

Thousands of researchers are taking science and technology in new directions in laboratories and research programs across the country. Research and development (R&D) advances knowledge, leads to new technologies and creates employment opportunities.

Businesses, governments, higher-education institutions and non-profit organizations all invest significantly in R&D. The players are linked through contracts, collaborative arrangements, partnerships or donations.

The key indicator of how much money a country spends on R&D in a given year is gross domestic expenditures on research and development (GERD). Like other indicators, GERD is useful for making international comparisons of R&D activity.

In 2009, Canada's anticipated GERD totalled \$29.9 billion (in current dollars). This compares with \$17.6 billion in 1999.

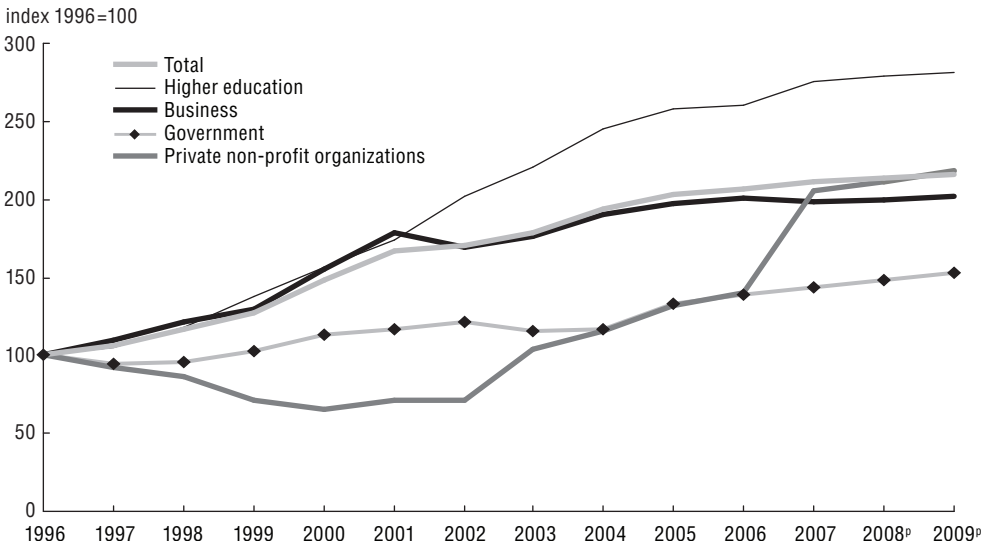
How science is funded

Businesses expected to fund \$14.2 billion in 2009, or nearly half of the total GERD, and almost the same as in each of the previous three years. The federal government is the second largest source of R&D funding (\$5.7 billion in 2009), followed by the higher-education sector (\$4.7 billion). The rest of GERD funding comes from provincial governments, the private non-profit sector and the foreign sector.

Leading R&D performers

Businesses not only fund most R&D in the economy, they also perform most of it—\$16.1 billion worth in 2009, or 54% of GERD—and employ the majority of Canada's R&D personnel. With plans to spend \$10.4 billion or 35% of GERD, the higher-education sector is the second largest R&D performer. The federal government is third with R&D spending

Chart 27.1
Research and development gross domestic expenditures, by sector



Source: Statistics Canada, CANSIM table 358-0001 and Catalogue no. 88-003-X.

of \$2.7 billion in 2009. The remainder of GERD performance takes place in the provincial government and private non-profit sectors.

Information and cultural industries (including software publishing, computer games and telecommunications) became the leading industrial group performing R&D in 2005, taking over from the communications equipment industry.

R&D expenditures by the information communications technology (ICT) sector are expected to reach \$6.2 billion or 39% of total industrial R&D spending intentions in 2009. The ICT sector spans the manufacturing and services sectors and includes representation from the industry's leading R&D performers.

The manufacturing sector's share of industrial R&D declined from 68% in 2000 to 52% in 2009. In constant dollars, total industrial R&D spending had not yet recovered from the technology downturn that took place at the beginning of the millennium.

Table 27.a
Personnel engaged in research and development, by sector

	1998 ^r	2007
	number	
Total	147,860	228,680
Federal government	13,730	15,630
Provincial governments ¹	13,730	3,120
Business enterprises ²	85,930	147,600
Higher education	44,320	60,140
Private non-profit organizations ³	1,030	2,190

Note: Personnel counts are reported as full-time equivalents (rounded to the nearest 10).

1. Includes provincial research organizations.

2. Natural sciences and engineering only.

3. Counts may fluctuate because of intramural research and development activities.

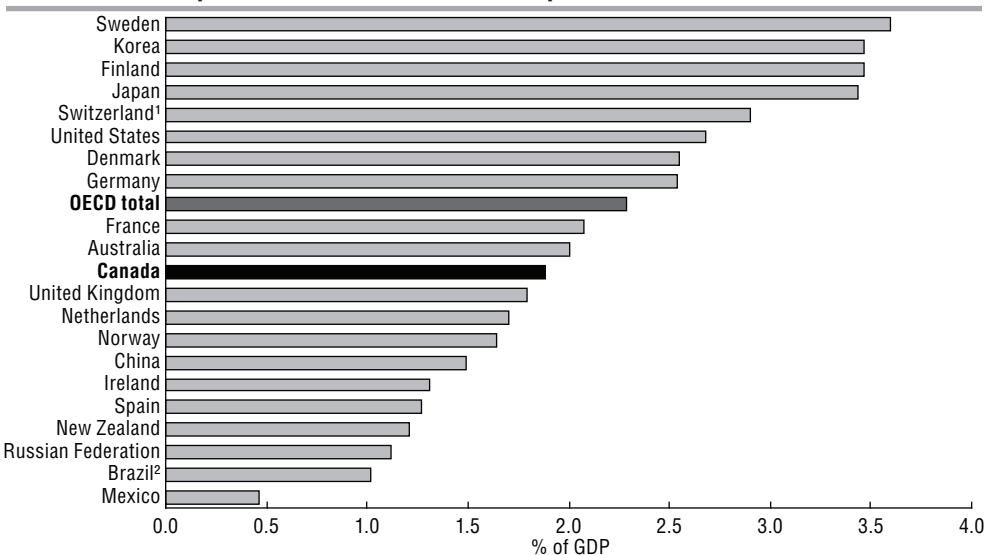
Source: Statistics Canada, Catalogue no. 88-001-X.

The leading federal departments or agencies performing R&D activities in 2009 included the National Research Council, Natural Resources Canada, Energy Canada, National Defence, Agriculture and Agri-Food Canada.

Canada's 2007 GERD spending comprised 1.9% of the gross domestic product (GDP), below the 2.3% average for OECD countries.

Chart 27.2

Gross domestic expenditure on research and development of selected OECD countries, 2007



1. 2004 data.

2. 2006 data.

Source: OECD, *OECD in figures*, 2009.

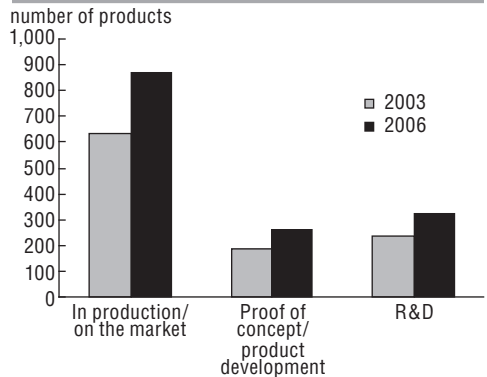
Commercializing bioproducts

Canadian firms have been relatively successful in commercializing bioproducts (products other than food, feed and medicines developed from biological or renewable materials). The number of bioproduct firms rose from 232 to 239 from 2003 to 2006. In 2006, firms had more bioproducts in production or on the market than in 2003, up 37% to reach 870 products. However, bioproduct revenue, employment and average firm size all declined.

Firms rated 'greener and cleaner products' as the main benefit to developing and producing bioproducts, followed by lower production costs.

Bioproduct revenues declined from \$3.1 billion in 2003 to \$1.8 billion in 2006, while the number of people with bioproduct responsibilities fell from 7,851

Chart 27.3
Bioproducts industry



Source: Statistics Canada, Catalogue no. 21-004-X.

to 3,974. Firms reported difficulties filling vacant positions.

The firms' highest barriers to developing or producing bioproducts in 2006 were the price and transportation cost of biomass and the difficulties of entering the marketplace.

Patents and spinoffs

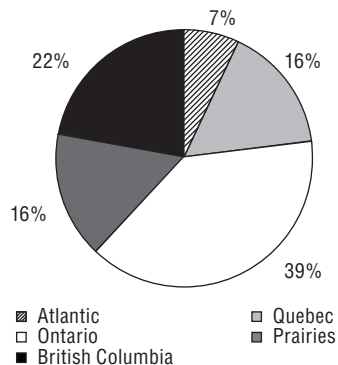
In 2007, researchers reported or disclosed 1,357 new inventions to Canadian universities and teaching hospitals, a number virtually unchanged from the previous year. Educational institutions filed 1,634 patent applications, up 13% from 2006.

The number of patents issued to universities and affiliated hospitals rose 41% from 339 in 2006 to 479 in 2007. The total number of patents held at the end of 2007 declined 13% from 4,784 to 4,185.

Universities and affiliated hospitals launched 24 companies in 2007 to commercialize their technologies. This brings the number of companies they have spun off since 1999 to 1,174. One in three of those spinoffs are related to health sciences.

Spending on research and development by higher-education institutions and affiliated research hospitals, experimental

Chart 27.4
Spin-off companies, by region, 2007



Source: Statistics Canada, Catalogue no. 88-222-X.

stations and clinics added to \$10.2 billion current dollars in 2007/2008. In 2002 constant dollars, this was \$8.8 billion, or 85% more than in 1998/1999.

Table 27.1 Gross domestic expenditures on research and development, by performing sector and funding sector, 1995 to 2009

	Total	Federal government	Provincial governments	Provincial research organizations	Business enterprises	Higher education	Private non-profit	Foreign sources
\$ millions								
Performing sector								
1995	13,754	1,727	186	68	7,991	3,691	91	...
1996	13,817	1,792	163	79	7,997	3,697	89	...
1997	14,635	1,720	156	58	8,739	3,879	82	...
1998	16,088	1,743	155	61	9,682	4,370	77	...
1999	17,637	1,859	173	60	10,399	5,082	63	...
2000	20,556	2,080	164	66	12,395	5,793	58	...
2001	23,133	2,103	253	23	14,266	6,424	63	...
2002	23,536	2,190	256	26	13,545	7,455	63	...
2003	24,691	2,083	254	24	14,095	8,143	92	...
2004	26,783	2,084	265	25	15,249	9,058	103	...
2005	28,126	2,414	280	23	15,774	9,518	117	...
2006	28,599	2,496	311	22	16,021	9,625	125	...
2007	29,170	2,532	330	57	15,882	10,187	183	...
2008 ^P	29,487	2,605	365	40	15,980	10,310	188	...
2009 ^P	29,854	2,692	369	40	16,146	10,413	194	...
Funding sector								
1995	13,754	2,989	652	0	6,288	1,926	309	1,590
1996	13,817	2,814	629	0	6,395	1,905	358	1,714
1997	14,635	2,813	656	1	7,030	1,971	367	1,795
1998	16,088	2,830	640	0 ^S	7,355	2,339	372	2,552
1999	17,637	3,216	767	3	7,917	2,649	380	2,705
2000	20,556	3,560	853	1	9,223	2,892	445	3,582
2001	23,133	4,095	1,023	0 ^S	11,637	2,928	536	2,915
2002	23,536	4,251	1,152	0 ^S	12,117	3,462	628	1,925
2003	24,691	4,526	1,354	0 ^S	12,427	3,589	637	2,158
2004	26,783	4,651	1,370	0 ^S	13,381	4,147	735	2,499
2005	28,126	5,249	1,343	0 ^S	13,820	4,341	777	2,593
2006	28,599	5,222	1,405	0 ^S	14,144	4,435	830	2,562
2007	29,170	5,491	1,454	0 ^S	13,946	4,574	968	2,736
2008 ^P	29,487	5,594	1,495	0 ^S	14,034	4,629	981	2,754
2009 ^P	29,854	5,718	1,513	0 ^S	14,172	4,675	993	2,783

Source: Statistics Canada, CANSIM table 358-0001.

Table 27.2 Gross domestic expenditures on research and development, by province and territory, 1995, 1999, 2003 and 2007

	1995	1999	2003	2007
	\$ millions			
Canada	13,754	17,637	24,691	29,170
Newfoundland and Labrador	100	127	173	262
Prince Edward Island	16	26	43	58
Nova Scotia	265	339	409	501
New Brunswick	140	164	215	314
Quebec	3,719	4,918	6,965	7,824
Ontario	6,923	8,888	11,983	13,601
Manitoba	295	385	455	585
Saskatchewan	254	323	398	441
Alberta	972	1,165	1,901	2,403
British Columbia	1,068	1,290	2,050	2,935
Yukon, Northwest Territories and Nunavut	2	9	6	63

Source: Statistics Canada, CANSIM table 358-0001.

Table 27.3 Gross domestic expenditures on research and development, health sector compared with all sectors, 1989 to 2009

	All sectors		Health sector	
	\$ millions	\$ millions	% of all sectors	\$ per capita
1989	9,517	1,365	14.3	50
1990	10,260	1,551	15.1	56
1991	10,767	1,665	15.5	59
1992	11,338	1,783	15.7	63
1993	12,184	2,006	16.5	70
1994	13,341	2,105	15.8	73
1995	13,754	2,196	16.0	75
1996	13,817	2,316	16.8	78
1997	14,635	2,644	18.1	88
1998	16,088	2,930	18.2	97
1999	17,637	3,246	18.4	107
2000	20,556	3,696	18.0	120
2001	23,133	4,383	18.9	141
2002	23,536	5,273	22.4	168
2003	24,691	5,361	21.7	169
2004	26,783	6,127	22.8	192
2005	28,126	6,164 ^r	21.9	191
2006	28,599	5,942 ^r	20.8	182
2007	29,170	6,271	21.5	190
2008	29,487^p	6,349 ¹	21.5	190
2009	29,854^p	6,387 ¹	21.4	189

1. Estimate.

Source: Statistics Canada, CANSIM table 358-0001 and Catalogue no. 88-001-X.

Table 27.4 Federal expenditures on research and development, by performing province and territory and funding province and territory, 1993 to 2007

	Canada	Newfoundland and Labrador	Prince Edward Island	Nova Scotia	New Brunswick
	\$ millions				
Performing province					
1993	1,757	36	11	75	33
1994	1,753	33	11	84	28
1995	1,727	27	9	77	29
1996	1,792	25	10	79	32
1997	1,720	23	10	71	29
1998	1,743	26	10	77	32
1999	1,859	26	12	72	32
2000	2,080	30	16	88	27
2001	2,103	27	16	70	26
2002	2,190	32	8	76	46
2003	2,083	23	12	66	30
2004	2,084	23	10	81	26
2005	2,414	28	28	66	26
2006	2,496	27	26	73	30
2007	2,532	28	13	77	46
Funding province					
1993	3,156	59	12	120	63
1994	3,094	52	12	127	60
1995	2,989	42	11	113	60
1996	2,814	42	12	112	44
1997	2,813	40	11	108	42
1998	2,830	45	12	113	44
1999	3,216	48	13	113	49
2000	3,560	54	19	129	42
2001	4,095	53	19	121	45
2002	4,251	63	13	131	68
2003	4,526	61	20	131	61
2004	4,651	61	18	157	57
2005	5,249	80	37	150	63
2006	5,222	74	35	158	65
2007	5,491	81	26	160	84

Source: Statistics Canada, CANSIM table 358-0001.

Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Territories
\$ millions						
265	1,035	83	54	75	88	2
268	998	79	48	93	103	7
248	1,034	71	52	98	81	1
247	1,098	77	47	94	77	5
230	1,040	59	74	96	83	5
257	1,057	49	54	94	84	4
283	1,096	58	60	108	106	7
390	1,164	69	62	116	111	9
413	1,213	77	63	98	97	3
436	1,273	72	53	92	99	3
364	1,301	63	54	87	80	5
368	1,241	73	54	110	91	6
451	1,435	83	68	130	91	9
457	1,506	81	67	133	91	5
410	1,582	85	63	116	108	4
675	1,601	121	87	164	251	2
635	1,540	119	82	190	270	7
610	1,523	108	81	207	234	1
566	1,452	108	74	192	205	5
565	1,462	88	97	195	200	5
570	1,504	81	78	182	198	4
697	1,630	98	103	219	238	7
844	1,733	111	120	234	262	8
1,038	1,994	124	123	282	290	3
1,055	2,046	130	113	282	338	3
1,099	2,222	131	121	321	340	5
1,111	2,223	146	123	328	409	5
1,243	2,521	157	126	405	419	9
1,223	2,560	150	123	372	420	4
1,272	2,719	163	136	350	451	5

Table 27.5 Federal expenditures on science and technology, by province and territory, 2002/2003 to 2006/2007

	2002/2003	2003/2004	2004/2005	2005/2006	2006/2007
	\$ millions				
Canada	7,299	7,976	8,156	8,682	8,745
National Capital Region ¹	2,608	2,642	2,709	2,912	2,989
Newfoundland and Labrador	117	121	137	128	119
Prince Edward Island	24	32	39	47	47
Nova Scotia	247	257	295	261	303
New Brunswick	102	100	122	93	107
Quebec ²	1,243	1,328	1,352	1,485	1,468
Ontario ²	1,581	2,038	1,966	2,101	2,045
Manitoba	214	195	226	254	235
Saskatchewan	151	159	157	193	208
Alberta	396	470	474	484	499
British Columbia	582	588	645	673	681
Yukon, Northwest Territories and Nunavut	35	46	35	51	42

1. Federal intramural expenditures only.

2. Includes extramural expenditures made in the National Capital Region and executed within the province.

Source: Statistics Canada, Catalogue no. 88-204-X.

Table 27.6 Federal expenditures on research and development, by activity, 2005/2006 to 2009/2010

	2005/2006	2006/2007	2007/2008 ^r	2008/2009 ^p	2009/2010 ^p
	\$ millions				
Research and development and related scientific activities	9,449	9,633	10,176	10,358	10,664
Research and development	6,042	6,073	6,603	6,631	6,949
Current expenditures	5,611	5,642	6,170	6,088	6,372
Administration of extramural programs	285	279	294	308	316
Capital expenditures	146	152	139	235	261
Related scientific activities	3,407	3,560	3,573	3,727	3,714
Data collection	1,715	1,870	1,759	1,842	1,785
Information services	676	669	639	650	665
Special services and studies	627	576	743	780	777
Education support	259	298	286	289	318
Administration of extramural programs	59	64	70	74	72
Capital expenditures	70	83	77	91	98

Notes: Current expenditures includes indirect costs of university research funded by the Social Sciences and Humanities Research Council of Canada totalling \$245 million in 2005/2006, \$260 million in 2006/2007, \$300 million in 2007/2008, and \$315 million in both 2008/2009 and 2009/2010.

In 2006/2007, capital expenditures included \$30 million for the Agriculture Development Fund project funded by Agriculture and Agri-Food Canada.

Source: Statistics Canada, Catalogue no. 88-001-X.

Table 27.7 Research and development performed by the business enterprise sector, 2005 to 2009

	2005 ^r	2006 ^r	2007 ^p	2008 ^p	2009 ^p
All industries					
\$ millions					
Total research and development expenditures	15,774	16,021	15,882	15,980	16,146^E
Current expenditures	14,678	14,876	14,888	15,075	14,856 ^E
Wages and salaries	8,646	8,843	9,030	9,249	9,090 ^E
Other current expenditures	6,032	6,033	5,858	5,826	5,766 ^E
Capital expenditures	1,096	1,145	994	906	1,290 ^E
number of full-time equivalents					
Total research and development personnel	142,032	146,666	147,599
Professionals	84,399	86,581	86,368
Technicians	40,421	42,206	44,057
Other support staff	17,212	17,879	17,174

Note: Business enterprise research and development refers to research and development activities performed in Canada by the industrial (business enterprise) sector.

Source: Statistics Canada, CANSIM table 358-0024 and Catalogue no. 88-202-X.

Table 27.8 Intellectual property management at universities and research hospitals, 2003 to 2007

	2003	2004	2005	2006	2007
%					
Institutions engaged in intellectual property management	72	76	80	82	71
number					
Full-time equivalent employees engaged in intellectual property management	255	280	292	323	285
Research contracts	11,432	14,324	15,877	13,996	..
Invention disclosures	1,133	1,432	1,452	1,356	1,357
Inventions protected ¹	527	629	761	707	668
Inventions declined by the institution	256	355	322	353	333
Patent applications	1,252	1,264	1,410	1,442	1,634
Patents issued	347	397	376	339	479
Patents held	3,047	3,827	3,961	4,784	4,185
New licences and options	422	494	621	437	538
Active licences and options	1,756	2,022	2,836	2,038	2,679
\$ thousands					
Total operational expenditures for intellectual property management	36,419	36,927	41,544	42,492	41,851
Value of research contracts	810,431	940,993	1,001,270	1,154,268	1,224,897
Income from intellectual property	55,525	51,210	55,173	59,689	52,477
Value of remaining equity held by the institution in publicly traded spinoffs	52,351	49,872	41,336	41,524	34,754
Investment in spinoffs raised with the assistance of the institution	54,640	56,421	23,002	x	5,884

1. Resulted in protection activity.

Source: Statistics Canada, CANSIM table 358-0025.

Table 27.9 University enrolment in natural and applied science and technology programs, by sex, 2003/2004 to 2007/2008

	2003/2004	2004/2005	2005/2006	2006/2007	2007/2008
	number				
All instructional programs					
Both sexes ¹	993,714	1,019,487	1,047,507	1,059,912	1,066,353
Men	419,634	431,367	442,290	446,943	452,589
Women	573,828	587,880	604,848	612,717	613,566
Physical and life sciences and technologies					
Both sexes ¹	85,143	89,868	92,052	93,789	94,677
Men	37,329	39,558	41,109	42,201	43,227
Women	47,808	50,310	50,937	51,582	51,438
Mathematics, computer and information sciences					
Both sexes ¹	43,977	40,764	36,600	34,011	32,442
Men	32,121	29,751	26,652	24,729	23,640
Women	11,832	10,971	9,945	9,279	8,799
Architecture, engineering and related technologies					
Both sexes ¹	85,800	86,544	85,518	86,238	88,164
Men	66,552	67,431	67,542	67,953	69,633
Women	19,236	19,107	17,973	18,270	18,525
Agriculture, natural resources and conservation					
Both sexes ¹	14,760	14,913	15,255	15,630	15,975
Men	6,648	6,690	6,768	6,861	6,987
Women	8,109	8,223	8,487	8,769	8,985

Notes: All counts are randomly rounded to a multiple of 3.

Historical data coded with the University Student Information System classification have been converted to the Classification of Instructional Programs 2000.

1. Figures may not add to the totals because of the exclusion of the 'sex unknown' category in the table or because of rounding.

Source: Statistics Canada, CANSIM table 477-0013.