD. The Property and business services, Mining and Finance and insurance industries were the next largest contributors to BERD at 23%, 11% and 9% respectively. Commentary focuses on the six largest industry divisions, which together contribute 96% of BERD.

Industry Comparison

The Mining and Manufacturing industries recorded expenditure increases of 28% and 13% respectively. Within Manufacturing, the largest percentage increases (of 47% each) were in Textile, clothing, footwear and leather and Other transport equipment.

Expenditure on R&D increased by 20% in Property and business services, within which, the Scientific research industry group had the largest expenditure increase (28%).

Finance and insurance expenditure on R&D increased by 4%, whereas Wholesale trade and Communication services showed decreases of 15% and 37% respectively.

Type of Expenditure

The largest component of BERD was Other current expenditure (49%). Labour costs and Capital expenditure were 44% and 7% respectively.

Mining reported the lowest level of labour costs as a proportion of BERD at 12%. Property and business services and Wholesale trade both reported the highest proportion of labour costs at 58%.

At 82%, Mining had the highest level of other current expenditure as a proportion of BERD. Wholesale trade and Property and business services were amongst the lowest proportions reported, at 37% and 36% respectively.

Source of Funds

The business sector itself was the main source of R&D funding, with $6,348m (88%) from Own funds and $223m (3%) from Other businesses. The Commonwealth government was the source of $268m (4%) while $284m (4%) was from Overseas organisations.

Finance and insurance provided the majority of its R&D funding, while Property and business services main funding sources were Own funds (74%), Other businesses (9%) and Commonwealth government (8%).

Expenditure by Location

New South Wales and Victorian locations recorded the highest levels of R&D expenditure, at $2,716m (38%) and $2,073m (29%) respectively.

When R&D expenditure by location is expressed as a percentage of Gross State Product (GSP), the states with the highest ratios are South Australia (1.07%), Victoria (1.00%) and New South Wales (0.96%).

1.3 EXPENDITURE ON R&D, by location, GSP ratios

		NSW	*Vic.*	*Qld*	*SA*	*WA*	*Tas.*	*NT*	*ACT*
Expenditure on R&D									
Total(a)	$m	2716.5	2072.5	837.1	576.8	756.5	74.8	46.9	60.9
As a proportion of GSP(b)	%	0.96	1.00	0.59	1.07	0.85	0.52	0.49	0.37

(a) Australian External Territories are excluded.

(b) See paragraph 3 of the Explanatory Notes.

Expenditure by Location continued

Mining reported its highest expenditure in Western Australian (37% or $286m) and Queensland locations (26% or $205m). Manufacturing reported its highest expenditure on R&D in Victorian (38% or $1,253m) and New South Wales locations (31% or$1,037m).

Expenditure by Size of Business

Businesses which employed 1,000 or more people accounted for $2,550m (35%) of total BERD. The Finance and insurance industry reported 93% of its expenditure in this employment size group, whereas only 11% of Property and business services expenditure was in this employment size group.

Businesses which employed less than 10 people accounted for $700m (10%) of total BERD. This employment size group was dominated by Property and business services ($312m), Mining ($148m) and Manufacturing ($125m).

Socio-Economic Objectives (SEO)

Business directed 90% of R&D expenditure into Economic development ($6,352m). Manufacturing was the SEO subdivision with the highest expenditure at $2,929m, followed by Information and communication services at $1,125m.

Research Fields

Engineering and technology and Information, computing and communication sciences were the Research Fields, Courses and Disciplines (RFCD) divisions of the highest R&D expenditure at 54% and 26% respectively. Within these divisions, the fields of highest expenditure were Computer software (11%), Information systems (10%), and Automotive engineering (10%).

HUMAN RESOURCES DEVOTED TO R&D

Manufacturing and Property and business services contributed the highest level of human resources devoted to R&D, at 49% and 30% of total effort respectively.

Industry Comparison

In 2003–04 Mining and Manufacturing both recorded increases in human resources devoted to R&D from 2002–03 of 50% and 5% respectively. Property and business services and Finance and insurance also showed increases of 18% and 13% respectively. Wholesale trade recorded a decrease of 11%.

Human Resources by Size of Business

Businesses which employed 1,000 or more people accounted for 29% of the total human resources devoted to R&D in person years of effort. Whereas, businesses which employed less than 10 employees contributed only 10%.

Type of Employee

Researchers comprised 58% of the total human resources devoted to R&D, followed by Technicians and Other supporting staff with 28% and 14% respectively. In the Mining industry, Researchers accounted for 49% and Technicians 36%.

Within Manufacturing, the proportion of human resources devoted to R&D contributed by Researchers ranged from highs of 64% in Photographic and scientific equipment and 62% in Electronic equipment to a low of 14% in Other transport equipment.

Socio-Economic Objectives

Economic development recorded 33,668 person years of effort on R&D, being 88% of total human resources devoted to R&D. Within Economic development the SEO groups with the highest proportion of total human resources devoted to R&D were Manufacturing (44%) and Information and communication services (20%).

Research Fields

The Engineering and technology and Information, computing and communication sciences RFCD divisions recorded the highest proportion of total R&D effort, contributing 49% and 33% respectively. The RFCD disciplines with the highest proportions of total R&D effort were Computer software (18%), Automotive engineering (10%) and Information systems (9%).

EXPECTED R&D EXPENDITURE

Business expectation of expenditure on R&D for 2004–05 was $7,281m, which is an anticipated growth of 1% in expenditure from 2003–04.

1.4 RESOURCES DEVOTED TO R&D, by industry

	NUMBER OF BUSINESSES			EXPENDITURE ON R&D			HUMAN RESOURCES DEVOTED TO R&D		
	2001-02	*2002-03*	*2003-04*	*2001-02*	*2002-03*	*2003-04*	*2001-02*	*2002-03*	*2003-04*
	no.	no.	no.	$m	$m	$m	PYE	PYE	PYE
Mining	r*120*	r*142*	*168*	r*566*	r*612*	*783*	r*839*	r*653*	*983*
Manufacturing									
Food, Beverage & Tobacco	140	r158	199	231	r237	260	1 434	1 430	1 482
Textile, Clothing, Footwear & Leather	43	45	65	22	28	41	165	195	246
Wood & Paper Product	34	45	50	84	98	126	323	359	317
Printing, Publishing & Recorded Media	r41	r44	45	r18	r17	26	r135	r151	178
Petroleum, Coal, Chemical & Associated Product	352	r379	420	430	r517	584	r2 419	r2 921	2 921
Non-Metallic Mineral Product	52	r71	82	74	r87	97	238	379	356
Metal Product	r177	r175	219	r256	r342	345	r1 027	r1 411	1 189
Machinery & Equipment									
Motor Vehicle & Part	99	113	138	490	631	721	3 062	3 693	3 827
Other Transport Equipment	30	34	53	65	100	147	391	844	876
Photographic & Scientific Equip.	138	r141	184	279	r305	333	1 596	r2 108	2 386
Electronic Equipment	r254	r248	243	r351	r273	270	r2 546	r2 182	2 429
Electrical Equipment & Appliance	112	r132	152	78	r89	119	608	r671	871
Industrial Machinery & Equip.	232	r268	357	r134	r165	201	r1 065	r1 238	1 505
Total	r865	r936	1 127	r1 397	r1 563	1 790	r9 267	r10 735	11 894
Other Manufacturing	r79	76	80	r24	r21	24	r183	r228	191
Total	r*1 783*	r*1 929*	*2 287*	r*2 537*	r*2 908*	*3 294*	r*15 192*	r*17 809*	*18 774*
Electricity, Gas and Water Supply	*38*	r*45*	*42*	*67*	r*64*	*75*	*222*	r*180*	*181*
Construction	r*85*	r*96*	*112*	r*95*	r*147*	*128*	r*275*	r*468*	*369*
Wholesale Trade	r*281*	r*298*	*292*	r*397*	r*342*	*290*	r*2 594*	r*2 352*	*2 095*
Retail Trade	*52*	*64*	*74*	*18*	*22*	*31*	*137*	*182*	*232*
Accommodation, Cafes and Restaurants	np	np	—	np	np	—	np	np	—
Transport and Storage	*23*	r*28*	*26*	*20*	r*36*	*38*	*182*	r*210*	*196*
Communication Services	*33*	r*39*	*51*	*389*	r*394*	*247*	*1 006*	r*1 005*	*573*
Finance and Insurance	r*52*	r*56*	*67*	r*579*	r*603*	*625*	r*1 667*	r*2 438*	*2 764*
Property and Business Services									
Scientific Research	220	r242	300	r329	r361	463	r1 778	r1 702	2 346
Technical Services	263	274	328	r219	r228	276	r1 538	r1 670	1 883
Computer Services	r630	r794	1 018	r696	r632	730	r5 410	r5 571	6 226
Property & Business Services n.e.c.	161	r188	249	r192	r154	181	r930	r877	1 109
Total	r*1 274*	r*1 498*	*1 895*	r*1 436*	r*1 375*	*1 650*	r*9 656*	r*9 819*	*11 563*
Education	np	np	*13*	np	np	*4*	np	np	*46*
Health and Community Services	*38*	r*46*	*52*	*17*	r*21*	*20*	*146*	r*140*	*151*
Cultural and Recreational Services	*18*	r*17*	*19*	*52*	r*24*	*21*	*165*	r*150*	*122*
Personal and Other Services	*12*	*12*	*18*	*17*	*18*	*15*	*111*	*109*	*43*
Total	r**3 816**	r**4 279**	**5 116**	r**6 192**	r**6 571**	**7 220**	r**32 209**	r**35 567**	**38 093**

— nil or rounded to zero (including null cells)
np not available for publication but included in totals where applicable, unless otherwise indicated
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1.5 RESOURCES DEVOTED TO R&D, by industry—annual percentage change

	NUMBER OF BUSINESSES		EXPENDITURE ON R&D		HUMAN RESOURCES DEVOTED TO R&D	
	2002-03	*2003-04*	*2002-03*	*2003-04*	*2002-03*	*2003-04*
	%	%	%	%	%	%
Mining	r*18*	*18*	r*8*	*28*	r*–22*	*50*
Manufacturing						
Food, Beverage & Tobacco	r13	26	r2	10	—	4
Textile, Clothing, Footwear & Leather	5	44	24	47	18	26
Wood & Paper Product	32	11	16	29	11	–12
Printing, Publishing & Recorded Media	r7	2	r–9	59	r11	18
Petroleum, Coal, Chemical & Associated Product	r8	11	r20	13	r21	—
Non-Metallic Mineral Product	r37	15	r17	11	59	–6
Metal Product	r–1	25	r34	1	r37	–16
Machinery & Equipment						
Motor Vehicle & Part	14	22	29	14	21	4
Other Transport Equipment	13	56	54	47	116	4
Photographic & Scientific Equip.	r2	30	r9	9	r32	13
Electronic Equipment	r–2	–2	r–22	–1	r–14	11
Electrical Equipment & Appliance	r18	15	r15	34	r10	30
Industrial Machinery & Equip.	r16	33	r23	22	r16	22
Total	r8	20	r12	15	r16	11
Other Manufacturing	–4	5	r–11	14	r24	–16
Total	r*8*	*19*	r*15*	*13*	r*17*	*5*
Electricity, Gas and Water Supply	r*18*	*–7*	r*–5*	*18*	r*–19*	*1*
Construction	r*13*	*17*	r*55*	*–13*	r*70*	*–21*
Wholesale Trade	r*6*	*–2*	r*–14*	*–15*	r*–9*	*–11*
Retail Trade	*23*	*16*	*25*	*39*	*32*	*28*
Accommodation, Cafes and Restaurants	np	—	np	—	np	—
Transport and Storage	r*22*	*–7*	r*78*	*8*	r*16*	*–7*
Communication Services	r*18*	*31*	r*1*	*–37*	—	*–43*
Finance and Insurance	r*8*	*20*	r*4*	*4*	r*46*	*13*
Property and Business Services						
Scientific Research	r10	24	r10	28	r–4	38
Technical Services	4	20	r4	21	r9	13
Computer Services	r26	28	r–9	15	r3	12
Property & Business Services n.e.c.	r17	32	r–20	18	r–6	26
Total	r*18*	*27*	r*–4*	*20*	r*2*	*18*
Education	np	*63*	np	*–19*	np	*–13*
Health and Community Services	r*21*	*13*	r*23*	*–5*	r*–5*	*8*
Cultural and Recreational Services	r–6	*12*	r*–54*	*–12*	r*–9*	*–18*
Personal and Other Services	—	*50*	*6*	*–21*	*–1*	*–61*
Total	r**12**	**20**	r**6**	**10**	r**10**	**7**

— nil or rounded to zero (including null cells)
np not available for publication but included in totals where applicable, unless otherwise indicated
r revised

1.6 EXPENDITURE ON R&D, by industry—by type of expenditure

	Capital expenditure	*Labour costs*	*Other current expenditure*	*Total*
	$'000	$'000	$'000	$'000
Mining	*49 105*	*92 100*	*641 338*	*782 543*
Manufacturing				
Food, Beverage & Tobacco	30 795	116 674	112 645	260 114
Textile, Clothing, Footwear & Leather	6 985	15 781	18 114	40 880
Wood & Paper Product	4 670	33 760	88 004	126 434
Printing, Publishing & Recorded Media	np	12 280	np	26 377
Petroleum, Coal, Chemical & Associated Product	40 188	239 700	304 307	584 195
Non-Metallic Mineral Product	11 907	28 830	56 030	96 767
Metal Product	22 102	92 346	230 721	345 170
Machinery & Equipment				
Motor Vehicle & Part	67 781	308 266	344 828	720 875
Other Transport Equipment	8 602	60 561	78 047	147 211
Photographic & Scientific Equip.	20 719	177 800	133 984	332 502
Electronic Equipment	13 483	171 406	84 783	269 673
Electrical Equipment & Appliance	5 053	54 499	59 659	119 211
Industrial Machinery & Equip.	11 975	96 776	92 134	200 885
Total	127 613	869 308	793 437	1 790 357
Other Manufacturing	np	12 627	np	23 835
Total	*250 817*	*1 421 307*	*1 622 005*	*3 294 129*
Electricity, Gas and Water Supply	*34 325*	*13 905*	*26 960*	*75 190*
Construction	*5 299*	*32 949*	*90 160*	*128 408*
Wholesale Trade	*14 366*	*167 640*	*108 392*	*290 398*
Retail Trade	*3 491*	*15 270*	*11 922*	*30 683*
Accommodation, Cafes and Restaurants	—	—	—	—
Transport and Storage	*1 427*	*20 496*	*16 514*	*38 437*
Communication Services	np	np	*179 459*	*246 551*
Finance and Insurance	*13 676*	*357 932*	*252 950*	*624 558*
Property and Business Services				
Scientific Research	32 532	203 796	226 950	463 278
Technical Services	19 229	148 869	108 115	276 212
Computer Services	30 627	508 361	190 750	729 738
Property & Business Services n.e.c.	14 665	93 049	72 966	180 680
Total	*97 053*	*954 075*	*598 780*	*1 649 908*
Education	*60*	*2 809*	*881*	*3 749*
Health and Community Services	*1 775*	*10 956*	*7 183*	*19 914*
Cultural and Recreational Services	np	np	*6 406*	*21 145*
Personal and Other Services	np	np	*8 739*	*14 586*
Total	**491 339**	**3 157 171**	**3 571 688**	**7 220 199**

— nil or rounded to zero (including null cells)

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

1.7 EXPENDITURE ON R&D, by industry—by type of expenditure: **proportions**(a)

	Capital expenditure	*Labour costs*	*Other current expenditure*	*Total*(b)
	%	%	%	%
Mining	*6*	*12*	*82*	*11*
Manufacturing				
Food, Beverage & Tobacco	12	45	43	4
Textile, Clothing, Footwear & Leather	17	39	44	1
Wood & Paper Product	4	27	70	2
Printing, Publishing & Recorded Media	np	47	np	—
Petroleum, Coal, Chemical & Associated Product	7	41	52	8
Non-Metallic Mineral Product	12	30	58	1
Metal Product	6	27	67	5
Machinery & Equipment				
Motor Vehicle & Part	9	43	48	10
Other Transport Equipment	6	41	53	2
Photographic & Scientific Equip.	6	53	40	5
Electronic Equipment	5	64	31	4
Electrical Equipment & Appliance	4	46	50	2
Industrial Machinery & Equip.	6	48	46	3
Total	7	49	44	25
Other Manufacturing	np	53	np	—
Total	*8*	*43*	*49*	*46*
Electricity, Gas and Water Supply	*46*	*18*	*36*	*1*
Construction	*4*	*26*	*70*	*2*
Wholesale Trade	*5*	*58*	*37*	*4*
Retail Trade	*11*	*50*	*39*	—
Accommodation, Cafes and Restaurants	—	—	—	—
Transport and Storage	*4*	*53*	*43*	*1*
Communication Services	np	np	*73*	*3*
Finance and Insurance	*2*	*57*	*41*	*9*
Property and Business Services				
Scientific Research	7	44	49	6
Technical Services	7	54	39	4
Computer Services	4	70	26	10
Property & Business Services n.e.c.	8	51	40	3
Total	*6*	*58*	*36*	*23*
Education	*2*	*75*	*23*	—
Health and Community Services	*9*	*55*	*36*	—
Cultural and Recreational Services	np	np	*30*	—
Personal and Other Services	np	np	*60*	—
Total	**7**	**44**	**49**	**100**

— nil or rounded to zero (including null cells)

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

(a) Component proportions are of the industry level total.

(b) Proportion of Total BERD.

1.8 EXPENDITURE ON R&D, by industry—by source of funds

	Own funds	*Other businesses*	*Commonwealth government*	*State and local government*	*Other Australian*(a)	*Overseas*
	$'000	$'000	$'000	$'000	$'000	$'000
Mining	*720 367*	np	*3 425*	—	np	*7 247*
Manufacturing						
Food, Beverage & Tobacco	248 379	np	4 151	363	np	np
Textile, Clothing, Footwear & Leather	31 918	np	7 666	np	np	—
Wood & Paper Product	124 944	—	np	np	—	np
Printing, Publishing & Recorded Media	np	—	np	—	—	—
Petroleum, Coal, Chemical & Associated Product	507 700	1 875	19 891	np	np	54 322
Non-Metallic Mineral Product	91 627	np	624	np	—	—
Metal Product	342 600	285	2 039	np	np	—
Machinery & Equipment						
Motor Vehicle & Part	689 270	1 098	20 540	40	np	np
Other Transport Equipment	131 850	np	1 713	7	np	np
Photographic & Scientific Equip.	242 072	np	37 911	1 406	3 738	np
Electronic Equipment	249 656	2 722	10 417	np	np	3 803
Electrical Equipment & Appliance	116 653	1 099	1 344	np	np	—
Industrial Machinery & Equip.	186 095	5 238	9 273	np	np	—
Total	1 615 595	11 684	81 199	2 190	6 840	72 849
Other Manufacturing	np	np	1 444	np	np	—
Total	*3 010 325*	*20 011*	*117 642*	*5 298*	*10 178*	*130 674*
Electricity, Gas and Water Supply	*64 534*	np	*3 562*	np	*557*	np
Construction	*123 001*	np	*1 647*	np	—	*3 702*
Wholesale Trade	*257 529*	*2 027*	*5 212*	*2 465*	*133*	*23 033*
Retail Trade	*27 869*	*1 587*	*1 070*	np	np	—
Accommodation, Cafes and Restaurants	—	—	—	—	—	—
Transport and Storage	*37 863*	np	np	np	np	—
Communication Services	*197 775*	np	*587*	np	np	np
Finance and Insurance	*624 188*	np	np	—	—	—
Property and Business Services						
Scientific Research	289 117	37 571	71 978	10 476	44 154	9 982
Technical Services	178 428	79 410	11 799	np	2 620	np
Computer Services	630 458	25 478	44 834	2 326	4 358	22 283
Property & Business Services n.e.c.	129 751	3 688	3 657	np	6 915	np
Total	*1 227 754*	*146 146*	*132 268*	*14 440*	*58 047*	*71 252*
Education	np	—	np	—	—	—
Health and Community Services	*17 940*	*405*	*1 476*	np	np	—
Cultural and Recreational Services	*20 610*	—	np	—	np	—
Personal and Other Services	np	np	*75*	—	—	—
Total	**6 347 726**	**223 388**	**268 236**	**27 769**	**69 440**	**283 640**

— nil or rounded to zero (including null cells)

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

(a) Includes Higher Education and Private Non-Profit organisations.

1.9 EXPENDITURE ON R&D, by industry—by source of funds: **proportions**(a)

	Own funds	*Other businesses*	*Commonwealth government*	*State and local government*	*Other Australian*(b)	*Overseas*
	%	%	%	%	%	%
Mining	*92*	np	—	—	np	*1*
Manufacturing						
Food, Beverage & Tobacco	95	np	2	—	np	np
Textile, Clothing, Footwear & Leather	78	np	19	np	np	—
Wood & Paper Product	99	—	np	np	—	np
Printing, Publishing & Recorded Media	np	—	np	—	—	—
Petroleum, Coal, Chemical & Associated Product	87	—	3	np	np	9
Non-Metallic Mineral Product	95	np	1	np	—	—
Metal Product	99	—	1	np	np	—
Machinery & Equipment						
Motor Vehicle & Part	96	—	3	—	np	np
Other Transport Equipment	90	np	1	—	np	np
Photographic & Scientific Equip.	73	np	11	—	1	np
Electronic Equipment	93	1	4	np	np	1
Electrical Equipment & Appliance	98	1	1	np	np	—
Industrial Machinery & Equip.	93	3	5	np	np	—
Total	90	1	5	—	—	4
Other Manufacturing	np	np	6	np	np	—
Total	*91*	*1*	*4*	—	—	*4*
Electricity, Gas and Water Supply	*86*	np	*5*	np	*1*	np
Construction	*96*	np	*1*	np	—	*3*
Wholesale Trade	*89*	*1*	*2*	*1*	—	*8*
Retail Trade	*91*	*5*	*3*	np	np	—
Accommodation, Cafes and Restaurants	—	—	—	—	—	—
Transport and Storage	*99*	np	np	np	np	—
Communication Services	*80*	np	—	np	np	np
Finance and Insurance	*100*	np	np	—	—	—
Property and Business Services						
Scientific Research	62	8	16	2	10	2
Technical Services	65	29	4	np	1	np
Computer Services	86	3	6	—	1	3
Property & Business Services n.e.c.	72	2	2	np	4	np
Total	*74*	*9*	*8*	*1*	*4*	*4*
Education	np	—	np	—	—	—
Health and Community Services	*90*	*2*	*7*	np	np	—
Cultural and Recreational Services	*97*	—	np	—	np	—
Personal and Other Services	np	np	*1*	—	—	—
Total	**88**	**3**	**4**	—	**1**	**4**

— nil or rounded to zero (including null cells)

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

(a) Component proportions are of the industry level total.

(b) Includes Higher Education and Private Non-Profit organisations.

1.10 EXPENDITURE ON R&D, by industry—by location(a)

	NSW	Vic.	Qld	SA	WA	Other States and Territories(b)	Overseas
	$'000	$'000	$'000	$'000	$'000	$'000	$'000
Mining	*148 156*	*56 161*	*205 377*	np	*286 445*	*33 579*	np
Manufacturing							
Food, Beverage & Tobacco	85 002	90 500	34 018	22 202	13 381	14 117	894
Textile, Clothing, Footwear & Leather	7 165	24 157	np	2 514	3 553	np	np
Wood & Paper Product	14 259	73 901	np	np	np	np	339
Printing, Publishing & Recorded Media	18 670	2 470	3 324	np	1 134	np	np
Petroleum, Coal, Chemical & Associated Product	218 553	190 419	57 948	41 627	57 935	10 985	6 728
Non-Metallic Mineral Product	57 761	15 934	7 995	2 905	8 735	np	np
Metal Product	144 948	84 419	38 621	19 818	52 298	4 864	202
Machinery & Equipment							
Motor Vehicle & Part	30 028	555 095	12 363	100 001	np	381	np
Other Transport Equipment	44 587	11 182	23 344	np	np	np	np
Photographic & Scientific Equip.	140 629	75 519	15 539	73 517	19 167	np	np
Electronic Equipment	138 612	52 220	26 935	17 591	29 385	3 868	1 062
Electrical Equipment & Appliance	54 551	18 727	17 962	19 832	7 604	np	np
Industrial Machinery & Equip.	73 585	50 314	33 102	np	24 808	6 391	np
Total	481 992	763 057	129 245	230 639	117 623	np	np
Other Manufacturing	8 554	7 830	4 707	724	np	736	np
Total	*1 036 903*	*1 252 688*	*301 162*	*329 444*	*260 396*	*72 737*	*40 798*
Electricity, Gas and Water Supply	*10 138*	*10 867*	*14 663*	np	np	*2 486*	np
Construction	*52 234*	*16 545*	*17 757*	*3 919*	*34 301*	np	np
Wholesale Trade	*116 296*	*84 055*	*22 778*	*43 867*	*15 261*	*5 909*	*2 232*
Retail Trade	*11 135*	*12 678*	*2 257*	*1 715*	*2 660*	*116*	*122*
Accommodation, Cafes and Restaurants	—	—	—	—	—	—	—
Transport and Storage	*13 129*	*10 178*	np	*1 061*	*498*	np	np
Communication Services	*139 213*	*97 748*	*5 033*	np	*2 624*	np	np
Finance and Insurance	*572 679*	*28 799*	np	np	*2 252*	np	np
Property and Business Services							
Scientific Research	145 752	169 756	50 006	31 695	26 448	23 687	15 934
Technical Services	51 180	76 767	57 852	41 504	44 903	2 597	1 410
Computer Services	279 519	193 762	117 232	43 171	56 489	30 943	8 623
Property & Business Services n.e.c.	104 208	48 742	10 555	2 630	7 938	6 420	187
Total	*580 659*	*489 027*	*235 645*	*119 000*	*135 778*	*63 647*	*26 153*
Education	*2 619*	np	*725*	—	—	np	—
Health and Community Services	*9 616*	*5 537*	*1 757*	np	*2 329*	np	np
Cultural and Recreational Services	np	np	*2 179*	np	np	np	np
Personal and Other Services	np	*5 559*	*995*	—	*695*	np	—
Total	**2 716 454**	**2 072 544**	**837 072**	**576 844**	**756 523**	**184 600**	**76 162**

— nil or rounded to zero (including null cells)

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

(a) Location of the R&D expenditure. This may not be the location of the organisation's head office.

(b) Includes Tasmania, Northern Territory, Australian Capital Territory and Australian External Territories.

1.11 EXPENDITURE ON R&D, by industry—by location(a): **proportions**(b)

	NSW	*Vic.*	*Qld*	*SA*	*WA*	*Other States and Territories*(c)	*Overseas*
	%	%	%	%	%	%	%
Mining	*19*	*7*	*26*	np	*37*	*4*	np
Manufacturing							
Food, Beverage & Tobacco	33	35	13	9	5	5	—
Textile, Clothing, Footwear & Leather	18	59	np	6	9	np	np
Wood & Paper Product	11	58	np	np	np	np	—
Printing, Publishing & Recorded Media	71	9	13	np	4	np	np
Petroleum, Coal, Chemical & Associated Product	37	33	10	7	10	2	1
Non-Metallic Mineral Product	60	16	8	3	9	np	np
Metal Product	42	24	11	6	15	1	—
Machinery & Equipment							
Motor Vehicle & Part	4	77	2	14	np	—	np
Other Transport Equipment	30	8	16	np	np	np	np
Photographic & Scientific Equip.	42	23	5	22	6	np	np
Electronic Equipment	51	19	10	7	11	1	—
Electrical Equipment & Appliance	46	16	15	17	6	np	np
Industrial Machinery & Equip.	37	25	16	np	12	3	np
Total	27	43	7	13	7	np	np
Other Manufacturing	36	33	20	3	np	3	np
Total	*31*	*38*	*9*	*10*	*8*	*2*	*1*
Electricity, Gas and Water Supply	*13*	*14*	*20*	np	np	*3*	np
Construction	*41*	*13*	*14*	*3*	*27*	np	np
Wholesale Trade	*40*	*29*	*8*	*15*	*5*	*2*	*1*
Retail Trade	*36*	*41*	*7*	*6*	*9*	—	—
Accommodation, Cafes and Restaurants	—	—	—	—	—	—	—
Transport and Storage	*34*	*26*	np	*3*	*1*	np	np
Communication Services	*56*	*40*	*2*	np	*1*	np	np
Finance and Insurance	*92*	*5*	np	np	—	np	np
Property and Business Services							
Scientific Research	31	37	11	7	6	5	3
Technical Services	19	28	21	15	16	1	1
Computer Services	38	27	16	6	8	4	1
Property & Business Services n.e.c.	58	27	6	1	4	4	—
Total	*35*	*30*	*14*	*7*	*8*	*4*	*2*
Education	*70*	np	*19*	—	—	np	—
Health and Community Services	*48*	*28*	*9*	np	*12*	np	np
Cultural and Recreational Services	np	np	*10*	np	np	np	np
Personal and Other Services	np	*38*	*7*	—	*5*	np	—
Total	**38**	**29**	**12**	**8**	**10**	**3**	**1**

— nil or rounded to zero (including null cells)

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

(a) Location of the R&D expenditure. This may not be the location of the organisation's head office.

(b) Component proportions are of the industry level total.

(c) Includes Tasmania, Northern Territory, Australian Capital Territory and Australian External Territories.

1.12 EXPENDITURE ON R&D, by industry—by employment size

	EMPLOYMENT SIZE							
	Less than 10 persons	*10-19 persons*	*20-49 persons*	*50-99 persons*	*100-199 persons*	*200-499 persons*	*500-999 persons*	*1000 or more persons*
	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000
Mining	*148 442*	*18 795*	*41 627*	*15 592*	*100 969*	*144 157*	*110 122*	*202 839*
Manufacturing								
Food, Beverage & Tobacco	6 398	3 829	13 793	18 928	19 204	45 438	34 789	117 735
Textile, Clothing, Footwear & Leather	1 799	np	4 953	6 377	9 748	11 589	np	—
Wood & Paper Product	2 781	np	993	np	np	3 602	np	112 384
Printing, Publishing & Recorded Media	1 518	4 211	7 365	4 148	np	6 327	np	—
Petroleum, Coal, Chemical & Associated Product	20 829	22 657	34 010	41 087	47 977	121 083	223 397	73 155
Non-Metallic Mineral Product	5 174	10 597	5 236	4 541	4 162	8 425	47 209	11 423
Metal Product	6 821	18 063	12 514	17 058	24 354	38 711	45 572	182 077
Machinery & Equipment								
Motor Vehicle & Part	3 031	10 329	8 755	7 584	18 539	38 957	108 883	524 797
Other Transport Equipment	6 201	816	2 614	np	np	30 158	np	97 205
Photographic & Scientific Equip.	16 835	23 554	41 706	31 441	22 167	53 873	np	np
Electronic Equipment	17 361	25 585	37 380	36 192	18 047	30 525	np	np
Electrical Equipment & Appliance	5 363	8 602	11 331	8 080	np	18 826	20 797	np
Industrial Machinery & Equip.	27 361	21 629	54 694	np	32 087	31 524	np	—
Total	76 152	90 515	156 480	111 012	100 407	203 863	240 670	811 258
Other Manufacturing	4 010	4 175	5 991	np	np	5 363	—	—
Total	*125 482*	*157 611*	*241 335*	*207 334*	*209 334*	*444 401*	*600 600*	*1 308 032*
Electricity, Gas and Water Supply	*2 638*	np	*19 157*	—	np	*29 082*	*2 628*	*16 794*
Construction	*7 239*	*10 371*	*7 089*	*4 861*	np	*11 077*	np	*78 733*
Wholesale Trade	*20 584*	*16 481*	*30 514*	*19 073*	*22 117*	*86 249*	*79 120*	*16 260*
Retail Trade	*6 195*	*5 118*	*8 179*	np	np	np	—	*6 439*
Accommodation, Cafes and Restaurants	—	—	—	—	—	—	—	—
Transport and Storage	*438*	*1 613*	*1 354*	np	np	np	np	*20 158*
Communication Services	np	*4 021*	*55 358*	—	*3 509*	np	—	np
Finance and Insurance	*7 260*	*3 478*	np	*6 216*	*12 249*	np	*11 648*	*578 743*
Property and Business Services								
Scientific Research	114 906	64 681	129 716	89 051	np	np	—	30 055
Technical Services	51 957	26 103	36 524	17 940	40 613	14 865	57 195	31 015
Computer Services	111 187	114 331	136 937	138 647	90 173	np	np	65 617
Property & Business Services n.e.c.	33 929	11 133	23 525	17 036	np	39 895	np	50 104
Total	*311 979*	*216 248*	*326 702*	*262 674*	*161 737*	*118 910*	*74 867*	*176 791*
Education	*1 262*	*1 066*	np	—	np	—	—	—
Health and Community Services	*8 616*	*1 811*	*4 808*	np	np	—	np	np
Cultural and Recreational Services	*1 435*	*413*	*419*	—	np	np	*6 566*	np
Personal and Other Services	np	np	*1 229*	np	—	np	np	np
Total	**700 466**	**438 696**	**739 587**	**521 699**	**531 267**	**844 314**	**893 765**	**2 550 405**

— nil or rounded to zero (including null cells)

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

1.13 EXPENDITURE ON R&D, by industry—by employment size: **proportions**(a)

	EMPLOYMENT SIZE							
	Less than 10 persons	*10-19 persons*	*20-49 persons*	*50-99 persons*	*100-199 persons*	*200-499 persons*	*500-999 persons*	*1000 or more persons*
	%	%	%	%	%	%	%	%
Mining	*19*	*2*	*5*	*2*	*13*	*18*	*14*	*26*
Manufacturing								
Food, Beverage & Tobacco	2	1	5	7	7	17	13	45
Textile, Clothing, Footwear & Leather	4	np	12	16	24	28	np	—
Wood & Paper Product	2	np	1	np	np	3	np	89
Printing, Publishing & Recorded Media	6	16	28	16	np	24	np	—
Petroleum, Coal, Chemical & Associated Product	4	4	6	7	8	21	38	13
Non-Metallic Mineral Product	5	11	5	5	4	9	49	12
Metal Product	2	5	4	5	7	11	13	53
Machinery & Equipment								
Motor Vehicle & Part	—	1	1	1	3	5	15	73
Other Transport Equipment	4	1	2	np	np	20	np	66
Photographic & Scientific Equip.	5	7	13	9	7	16	np	np
Electronic Equipment	6	9	14	13	7	11	np	np
Electrical Equipment & Appliance	4	7	10	7	np	16	17	np
Industrial Machinery & Equip.	14	11	27	np	16	16	np	—
Total	4	5	9	6	6	11	13	45
Other Manufacturing	17	18	25	np	np	23	—	—
Total	*4*	*5*	*7*	*6*	*6*	*13*	*18*	*40*
Electricity, Gas and Water Supply	*4*	np	*25*	—	np	*39*	*3*	*22*
Construction	*6*	*8*	*6*	*4*	np	*9*	np	*61*
Wholesale Trade	*7*	*6*	*11*	*7*	*8*	*30*	*27*	*6*
Retail Trade	*20*	*17*	*27*	np	np	np	—	*21*
Accommodation, Cafes and Restaurants	—	—	—	—	—	—	—	—
Transport and Storage	*1*	*4*	*4*	np	np	np	np	*52*
Communication Services	np	*2*	*22*	—	*1*	np	—	np
Finance and Insurance	*1*	*1*	np	*1*	*2*	np	*2*	*93*
Property and Business Services								
Scientific Research	25	14	28	19	np	np	—	6
Technical Services	19	9	13	6	15	5	21	11
Computer Services	15	16	19	19	12	np	np	9
Property & Business Services n.e.c.	19	6	13	9	np	22	np	28
Total	*19*	*13*	*20*	*16*	*10*	*7*	*5*	*11*
Education	*34*	*28*	np	—	np	—	—	—
Health and Community Services	*43*	*9*	*24*	np	np	—	np	np
Cultural and Recreational Services	*7*	*2*	*2*	—	np	np	*31*	np
Personal and Other Services	np	np	*8*	np	—	np	np	np
Total	**10**	**6**	**10**	**7**	**7**	**12**	**12**	**35**

— nil or rounded to zero (including null cells)

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

(a) Component proportions are of the industry level total.

1.14 HUMAN RESOURCES DEVOTED TO R&D, by industry—by employment size

EMPLOYMENT SIZE

	Less than 10 persons	*10-19 persons*	*20-49 persons*	*50-99 persons*	*100-199 persons*	*200-499 persons*	*500-999 persons*	*1000 or more persons*	*Total*
	PYE	PYE	PYE	PYE	PYE	PYE	PYE	PYE	PYE
Mining	*78*	*24*	*82*	*28*	*118*	*230*	*92*	*331*	*983*
Manufacturing									
Food, Beverage & Tobacco	23	25	60	89	108	260	154	763	1 482
Textile, Clothing, Footwear & Leather	9	13	53	26	np	82	np	—	246
Wood & Paper Product	20	6	np	4	2	14	np	240	317
Printing, Publishing & Recorded Media	19	24	77	17	np	27	np	—	178
Petroleum, Coal, Chemical & Associated Product	147	174	225	237	270	454	892	522	2 921
Non-Metallic Mineral Product	35	46	52	22	28	32	117	25	356
Metal Product	36	85	91	111	122	115	182	447	1 189
Machinery & Equipment									
Motor Vehicle & Part	26	70	122	78	157	247	779	2 349	3 827
Other Transport Equipment	34	7	22	8	np	163	np	604	876
Photographic & Scientific Equip.	124	119	320	241	165	376	np	np	2 386
Electronic Equipment	140	236	370	414	169	262	np	np	2 429
Electrical Equipment & Appliance	47	87	101	61	70	150	72	285	871
Industrial Machinery & Equip.	149	192	405	210	np	228	np	—	1 505
Total	519	710	1 340	1 013	822	1 426	1 489	4 575	11 894
Other Manufacturing	44	34	np	26	np	38	—	—	191
Total	*851*	*1 116*	*1 947*	*1 544*	*1 413*	*2 448*	*2 882*	*6 572*	*18 774*
Electricity, Gas and Water Supply	*7*	np	*24*	—	np	*46*	*20*	*36*	*181*
Construction	*52*	*40*	*62*	*34*	*32*	*36*	*6*	*108*	*369*
Wholesale Trade	*199*	*109*	*228*	*184*	*188*	*573*	*492*	*124*	*2 095*
Retail Trade	*55*	*43*	*64*	np	np	np	—	np	*232*
Accommodation, Cafes and Restaurants	—	—	—	—	—	—	—	—	—
Transport and Storage	*4*	*8*	*11*	np	np	np	np	*101*	*196*
Communication Services	*38*	*19*	*129*	—	np	np	—	*326*	*573*
Finance and Insurance	*45*	*32*	*11*	*23*	*44*	np	np	*2 514*	*2 764*
Property and Business Services									
Scientific Research	491	363	629	464	256	np	—	np	2 346
Technical Services	304	208	245	108	213	130	487	188	1 883
Computer Services	1 115	1 207	1 265	1 088	623	500	np	np	6 226
Property & Business Services n.e.c.	308	93	171	58	19	np	np	198	1 109
Total	*2 217*	*1 871*	*2 310*	*1 717*	*1 111*	*952*	*626*	*757*	*11 563*
Education	*9*	*15*	np	—	np	—	—	—	*46*
Health and Community Services	*70*	*17*	*38*	np	np	—	np	np	*151*
Cultural and Recreational Services	14	np	np	—	np	np	40	np	122
Personal and Other Services	*4*	*3*	*7*	np	—	np	np	np	*43*
Total	**3 643**	**3 305**	**4 931**	**3 575**	**3 090**	**4 328**	**4 243**	**10 978**	**38 093**

— nil or rounded to zero (including null cells)

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

1.15 HUMAN RESOURCES DEVOTED TO R&D, by industry—by employment size: proportions(a)

	EMPLOYMENT SIZE								
	Less than 10 persons	*10-19 persons*	*20-49 persons*	*50-99 persons*	*100-199 persons*	*200-499 persons*	*500-999 persons*	*1000 or more persons*	*Total*(b)
	%	%	%	%	%	%	%	%	%
Mining	*8*	*2*	*8*	*3*	*12*	*23*	*9*	*34*	*3*
Manufacturing									
Food, Beverage & Tobacco	2	2	4	6	7	18	10	51	4
Textile, Clothing, Footwear & Leather	4	5	21	11	np	33	np	—	1
Wood & Paper Product	6	2	np	1	1	4	np	76	1
Printing, Publishing & Recorded Media	10	14	43	10	np	15	np	—	—
Petroleum, Coal, Chemical & Associated Product	5	6	8	8	9	16	31	18	8
Non-Metallic Mineral Product	10	13	15	6	8	9	33	7	1
Metal Product	3	7	8	9	10	10	15	38	3
Machinery & Equipment									
Motor Vehicle & Part	1	2	3	2	4	6	20	61	10
Other Transport Equipment	4	1	3	1	np	19	np	69	2
Photographic & Scientific Equip.	5	5	13	10	7	16	np	np	6
Electronic Equipment	6	10	15	17	7	11	np	np	6
Electrical Equipment & Appliance	5	10	12	7	8	17	8	33	2
Industrial Machinery & Equip.	10	13	27	14	np	15	np	—	4
Total	4	6	11	9	7	12	13	38	31
Other Manufacturing	23	18	np	13	np	20	—	—	1
Total	*5*	*6*	*10*	*8*	*8*	*13*	*15*	*35*	*49*
Electricity, Gas and Water Supply	*4*	np	*13*	—	np	*25*	*11*	*20*	—
Construction	*14*	*11*	*17*	*9*	*9*	*10*	*2*	*29*	*1*
Wholesale Trade	*9*	*5*	*11*	*9*	*9*	*27*	*23*	*6*	*6*
Retail Trade	*24*	*19*	*27*	np	np	np	—	np	*1*
Accommodation, Cafes and Restaurants	—	—	—	—	—	—	—	—	—
Transport and Storage	*2*	*4*	*5*	np	np	np	np	*52*	*1*
Communication Services	*7*	*3*	*23*	—	np	np	—	*57*	*2*
Finance and Insurance	*2*	*1*	—	*1*	*2*	np	np	*91*	*7*
Property and Business Services									
Scientific Research	21	15	27	20	11	np	—	np	6
Technical Services	16	11	13	6	11	7	26	10	5
Computer Services	18	19	20	17	10	8	np	np	16
Property & Business Services n.e.c.	28	8	15	5	2	np	np	18	3
Total	*19*	*16*	*20*	*15*	*10*	*8*	*5*	*7*	*30*
Education	*19*	*33*	np	—	np	—	—	—	—
Health and Community Services	*46*	*12*	*25*	np	np	—	np	np	—
Cultural and Recreational Services	*12*	np	np	—	np	np	*33*	np	—
Personal and Other Services	*10*	*8*	*17*	np	—	np	np	np	—
Total	**10**	**9**	**13**	**9**	**8**	**11**	**11**	**29**	**100**

— nil or rounded to zero (including null cells)

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

(a) Component proportions are of the industry level total.

(b) Proportion of Total Human resources devoted to R&D.

1.16 HUMAN RESOURCES DEVOTED TO R&D, by industry—by type of employee

	Researchers	*Technicians*	*Other supporting staff*
	PYE	PYE	PYE
Mining	*479*	*349*	*155*
Manufacturing			
Food, Beverage & Tobacco	713	520	249
Textile, Clothing, Footwear & Leather	102	75	70
Wood & Paper Product	164	82	72
Printing, Publishing & Recorded Media	99	43	36
Petroleum, Coal, Chemical & Associated Product	1 700	812	409
Non-Metallic Mineral Product	151	96	109
Metal Product	627	378	184
Machinery & Equipment			
Motor Vehicle & Part	2 168	1 083	577
Other Transport Equipment	124	422	330
Photographic & Scientific Equip.	1 538	555	293
Electronic Equipment	1 496	705	228
Electrical Equipment & Appliance	463	305	103
Industrial Machinery & Equip.	707	490	308
Total	6 495	3 559	1 839
Other Manufacturing	96	47	48
Total	*10 145*	*5 612*	*3 017*
Electricity, Gas and Water Supply	*121*	*39*	*22*
Construction	*198*	*106*	*65*
Wholesale Trade	*1 353*	*503*	*239*
Retail Trade	*143*	*45*	*45*
Accommodation, Cafes and Restaurants	—	—	—
Transport and Storage	*107*	*63*	*26*
Communication Services	*392*	*128*	*53*
Finance and Insurance	*1 736*	*688*	*340*
Property and Business Services			
Scientific Research	1 380	664	301
Technical Services	1 163	466	254
Computer Services	4 096	1 659	471
Property & Business Services n.e.c.	633	222	254
Total	*7 272*	*3 010*	*1 280*
Education	*29*	*13*	*4*
Health and Community Services	*83*	*47*	*22*
Cultural and Recreational Services	*65*	*34*	*23*
Personal and Other Services	*28*	*8*	*7*
Total	**22 152**	**10 644**	**5 297**

— nil or rounded to zero (including null cells)

1.17 HUMAN RESOURCES DEVOTED TO R&D, by industry—by type of employee: **proportions**(a)

	Researchers	*Technicians*	*Other Supporting Staff*
	%	%	%
Mining	*49*	*36*	*16*
Manufacturing			
Food, Beverage & Tobacco	48	35	17
Textile, Clothing, Footwear & Leather	41	30	28
Wood & Paper Product	52	26	23
Printing, Publishing & Recorded Media	55	24	20
Petroleum, Coal, Chemical & Associated Product	58	28	14
Non-Metallic Mineral Product	42	27	31
Metal Product	53	32	16
Machinery & Equipment			
Motor Vehicle & Part	57	28	15
Other Transport Equipment	14	48	38
Photographic & Scientific Equip.	64	23	12
Electronic Equipment	62	29	9
Electrical Equipment & Appliance	53	35	12
Industrial Machinery & Equip.	47	33	20
Total	55	30	15
Other Manufacturing	50	25	25
Total	*54*	*30*	*16*
Electricity, Gas and Water Supply	*67*	*21*	*12*
Construction	*54*	*29*	*18*
Wholesale Trade	*65*	*24*	*11*
Retail Trade	*61*	*19*	*19*
Accommodation, Cafes and Restaurants	—	—	—
Transport and Storage	*54*	*32*	*13*
Communication Services	*68*	*22*	*9*
Finance and Insurance	*63*	*25*	*12*
Property and Business Services			
Scientific Research	59	28	13
Technical Services	62	25	13
Computer Services	66	27	8
Property & Business Services n.e.c.	57	20	23
Total	*63*	*26*	*11*
Education	*63*	*29*	*8*
Health and Community Services	*55*	*31*	*14*
Cultural and Recreational Services	*53*	*28*	*19*
Personal and Other Services	*66*	*18*	*16*
Total	**58**	**28**	**14**

— nil or rounded to zero (including null cells)

(a) Component proportions are of the industry level total.

1.18 RESOURCES DEVOTED TO R&D, by socio-economic objective—by type of resource

	EXPENDITURE ON R&D				
	Capital expenditure	*Labour costs*	*Other current expenditure*	*Total*	*Human Resources Devoted to R&D*
	$'000	$'000	$'000	$'000	PYE
DEFENCE	*4 771*	*104 038*	*68 573*	*177 382*	*1 422*
ECONOMIC DEVELOPMENT					
Plant Prod. & Plant Primary Products	10 048	42 531	47 319	99 899	627
Animal Prod. & Animal Primary Products	8 195	22 573	37 498	68 265	311
Mineral Resources (excl. Energy)					
Primary Mining & Extraction Proc.	25 161	56 053	288 468	369 683	617
First Stage Treatment of Ores & Minerals	10 228	28 115	158 543	196 886	356
Mineral Resources (excl. Energy) n.e.c.	2 179	18 055	64 303	84 537	216
Total	37 568	102 223	511 314	651 106	1 189
Energy Resources	23 337	53 904	190 871	268 112	573
Energy Supply	40 727	49 549	80 523	170 798	666
Manufacturing					
Processed Food Products & Beverages	23 125	120 931	104 404	248 461	1 559
Wood, Wood Products & Paper	7 751	32 119	71 527	111 397	362
Human Pharmaceutical Products	12 512	127 142	150 081	289 735	1 424
Industrial Chemicals & Related Products	18 664	74 049	131 483	224 195	1 014
Basic Metal Products (incl. Smelting)	3 877	35 646	87 644	127 167	358
Fabricated Metal Products	14 158	73 717	88 458	176 333	1 006
Transport Equipment	61 604	333 007	390 174	784 785	4 129
Computer Hardware & Electronic Equip.	9 099	117 504	81 033	207 636	1 751
Communication Equipment	2 843	66 490	44 758	114 091	893
Instrumentation	2 420	44 201	21 766	68 387	566
Machinery & Equipment	22 005	106 135	101 144	229 285	1 712
Other Manufactured Products	11 103	87 103	70 275	168 481	1 114
Manufacturing n.e.c.	18 946	62 034	98 548	179 529	825
Total	208 108	1 280 078	1 441 296	2 929 481	16 712
Construction	17 254	85 346	165 046	267 646	1 007
Transport	16 477	56 226	55 041	127 744	800
Information & Comm. Services					
Computer Software & Services	29 521	466 496	184 250	680 268	5 536
Communication Services	21 327	159 682	224 897	405 906	1 879
Information & Comm. Services n.e.c.	2 590	21 918	14 251	38 759	273
Total	53 439	648 096	423 398	1 124 933	7 689
Commercial Services & Tourism					
Finance, Property & Business Serv.	16 639	389 766	269 066	675 471	3 114
Other Commercial Services	4 121	42 790	21 268	68 179	450
Commercial Services & Tourism n.e.c.	5 148	27 271	33 326	65 744	387
Total	25 908	459 826	323 660	809 395	3 950
Economic Framework	642	9 762	4 622	15 026	143
Total	*441 703*	*2 810 115*	*3 280 587*	*6 532 405*	*33 668*
SOCIETY					
Health	34 393	184 147	171 987	390 527	2 087
Education & Training	885	10 102	5 513	16 500	187
Social Development & Community Serv.	2 263	19 775	10 079	32 117	296
Total	*37 541*	*214 024*	*187 579*	*439 144*	*2 570*
ENVIRONMENT					
Environ. Policy Frameworks & Other Aspects	996	9 091	8 531	18 618	111
Environmental Management	6 126	18 373	25 432	49 931	298
Total	*7 122*	*27 464*	*33 963*	*68 548*	*409*
NON-ORIENTED RESEARCH	*202*	*1 531*	*987*	*2 720*	*24*
Total	**491 339**	**3 157 171**	**3 571 688**	**7 220 199**	**38 093**

1.19 RESOURCES DEVOTED TO R&D, by socio-economic objective—by type of resource: **proportions**(a)

	EXPENDITURE ON R&D				
	Capital expenditure	*Labour costs*	*Other current expenditure*	*Total*(c)	*Human resources devoted to R&D*(b)
	%	%	%	%	%
DEFENCE	*3*	*59*	*39*	*2*	*4*
ECONOMIC DEVELOPMENT					
Plant Prod. & Plant Primary Products	10	43	47	1	2
Animal Prod. & Animal Primary Products	12	33	55	1	1
Mineral Resources (excl. Energy)					
Primary Mining & Extraction Proc.	7	15	78	5	2
First Stage Treatment of Ores & Minerals	5	14	81	3	1
Mineral Resources (excl. Energy) n.e.c.	3	21	76	1	1
Total	6	16	79	9	3
Energy Resources	9	20	71	4	2
Energy Supply	24	29	47	2	2
Manufacturing					
Processed Food Products and Beverages	9	49	42	3	4
Wood, Wood Products and Paper	7	29	64	2	1
Human Pharmaceutical Products	4	44	52	4	4
Industrial Chemicals & Related Products	8	33	59	3	3
Basic Metal Products (incl. Smelting)	3	28	69	2	1
Fabricated Metal Products	8	42	50	2	3
Transport Equipment	8	42	50	11	11
Computer Hardware & Electronic Equip.	4	57	39	3	5
Communication Equipment	2	58	39	2	2
Instrumentation	4	65	32	1	1
Machinery & Equipment	10	46	44	3	4
Other Manufactured Products	7	52	42	2	3
Manufacturing n.e.c.	11	35	55	2	2
Total	7	44	49	41	44
Construction	6	32	62	4	3
Transport	13	44	43	2	2
Information and Communication Services					
Computer Software & Services	4	69	27	9	15
Communication Services	5	39	55	6	5
Information & Comm. Services n.e.c.	7	57	37	1	1
Total	5	58	38	16	20
Commercial Services and Tourism					
Finance, Property & Business Serv.	2	58	40	9	8
Other Commercial Services	6	63	31	1	1
Commercial Services & Tourism n.e.c.	8	41	51	1	1
Total	3	57	40	11	10
Economic Framework	4	65	31	—	—
Total	*7*	*43*	*50*	*90*	*88*
SOCIETY					
Health	9	47	44	5	5
Education & Training	5	61	33	—	—
Social Development & Community Serv.	7	62	31	—	1
Total	*9*	*49*	*43*	*6*	*7*
ENVIRONMENT					
Environ. Policy Frameworks & Other Aspects	5	49	46	—	—
Environmental Management	12	37	51	1	1
Total	*10*	*40*	*50*	*1*	*1*
NON-ORIENTED RESEARCH	*7*	*56*	*36*	—	—
Total	**7**	**44**	**49**	**100**	**100**

— nil or rounded to zero (including null cells)

(a) Component proportions are of the socio-economic objective level total.

(b) Proportion of Total Human Resources Devoted to R&D.

(c) Proportion of Total BERD.

1.20 RESOURCES DEVOTED TO R&D, by research field—by type of resource

	EXPENDITURE ON R&D				
	Capital expenditure	*Labour costs*	*Other current expenditure*	*Total*	*Human resources devoted to R&D*
	$'000	$'000	$'000	$'000	PYE
Mathematical Sciences	*556*	*14 723*	*7 320*	*22 599*	*186*
Physical Sciences	*1 939*	*26 615*	*17 941*	*46 495*	*316*
Chemical Sciences	*13 224*	*86 376*	*110 003*	*209 604*	*1 168*
Earth Sciences	*15 110*	*26 795*	*99 966*	*141 870*	*304*
Biological Sciences	*16 086*	*110 406*	*100 124*	*226 616*	*1 276*
Information, Computing & Communication Sciences					
Information Systems	16 884	385 602	304 493	706 979	3 428
Computer Software	45 140	572 164	197 771	815 076	6 863
Other Information, Computing & Comm. Sciences	3 843	109 036	97 569	210 448	1 246
Information, Computing & Comm. Sciences n.e.c.	7 852	101 871	58 222	167 945	1 093
Total	*73 719*	*1 168 672*	*658 056*	*1 900 447*	*12 631*
Engineering & Technology					
Industrial Biotechnology & Food Sciences	8 803	77 715	69 663	156 181	931
Manufacturing Engineering	57 707	227 225	271 740	556 672	3 082
Automotive Engineering	68 896	312 045	366 459	747 399	3 840
Mechanical & Industrial Engineering	15 675	96 597	115 534	227 806	1 436
Resources Engineering	34 743	88 062	451 876	574 681	914
Civil Engineering	5 521	43 508	66 817	115 845	469
Electrical & Electronic Engineering	19 080	147 068	123 238	289 387	2 348
Metallurgy	11 824	43 797	186 375	241 995	469
Materials Engineering	6 809	56 761	87 101	150 671	765
Communications Technologies	20 173	154 702	193 609	368 484	2 039
Other Engineering & Technology	28 312	44 330	50 811	123 453	589
Engineering & Technology n.e.c.	33 494	130 452	202 294	366 240	1 706
Total	*311 036*	*1 422 261*	*2 185 516*	*3 918 813*	*18 588*
Agricultural, Veterinary & Environmental Sciences	*25 818*	*83 606*	*125 847*	*235 270*	*1 184*
Architecture, Urban Environment & Building	*1 946*	*9 576*	*21 551*	*33 073*	*129*
Medical & Health Sciences					
Pharmacology & Pharmaceutical Sciences	5 669	57 889	84 514	148 072	649
Clinical Sciences	2 514	63 292	74 238	140 044	640
Medical & Health Sciences n.e.c.	22 585	71 289	73 064	166 939	816
Total	*30 768*	*192 470*	*231 817*	*455 055*	*2 106*
Education	*96*	*2 273*	*2 693*	*5 061*	*35*
Economics	*104*	*3 214*	*2 231*	*5 550*	*27*
Commerce, Management, Tourism & Services	*803*	*8 139*	*6 890*	*15 832*	*112*
Studies in Human Society	—	*132*	*89*	*221*	*2*
Behavioural & Cognitive Sciences	*22*	*543*	*333*	*899*	*7*
Law, Justice & Law Enforcement	np	*96*	np	*453*	*1*
Journalism, Librarianship & Curatorial Studies	np	np	np	np	np
The Arts	*76*	*1 210*	*926*	*2 212*	*19*
Language & Culture	np	np	np	np	np
History & Archaeology	np	np	np	np	np
Total	**491 339**	**3 157 171**	**3 571 688**	**7 220 199**	**38 093**

— nil or rounded to zero (including null cells)

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

1.21 RESOURCES DEVOTED TO R&D, by research field—by type of resource: proportions(a)

	EXPENDITURE ON R&D				
	Capital expenditure	*Labour costs*	*Other current expenditure*	*Total*(c)	*Human Resources Devoted to R&D*(b)
	%	%	%	%	%
Mathematical Sciences	*2*	*65*	*32*	—	—
Physical Sciences	*4*	*57*	*39*	*1*	*1*
Chemical Sciences	*6*	*41*	*52*	*3*	*3*
Earth Sciences	*11*	*19*	*70*	*2*	*1*
Biological Sciences	*7*	*49*	*44*	*3*	*3*
Information, Computing and Communication Sciences					
Information Systems	2	55	43	10	9
Computer Software	6	70	24	11	18
Other Information, Computing and Communication Sciences	2	52	46	3	3
Information, Computing and Communication Sciences n.e.c.	5	61	35	2	3
Total	*4*	*61*	*35*	*26*	*33*
Engineering and Technology					
Industrial Biotechnology and Food Sciences	6	50	45	2	2
Manufacturing Engineering	10	41	49	8	8
Automotive Engineering	9	42	49	10	10
Mechanical and Industrial Engineering	7	42	51	3	4
Resources Engineering	6	15	79	8	2
Civil Engineering	5	38	58	2	1
Electrical and Electronic Engineering	7	51	43	4	6
Metallurgy	5	18	77	3	1
Materials Engineering	5	38	58	2	2
Communications Technologies	5	42	53	5	5
Other Engineering and Technology	23	36	41	2	2
Engineering and Technology n.e.c.	9	36	55	5	4
Total	*8*	*36*	*56*	*54*	*49*
Agricultural, Veterinary and Environmental Sciences	*11*	*36*	*53*	*3*	*3*
Architecture, Urban Environment and Building	*6*	*29*	*65*	—	—
Medical and Health Sciences					
Pharmacology and Pharmaceutical Sciences	4	39	57	2	2
Clinical Sciences	2	45	53	2	2
Medical and Health Sciences n.e.c.	14	43	44	2	2
Total	*7*	*42*	*51*	*6*	*6*
Education	*2*	*45*	*53*	—	—
Economics	*2*	*58*	*40*	—	—
Commerce, Management, Tourism and Services	*5*	*51*	*44*	—	—
Studies in Human Society	—	*60*	*40*	—	—
Behavioural and Cognitive Sciences	*3*	*60*	*37*	—	—
Law, Justice and Law Enforcement	np	*21*	np	—	—
Journalism, Librarianship and Curatorial Studies	np	np	np	np	np
The Arts	*3*	*55*	*42*	—	—
Language and Culture	np	np	np	np	np
History and Archaeology	np	np	np	np	np
Total	**7**	**44**	**49**	**100**	**100**

— nil or rounded to zero (including null cells)
np not available for publication but included in totals where applicable, unless otherwise indicated

(a) Component proportions are of the research field level total.
(b) Proportion of Total Human resources devoted to R&D.
(c) Proportion of Total BERD.

1.22 EXPECTED EXPENDITURE ON R&D 2004-05, by industry

	2003-04 Actual expenditure on R&D	*2004-05 Expected expenditure on R&D*(a)	*Anticipated growth in expenditure on R&D*(b)
	$'000	$'000	%
Mining	*782 543*	*678 680*	*–13*
Manufacturing			
Food, Beverage & Tobacco	260 114	265 750	2
Textile, Clothing, Footwear & Leather	40 880	36 411	–11
Wood & Paper Product	126 434	114 980	–9
Printing, Publishing & Recorded Media	26 377	24 206	–8
Petroleum, Coal, Chemical & Associated Product	584 195	566 451	–3
Non-Metallic Mineral Product	96 767	82 882	–14
Metal Product	345 170	323 040	–6
Machinery & Equipment			
Motor Vehicle & Part	720 875	709 510	–2
Other Transport Equipment	147 211	133 527	–9
Photographic & Scientific Equip.	332 502	528 067	59
Electronic Equipment	269 673	266 077	–1
Electrical Equipment & Appliance	119 211	117 444	–1
Industrial Machinery & Equip.	200 885	213 807	6
Total	1 790 357	1 968 433	10
Other Manufacturing	23 835	20 977	–12
Total	*3 294 129*	*3 403 130*	*3*
Electricity, Gas and Water Supply	*75 190*	*51 826*	*–31*
Construction	*128 408*	*89 263*	*–30*
Wholesale Trade	*290 398*	*308 222*	*6*
Retail Trade	*30 683*	*26 407*	*–14*
Accommodation, Cafes and Restaurants	—	—	—
Transport and Storage	*38 437*	*39 728*	*3*
Communication Services	*246 551*	*240 204*	*–3*
Finance and Insurance	*624 558*	*650 842*	*4*
Property and Business Services			
Scientific Research	463 278	552 859	19
Technical Services	276 212	280 297	1
Computer Services	729 738	723 861	–1
Property & Business Services n.e.c.	180 680	180 507	—
Total	*1 649 908*	*1 737 524*	*5*
Education	*3 749*	*3 194*	*–15*
Health and Community Services	*19 914*	*22 860*	*15*
Cultural and Recreational Services	*21 145*	*14 440*	*–32*
Personal and Other Services	*14 586*	*14 875*	*2*
Total	**7 220 199**	**7 281 196**	**1**

— nil or rounded to zero (including null cells)

(a) Reflects business estimates of expenditure on R&D for 2004-05, as collected in 2003-04.

(b) Calculated by dividing expected expenditure by actual expenditure.

CHAPTER 2 BIOTECHNOLOGY RELATED R&D

INTRODUCTION

The 2003–04 Business R&D survey collected additional information specific to biotechnology related R&D. Businesses that performed and/or paid others to perform biotechnology related R&D (extramural), were asked additional questions. Extramural R&D is out of scope of BERD, hence the extramural biotechnology related R&D expenditure reported in this chapter is not a component of BERD.

Exclusion of ANZSIC Division A from the Business R&D survey may impact these figures.

BIOTECHNOLOGY ACTIVE BUSINESSES

In 2003–04, 304 businesses performed and/or paid another to perform biotechnology related R&D, totalling $377.8m in expenditure.

2.1 BIOTECHNOLOGY ACTIVE BUSINESSES

	Number of businesses	*Expenditure*
	no.	$'000
Businesses that ONLY		
Performed biotechnology related R&D	149	144 305
Paid another to perform biotechnology related R&D	77	42 235
Businesses which both performed and paid another organisation to perform biotechnology related R&D	78	191 275
Total	**304**	**377 815**

There was $270.8m (3.8% of BERD) of biotechnology related R&D expenditure, which was performed by 226 businesses. There were 155 businesses which paid $107.0m to others to perform biotechnology related R&D. Property and business services reported the highest number of biotechnology active businesses and the highest level of expenditure on both biotechnology related R&D performed by the business ($187.1m) and paid to another ($81.2m).

2.2 EXPENDITURE ON BIOTECHNOLOGY RELATED R&D, by industry

		Manufacturing	*Wholesale Trade*	*Property and Business Services*	*Other Industries n.e.c.*	*Total*
Businesses that						
Performed biotechnology related R&D	no.	60	13	138	16	227
Paid another to perform biotechnology related R&D	no.	38	11	101	5	155
Expenditure on Biotechnology related R&D						
Performed by this business						
For own purposes	$'000	np	np	141 544	8 063	223 371
For another	$'000	np	np	45 546	59	47 463
Total	$'000	*72 378*	*3 244*	*187 090*	*8 122*	*270 834*
Paid to another organisation to perform who were						
Located within Australia	$'000	np	np	53 962	586	76 198
Located overseas	$'000	np	np	27 204	—	30 783
Total	$'000	*20 479*	*4 750*	*81 166*	*586*	*106 981*
Total	$'000	**92 857**	**7 994**	**268 256**	**8 708**	**377 815**

— nil or rounded to zero (including null cells)

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

BIOTECHNOLOGY ACTIVE R&D PERFORMERS

Of the 304 biotechnology active businesses, 252 performed R&D of some type spending $534.4m (7% of total BERD). These R&D performers were predominantly within Property and business services (59%), Manufacturing (27%) and Wholesale trade (7%).

2.3 RESOURCES DEVOTED TO R&D, by biotechnology active R&D performers(a)—by industry

		Manufacturing	*Wholesale Trade*	*Property and Business Services*	*Other industries n.e.c.*	*Total*
Number of businesses	no.	69	17	148	18	252
Expenditure on R&D						
Total	$'000	179 264	24 934	313 213	17 041	534 452
As a proportion of total BERD	%	5	9	19	1	7
Human Resources devoted to R&D						
Total	PYE	959	123	1 600	112	2 794
As a proportion of total human resources	%	5	6	14	2	7

(a) Only includes R&D performers who had expenditure on biotechnology related R&D. The R&D was performed by themself and/or another.

BIO-INDUSTRY SECTOR

Most businesses classified their biotechnology related R&D to Human health, which represented $262.7m or 70% of total biotechnology related R&D expenditure. Agricultural biotechnology had the next highest expenditure of $43.4m or 11% of total biotechnology related R&D expenditure. See paragraph 19 of the Explanatory Notes for detail on the bio-industry sector.

BIOTECHNOLOGY RELATED R&D OUTSOURCING

Of the 304 biotechnology active businesses, approximately half (155) paid others to perform biotechnology related R&D.

Australian organisations

There were 145 businesses which paid one or more Australian organisations to perform biotechnology related R&D. Of these:

- 66% paid a University or other higher education institution;

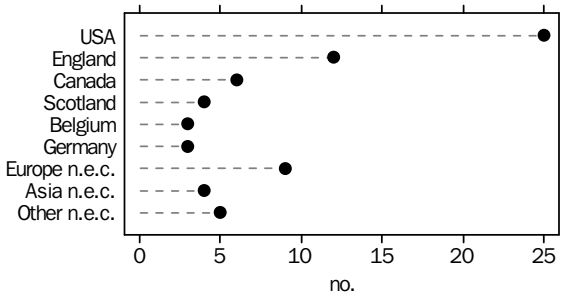
Australian organisations continued

- 13% paid CSIRO;
- 30% paid another government or private non-profit research institute;
- 27% paid a CRO; and
- 15% paid another business.

Overseas organisations

There were 36 businesses which paid overseas organisations to perform biotechnology related R&D. The locations most frequently reported were the USA, England and Canada.

OVERSEAS COUNTRY OUTSOURCED TO, Frequency (a)



(a) Businesses could report more than one country.

See paragraph 18 of the Explanatory Notes for more detail on the country classification.

Reasons for outsourcing

Across all employment size groups, the most common reason cited for outsourcing biotechnology related R&D was a Lack of technical skill/expertise. For businesses which employed 0–19 and 20–99 persons, the second most common reason for outsourcing was Cost effectiveness. However, businesses which employed 100 or more persons reported the second most common reason as Not core business.

FACTORS ADVERSELY AFFECTING BIOTECHNOLOGY

For businesses which employed 0–19 persons the most severe adverse effects to both the advancement of biotechnology related R&D and biotechnology product commercialisation were Access to capital and Access to grants.

Businesses which employed 20–99 persons reported Australian/foreign regulations as the next most severe adverse effect after Access to capital, for both the advancement of biotechnology related R&D and biotechnology product commercialisation.

Access to grants and Public acceptance and ethical considerations were the most severe adverse effects to the advancement of biotechnology related R&D for businesses which employed 100 or more persons. However, for biotechnology product commercialisation, Australian/foreign regulations and Public acceptance and ethical considerations were the two factors considered to have the most severe adverse effect.

2.4 EXPENDITURE ON BIOTECHNOLOGY RELATED R&D, by bio-industry sector(a)—counts

	PERFORMED BY THE BUSINESS		
	For own purposes	*For another*	*Paid another to perform*
	no.	no.	no.
Human health			
Diagnostics	61	8	31
Therapeutics	80	14	74
Total	*141*	*22*	*105*
Bioinformatics	*17*	*3*	*11*
Agricultural biotechnology			
Plant	31	9	21
Animal	31	3	20
Aquaculture	8	—	5
Total	*70*	*12*	*46*
Industrial processing			
Food processing	23	4	6
Speciality chemicals	8	1	2
Other industrial activity	8	2	4
Total	*39*	*7*	*12*
Natural resource recovery	*6*	—	*3*
Environment	*21*	*3*	*9*
Other	*9*	np	*4*

— nil or rounded to zero (including null cells)

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

(a) Businesses can respond against more than one category, hence these counts will sum to more than those in Table 2.1.

2.5 EXPENDITURE ON BIOTECHNOLOGY RELATED R&D, by bio-industry sector

	PERFORMED BY THE BUSINESS			
	For own purposes	*For another*	*Paid another to perform*	*Total*
	$'000	$'000	$'000	$'000
Human health				
Diagnostics	62 036	np	np	99 483
Therapeutics	82 551	np	np	163 193
Total	*144 588*	*42 568*	*75 519*	*262 675*
Bioinformatics	np	np	*13 075*	*24 498*
Agricultural biotechnology				
Plant	13 207	np	np	21 550
Animal	10 758	np	np	17 615
Aquaculture	3 815	—	432	4 247
Total	*27 780*	*3 401*	*12 231*	*43 412*
Industrial processing				
Food processing	10 043	np	np	11 111
Speciality chemicals	5 222	np	np	6 383
Other industrial activity	488	np	np	1 170
Total	*15 753*	*639*	*2 272*	*18 663*
Natural resource recovery	np	—	np	np
Environment	*4 132*	*68*	*1 336*	*5 536*
Other	np	np	np	np
Total	**223 371**	**47 463**	**106 981**	**377 815**

— nil or rounded to zero (including null cells)

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

2.6 AUSTRALIAN ORGANISATIONS PAID TO PERFORM BIOTECHNOLOGY RELATED R&D, by employment size(a)—proportions

		EMPLOYMENT SIZE			
		0-19 persons	*20-99 persons*	*100 or more persons*	*Total*
Type of Australian organisation					
Universities or other higher education institutions	%	67	77	31	66
CSIRO	%	7	27	38	13
Other government or private non-profit research institutes	%	30	38	np	30
CROs	%	22	42	38	27
Other business	%	17	12	8	15
Businesses that paid Australian organisations to perform biotechnology related R&D	no.	**106**	**26**	**13**	**145**

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

(a) Proportions are of all businesses (that paid Australian organisations to perform biotechnology related R&D) for the relevant employment size category. Businesses can respond to more than one category, hence the proportions will sum to more than 100%.

2.7 REASON FOR BIOTECHNOLOGY RELATED R&D OUTSOURCING, by employment size(a)—proportions

		EMPLOYMENT SIZE			
		0-19 persons	*20-99 persons*	*100 or more persons*	*Total*
Reason for outsourcing					
Lack of technical skill/expertise	%	67	71	92	70
Not core business	%	26	43	46	31
Cost effectiveness	%	51	61	31	51
To diversify risk	%	6	np	—	6
Third party validation	%	26	18	np	23
Timeliness	%	25	36	np	26
Other	%	16	14	—	14
Businesses that paid another to perform biotechnology related R&D	no.	**114**	**28**	**13**	**155**

— nil or rounded to zero (including null cells)

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

(a) Proportions are of all businesses (that paid another to perform biotechnology related R&D) for the relevant employment size category. Businesses can respond to more than one category, hence the proportions will sum to more than 100%.

2.8 FACTORS ADVERSELY AFFECTING ADVANCEMENT OF BIOTECHNOLOGY RELATED R&D, by level of effect—by employment size: **proportions**

	Not applicable	*No effect*	*Some effect*	*Severe effect*
	%	%	%	%
0–19 PERSONS				
Access to capital	4	10	47	39
Access to grants	8	27	45	20
Access to Intellectual Property (IP)	20	49	27	4
Access to 'networks'	16	49	30	5
Access to specialist facilities	15	45	31	9
Access to suitably trained scientific/technical staff	13	34	43	10
Australian/foreign regulations	24	50	23	4
Australian taxation environment	18	45	29	8
Patent fees and approval processes	16	37	36	10
Public acceptance and ethical considerations	21	59	18	2
Unsuccessful R&D	21	43	29	7
Other	92	5	np	np
20–99 PERSONS				
Access to capital	24	27	35	13
Access to grants	15	37	42	6
Access to Intellectual Property (IP)	np	48	23	np
Access to 'networks'	16	65	19	—
Access to specialist facilities	np	48	35	np
Access to suitably trained scientific/technical staff	np	42	42	np
Australian/foreign regulations	19	52	21	8
Australian taxation environment	13	50	31	6
Patent fees and approval processes	np	40	32	np
Public acceptance and ethical considerations	23	52	19	6
Unsuccessful R&D	np	44	31	np
Other	79	15	np	np
100 OR MORE PERSONS				
Access to capital	np	42	35	np
Access to grants	19	35	29	16
Access to Intellectual Property (IP)	np	45	26	np
Access to 'networks'	16	48	35	—
Access to specialist facilities	np	45	35	np
Access to suitably trained scientific/technical staff	np	52	39	np
Australian/foreign regulations	np	39	32	np
Australian taxation environment	np	52	23	np
Patent fees and approval processes	19	42	29	10
Public acceptance and ethical considerations	19	35	32	13
Unsuccessful R&D	16	39	35	10
Other	81	10	—	10

— nil or rounded to zero (including null cells)

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

2.9 FACTORS ADVERSELY AFFECTING BIOTECHNOLOGY PRODUCT COMMERCIALISATION, by level of effect—by employment size: **proportions**

	Not applicable	*No effect*	*Some effect*	*Severe effect*
	%	%	%	%
0–19 PERSONS				
Access to capital	17	9	36	38
Access to Contract Research Organisations (CROs)	30	55	12	3
Access to grants	19	26	38	17
Access to Intellectual Property (IP)	29	44	25	3
Access to international market	27	33	36	5
Access to manufacturing facilities	29	50	17	4
Access to 'networks'	25	45	27	4
Access to specialist infrastructure (e.g. toxicology testing)	29	43	22	7
Australian/foreign regulations	28	48	18	6
Lack of commercial management skills	25	46	26	3
Patent fees and approval processes	25	36	31	9
Product liability insurance	27	37	25	11
Public acceptance and ethical considerations	np	52	18	np
Size of market	26	39	30	4
Unsuccessful R&D	30	38	26	6
Other	90	7	2	1
20–99 PERSONS				
Access to capital	31	39	19	11
Access to Contract Research Organisations (CROs)	np	53	10	np
Access to grants	np	39	31	np
Access to Intellectual Property (IP)	np	48	18	np
Access to international market	29	39	27	5
Access to manufacturing facilities	np	50	13	np
Access to 'networks'	29	53	18	—
Access to specialist infrastructure (e.g. toxicology testing)	34	48	13	5
Australian/foreign regulations	34	40	18	8
Lack of commercial management skills	np	52	13	np
Patent fees and approval processes	35	39	26	—
Product liability insurance	31	45	18	6
Public acceptance and ethical considerations	np	42	24	np
Size of market	27	39	29	5
Unsuccessful R&D	np	45	19	np
Other	81	15	np	np
100 OR MORE PERSONS				
Access to capital	np	48	32	np
Access to Contract Research Organisations (CROs)	16	71	13	—
Access to grants	23	35	32	10
Access to Intellectual Property (IP)	19	58	23	—
Access to international market	19	52	16	13
Access to manufacturing facilities	np	48	26	np
Access to 'networks'	16	55	29	—
Access to specialist infrastructure (e.g. toxicology testing)	np	48	32	np
Australian/foreign regulations	23	35	23	19
Lack of commercial management skills	np	48	23	np
Patent fees and approval processes	np	48	26	np
Product liability insurance	23	48	19	10
Public acceptance and ethical considerations	13	45	26	16
Size of market	19	42	26	13
Unsuccessful R&D	np	48	26	np
Other	84	np	—	np

— nil or rounded to zero (including null cells)

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

EXPLANATORY NOTES

DATA SOURCES

1 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 2004. The survey was conducted by mail questionnaire and an 86% response rate was obtained.

2 The GDP figures used to derive BERD/GDP ratios are current at the time of manuscript finalisation - *Australian National Accounts: National Income, Expenditure and Product, March quarter 2005* (cat no. 5206.0) - and, at current prices, are as follows: $527,994m (1996–97); $559,139m (1997–98); $589,597m (1998–99); $623,461m (1999–2000); $668,426m (2000–01); $713,229m (2001–02); $758,147m (2002–03); and $813,225m (2003–04). The BERD/GDP ratios for other OECD countries are current at the time of manuscript finalisation and are sourced from *Main Science and Technology Indicators*, 2005/1, OECD, Paris, 2005.

3 The GSP figures used to derive R&D expenditure to GSP ratios are current at the time of manuscript finalisation - *Australian National Accounts, State Accounts, 2003-04* (cat no. 5220.0) - and, at current prices, are as follows: New South Wales $283,067m; Victoria $206,733m; Queensland $140,574m; South Australia $53,897m; Western Australia $88,935m; Tasmania $14,283m; Northern Territory $9,494m; and Australian Capital Territory $16,246m.

STATISTICAL UNIT

4 The statistical unit used to represent businesses and for which statistics are reported is, in most cases, the Australian Business Number (ABN) unit. The ABN unit is the business unit which has registered for an ABN and thus appears on the Australian Taxation Office (ATO) administered Australian Business Register (ABR). This unit is suitable for ABS statistical needs when the business is simple in structure. For more significant and diverse businesses where the ABN unit is not suitable for ABS statistical needs, the statistical unit used is the Type of Activity Unit (TAU). A TAU is comprised of one or more business entities, sub-entities or branches of a business entity within an Enterprise Group that can report production and employment data for similar economic activities. Further details about the ABS economic statistical units used in this survey and in other ABS economic surveys (both sample and census) can be found in Chapter 2 of the *Standard Economic Sector Classifications of Australia (SESCA) 2002* (cat. no. 1218.0).

DEFINITIONS

5 R&D as collected by the ABS 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'. Although outside the economic boundary of R&D as defined by the OECD, R&D performed overseas by Australian businesses is included in the data in this publication. See the Glossary for a fuller definition of R&D.

6 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 of Research and Experimental Development ('Frascati Manual') 2002*, OECD, Paris, 2003.

SCOPE

7 The scope of this survey is all businesses within the business sector of Australia, excluding businesses mainly engaged in Agriculture, forestry and fishing (i.e. Division A of the *Australian and New Zealand Standard Industrial Classification (ANZSIC), 1993*(cat. no. 1292.0)). This is 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).

8 The business sector includes all businesses (whose primary activity is the production of goods and services for sale to the general public at a price intended to cover at least the costs of production) and the private non-profit institutions mainly serving them.

9 The vast majority of businesses in this sector are private businesses. The remainder are public businesses mainly engaged in trading or financial activities.

COVERAGE

10 The R&D survey comprises a complete enumeration of businesses identified by the ABS as likely to have carried out R&D activity.

11 Within the scope of the survey, businesses were included in the collection if they:

- reported R&D activity in previous R&D surveys; or
- applied for an AusIndustry administered R&D Tax Concession and/or grant for industry R&D; or
- were identified as likely to have R&D activity from reports in newspapers, industrial journals, research compendia etc.; or
- indicated that R&D activity had been performed in the reference year via a coverage questionnaire.

12 The ABS continues to investigate enhancement of the above criteria, or the introduction of additional criteria, with the aim of further improving the coverage of the R&D survey.

13 For 2003–04, businesses identified as possibly undertaking biotechnology related R&D were added to the collection. Business names were obtained from lists held by Biotechnology Australia and other government sources.

INDUSTRY CLASSIFICATION

14 The statistics in this publication are classified to industry in accordance with the *Australian and New Zealand Standard Industrial Classification (ANZSIC), 1993* (cat. no. 1292.0). Aggregated groupings of industries annotated with n.e.c. reflect the remnant of the relevant ANZSIC Division.

15 Each ABN unit/TAU is classified by the ABS to the industry in which it mainly operates. In cases where an Enterprise Group sets up a dedicated research unit, that unit is classified to the predominant industry of the group rather than to Scientific Research (ANZSIC 7810), in accordance with standards laid down in the Frascati Manual.

EMPLOYMENT SIZE

16 Employment size relates to the number of persons employed by the business during the last pay period in June 2004.

SOCIO-ECONOMIC OBJECTIVE (SEO) AND RESEARCH FIELDS, COURSES AND DISCIPLINES CLASSIFICATIONS (RFCD)

17 Statistics classified by SEO and RFCD have been collected and presented in this publication. Data were subjectively allocated by businesses at the time of reporting. See the Technical Note on Reliability of Statistics for further detail. For more information on these classifications, see the *Australian Standard Research Classification (ASRC), 1998* (cat. no. 1297.0). Aggregated groupings of SEOs or RFCDs are annotated with n.e.c. and reflect the remnant of the relevant SEO Subdivision or RFCD Division.

COUNTRY CLASSIFICATION

18 Countries identified as locations for biotechnology related R&D outsourcing were classified in accordance with the *Standard Australian Classification of Countries (SACC) 1998* (cat no. 1269.0). Aggregated groupings of countries annotated with n.e.c. reflect the remnant of continental countries not separately reported.

BIO-INDUSTRY SECTOR

19 The bio-industry sector classification is an unregistered classification assembled by the ABS in conjunction with government and industry groups. This classification was established specifically for the biotechnology portion of the Business R&D survey, to enable areas within the biotechnology sector to be classified at a finer level.

CHAIN VOLUME MEASURES

20 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 2003-04). 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).

RELATED PUBLICATIONS

21 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, All Sector Summary, Australia, 2002-03*, cat. no. 8112.0, 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, 2004*, cat. no. 8111.0, ABS, Canberra

Australian Bureau of Statistics 2005, *Innovation in Australian Business 2003*, cat. no. 8158.0, ABS, Canberra

Organisation for Economic Co-operation and Development 2003, *Proposed Standard Practice for Surveys of Research and Experimental Development ('Frascati Manual') 2002*, OECD, Paris

22 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.

ABS DATA AVAILABLE ON REQUEST

23 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.

ROUNDING

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

TECHNICAL NOTE

DATA QUALITY

NON-SAMPLING ERROR

1 Non-sampling errors may arise as a result of errors in the reporting, recording or processing of data. These errors can be introduced through inadequacies in the questionnaire, treatment of non-response, inaccurate reporting by providers, errors in the application of survey procedures, incorrect recording of answers and errors in data capture and processing.

2 The extent to which non-sampling error affects the results are difficult to measure. Every effort is made to minimise non-sampling error by careful design and testing of the questionnaire, the use of efficient operating procedures and systems, and the use of appropriate methodologies.

Reliability of Statistics

3 When interpreting the statistics in this publication, the reliability of the estimates may be affected by the following specific non-sampling errors:

- Many businesses provided estimates due to a lack of separately recorded data on R&D activity.
- The OECD standard definition of R&D used in this survey may differ from what businesses regard as R&D activity. This is mainly due to slight differences, from the international standard, in the R&D definition used within the grants for industry R&D schemes (for the allocation of grants) and the AusIndustry administered R&D Tax Concession scheme (for tax deductibility for specific R&D activities). It is possible that some businesses have not reported R&D data as per the OECD definition.
- Data were subjectively classified, by businesses, to research fields and socio-economic objectives at the time of reporting. Some businesses may have experienced difficulty in classifying their R&D programs. The ABS makes every effort to ensure correct and consistent interpretation and reporting of these data by applying consistent processing methodologies.

Treatment of non-response

4 Non-responding businesses which reported R&D activity in the previous cycle, had data imputed based on the 2003–04 expected R&D expenditure provided in 2002–03..

5 Non-responding businesses which have not previously reported R&D activity, have been assumed to have no R&D activity and do not contribute to estimates.

REVISIONS

6 Revisions to previous cycle data occur on discovery of: errors in previously reported data; and newly identified R&D performers in the previous cycle(s). Where newly identified R&D performers indicate that significant levels of R&D have been undertaken in earlier years, details are collected and used to revise previously released estimates.

7 Revisions only occur for significant changes to the data where the impact from individual businesses is of the order of $5m at any classification level, e.g. industry, employment size group, socio-economic objective, research field. Revisions are only applied up to two cycles prior to the current cycle.

GLOSSARY

Bioinformatics	Computer based collection, organisation and analysis of biological information, especially genomics and molecular modelling (DNA/RNA/protein sequencing and databases for humans, plants etc).
Biotechnology	The application of science and engineering principles to living organisms as well as parts, products or models thereof, to alter living or non-living materials for the production of knowledge, goods and services.
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 2003-04). 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).
Current expenditure	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 are attributable to R&D activity.
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.
Labour costs	Expenditure relating to: wages and salaries; overtime earnings; penalty payments; shift allowances; employer contributions into superannuation; fringe benefits and payroll taxes; severance, termination and redundancy payments; workers' compensation premiums/costs; provisions for employee entitlements; salaries and fees of directors and executives; retainers and commissions of persons who received a retainer; bonuses; annual and other types of paid leave.
Other current expenditure	Expenditure on: materials, fuels and other inputs; rent, leasing and hiring expenses; repair and maintenance expenses; payments to outside organisations for use of specialised testing facilities or for analytical work, engineering or other specialised services in support of R&D projects carried out by the business; commission and consultant expenses for research projects carried out by the business (except direct labour costs); software for own account produced as part of R&D; and the proportion of expenditure on general services and overheads which is attributable to R&D activity.
Other supporting staff	Skilled and unskilled craftpersons, secretarial and clerical staff directly associated with R&D activity.
Person years of effort	One person year of effort is equal to a full time employee whose time is wholly devoted to R&D for a whole year.
R&D activity	The 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 RFCD classification is primarily structured around disciplines or activities. In short, it describes the nature of the research being performed.

Researchers 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.

Socio-economic objective The broad socio-economic areas of expected benefit rather than the immediate objectives of the researcher. The SEO classification defines the main areas of Australian economic and social activity to which the results of research programs are applied. In short, it describes the purpose of the research.

Technicians 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, etc.

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