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Human Activity and the Environment

Annual Statistics 2004

Feature Article
Energy in Canada



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Human Activity and the Environment

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Symbols

The symbols described in this document apply to all data published by Statistics Canada from all origins including surveys, censuses and administrative sources, as well as straight tabulations and all estimations.

- . not available for any reference period
- .. not available for a specific reference period
- ... not applicable
- 0 true zero or a value rounded to zero
- 0^s value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
- P preliminary
- r revised
- x suppressed to meet the confidentiality requirements of the *Statistics Act*
- E use with caution
- F too unreliable to be published

Prefixes of the Metric System

Prefix	Abbreviation	Multiplication factor
exa	E	10 ¹⁸
peta	P	10 ¹⁵
tera	T	10 ¹²
giga	G	10 ⁹
mega	M	10 ⁶
kilo	k	10 ³
hecto	h	10 ²
deca	da	10 ¹
deci	d	10 ⁻¹
centi	c	10 ⁻²
milli	m	10 ⁻³
micro	μ	10 ⁻⁶
nano	n	10 ⁻⁹
pico	p	10 ⁻¹²
femto	f	10 ⁻¹⁵
atto	a	10 ⁻¹⁸

Equivalences

- 1 hectare = 1 km² / 100
- 1 km² = 100 hectares
- 1 tonne = 1 000 kilograms

Abbreviations

°C	degree Celsius
CH ₄	methane
CO	carbon monoxide
CO ₂	carbon dioxide
GDP	gross domestic product
GHG	greenhouse gas
GJ	gigajoule
GW	gigawatt
GWh	gigawatt hour
h	hour
ha	hectare
kg	kilogram
km	kilometre
km ²	square kilometre
km ³	cubic kilometre
kt	kilotonne
kW	kilowatt
kWh	kilowatt hour
L	litre
LLRW	low-level radioactive waste
m ²	square metre
m ³	cubic metre
MJ	megajoule
mm	millimetre
Mt	megatonne
MW	megawatt
MWh	megawatt hour
N ₂ O	nitrous oxide
NAICS	North American Industry Classification System
NO _x	nitrogen oxides
PJ	petajoule
PM	particulate matter
PV	photovoltaic
R&D	research and development
s	second
SO ₂	sulphur dioxide
t	tonne
t-km	tonne kilometre
TJ	terajoule
TWh	terawatt hour
VOCs	volatile organic compounds

Preface

Canadians recognize the importance of a clean and healthy environment. We understand that the capacity of the environment to supply materials and absorb wastes is finite. But to be effective at reducing our collective impact on the environment we need systematic, accessible and relevant information. Without such information, we are unable to understand and respond to environmental change.

The annual *Human Activity and the Environment* publications meet this need with a collection of environmental statistics, brought together from many sources. These annual reports provide a statistical picture of Canada's environment with special emphasis on human activity and its relationship to natural systems—air, water, soil, plants and animals.

Human Activity and the Environment: Annual Statistics 2004 is the third annual environment statistics compendium produced by Statistics Canada. Many of the statistics presented are revised on a biennial, annual and even quarterly basis.

New for 2004

The Annual Statistics section has been redesigned to serve as a general reference document for environmental statistics in Canada. It's organized using the pressure-state-response framework, in which information is classified as measuring the pressure placed on the environment by human activities, the state of the environment at a point in time, or the socio-economic response to environmental conditions.

The Annual Statistics section includes 75 data tables, 11 figures and 8 maps. Data highlights, which are interspersed throughout the Annual Statistics section, briefly describe notable developments in relation to human activity and the environment.

This publication also includes a feature article, "Energy in Canada." Future editions will examine other current environmental issues of concern to Canadians and will provide additional updated data.

Data for *Human Activity and the Environment* come from a variety of sources, including various divisions within Statistics Canada and other federal and provincial government departments.

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- **Transport Canada** (Surface and Marine Statistics and Forecasts)
- **Canadian Council of Forest Ministers**

How to Use this Publication

Human Activity and the Environment: Annual Statistics 2004 is a printed publication which includes a CD-ROM containing electronic versions of the statistics presented in the report. The report features an in-depth article along with an extensive Annual Statistics section which includes data highlights. This annual publication is intended to provide users with quick access to relevant environment statistics using a variety of presentation formats that are convenient and easy to read.

The publication's CD-ROM contains

- a reproduction of the printed publication in Adobe Acrobat format; and
- a database of the statistical tables found in the printed publication, accessible through Microsoft Excel, Microsoft Excel Viewer (included on the CD-ROM), or other spreadsheet software packages (for example, Lotus and QuattroPro).

The CD-ROM is found in the plastic pouch attached to the inside back cover of the printed publication. Complete instructions for the computer installation of the system are also found there.

Statistical tables linked electronically

To aid users in locating the electronic statistical tables, links have been established between an HTML interface and Excel (or Excel Viewer).

Each table name in the HTML interface contains a link that can be clicked with your mouse to go directly to the data associated with that table. Simply by clicking on the table name that you are most interested in, you can automatically launch Excel (or Excel Viewer), with that particular table open for viewing.

Users can also directly access the statistical tables using Excel, Excel Viewer or other spreadsheet software packages.

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Subject-matter assistance: Users with questions regarding the content of *Human Activity and the Environment: Annual Statistics 2004* are requested to call **(613) 951-0297**.

Energy in Canada

Canadians live in a vast country with an abundance of energy resources. This natural resource wealth has played an important role in our economy, enabling us to meet our own energy needs and at the same time become one of the world's leading exporters of energy.

Geography and geology have provided Canada with many sources of energy. We have access to nearly 7% of the world's total renewable water flow,¹ and this has helped to make us the world leader in hydro-electric power

1. Environment Canada, *Freshwater Website: Quickfacts*, www.ec.gc.ca/water/en/e_quickfacts.htm (accessed April 28, 2004).

production. Canada also has one of the world's largest deposits of oil—the Alberta oil sands.

In the worldwide rankings of energy producers (tables 1.1 and 1.2), Canada claims top spot in hydro-electricity production and ranks in the top 10 for all energy sources except coal. Only the United States and Russia are in the top 10 in all energy categories.

Canadians are concerned about

- the supply of energy and available alternatives
- the impacts of energy use on the environment
- government action to address energy-related issues.

This article creates a statistical portrait of Canada's energy resources to examine these concerns.

Table 1.1
Top 10 producers worldwide of crude oil, natural gas, coal and electricity, 2001 and 2002

World rank	Crude oil			Natural gas			Coal ¹			Electricity		
	Country	Production Mt	Share of world total %	Country	Production million m ³	Share of world total %	Country	Production Mt	Share of world total %	2001		
										Country	Production TWh	Share of world total %
1	Saudi Arabia	409	11.5	Russia	595 000	22.7	China	1 326	28.1	United States	3 864	25.0
2	Russia	378	10.7	United States	539 349	20.6	United States	992	21.0	China	1 472	9.5
3	United States	350	9.9	Canada	182 075	7.0	India	356	7.6	Japan	1 033	6.7
4	Mexico	178	5.0	United Kingdom	108 204	4.1	Australia	343	7.3	Russia	889	5.7
5	Iran	176	5.0	Algeria	82 554	3.2	South Africa	223	4.7	Canada	588	3.8
6	China	169	4.8	Netherlands	75 315	2.9	Russia	235	5.0	Germany	580	3.7
7	Norway	156	4.4	Indonesia	70 816	2.7	Poland	162	3.4	India	577	3.7
8	Venezuela	153	4.3	Norway	67 627	2.6	Indonesia	101	2.1	France	546	3.5
9	Canada	133	3.7	Iran	66 320	2.5	Ukraine	84	1.8	United Kingdom	383	2.5
10	United Kingdom	115	3.2	Saudi Arabia	60 570	2.3	Kazakhstan	74	1.6	Brazil	328	2.1
Total top 10 producers		2 217	62.5	1 847 830		70.6	3 896		82.7	10 260		66.3
Rest of world		1 331	37.5	770 023		29.4	817		17.3	5 216		33.7
Total world		3 548	100.0	2 617 853		100.0	4 713		100.0	15 476		100.0

Note:

1. Includes both hard coal and brown coal.

Source:

International Energy Agency, 2003, *Key World Energy Statistics*, www.iea.org (accessed April 28, 2004).

Table 1.2
Top 10 producers worldwide of nuclear and hydro electricity, 2001

World rank	Nuclear electricity					Hydro electricity				
	Country	Production TWh	Share of world total %	Capacity GW	Share of total generation ¹ %	Country	Production TWh	Share of world total %	Capacity ² GW	Share of total generation ³ %
1	United States	808	30.5	95	21.0	Canada	333	12.6	67	56.7
2	France	421	15.9	63	77.0	China	277	10.5	55	18.9
3	Japan	320	12.1	44	31.0	Brazil	268	10.1	61	81.7
4	Germany	171	6.4	21	30.0	United States	223	8.4	98	5.7
5	Russia	137	5.2	21	15.0	Russia	176	6.7	44	19.7
6	Korea	112	4.2	14	40.0	Norway	124	4.7	30	99.3
7	United Kingdom	90	3.4	13	23.0	Japan	94	3.6	45	9.0
8	Canada	77	2.9	12	13.0	Sweden	79	3.0	..	49.0
9	Ukraine	76	2.9	11	44.0	France	79	3.0	25	14.3
10	Sweden	72	2.7	9	45.0	India	74	2.8	24	12.8
Total top 10 producers		2 284	86.1	303	...	1 727		65.3	471	...
Rest of world ⁴		369	13.9	53	...	919		34.7	284	...
Total world		2 653	100.0	356	17.0	2 646		100.0	755	17.0

Notes:

1. Percentage of nuclear in total domestic electricity generation.

2. Based on production.

3. Percentage of hydro in total domestic electricity generation.

4. Countries with nuclear or hydro production only.

Source:

International Energy Agency, 2003, *Key World Energy Statistics*, www.iea.org (accessed April 28, 2004).

1 State of our energy resources

Canada has many types of energy resources. From coal, oil and gas, to uranium and the water that produces hydro electricity, our primary energy sources¹ rank us among the world's leading producers of energy.

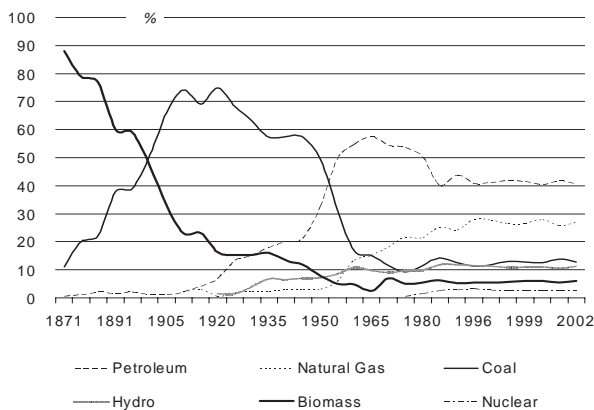
In the 1870s, wood provided almost 90% of Canada's energy needs. Today no single energy source is dominant (Figure 1.1). New energy technologies and improvements in the use of existing energy sources have helped make our current energy mix possible.

Canada moved from consuming more energy than it produced to being a significant net exporter of energy in 1967 (Figure 1.2). Since that time, primary energy production has grown to outstrip consumption by 45% (Table 1.3).

The production and distribution of energy is an important economic activity in Canada. Canadian primary energy production has doubled since the early 1970s (Figure 1.3), with natural gas responsible for the bulk of this increase. The production of all other primary energy sources has also increased.

In 2001, the value of Canadian energy exports amounted to \$55.1 billion, or 14% of all exports. These energy exports,

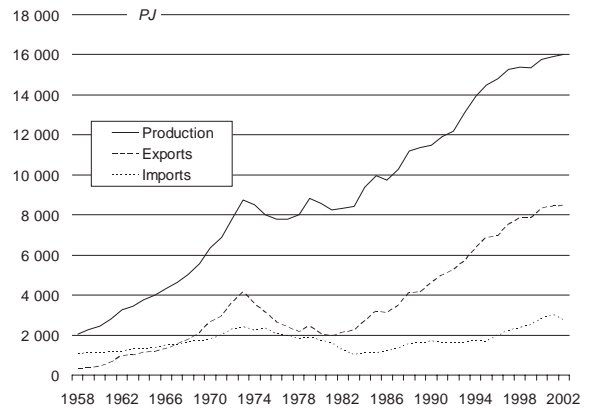
Figure 1.1
Energy consumption by primary energy source, 1871 to 2002



Source: Natural Resources Canada, n.d., *Schema of Energy Indicators for Sustainable Development*, www2.nrcan.gc.ca/es/es/sdi/English/SD_Indicators_web.pdf (accessed April 28, 2004).

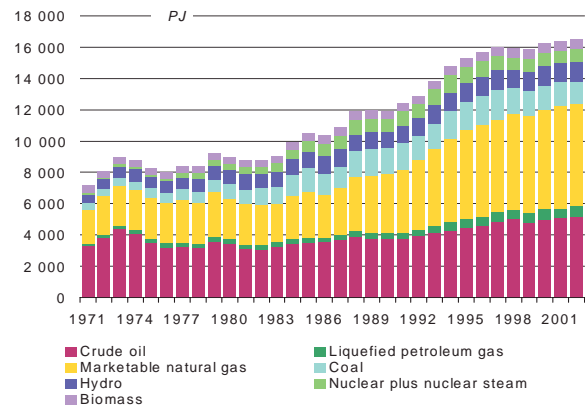
1. A primary energy source is an energy source that is either consumed directly in the form in which it is produced or converted into secondary energy sources and then consumed. The primary energy sources used in Canada are coal, crude oil, natural gas and its associated liquids (ethane, butane, propane and pentanes plus), hydro and other renewable sources of electricity, and nuclear electricity.

Figure 1.2
Primary energy production, exports and imports, 1958 to 2002



Source: Statistics Canada, Environment Accounts and Statistics Division.

Figure 1.3
Primary energy production by source, 1971 to 2002



Source: Natural Resources Canada, n.d., *Schema of Energy Indicators for Sustainable Development*, www2.nrcan.gc.ca/es/es/sdi/English/SD_Indicators_web.pdf (accessed April 28, 2004).

which flow primarily to the United States, were about 62% of annual oil production and 55% of annual gas production in 2001. In 2002, the energy sector directly employed 324 000 persons or 2.5% of the Canadian work force.²

With the exception of brief periods during the recessions of 1982 and 1991, total consumption of primary energy has been on the increase since 1958 (Table 1.4). Energy consumption per capita has followed the same trend, rising continuously except during the 1982 and 1991 recessions. In contrast, energy consumption per dollar of inflation-

2. Statistics Canada, CANSIM, table 281-0024.

Table 1.3
Production and consumption¹ of primary energy resources, 1958 to 2002

Year	Coal		Crude oil		Natural gas ²		Electricity ³		Total	
	Production	Consumption	Production	Consumption	Production	Consumption	Production	Consumption	Production	Consumption
TJ										
1958	263 975	637 271	1 020 859	1 490 275	437 088	366 256	325 683	358 649	2 047 605	2 852 451
1959	240 377	625 320	1 144 630	1 644 153	517 304	433 488	350 028	334 498	2 252 338	3 037 459
1960	244 418	559 287	1 192 301	1 715 098	624 773	496 872	381 003	362 454	2 442 495	3 133 711
1961	234 489	547 655	1 404 934	1 802 978	774 922	579 330	373 937	363 994	2 788 282	3 293 957
1962	229 599	556 731	1 601 832	1 903 300	1 044 080	661 570	374 490	369 691	3 250 001	3 491 293
1963	239 665	598 128	1 709 818	2 049 921	1 127 634	720 897	373 937	371 316	3 451 054	3 740 263
1964	253 348	620 641	1 835 513	2 091 638	1 255 120	809 498	408 360	404 624	3 752 340	3 926 401
1965	255 521	647 683	1 955 978	2 167 589	1 356 473	894 794	421 667	421 274	3 989 639	4 131 339
1966	247 496	634 962	2 136 681	2 327 897	1 466 721	981 519	467 769	463 525	4 318 667	4 407 903
1967	247 777	629 097	2 332 727	2 371 570	1 568 068	1 044 722	478 186	478 859	4 626 758	4 524 248
1968	234 133	683 468	2 520 354	2 544 142	1 776 261	1 159 897	488 768	490 434	5 019 516	4 877 941
1969	227 407	659 869	2 746 152	2 653 888	2 047 114	1 294 439	538 818	533 133	5 559 491	5 141 328
1970	354 634	708 448	3 087 416	2 860 028	2 349 711	1 418 190	567 381	558 794	6 359 142	5 545 461
1971	405 139	673 351	3 297 078	3 118 881	2 566 442	1 518 032	593 628	579 442	6 862 288	5 889 706
1972	460 770	635 417	3 803 963	3 424 584	2 899 986	1 710 604	671 751	640 604	7 836 470	6 411 208
1973	496 434	654 390	4 385 206	3 770 655	3 108 262	1 817 662	745 212	694 703	8 735 114	6 937 409
1974	526 092	664 922	4 120 340	3 930 715	3 041 698	1 850 945	808 912	762 283	8 497 041	7 208 865
1975	633 668	657 563	3 528 342	3 805 636	3 092 605	1 873 331	770 960	744 198	8 025 575	7 080 727
1976	619 975	709 029	3 235 522	3 769 982	3 107 651	1 912 329	824 819	791 664	7 787 967	7 183 004
1977	685 448	772 789	3 240 618	4 003 822	2 977 742	1 699 212	881 594	819 730	7 785 402	7 295 553
1978	743 553	788 597	3 194 640	4 017 147	3 106 827	1 957 312	948 475	878 300	7 993 495	7 641 356
1979	811 421	876 372	3 600 201	4 327 941	3 382 338	2 059 052	1 019 185	912 675	8 813 145	8 176 040
1980	891 070	928 409	3 444 041	4 216 120	3 180 730	2 116 374	1 052 072	953 991	8 567 913	8 214 894
1981	969 542	947 942	3 093 450	3 911 507	3 080 003	2 010 520	1 114 624	992 669	8 257 619	7 862 638
1982	1 028 279	1 001 681	3 052 121	3 359 122	3 163 161	2 040 386	1 093 191	980 277	8 336 752	7 381 466
1983	1 066 011	1 048 015	3 232 271	3 201 037	2 980 532	2 027 274	1 150 257	1 020 347	8 429 071	7 296 673
1984	1 396 400	1 167 377	3 430 899	3 183 745	3 311 332	2 292 108	1 235 057	1 094 325	9 373 688	7 737 555
1985	1 487 132	1 122 086	3 516 525	3 085 568	3 622 687	2 532 461	1 313 821	1 168 658	9 940 165	7 908 773
1986	1 382 118	1 039 979	3 531 205	3 055 190	3 458 952	2 480 595	1 381 010	1 258 688	9 753 285	7 834 452
1987	1 393 936	1 117 744	3 690 859	3 172 058	3 766 024	2 574 349	1 416 413	1 258 110	10 267 232	8 122 261
1988	1 614 195	1 200 307	3 877 941	3 359 461	4 313 054	2 809 862	1 390 669	1 290 430	11 195 859	8 660 060
1989	1 718 400	1 197 786	3 769 304	3 423 980	4 552 627	3 025 526	1 331 644	1 297 953	11 371 975	8 945 245
1990	1 673 101	1 136 171	3 765 187	3 874 090	4 574 109	2 899 032	1 321 912	1 320 656	11 334 309	9 229 949
1991	1 747 976	1 099 786	3 765 443	3 726 587	4 805 528	2 922 760	1 408 181	1 341 838	11 727 128	9 090 971
1992	1 553 530	1 120 353	3 931 692	3 615 091	5 298 028	3 116 689	1 414 322	1 324 135	12 197 572	9 176 268
1993	1 651 313	994 715	4 116 941	3 741 690	5 832 901	3 196 872	1 479 535	1 380 835	13 080 690	9 314 112
1994	1 735 269	1 054 689	4 299 874	3 808 804	6 331 888	3 312 684	1 546 239	1 388 145	13 913 270	9 564 322
1995	1 800 811	1 056 083	4 457 769	3 801 848	6 711 568	3 434 306	1 532 656	1 402 976	14 502 804	9 695 213
1996	1 832 286	1 099 131	4 590 726	3 984 463	6 932 462	3 563 509	1 585 629	1 450 067	14 941 103	10 097 170
1997	1 897 322	1 168 601	4 842 646	4 087 294	7 012 563	3 540 975	1 531 890	1 403 258	15 284 421	10 200 128
1998	1 651 482	1 287 709	5 021 730	4 090 494	7 269 299	3 488 847	1 426 237	1 327 829	15 368 748	10 194 879
1999	1 589 310	1 278 044	4 788 758	4 167 500	7 498 476	3 695 016	1 481 669	1 377 703	15 358 213	10 518 263
2000	1 509 905	1 330 940	4 999 607	4 251 781	7 734 303	3 852 022	1 524 557	1 396 249	15 768 372	10 830 992
2001	1 532 994	1 421 952	5 056 168	4 388 726	7 857 807	3 775 073	1 447 914	1 364 650	15 894 883	10 950 401
2002	1 429 897	1 324 975	5 204 851	4 325 400	7 882 243	3 992 363	1 505 402	1 433 295	16 022 393	11 076 033

Notes:

1. Defined as the amount that was available for use in the Canadian economy. Includes the use of energy resources for non-energy purposes (e.g., petrochemical feedstocks in fertilizer production). Excludes the use of wood and wastes as energy sources.

2. Includes natural gas liquids (ethane, butane, propane and pentanes plus).

3. Includes primary steam.

Source:

Statistics Canada, CANSIM, table 128-0002.

adjusted (real) gross domestic product (GDP) began to fall following the 1974 oil crisis. This decline suggests that the fourfold increase in crude oil prices that resulted from the oil crisis (Figure 1.4) provided real incentives to conserve energy.

1.1 Non-renewable energy resources

In Canada, most primary fuels (oil, gas, coal and uranium) are found in the western provinces and off the east coast (oil and gas). Oil, gas, coal and uranium are mined or extracted; supplies of these are finite. Hydro electricity, Canada's major source of renewable energy, is produced at varying levels in every province and territory except for Prince

Table 1.4
Basic energy indicators, 1958 to 2002

Year	Consumption ¹ of primary energy	Population	Real GDP	Energy consumption per capita	Energy consumption per dollar of real GDP																																							
						PJ	thousands	\$ million chained 1997	GJ/person	MJ/ \$ chained 1997																																		
											1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1958	2 852.5	17 120	..	166.6	..																																							
1959	3 037.5	17 522	..	173.4	..																																							
1960	3 133.7	17 909	..	175.0	..																																							
1961	3 294.0	18 271	245 230	180.3	13.43																																							
1962	3 491.3	18 614	262 382	187.6	13.31																																							
1963	3 740.3	18 964	276 306	197.2	13.54																																							
1964	3 926.4	19 325	294 196	203.2	13.35																																							
1965	4 131.3	19 678	312 930	209.9	13.20																																							
1966	4 407.9	20 048	333 724	219.9	13.21																																							
1967	4 524.2	20 412	343 454	221.6	13.17																																							
1968	4 877.9	20 729	360 214	235.3	13.54																																							
1969	5 141.3	21 028	378 344	244.5	13.59																																							
1970	5 545.5	21 324	389 809	260.1	14.23																																							
1971	5 889.7	21 962	405 860	268.2	14.51																																							
1972	6 411.2	22 218	427 962	288.6	14.98																																							
1973	6 937.4	22 492	457 766	308.4	15.15																																							
1974	7 208.9	22 808	474 663	316.1	15.19																																							
1975	7 080.7	23 143	483 316	306.0	14.65																																							
1976	7 183.0	23 450	508 445	306.3	14.13																																							
1977	7 295.6	23 726	526 028	307.5	13.87																																							
1978	7 641.3	23 963	546 825	318.9	13.97																																							
1979	8 176.0	24 202	567 631	337.8	14.40																																							
1980	8 214.9	24 516	579 907	335.1	14.17																																							
1981	7 862.6	24 820	600 253	316.8	13.10																																							
1982	7 381.5	25 117	583 089	293.9	12.66																																							
1983	7 299.9	25 367	598 941	287.8	12.19																																							
1984	7 737.5	25 608	633 756	302.2	12.21																																							
1985	7 908.8	25 843	664 059	306.0	11.91																																							
1986	7 834.4	26 101	680 144	300.2	11.52																																							
1987	8 122.2	26 449	709 058	307.1	11.45																																							
1988	8 660.1	26 795	744 333	323.2	11.63																																							
1989	8 945.2	27 282	763 837	327.9	11.71																																							
1990	9 229.9	27 698	765 311	333.2	12.06																																							
1991	9 091.0	28 031	749 294	324.3	12.13																																							
1992	9 176.3	28 367	755 848	323.5	12.14																																							
1993	9 314.1	28 682	773 528	324.7	12.04																																							
1994	9 564.3	28 999	810 695	329.8	11.80																																							
1995	9 695.2	29 302	833 456	330.9	11.63																																							
1996	10 097.2	29 611	846 952	341.0	11.92																																							
1997	10 200.1	29 907	882 733	341.1	11.56																																							
1998	10 194.9	30 157	918 910	338.1	11.09																																							
1999	10 518.3	30 404	969 750	346.0	10.85																																							
2000	10 831.0	30 689	1 020 786	352.9	10.61																																							
2001	10 950.4	31 021	1 040 388	353.0	10.53																																							
2002	11 076.0	31 362	1 074 516	353.2	10.31																																							

Note:

1. Defined as the amount which was available for use in the Canadian economy. Includes the use of energy resources for non-energy purposes (e.g., petrochemical feedstocks in fertilizer production). Excludes the use of wood and wastes as energy sources.

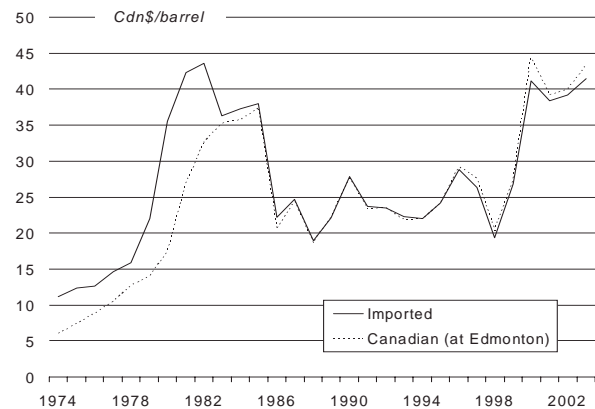
Source:

Statistics Canada, CANSIM, tables 051-0005, 128-0002 and 380-0017.

Edward Island. Nuclear power generation is concentrated mainly in Ontario and to a far lesser extent in both New Brunswick and Quebec. Secondary energy sources,¹ such

1. Secondary energy sources refer to types of energy created using primary energy sources such as coal and natural gas. The major secondary energy source in Canada is thermal power generation used to produce electricity.

Figure 1.4
Crude oil prices, 1974 to 2003

**Source:**

Natural Resources Canada, Oil Division.

as thermal-electric power plants, can be found across the country.

Oil and gas

Throughout the world, oil and gas are found in sedimentary rock below the earth's surface, both on land and under the ocean. In Canada, the region that produces the most oil and gas is the Western Canada Sedimentary Basin (Map 1.1). This region holds the Alberta oil sands,² which are found in three areas of Alberta: Athabasca, Peace River and Cold Lake. These deposits contain bitumen, a thick, sticky form of crude oil. Canada's oil sands are estimated to contain more petroleum than the conventional oil deposits of the Middle East.³

Natural gas replaced crude oil as the most important primary energy source in terms of production in the late 1980s (Table 1.3). By 2002, it represented almost 50% of total primary energy production, up from 21% in 1958. Oil experienced a reverse trend over the same time period, falling from 50% to 32% of total primary energy production. From 1958 to 2002 the consumption of natural gas increased at a much faster rate than any of the other primary energy sources.

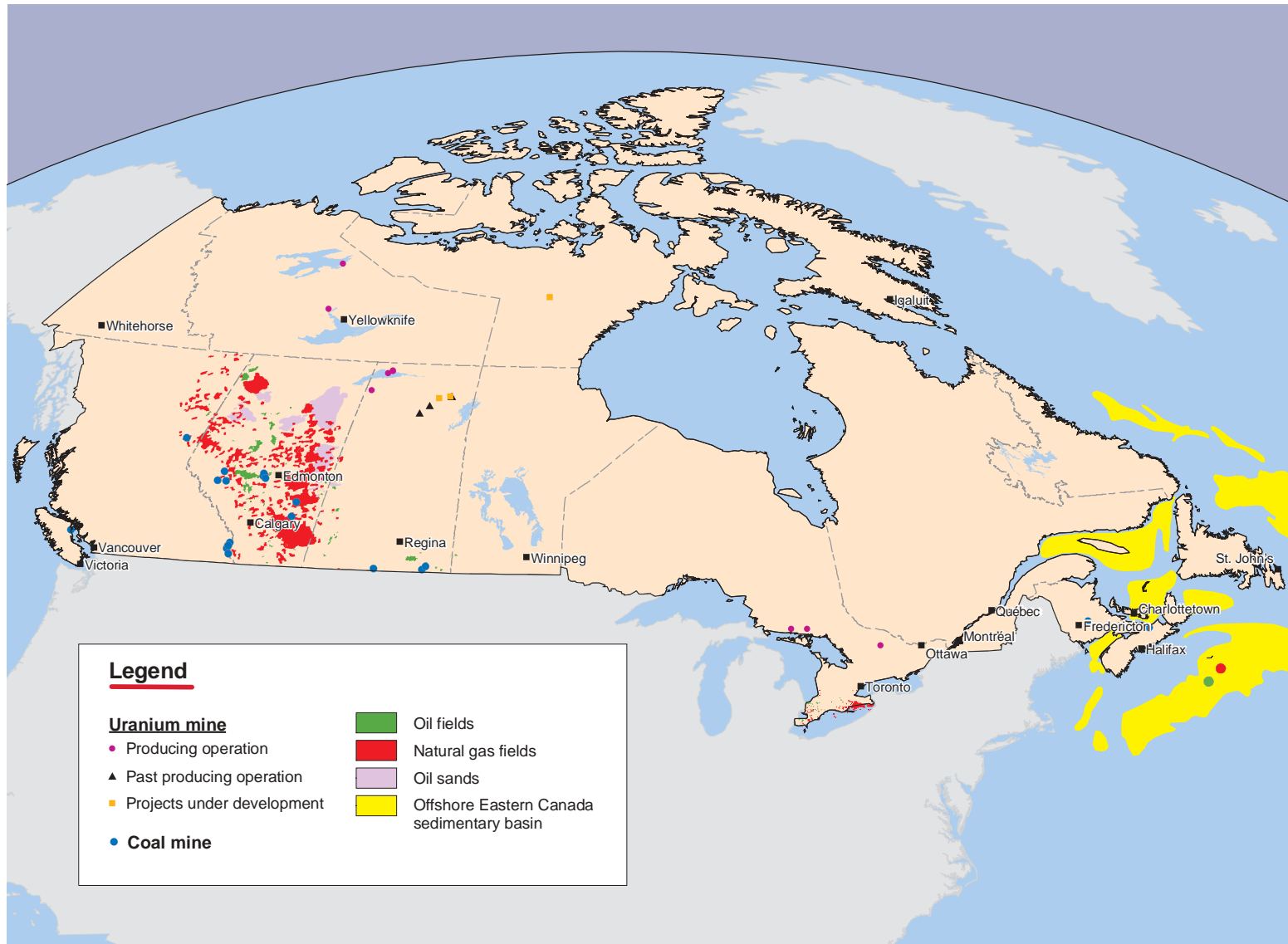
Coal

Coal reserves in Canada are widespread, from British Columbia to Cape Breton Island (Map 1.1). The main types of coal found in Canada are anthracite, bituminous, sub-bituminous and lignite. In 2002, Canadian coal mines

2. The Alberta oil sands contain a mixture of bitumen, water, sand and clay.

3. Centre for Energy, n.d., *Canada: A vast land with abundant energy resources*, www.centreforenergy.com (accessed February 5, 2004).

Map 1.1
Uranium, coal, oil and gas production locations in Canada, 2002



Sources:
 Natural Resources Canada, n.d., *Mineral and Metal Commodity Reviews: Uranium*, www.nrcan.gc.ca/mms/cmy/com_e.html (accessed March 25, 2004).
 Natural Resources Canada, n.d., *Mineral and Metal Commodity Reviews: Coal*, www.nrcan.gc.ca/mms/cmy/com_e.html (accessed March 25, 2004).
 Petroleum Communication Foundation, 1999, *Our Petroleum Challenge*, Calgary, www.centreforenergy.com (accessed June 21, 2004).
 Statistics Canada, Environment Accounts and Statistics Division.

Table 1.5
Coal production, 2001 and 2002

Province	2001		2002 ^P	
	Quantity t	Value \$ thousand	Quantity t	Value \$ thousand
Nova Scotia	x	x	x	x
New Brunswick	165 000	19 923	194 000	22 088
Saskatchewan	x	x	x	x
Alberta	30 911 000	389 377	30 758 000	386 698
British Columbia	27 007 000	959 292	24 373 000	1 024 311
Total	70 354 500	1 557 115	66 822 000	1 593 091

Sources:

Natural Resources Canada and Statistics Canada.

Table 1.6
Operating nuclear reactors in Canada, 2004

Unit	Number of reactors	Total capacity
		MW
Pickering A ¹ (Ontario)	1	542
Pickering B (Ontario)	4	2 160
Darlington (Ontario)	4	3 740
Bruce A ² (Ontario)	2	1 610
Bruce B (Ontario)	4	3 360
Gentilly 2 (Quebec)	1	675
Point Lepreau (New Brunswick)	1	680

Notes:

1. Three reactors at Pickering A, with a total capacity of 1 626 MW, will be returning to service. Dates are to be determined.

2. Two reactors at Bruce A, with a total capacity of 1 650 MW, will be returning to service. Dates are to be determined.

Source:Canadian Nuclear Association, n.d., www.cna.ca/english/nuclear.asp (accessed May 31, 2004).

produced almost 67 million tonnes of coal (Table 1.5), most of which was exported as metallurgical coal to make steel.¹

Canadian coal production peaked in the mid-1990s and began a downward trend just as the domestic consumption of coal began to increase (Table 1.3). By 2002, production exceeded consumption by only 8%. Coal has lost share of total primary energy production since 1958, dropping from 22% to 12%.

Nuclear power (uranium)

Nuclear power plants in Canada use steam generated through the fission of uranium fuel to produce electricity. As shown in Map 1.2 and Table 1.6, nuclear power is produced in Ontario, New Brunswick and Quebec.

Canada produces more uranium than any other country in the world. All uranium mining in Canada occurs in the Athabasca basin of northern Saskatchewan (Map 1.1). In 2001, Canada produced 12 522 tonnes of uranium (Table 1.7). Of this, 10 031 tonnes was exported, representing 34% of the world uranium supply for that year.²

1. Natural Resources Canada, n.d., *Mineral and Metal Commodity Reviews: Coal*, www.nrcan.gc.ca/mms/cmy/com_e.html (accessed March 25, 2004).

Table 1.7
Uranium production in Canada¹, 1999 to 2001

Location	Annual output		
	1999	2000	2001
	t		
Cluff Lake	1 234	1 443	1 288
Key Lake	3 715	402	299
Rabbit Lake	2 705	2 790	1 755
McClellan Lake	560	2 308	2 540
McArthur River	0	3 740	6 639
Cigar Lake (preproduction)	0	0	0
Total	8 214	10 683	12 522

Note:

1. All uranium in Canada is produced in Saskatchewan's Athabasca Basin.

Source:

Canadian Nuclear Safety Commission open files, company annual reports.

Stocks of non-renewable energy sources

Three measures are used to evaluate stocks of energy resources: established reserves, reserve life and total resource base (Text Box 1.1).

Established crude oil reserves declined by over one-half from 1976 to 2001 (Table 1.8). This drop is mainly attributable to a declining rate of additions to reserves rather than to an increasing rate of extraction. As a result of the decline, the reserve life of crude oil fell from about 14 years in 1976 to 7 years in 2001.

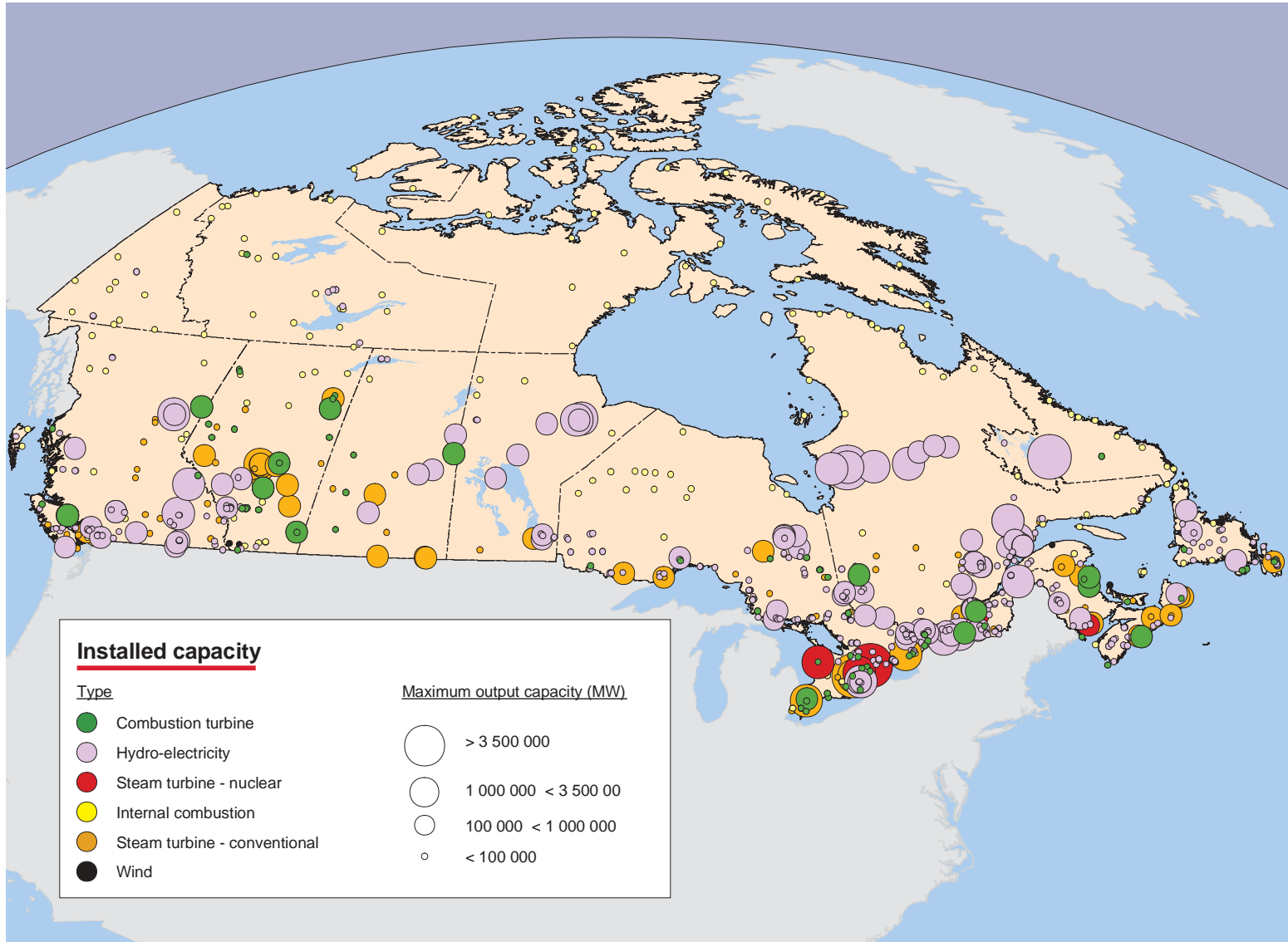
Text Box 1.1

Evaluation criteria for resource stocks

- **Established reserves** are defined as all existing oil and gas wells, coal seams, etc. that can be profitably exploited under current economic and technological conditions. Established reserves fluctuate from year to year as existing deposits are depleted and new deposits are added (or previously non-economic deposits are reclassified as a result of changing technological and economic conditions). A constant reserve size means that current rates of depletion are exactly offset by new additions and reclassifications.
- **Reserve life** is the ratio of the size of established reserves to that of current annual extraction. It provides a measure of the number of years that reserves will last at current rates of extraction.
- **Total energy resource base** provides an estimate of the energy resources that may ultimately be available in the future, regardless of current prices, technology and knowledge. These estimates are subject to a large degree of uncertainty.

2. Natural Resources Canada, n.d., *Mineral and Metal Commodity Reviews: Uranium*, www.nrcan.gc.ca/mms/cmy/com_e.html (accessed March 25, 2004).

Map 1.2
Electricity production by type of generation, 2001



Sources:
 Statistics Canada, Manufacturing, Construction and Energy Division.
 Statistics Canada, 2004, *Electric Power Generation, Transmission and Distribution, 2002*, Catalogue no. 57-202-XIB, Ottawa.
 Statistics Canada, Environment Accounts and Statistics Division.

Table 1.8
Established energy resource reserves, 1976 to 2001

Year	Coal ¹		Crude oil		Crude bitumen		Natural gas ²		Uranium	
	Reserves	Reserve life	Reserves	Reserve life	Reserves	Reserve life	Reserves	Reserve life	Reserves	Reserve life
	Mt	years	million m ³	years	million m ³	years	billion m ³	years	kt	years
1976	4 310.7	169.2	1 014.6	13.9	150.7	39.7	1 738.7	26.5	405	74.5
1977	4 117.0	144.3	969.1	13.3	111.2	32.7	1 790.8	24.9	415	71.7
1978	4 092.6	134.3	942.7	13.0	321.5	68.4	1 911.8	25.2	438	53.3
1979	4 021.8	121.1	903.3	11.2	353.1	47.7	1 977.6	24.1	468	71.7
1980	4 192.5	114.3	860.7	11.4	333.9	32.4	2 028.9	27.9	444	65.9
1981	4 159.9	103.8	827.8	12.4	325.0	36.5	2 085.5	27.0	340	45.3
1982	5 704.0	133.2	780.6	12.1	315.6	33.6	2 148.4	31.1	376	49.2
1983	5 981.0	133.5	792.4	11.6	310.4	17.9	2 126.6	28.7	333	48.8
1984	6 120.6	106.6	776.3	10.6	328.8	28.3	2 106.7	27.4	260	25.3
1985	6 011.8	99.5	790.5	11.2	343.4	22.3	2 080.5	24.9	263	25.2
1986	6 338.9	109.7	774.6	11.4	574.4	30.4	2 032.8	25.7	265	23.0
1987	6 583.5	107.6	753.6	10.9	572.5	28.5	1 956.0	24.6	258	19.0
1988	6 542.3	92.6	739.2	10.2	566.5	26.5	1 931.9	19.0	248	20.6
1989	6 472.6	91.8	707.8	10.3	542.2	23.4	1 957.8	19.0	249	22.6
1990	6 580.7	96.3	657.3	9.6	524.0	23.1	1 979.2	18.0	295	30.3
1991	6 545.2	92.0	614.9	9.2	501.7	22.2	1 965.8	19.9	305	37.4
1992	6 522.1	99.4	590.4	8.5	482.2	20.3	1 929.8	15.3	309	33.9
1993	6 449.4	93.4	526.5	6.7	457.6	18.6	1 860.5	13.1	313	36.0
1994	6 372.2	87.5	532.2	6.7	565.0	23.5	1 833.3	12.8	300	26.8
1995	6 293.4	83.9	553.0	7.2	574.0	20.4	1 841.5	12.3	484	47.3
1996	6 210.7	81.9	526.5	6.7	660.8	23.5	1 726.4	11.1	430	37.9
1997	6 132.0	77.9	532.2	6.7	614.0	18.7	1 620.9	10.2	419	37.7
1998	6 056.9	80.6	528.4	6.9	1 336.0	35.2	1 562.6	9.6	433	43.3
1999	5 502.1	75.9	504.0	7.0	1 891.1	52.5	1 527.2	9.1	417	41.1
2000	4 722.8	68.3	507.7	7.1	1 860.0	47.7	1 536.9	9.1	437	44.1
2001	4 555.4	66.6	493.7	7.0	1 830.0	43.6	1 529.1	8.7	452	34.8

Notes:

1. Includes bituminous, sub-bituminous and lignite coal.

2. Includes natural gas liquids (ethane, butane, propane and pentanes plus).

Source:

Statistics Canada, Environment Accounts and Statistics Division.

In contrast to crude oil, established reserves of crude bitumen (tar sands) increased over tenfold from 1976 to 2001. The largest increase occurred from 1997 to 1998, when reserves of bitumen more than doubled.

Established reserves of natural gas increased between 1976 and 1982 and declined steadily thereafter, reflecting increased rates of extraction. Reserves of uranium, however, decreased substantially between 1976 and 1989, and then increased. Reserve life declined for both resources.

Established coal reserves peaked around 1990. Reserve life remained high at about 67 years in 2001, even though it had declined by 61% since 1976.

Total energy resource base

The total energy resource base comprises both 'discovered' and 'undiscovered' resources. Discovered resources have been shown to exist by drilling, testing or production; they are further classified into subgroups (Text Box 1.2). Undiscovered resources are estimated to exist, based on geological and geophysical evidence.

The estimated total crude oil resource base for 2002 was 9.3 billion m³. Of this, cumulative production had consumed

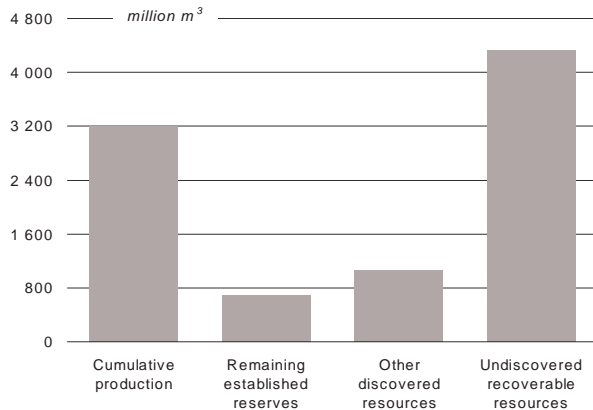
3.2 billion m³, while remaining established reserves represented another 691 million m³. Other discovered resources represented a further 1.1 billion m³. Undiscovered resources were thought to be on the order of 4.3 billion m³, of which 3.7 billion m³ was believed to be situated in frontier (undeveloped) areas (Figure 1.5).

The estimated total natural gas resource base in 2002 was 15.9 trillion m³, which includes both conventional and unconventional gas resources.¹ Of this, cumulative production had consumed 3.8 trillion m³ and remaining established reserves represented another 1.6 trillion m³. Other discovered resources made up 909 billion m³. Undiscovered resources were estimated to be 9.6 trillion m³, of which 5.4 trillion m³ were thought to remain in frontier basins (Figure 1.6).

The estimated total crude bitumen resource base in 2002 was a substantial 49 billion m³. Cumulative production had used just 620 million m³ (just over 1%). Remaining established reserves represented another 27.7 billion m³; and other discovered resources made up the rest of the

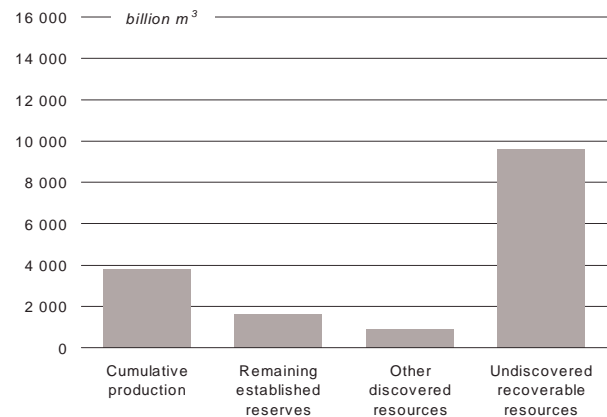
1. Conventional natural gas is found in porous and permeable reservoirs and can be economically produced using normal production practices. Unconventional natural gas (e.g. coal bed methane) is contained in reservoir rock that requires additional stimulus to allow gas to flow.

Figure 1.5
Crude oil resource base, 2002



Source:
National Energy Board, Commodities Business Unit.

Figure 1.6
Natural gas resource base, 2002



Source:
National Energy Board, Commodities Business Unit.

Text Box 1.2

Classification of discovered energy resources

Discovered resources are classified into the following subgroups:

- **Cumulative production** is the portion that has been produced since extraction of the resource began in Canada.
- **Remaining established reserves** are established reserves minus cumulative production.
- **Other discovered resources** refers to existing reserves that are not presently viable because of economic or technical conditions. Their viability requires an increase in selling prices, or a reduction in costs as a result of technological change or the construction of new infrastructure. In frontier areas, other discovered resources refers to resources that have been discovered by drilling, but that are waiting for suitable transportation schemes to allow production to begin.

estimated total resource base. No estimate was made for undiscovered resources as they are expected to be insignificant relative to the size of the discovered resource.¹

The remaining crude oil resource base in Canada is clearly overshadowed by the crude bitumen resource base. Given this, and the fact that cumulative production of crude bitumen was nearly negligible in comparison with the total resource base in 2002, crude bitumen appears very likely to

1. National Energy Board, 1999, *Canadian Energy: Supply and Demand to 2025*, Catalogue no. NE23-15/1999E, Calgary.

replace crude oil one day as the principal domestic source of petroleum.

The total coal resource base was estimated to be 78.9 billion tonnes in 1989. By 2001, remaining established reserves were estimated at 6.2 billion tonnes.² Data on cumulative production, other discovered resources and undiscovered coal resources are not available.

No estimates of Canada's total uranium resource base are currently available. However, as of January 2003, recoverable uranium resources were estimated to be 439 000 tonnes.³

Thermal electricity

Thermal-electric power plants use fossil fuels such as coal, oil or natural gas to generate steam, which is used to produce electricity. Table 1.9 shows the installed capacity and total generated electricity of thermal-electric power plants by province for 2002. Map 1.2 shows the distribution of these power plants across the country. While the majority of our electricity is generated by primary sources such as hydro electric and nuclear power, 28% of the supply in 2002 was provided by coal, oil and gas (Figure 1.7).⁴

Coal is the predominant source of fuel for thermal-electric power production in Canada (Table 1.10). The proportion of natural gas used in the generation of thermal electricity has increased substantially since the early 1990s.

2. National Energy Board, 2003, *Canada's Energy Future: Scenarios for Supply and Demand to 2025*, Catalogue no. NE23-15/2003E, Calgary.

3. Natural Resources Canada, n.d., *Mineral and Metal Commodity Reviews: Uranium*, www.nrcan.gc.ca/mms/cmy/com_e.html (accessed March 25, 2004).

4. Statistics Canada, 2003, *Report on Energy Supply and Demand in Canada, 2002*, Catalogue no. 57-003-XIB, Ottawa.

**Table 1.9
Thermal-electric installed capacity and generated electricity by province and territory, 2002**

Province/Territory	Installed thermal generating capacity ¹	Generation of thermal electric energy	Total electric energy generated
	MW	MWh	
Newfoundland and Labrador	726	2 708 612	44 124 516
Prince Edward Island	113	19 469	38 885
Nova Scotia	1 918	11 063 897	12 126 906
New Brunswick	2 565	11 874 855	17 882 725
Quebec	1 939	1 906 323	177 148 710
Ontario	12 547	52 951 628	154 334 732
Manitoba	383	616 601	29 437 135
Saskatchewan	2 662	15 090 761	17 969 669
Alberta	9 838	59 725 670	61 609 119
British Columbia	2 234	6 456 939	65 334 858
Yukon Territory	48	37 939	312 118
Northwest Territories and Nunavut	158	461 949	743 484
Canada	35 131	162 914 643	581 062 857

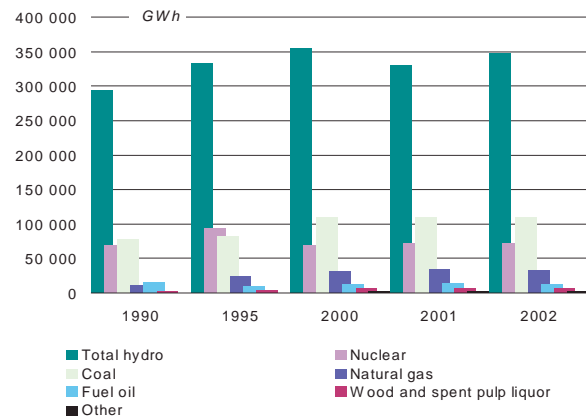
Note:

1. Nameplate rating in megawatts.

Source:

Statistics Canada, 2004, *Electric Power Generation, Transmission and Distribution, 2002*, Catalogue no. 57-202-XIB, Ottawa.

**Figure 1.7
Electricity production by source, 1990 to 2002**



Source:

Natural Resources Canada, n.d., *Schema of Energy Indicators for Sustainable Development*, www2.nrcan.gc.ca/es/es/sdi/English/SD_Indicators_web.pdf (accessed April 28, 2004).

**Table 1.10
Energy consumed in thermal-electric power stations by fuel type, 1980 to 2002**

Year	Coal				Lignite TJ	Fuel oil			Natural gas	Wood
	Canadian bituminous	Imported bituminous	Canadian sub-bituminous	Imported sub-bituminous		Heavy	Light and diesel			
1980	108 955	249 422	183 478	..	77 541	105 286	12 619	71 159	..	
1981	123 737	261 758	196 493	..	83 624	70 106	11 105	51 057	..	
1982	114 238	283 650	227 007	..	102 310	77 043	10 724	42 124	..	
1983	126 315	279 586	254 165	..	121 137	45 627	9 559	33 454	..	
1984	139 267	297 373	290 931	..	131 173	42 030	9 210	23 619	..	
1985	145 449	227 090	317 016	..	134 416	47 958	9 104	23 259	..	
1986	119 666	188 934	321 289	..	117 393	43 598	9 175	17 316	..	
1987	151 508	229 026	340 572	..	142 376	75 702	9 987	20 619	..	
1988	162 522	244 213	364 652	..	170 660	99 195	8 504	40 419	..	
1989	163 602	245 290	369 774	..	155 005	154 053	12 136	102 753	..	
1990	150 746	183 215	384 276	..	134 968	137 048	12 158	50 530	..	
1991	170 019	212 996	430 106	..	131 390	112 131	11 813	41 525	..	
1992	159 353	195 313	392 792	..	141 328	132 502	10 346	99 820	..	
1993	141 190	118 909	436 468	..	144 378	93 734	11 104	126 992	..	
1994	123 014	131 018	478 936	..	150 410	70 834	9 909	154 846	..	
1995	122 419	146 541	477 598	..	153 209	79 934	11 088	149 890	..	
1996	132 402	169 149	458 122	..	159 646	61 305	10 418	105 074	..	
1997	112 114	216 821	475 008	22 193	169 137	99 336	8 691	154 899	..	
1998	90 160	281 115	468 503	40 004	177 657	147 675	8 015	200 450	14 959	
1999	84 148	300 861	445 127	63 881	170 501	119 554	7 782	204 930	17 112	
2000	47 231	381 795	437 491	126 800	166 262	108 955	7 632	273 301	21 024	
2001	51 580	351 178	450 912	140 385	169 140	127 541	8 172	333 946	27 293	
2002	45 823	305 444	465 280	143 415	166 599	111 800	7 178	278 613	27 620	

Sources:

Statistics Canada, *Electric Power Generation, Transmission and Distribution*, Catalogue no. 57-202-XPB, Ottawa, various issues.

Statistics Canada, *Electric Power Generation, Transmission and Distribution*, Catalogue no. 57-202-XIB, Ottawa, various issues.

Measured by the amount of energy generated, the use of coal in thermal-electric power production was responsible for the generation of over twice as much electricity as other fossil fuels in 2001 (Table 1.11).

Alberta and Ontario use the most coal to generate electricity at thermal-electric power stations.¹ Natural gas, which has a lower environmental impact than coal when burned, is also important in these provinces.

1. Statistics Canada, 2004, *Electric Power Generation, Transmission and Distribution, 2002*, Catalogue no. 57-202-XIB, Ottawa.

Table 1.11
Net energy generation in thermal-electric power stations by fuel type, 1980 to 2002

Year	Coal				Fuel oil					
	Canadian bituminous	Imported bituminous	Canadian sub-bituminous	Imported sub-bituminous	Lignite	Heavy	Light and diesel	Natural gas	Wood	
	TJ									
1980	34 102	89 540	58 612	..	21 133	34 564	3 102	19 175	..	
1981	36 693	92 867	62 547	..	22 972	22 451	3 256	13 097	..	
1982	37 070	100 930	71 820	..	27 892	25 852	3 062	11 030	..	
1983	40 109	100 592	80 439	..	33 222	14 658	2 791	8 615	..	
1984 ¹	46 928	106 065	90 662	..	38 555	13 554	2 735	5 777	..	
1985	48 576	80 331	98 869	..	38 025	15 419	2 710	5 773	..	
1986 ¹	42 038	69 406	109 398	..	36 947	15 385	2 865	4 349	..	
1987 ¹	53 808	84 830	116 663	..	45 297	27 065	2 995	5 649	..	
1988 ¹	58 411	90 953	125 044	..	52 989	35 833	2 463	11 727	..	
1989 ¹	58 285	91 097	123 637	..	48 603	54 493	3 913	32 494	..	
1990 ¹	53 613	66 888	132 608	..	42 661	49 113	3 715	14 887	..	
1991 ¹	57 684	74 519	139 965	..	40 808	39 965	3 434	12 327	..	
1992 ¹	56 474	71 853	145 984	..	44 792	46 861	3 193	30 620	..	
1993 ¹	50 148	42 944	150 070	..	46 265	33 537	3 541	42 180	..	
1994	41 040	44 603	152 382	..	44 731	23 307	3 097	45 040	..	
1995	41 244	49 124	152 976	..	45 861	26 223	3 895	52 634	..	
1996	44 809	58 752	148 520	..	46 909	19 591	3 327	35 011	..	
1997	38 510	76 698	153 122	7 745	49 155	33 222	2 724	54 897	..	
1998	30 623	104 460	152 275	13 959	52 801	48 659	2 581	69 600	5 987	
1999	28 498	107 224	145 601	22 418	49 652	39 708	2 367	72 474	6 055	
2000	14 770	132 830	143 509	42 042	49 995	36 002	2 159	95 844	6 590	
2001	16 727	115 049	146 051	40 027	50 929	42 052	2 398	114 738	7 313	
2002	13 844	103 636	152 767	47 306	50 257	37 481	2 111	100 130	7 487	

Note:

1. The years 1984 and 1986 to 1993 are gross generation. This means that station service was not deducted to get net generation.

Sources:

Statistics Canada, *Electric Power Generation, Transmission and Distribution*, Catalogue no. 57-202-XPB, Ottawa, various issues.

Statistics Canada, *Electric Power Generation, Transmission and Distribution*, Catalogue no. 57-202-XIB, Ottawa, various issues.

Efficiency of thermal-electric power production

Thermal-electric power plants primarily burn coal, oil, or natural gas to create the heat necessary to power the turbines that generate the electricity (Table 1.10). Across Canada, the efficiency of thermal power plants burning these fuels ranged from 24% to 37% between 1980 and 2002 (Table 1.12). This means that, on average, from one-quarter to one-third of the heat energy used in thermal power plants was actually converted to electricity; the rest was lost as waste heat. Put another way, it took on average 3.13 units of fossil fuel energy to generate every unit of electrical energy. With technological advancements, conventional coal-fired power plants are generating electricity at close to their efficiency limit of 40%. Other technologies that make use of waste heat from the generation process can achieve overall efficiencies of up to 60%. By comparison, the conversion of kinetic energy of falling water in hydro-electric plants is, on average, 80% to 90% efficient.¹

Thermal-electric power plants with high-efficiency electricity generation systems are often operated on a continuous basis. However, plants with older low-efficiency systems are usually operated only during periods of high electricity demand. Electrical utilities face two peak periods every day, one in the morning when people are preparing for the day and then again in the early evening when they are making dinner, washing dishes and taking care of other chores that use energy. Periods of high demand are also associated with extremely hot or cold weather, as people use air conditioners or turn up their furnaces to stay comfortable. Because thermal power stations are responsible for significant emissions of air pollutants (see Section 2.3, **Greenhouse gas emissions**), electricity consumption during peak periods has a relatively greater impact on air quality than consumption at other times.

1.2 Renewable energy sources

Canadians depend on reliable supplies of energy. As our population and economy continue to grow, so does the demand for energy.

Currently, hydro electricity is the biggest renewable energy source in Canada, providing us with 59% of our electricity

1. Trinity College, Department of Mechanical and Manufacturing Engineering, n.d., *Power Generation*, www.mecheng.tcd.ie/~torrance
 > Student Resources > First Years > Lecture4 (accessed June 9, 2004).

Table 1.12
Efficiency¹ of thermal-electric power stations by fuel type, 1980 to 2002

Year	Coal				Fuel oil			Natural gas	Wood
	Canadian bituminous	Imported bituminous	Canadian sub-bituminous	Imported sub-bituminous	Lignite	Heavy	Light and diesel		
1980	31.3	35.9	31.9	..	27.3	32.8	24.6	26.9	..
1981	29.7	35.5	31.8	..	27.5	32.0	29.3	25.7	..
1982	32.5	35.6	31.6	..	27.3	33.6	28.6	26.2	..
1983	31.8	36.0	31.6	..	27.4	32.1	29.2	25.8	..
1984	33.7	35.7	31.2	..	29.4	32.2	29.7	24.5	..
1985	33.4	35.4	31.2	..	28.3	32.2	29.8	24.8	..
1986	35.1	36.7	34.0	..	31.5	35.3	31.2	25.1	..
1987	35.5	37.0	34.3	..	31.8	35.8	30.0	27.4	..
1988	35.9	37.2	34.3	..	31.0	36.1	29.0	29.0	..
1989	35.6	37.1	33.4	..	31.4	35.4	32.2	31.6	..
1990	35.6	36.5	34.5	..	31.6	35.8	30.6	29.5	..
1991	33.9	35.0	32.5	..	31.1	35.6	29.1	29.7	..
1992	35.4	36.8	37.2	..	31.7	35.4	30.9	30.7	..
1993	35.5	36.1	34.4	..	32.0	35.8	31.9	33.2	..
1994	33.4	34.0	31.8	..	29.7	32.9	31.3	29.1	..
1995	33.7	33.5	32.0	..	29.9	32.8	35.1	35.1	..
1996	33.8	34.7	32.4	..	29.4	32.0	31.9	33.3	..
1997	34.3	35.4	32.2	34.9	29.1	33.4	31.3	35.4	..
1998	34.0	37.2	32.5	34.9	29.7	33.0	32.2	34.7	40.0
1999	33.9	35.6	32.7	35.1	29.1	33.2	30.4	35.4	35.4
2000	31.3	34.8	32.8	33.2	30.1	33.0	28.3	35.1	31.3
2001	32.4	32.8	32.4	28.5	30.1	33.0	29.3	34.4	26.8
2002	30.2	33.9	32.8	33.0	30.2	33.5	29.4	35.9	27.1

Note:

1. Efficiency is the electrical energy output as a percentage of primary energy input.

Sources:

Statistics Canada, *Electric Power Generation, Transmission and Distribution*, Catalogue no. 57-202-XPB, Ottawa, various issues.

Statistics Canada, *Electric Power Generation, Transmission and Distribution*, Catalogue no. 57-202-XIB, Ottawa, various issues.

supply in 2002.¹ Other renewable energy sources include wind, solar, biomass, earth and geothermal energy, small-scale hydro, and tidal. In 2002, renewable energy sources accounted for 17% of Canada's energy supply.²

Hydro electricity

Rugged geography and substantial water resources have helped to make Canada the leading producer of hydro electricity in the world.³ All provinces and territories in Canada produce hydro electricity, except Prince Edward Island (Table 1.13). Quebec generates almost half of the hydro electricity produced in Canada and is home to one of the largest hydro-electric projects in the world—the La Grande complex on James Bay. Map 1.2 shows the regional differences in installed capacity for all types of electricity production in Canada.

Canada has 450 hydro-electric power stations, with a total installed capacity of over 69 000 megawatts. In 2002, hydro-electric power stations generated over 346 000 gigawatt-hours of electricity (Table 1.13).

1. Statistics Canada, 2004, *Electric Power Generation, Transmission and Distribution, 2002*, Catalogue no. 57-202-XIB, Ottawa.

2. Natural Resources Canada, 2003, *Renewable Energy in Canada: Status Report 2002*, Catalogue no. M92-264/2002, Ottawa.

3. International Energy Agency, n.d., *Key World Energy Statistics (2003)*, library.iea.org/dbtw-wpd/bookshop/add.aspx?id=144 (accessed April 28, 2004)

Table 1.13
Hydro installed capacity and generated electricity by province and territory, 2002

Province/Territory	Installed hydro generating capacity ¹	Generation of hydro electric energy	Total electric energy generated
	MW	MWh	
Newfoundland and Labrador	6 699	41 415 904	44 124 516
Prince Edward Island	.	.	38 885
Nova Scotia	399	1 032 211	12 126 906
New Brunswick	922	2 250 720	17 882 725
Quebec	34 277	170 539 756	177 148 710
Ontario	8 163	38 415 693	154 334 732
Manitoba	5 021	28 820 534	29 437 135
Saskatchewan	853	2 835 665	17 969 669
Alberta	861	1 718 976	61 609 119
British Columbia	11 902	58 877 919	65 334 858
Yukon Territory	77	273 187	312 118
Northwest Territories and Nunavut	30	281 535	743 484
Canada	69 206	346 462 100	581 062 857

Note:

1. Nameplate rating in megawatts.

Source:

Statistics Canada, 2004, *Electric Power Generation, Transmission and Distribution, 2002*, Catalogue no. 57-202-XIB, Ottawa.

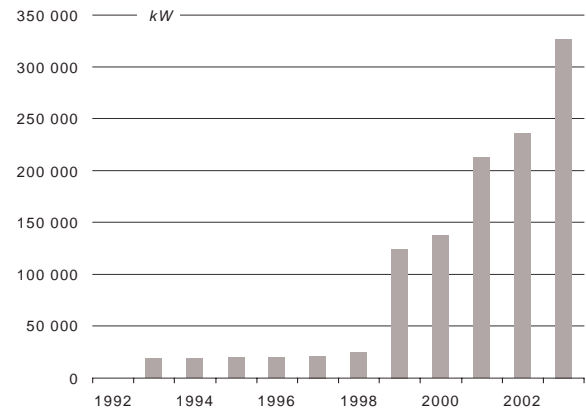
Wind energy

Wind energy is the fastest-growing form of renewable energy in the world, increasing over 30% annually over the past five years.¹ Worldwide wind-generated capacity exceeded 39 000 megawatts at the beginning of 2004.² Creating energy from wind involves harnessing the wind to generate electrical or mechanical energy. Wind energy is a clean sustainable form of energy production that requires no fuel and produces no greenhouse gases.

Canada's long coastlines and large land mass have excellent wind resources in many areas of the country (Map 1.3). Natural Resources Canada estimates that Canada has approximately 30 000 megawatts of developable wind resources.

Canada's installed wind energy capacity was 327 megawatts in 2003, an increase of over 300 megawatts since 1993 (Figure 1.8). Over the past five years the average annual growth rate in wind energy capacity has been over 27%; 2003 was a record year, with 86 megawatts

Figure 1.8
Electricity production by wind, 1992 to 2003



Sources:

Natural Resources Canada, n.d., *Schema of Energy Indicators for Sustainable Development*, ww2.nrcan.gc.ca/es/es/sdi/English/SD_Indicators_web.pdf (accessed April 28, 2004).

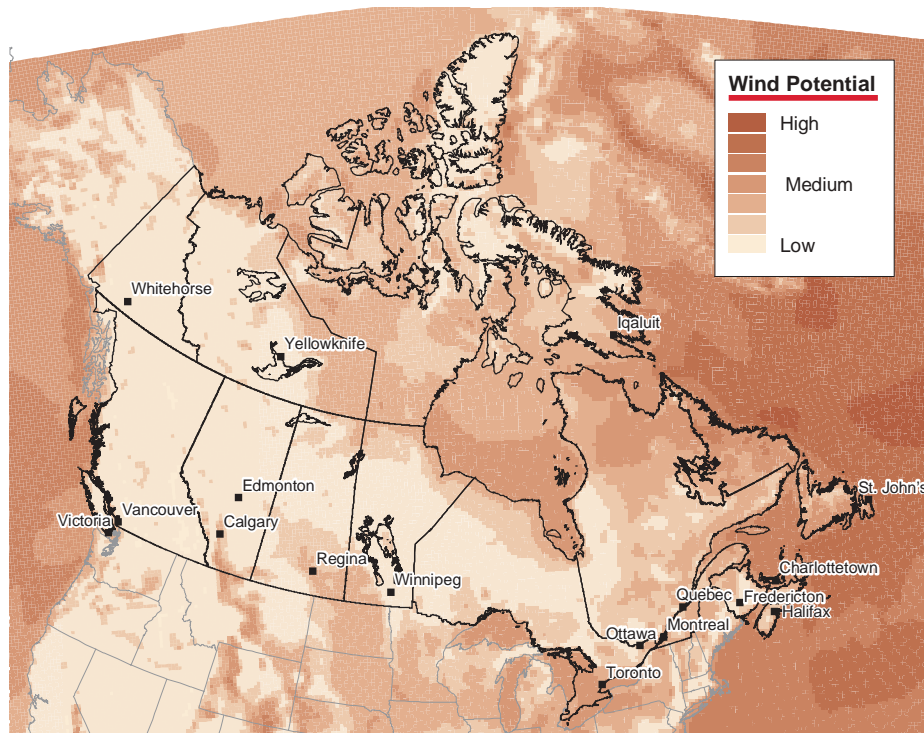
Canadian Wind Energy Association, n.d., www.canwea.ca (accessed March 23, 2004).

1. Canadian Wind Energy Association, n.d., *Quick Facts About Wind Energy*, www.canwea.ca/en/QuickFacts.html (accessed June 15, 2004).

2. Ibid.

Map 1.3

Wind potential in Canada



Sources:

Environment Canada, Canadian Meteorological Centre, 2002, *Canadian Wind Atlas*, www.cmc.ec.gc.ca/rpn/modcom/eole/CanadianAtlas.html (accessed June 15, 2004).
Statistics Canada, Environment Accounts and Statistics Division.

of wind power capacity installed in Alberta, Saskatchewan, Ontario, Quebec and Prince Edward Island.¹

Although wind energy has dropped in price from 20 cents per kilowatt hour in 1983 to the current cost in the 5- to 10-cent range, traditional sources of energy are still cheaper.² Costs for wind energy keep falling as the technology improves. Wind projects in remote northern locations have demonstrated that a wind energy source can be cost-effective where the cost of transporting conventional fuel is high.

In 2002, wind turbines were situated in six provinces and the Yukon Territory (Table 1.14). Canada's largest wind generation facilities are located in the Gaspé region of Quebec and in Pincher Creek, Alberta. The Gaspé Le Nordais project has 133 turbines (750 kilowatts each) producing 100 megawatts of electricity. Pincher Creek's 145 wind turbines represent 96 megawatts of installed wind power: a new 68-megawatt wind farm is currently under construction there.

Solar energy

The sun can be used effectively to provide energy for many applications. Solar energy technology has been around for many years and is improving.

There are three main ways to convert sunlight into other forms of energy:³

- **Passive solar energy** uses the positioning or design of a building to maintain maximum exposure to the sun. South-facing windows used to increase solar gain are one example of passive solar energy.
- **Active solar energy systems** directly convert solar radiation into thermal energy. Active solar technologies are used to heat water and ventilation air for heating systems.
- **Photovoltaic (PV) technology** converts sunlight directly into electricity using solar cells made from semiconductor materials and is ideal for energy supply in remote communities. Other applications of photovoltaics are solar-powered calculators and watches. Photovoltaic production of electricity produces no greenhouse gas emissions.

Solar photovoltaic modules are used in many applications throughout Canada. Most non-domestic applications consist of a PV solar array as a stand-alone, or off-grid,

1. Canadian Wind Energy Association, n.d., *The Current Status of Wind Energy in Canada*, www.canwea.ca/downloads/PDFS/OntarioWindSummit.pdf (accessed April 28, 2004).

2. Natural Resources Canada, n.d., *Canadian Renewable Energy Network: Wind Energy*, www.canren.gc.ca/wind/index.asp (accessed April 28, 2004).

3. Solar Energy Society of Canada Inc., n.d., *Solar Energy for Your Home*, www.solarenergysociety.ca/2003/home.asp (accessed March 23, 2004).

Table 1.14
Wind and tidal generated electricity by province and territory, 2002

Province/Territory	Amount generated MWh
Newfoundland and Labrador	.
Prince Edward Island	19 416
Nova Scotia	30 798
New Brunswick	.
Quebec	172 951
Ontario	2 925
Manitoba	.
Saskatchewan	43 243
Alberta	164 473
British Columbia	.
Yukon Territory	992
Northwest Territories and Nunavut	.
Canada	434 798

Source:

Statistics Canada, 2004, *Electric Power Generation, Transmission and Distribution, 2002*, Catalogue no. 57-202-X1B, Ottawa.

power source for road signals, navigational buoys, and remote telecommunication repeaters and similar systems. Domestic applications include PV systems for homes, cottages and recreational vehicles.⁴ Text Box 1.3 lists some PV programs and projects in Canada.

Biomass energy

Biomass energy, or bioenergy, is produced by burning fuel made from plant and animal matter. In 2000, 5.9% of Canada's primary energy was derived from converting biomass into energy.⁵

The forest products and pulp and paper industries produce most of Canada's biomass energy. These industries incinerate wood waste, producing steam and electricity that they can use themselves or sell to others. Table 1.15 lists applications of bioenergy.

Ethanol

Ethanol is a high-octane alcohol fuel additive that can be renewably produced from grains such as corn or wheat and technology currently under development is using agricultural residues such as wheat straw. Ethanol can be blended with gasoline up to a maximum of 10% without any modifications needed to automobile engines.

Using ethanol reduces vehicle emissions. For example, using a 10% ethanol-gasoline blend produces a 2% to 25% reduction in carbon monoxide emissions, depending on the vehicle and the fuel, and a 4% to 8% reduction in carbon dioxide emissions.⁶

4. International Energy Agency, n.d., *Co-operative programme on photovoltaic power systems*, www.oja-services.nl/iea-pvps/countries/canada/index.htm (accessed April 8, 2004)

5. Natural Resources Canada, n.d., *Canadian Renewable Energy Network: Bioenergy*, www.canren.gc.ca/bio/index.asp (accessed April 28, 2004).

6. Natural Resources Canada, Office of Energy Efficiency.

Text Box 1.3

Major programs and projects of solar photovoltaic (PV) use¹

The following programs and projects are underway in Canada:

On-site Generation at Federal Facilities Program

Eligible federal government departments can receive a two-year subsidy to install PV off-grid systems (25% refund) or grid connected systems (up to 75% refund).

Canada's first PV neighbourhood, Kitchener-Waterloo, Ontario

ARISE Technologies is developing Canada's first demonstration of community-scale photovoltaic systems in a Canadian neighbourhood. The aim of the project is to accelerate the acceptance of domestic PV technologies. Funding for this project is provided by the Climate Change Action Fund and Natural Resources Canada.

Alberta Government Centre, Edmonton, Alberta

As part of the Alberta government's plan for climate change, a grid-connected PV system was installed on the roof of the Alberta Legislature.

City of Airdrie Environment Education Centre, Airdrie, Alberta

The Airdrie Environmental Education Centre is designed as a single-stop location to demonstrate solar PV, solar water heating, solar air heating, solar daylighting, lighting efficiency, building envelope and water efficiency, indoor air quality, and straw bale construction.

Sponsored by the Alberta government's Municipal 2000 sponsorship program, the installed PV system is grid-connected.

Queen's University Goodwin Hall Facade, Kingston, Ontario

Queen's installed a grid-connected PV array on the facade of Goodwin Hall. The system is strictly an educational tool, whose main objective is to expose engineering students to PV technology so that they may one day take it out into industry and apply it.

1. International Energy Agency, n.d., *Co-operative programme on photovoltaic power systems*, www.oja-services.nl/iea-pvps/countries/canada/index.htm (accessed March 23, 2004)

Table 1.15

Applications of biomass energy

Applications	Potential users	Source of bioenergy
Process heat and/or electricity	Industrial	Pulping liquor and wood residues burned in large boilers Wood residues processed to produce fuel gas Forestry and agricultural residues processed to produce bio-solids
	Municipal	Municipal solid waste burned or buried in landfills to produce landfill gas Municipal sewage processed to produce biogas
Space and water heating	Residential	Chunk wood or pellets burned in high efficiency enclosed fireplaces, box stoves, furnaces and cook stoves
	Commercial	Wood or agricultural residues burned in furnaces to produce heat or to heat water in boilers
Automobile fuel	General public	Grain and agricultural residues (e.g. straw) used to produce ethanol
Heavy vehicle fuel	Trucking industry	Animal fats or vegetable oils used to produce bio-diesel fuels

Source:

Natural Resources Canada, n.d., *Canadian Renewable Energy Network: Bioenergy*, www.canren.gc.ca/bio/index.asp (accessed April 28, 2004).

Just over 200 million litres of ethanol per year are now produced in Canada.¹ In response to the Ethanol Expansion Program, announced in August 2003, seven ethanol production projects have been given funding by the federal government. These projects plan to add another 750 million litres of annual fuel ethanol capacity, which could bring Canada's yearly supply to almost a billion litres.²

Methane from landfills

The decomposition of waste in landfills produces a gas that is composed primarily of methane and carbon dioxide, both of which are greenhouse gases. In 2001, the waste sector contributed 3.4% of Canada's greenhouse gas emissions (24.8 megatonnes of CO₂ equivalent) with solid waste disposal on land accounting for 23 megatonnes. Wastewater handling and waste incineration accounted for 1.4 and 0.5 megatonnes, respectively.³

1. Canadian Renewable Fuels Association, n.d., *Ethanol Production in Canada*, www.greenfuels.org/ethaprod.html (accessed April 5, 2004).

2. Natural Resources Canada, n.d., *Backgrounder: Ethanol Expansion Program*, www.nrcan-mcan.gc.ca/media/newsreleases/2004/200402a_e.htm (accessed April 5, 2004).

3. Environment Canada, 2003, *Canada's Greenhouse Gas Inventory 1990-2001*, Ottawa.

Over the past decade, technologies have been developed to capture methane gas by drilling deep into landfill sites and pumping the gas out through a system of pipes. The gas is either burned off or used as fuel in producing electricity or heating buildings (Text Box 1.4). The amount of gas captured at Canadian landfill sites increased by 17% from 1997 to 2001 (Table 1.16).

Earth energy and geothermal energy

Earth energy uses the heat in the ground to provide space heating or cooling of air and water in buildings. Geothermal energy uses steam or hot water in the earth's crust to run turbines or heat air or water. There are over 30 000 earth-energy installations in Canada.¹

Small-scale hydro

Small-scale hydro systems² can generate electricity with the added benefit of having less impact on the environment than larger hydro developments. These systems can also be adapted to existing water-level control structures on rivers and lakes.

1. Natural Resources Canada, n.d., *Canadian Renewable Energy Network - About Earth and Geothermal Energy*, www.canren.gc.ca/tech_appl/index.asp?Cald=3&PgId=8 (accessed April 20, 2004).
2. In Canada, small-scale hydro systems are defined as 'micro' (100 kilowatts or less), which can supply one or two houses; 'mini' (100 kilowatts to 1 megawatt), which typically supplies a small factory or isolated community; and 'small' (1 to 30 megawatts), which is at the low end for supply to a regional or provincial power grid.

Table 1.16
Landfill gas recovery in Canada, 1997 to 2001

Year	Methane	CO ₂ equivalent
	kt	Mt
1997	292	6.1
1999	286	5.9
2001	342	7.2

Source:
Environment Canada, 2002, *Inventory of Landfill Gas Recovery and Utilization in Canada, 2001*, Ottawa.

Small-scale hydro capacity in Canada is about 2 000 megawatts or about 3% of the total installed hydro-electric capacity of 69 000 megawatts. In Canada, over 5 500 potential small-scale hydro sites capable of generating 11 000 megawatts of electricity have been identified (Map 1.4). However, given current prices, only 15% of this total would be economically feasible to develop.³

Tidal power

Tidal power is created by using the ebb and flow of tides to run turbines to produce electricity. The first tidal plant in North America, the Annapolis Tidal Generation Station (capacity 20 megawatts), was built in 1984 on the Annapolis River near the Bay of Fundy. Three other sites on the Bay of Fundy have been identified as having a potential capacity of 8 500 megawatts.⁴

3. International Small-hydro Atlas, n.d., *Country Brief: Canada*, www.small-hydro.com > Site Atlas > Continent > North America > Country > Canada (accessed April 20, 2004).
4. Natural Resources Canada, 2000, *Energy in Canada 2000*, Ottawa.

Text Box 1.4

Energy from waste

There are environmental and economic benefits of converting solid wastes to energy, which can then be consumed in place of traditional energy sources:

Landfill methane

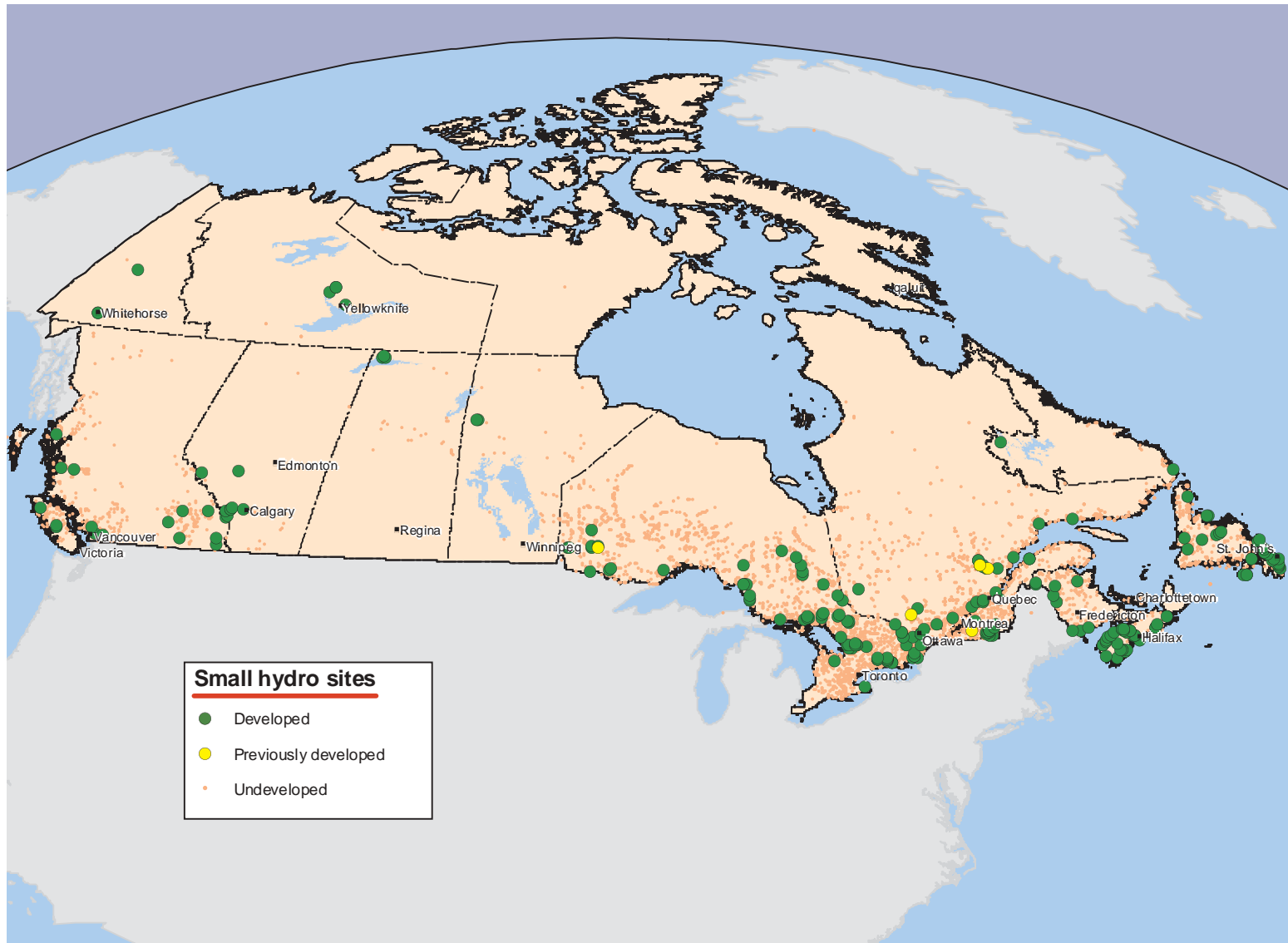
In 2001, 41 landfills in Canada captured and burned 342 kilotonnes of methane, equivalent to 7.2 megatonnes of CO₂. Of this, 43% was flared¹ while the remaining 57% was used to meet the energy needs of the landfill or to generate electricity.² Of the 16 installations that utilized the gas, 8 facilities generated electricity and the rest used the methane for applications ranging from heating buildings to providing fuel for a gypsum manufacturing plant, a steel refinery, a greenhouse and a recycling plant.³

Waste incineration

One way to dispose of waste is to burn it at very high temperatures. Many waste incinerators capture the energy that is released through the burning process and either sell this energy to outside customers or utilize it themselves. For example, the Energy from Waste facility in Brampton, Ontario is capable of producing up to 9.3 megawatts of electricity, which it can sell to the provincial power grid and to international customers. Similarly, the Burnaby Incinerator in Burnaby, British Columbia converts garbage generated by residents in the Greater Vancouver Regional District into steam, which is then sold to a nearby paper recycling facility.⁴

1. Flaring landfill methane creates carbon dioxide, which is a less harmful greenhouse gas.
2. Environment Canada, 2002, *Inventory of Landfill Gas Recovery and Utilization in Canada, 2001*, Ottawa.
3. *Ibid.*
4. Region of Peel, n.d., region.peel.on.ca/pw/waste/resident/kms.htm, (accessed April 23, 2003).

Map 1.4
Small-scale hydro in Canada



Sources:
Natural Resources Canada, 2004, *GeoGratis*, geogratis.cgdi.gc.ca/clf/en?action=intermDownload > Download Directory > hydro (accessed June 15, 2004).
International Small-Hydro Atlas, n.d., www.small-hydro.com (accessed April 20, 2004).
Statistics Canada, Environment Accounts and Statistics Division.

2 Environmental impacts of energy

All forms of energy, whether generated from renewable or non-renewable sources, have some impact on the environment. Both the production and consumption of energy can generate significant environmental impacts.

2.1 Energy extraction and production

Oil

In Canada, crude oil is extracted from subterranean reservoirs on land and offshore, as well as from the tar sands in Alberta. It can be used to make gasoline, diesel, kerosene, fuel oil and other fuels. Other non-fuel products include lubricants and asphalt.

The transportation sector is the largest user of refined petroleum products in Canada, consuming 51% of supply in 2002.¹ Approximately 8% of all thermal electricity produced in Canada in 2002 was generated from refined petroleum products.² The main environmental considerations in crude oil production are listed in Table 2.1.

Crude oil transportation can also result in environmental impacts, including oil spills. While major spills may appear in the headlines, smaller spills are more frequent. Transporting oil from source to user often requires many transfers, using ocean tankers, pipelines, tanker trucks and railways—and increases the risk for spills. In Canada, crude oil and natural gas are mainly transported through a network of over 540 000 kilometres of pipeline.³

Natural gas

Like oil and coal, natural gas is a non-renewable fossil fuel. It is commonly used for industrial, household and commercial purposes as well as in the generation of electricity. In 2002, approximately 20% of all thermal electricity produced in Canada was generated from natural gas.⁴

Table 2.1
Environmental considerations in crude oil production

Activity	Environmental consideration/effect
Extraction	Land removed from other uses
	Blowouts/spills
	Gaseous waste emissions, including hydrogen sulphide
	Damage to aquatic ecosystems
	Groundwater and soil contamination
	Brine disposal
Field treatment	Explosions and fires
	Land removed from other uses
	Gaseous waste emissions
	Particulate emissions
	Water consumption
	Disposal of waste water
	Odour
	Noise
Refining	Explosions and fires
	Solid, liquid and gaseous wastes
	Spills
	Groundwater and soil contamination

Note:

Not all of the effects listed here apply to any given crude oil production site. The actual environmental effects of crude oil production vary with the production process and the environmental controls used during production.

Sources:

Organisation for Economic Co-operation and Development, 1985, *Environmental Impacts of Electricity Generation*, Paris.

U.S. Environmental Protection Agency, n.d., *Electricity from Oil*, www.epa.gov/cleanenergy/oil.htm (accessed April 23, 2004).

Natural gas and crude oil production share many of the same environmental impacts (Table 2.2). Since much of the natural gas produced in Canada requires desulphurization (the removal of hydrogen sulphide and carbon dioxide),⁵ large quantities of elemental sulphur are produced. Sulphur is sold in world markets to produce fertilizers, pharmaceuticals and other products. Depending on demand, large stockpiles may accumulate at processing plants.⁶ This production of elemental sulphur may present a disposal problem.

Coal

Coal is mined in Canada both as a fuel to generate thermal electricity and for use in steel making. In 2002, approximately 67% of thermal electricity produced in Canada was generated from coal.⁷ The predominant method of coal mining in Canada is by surface strip-mining operations.⁸

The main environmental considerations in coal mining are listed in Table 2.3. The environmental effects of coal production can vary because of the physical and chemical properties of the coal as well as the mining process and environmental controls used during extraction and production.

1. Statistics Canada, 2003, *Report on Energy Supply and Demand in Canada 2002*, Catalogue no. 57-003-XIB, Ottawa.

2. *Ibid.*

3. Centre for Energy, n.d., *How is oil transported?*, www.centreforenergy.com/silos/ong/ET-ONG.asp (accessed April 29, 2004).

4. Statistics Canada, 2003, *Report on Energy Supply and Demand in Canada 2002*, Catalogue no. 57-003-XIB, Ottawa.

5. This removal is required since hydrogen sulphide becomes corrosive in the presence of water. This is an issue when transporting natural gas.

6. Petroleum Communication Foundation, 1999, *Our Petroleum Challenge*, Calgary, www.centreforenergy.com (accessed June 21, 2004).

7. Statistics Canada, 2003, *Report on Energy Supply and Demand in Canada 2002*, Catalogue no. 57-003-XIB, Ottawa.

8. Statistics Canada, 2002, *Coal Mining*, Catalogue no. 26-206-XIB, Ottawa.

Table 2.2
Environmental considerations in natural gas production

Activity	Environmental consideration/effect
Extraction	Land removed from other uses
	Land impacts include erosion, loss of soil productivity, and landslides
	Blowouts
	Hydrogen sulphide, methane and trace metal emissions
Field treatment	Hydrogen sulphide, methane and trace metal emissions
	Liquid wastes
	Noise
	Waste elemental sulphur

Note:

Not all of the effects listed here apply to any given natural gas production site. The actual environmental effects of natural gas production vary with the production process and the environmental controls used during production.

Sources:

Organisation for Economic Co-operation and Development, 1985, *Environmental Impacts of Electricity Generation*, Paris.
U.S. Environmental Protection Agency, n.d., *Electricity from Natural Gas*, www.epa.gov/cleanenergy/natgas.htm (accessed April 23, 2004).

Electricity

Electricity in Canada is produced at hydro-electric sites, by nuclear-electric plants and at thermal-electric plants that burn fossil fuels. Along with the environmental impacts that are associated with the generation of electricity, other impacts have the potential to cause great social and economic upheaval. The August 2003 power blackout affecting eastern North America is one example (Text Box 2.1). This event highlighted the vulnerability of the large interconnected power grids that deliver our electricity.

Hydro electricity

The impacts of hydro-electric developments are both numerous and complicated (Table 2.4). Since hydro-

Table 2.3
Environmental considerations in coal mining

Activity	Environmental consideration/effect
Extraction	Land removed from other uses, particularly agriculture
	Land subsidence (deep mines)
	Surface erosion (strip mining)
	Large-scale surface restructuring (strip mining)
	Acidic mine drainage containing heavy metals and sulphuric acid
	Large quantities of inorganic waste material
	Groundwater and soil contamination
	High water consumption
	Dust
	Noise
Treatment	Wash water containing dissolved and suspended solids
	Acidic runoff
	Solid waste
	Dust
	Noise

Note:

Not all of the effects listed here apply to any given coal site. The actual environmental effects of coal production vary with the type of coal and the mining process and environmental controls used during extraction.

Sources:

Organisation for Economic Co-operation and Development, 1985, *Environmental Impacts of Electricity Generation*, Paris.
Clean Air Task Force, n.d., *Cradle to Grave: The Environmental Impacts from Coal*, www.catf.us/publications/index.php (accessed May 11, 2004).
U.S. Environmental Protection Agency, n.d., *Electricity from Coal*, www.epa.gov/cleanenergy/coal.htm (accessed April 23, 2004).

electric power uses the Earth's water cycle to generate electricity, it is considered a renewable energy resource.

Hydro electricity produces almost no greenhouse gases, particulate matter and other airborne pollutants since no fuels are burned to produce the electricity. However, the construction and operation of dams can affect natural river systems and their associated fish and wildlife populations. In cases where a reservoir is created behind a dam, existing vegetation may decay once underwater, leading to the buildup and release of methane.

Text Box 2.1

August 2003 blackout

The largest blackout in North American history began on the afternoon of August 14, 2003. More than 50 million people were affected when the electricity they were consuming during an August heat wave ceased to flow. Most of Ontario and much of the Midwest and northeastern United States were blacked out. Power was not fully restored in some areas for up to a week. Nine refineries and 22 nuclear plants in Canada and the United States were shut down, as were many other fossil fuel-fired thermal electricity plants. Ten major airports and most business and government offices in the affected areas were also shut down. Land-based transportation networks reliant on electricity slowed to a crawl as vehicles approached intersections without traffic signals. The blackout tested the resilience of the population and the supporting emergency response networks in both Canada and the United States.

Causes of the blackout

The blackout was caused¹ by a convergence of several events relating to electricity demand and the management and maintenance of portions of the electrical grid. It occurred during a minor heat wave when electrical demand was high but not excessive. The blackout was initiated by a computer system failure at one U.S. electrical company; this sparked a widespread cascading power outage. Voltage fluctuations caused many large power plants to shut themselves down automatically to protect generating equipment. Both the Canadian and American governments reacted strongly to the blackout, and the U.S.–Canada Power System Outage Task Force was struck to determine the cause of the black out and suggest preventative measures.

1. Natural Resources Canada, Canada–U.S. Power System Outage Task Force, 2004, *Final Report on the August 14, 2003 Blackout in the United States and Canada: Causes and Recommendations*, www.nrcan.gc.ca/media/docs/final/finalrep_e.htm (accessed May 3, 2004).

**Table 2.4
Environmental considerations in hydro electricity production**

Impact category	Impacted system	Environmental consideration/effect
Physical / chemical	Hydrology	Altered discharge patterns
		Increased discharge water velocity
		Increased evaporative water losses
		Disruptive siltation patterns
		Increased turbidity
		Increased salinity and alkalinity
		Altered temperature profile
	Reduced dissolved oxygen content	
	Local micro-climate	Increased humidity
		Decreased rainfall
Increased cloud cover		
Increased fog		
Land	Moderated temperature	
	Restructuring for road construction	
	Increased local seismic activity	
Biological	Aquatic ecosystems	Increased local landslide activity
		Reduction in downstream plankton populations
		Disruption of fish spawning routes
		Growth of fish population in reservoir
		Possibility of magnified disease vectors
	Terrestrial ecosystems	Possible decay of vegetation leading to buildup and release of methane
		Reduced shoreline biodiversity
		Disruption of animal habitat and migration routes
		Reduced agricultural yields in floodlands
		Changed water recreation opportunities
Human	Economic systems	Relocation of population in flooded areas
	Sociocultural system	Political/legal challenges
		Loss of archeological patrimony

Note:
Not all of the effects listed here apply to any given hydro-electric site. The actual environmental effects of hydro-electric sites vary with the scale of each project and the environmental controls used during construction and operation.

Sources:
Organisation for Economic Co-operation and Development, 1985, *Environmental Impacts of Electricity Generation*, Paris.
U.S. Environmental Protection Agency, n.d., *Electricity from Hydropower*, www.epa.gov/cleanenergy/hydro.htm (accessed April 23, 2004).

Nuclear electricity

A number of environmental impacts are associated with the production of nuclear electricity (Table 2.5). Radioactive waste, the most serious consideration, can be grouped into the following categories:¹

Nuclear fuel waste includes spent nuclear fuel bundles that are discharged from the reactors used to produce nuclear electricity in Canada. Ontario has the majority of reactors and produces most of the nuclear fuel waste in Canada.

Spent fuel bundles are kept in wet or dry storage at the nuclear facility where they are produced since there is no permanent disposal facility in Canada to accommodate this type of waste. In 1998, power reactors in Canada produced

1. Low-level Radioactive Waste Management Office, n.d., *Ongoing Wastes: Inventory of Radioactive Waste in Canada*, www.llrwmoo.org/en/programs/ongoing/executive.html (accessed March 31, 2004)

**Table 2.5
Environmental considerations in nuclear electricity production**

Activity	Environmental consideration/effect
Uranium mining	Land subsidence
	Requirement for land reclamation
	Low-level radioactive dust release
	Low-level radioactive waste disposal
	Disposal of mine tailings drainage water
Uranium treatment/milling	Underground water contamination
	Mill tailings containing toxic metals
	Liquid and solid chemical wastes
Electricity generation	Low-level radioactive milling wastes
	Low-level radioactive dust releases
	High water consumption
	Waste heat releases
	Gaseous radionuclide emissions
Electricity generation	Liquid radionuclide emissions
	High-level radioactive wastes
	Decontamination and decommissioning
	Waste heat releases

Note:
Not all of the effects listed here apply to any given uranium extraction or nuclear electricity production site. The actual environmental effects of uranium extraction or nuclear electricity production sites vary with the scale of each project and the environmental controls used during production or construction and operation.

Sources:
Organisation for Economic Co-operation and Development, 1985, *Environmental Impacts of Electricity Generation*, Paris.
U.S. Environmental Protection Agency, n.d., *Electricity from Nuclear Energy*, www.epa.gov/cleanenergy/nuc.htm (accessed April 23, 2004).

78 138 bundles² of nuclear fuel waste,³ or 313 m³ (Table 2.6).

For 1998, the inventory of nuclear fuel waste for power reactors was 1 347 141 fuel bundles or 5 389 m³ of waste. This is projected to reach 3 541 301 fuel bundles, or 14 170 m³, by 2035.

Low-level radioactive waste (LLRW) includes all radioactive waste other than nuclear fuel waste and uranium mine and mill tailings. This includes wastes from decommissioning of facilities and wastes from the remediation of old sites. As shown in Text Box 2.2, LLRW is further broken down into ongoing and historic waste.

In 1998, just over 4 300 m³ of ongoing LLRW was produced in Canada (Table 2.7). This brought the total year-end 1998 LLRW inventory to about 1 771 000 m³, which included 1 200 000 m³ of historic LLRW. It is estimated that total LLRW inventories will reach approximately 2 100 000 m³ by the year 2035, with the biggest increase occurring in ongoing waste from the nuclear fuel cycle.

Uranium mine and mill tailings account for the most Canadian radioactive waste by volume.

Uranium has been mined in Canada since the 1930s. As shown in Table 2.8, the total mine and mill tailings inventory

2. A typical CANDU fuel bundle represents approximately 0.004 m³ of waste.
3. Low-Level Radioactive Waste Management Office, 1999, *Inventory of Radioactive Waste in Canada*, Catalogue no. LLRWMO-GN-TR-99-037, Ottawa.

Table 2.6
Nuclear fuel waste accumulation rate and inventory by reactor type, 1998 and 2035

Reactor type	Nuclear fuel waste generated in 1998		On-site waste inventory to 31 Dec. 1998			Projected inventory to 2035		
	Bundles number	Estimated volume ¹ m ³ /year	Bundles			Estimated volume ¹ m ³	Bundles number	Estimated volume ¹ m ³
			Dry storage	Wet storage	Total storage			
Power reactors	78 138	313	101 453	1 245 688	1 347 141	5 389	3 541 301	14 165
Research reactors	863	3	48 558	0	48 558	194	76 308	305
Total	79 001	316	150 011	1 245 688	1 395 699	5 583	3 617 609	14 470

Note:

1. A typical CANDU fuel bundle represents approximately 0.004 m³ of waste.

Source:

Low-level Radioactive Waste Management Office, 1999, *Inventory of Radioactive Waste in Canada*, Catalogue no. LLRWMO-GN-TR-99-037, Ottawa.

Text Box 2.2

Low-level radioactive waste

Low-level radioactive waste can be grouped into the following two broad categories:¹

- **Ongoing waste** is produced from the operation of nuclear utilities and research facilities, and from the production and use of medical radioisotopes. Businesses involved in these activities are responsible for the management and disposal of their waste.
- **Historic waste** is low-level waste that was previously managed in a manner that is no longer acceptable and whose original producer no longer exists or can no longer be held responsible. The federal government has accepted responsibility for this waste, most of which is now being held in interim waste storage sites.

1. Low-level Radioactive Waste Management Office, n.d., *Historic Waste*, www.llrwm.org/en/faq/lowlevel.html (accessed March 29, 2004)

was just over 210 megatonnes in 1998. The majority of this accumulation was on inactive or decommissioned sites.¹

Since the quality of the uranium ore being mined today is higher than in the past, total inventories are expected to grow only marginally over the next few years and are projected to reach about 250 megatonnes by 2035.²

Thermal electricity

The environmental impacts of thermal-electric power generation using fossil fuels begins with the extraction of the fossil fuel and continues throughout the various steps required to prepare the fuel for consumption and then transport it to the thermal-electric power plant.

1. Natural Resources Canada, 1996, *Backgrounder: Radioactive wastes in Canada*, www.nrcan.gc.ca/media/newsreleases/1996/199679a_e.htm (accessed March 23, 2004).

2. Low-level Radioactive Waste Management Office, 1999, *Inventory of Radioactive Waste in Canada*, Catalogue no. LLRWMO-GN-TR-99-037, Ottawa.

Table 2.7
Low-level radioactive waste accumulation rate and inventory by waste source, 1998 and 2035

Waste source	m ³ /year	LLRW inventory to 31 Dec. 1998 ¹			Projected inventory to 2035
		Waste	Contaminated soil	Total	
Ongoing waste					
Operations					
Nuclear fuel cycle ²	2 440	60 000	0	60 000	149 800
Nuclear R & D	1 230	105 930	382 800	488 730	536 800
Radioisotope production and use ³	550	16 610	0	16 610	44 400
Sub total	4 220	182 540	382 800	565 340	731 000
Decommissioning					
Nuclear fuel cycle ⁴	0	3 860	0	3 860	121 600
Nuclear R & D	90	2 050	0	2 050	5 800
Radioisotope production	0	0	0	0	0
Sub total	90	5 910	0	5 910	127 400
Ongoing waste, total	4 310	188 450	382 800	571 250	858 400
Historic waste ⁵	0	0	1 200 000	1 200 000	1 210 100
Total waste	4 310	188 450	1 582 800	1 771 250	2 068 500

Notes:

1. Waste volumes have been rounded to the nearest 10 m³. Volume presented is as-stated waste (i.e., after processing); as-generated volume may be about 50% higher.

2. Inventory includes approximately 5 000 m³ of recyclable wastes from uranium refining operations.

3. Total inventory includes wastes shipped to AECL-CRL since 1983; wastes to CRL from 1946 to 1982 are included under Nuclear R&D.

4. Inventory includes 2 210 m³ of wastes in dry storage modules from retubing program at Pickering A.

5. Historic waste volumes have been rounded to nearest 100 m³.

Source:

Low-level Radioactive Waste Management Office, 1999, *Inventory of Radioactive Waste in Canada*, Catalogue no. LLRWMO-GN-TR-99-037, Ottawa.

Table 2.8
Uranium mine and mill tailings accumulation rate and inventory, 1998

Sites	Accumulation rate 1998	Accumulated inventory 1998	Projected inventory to 2035
	t/year	t	
Operating sites	1 005 000	8 268 000	45 453 000
Inactive/ decommissioned sites	0	201 547 000	201 547 000
Development sites	18 000	203 000	866 000
Total	1 023 000	210 018 000	247 866 000

Source:

Low-Level Radioactive Waste Management Office, 1999, *Inventory of Radioactive Waste in Canada*, Catalogue no. LLRWMO-GN-TR-99-037, Ottawa.

Using crude oil, natural gas and coal to generate electricity releases many combustion products such as carbon dioxide, sulphur dioxide, nitrogen oxides, methane, mercury compounds and ash into the environment. Coal- and oil-fired power plants also use large quantities of water for producing steam and cooling. When this water is released back into the environment, both the pollutants released and the elevated water temperatures can have adverse effects on the environment.

Other environmental effects associated with thermal-electric power plants fired by fossil fuels include the accumulation of solid wastes from the burning of the fossil fuel and impacts related to the restructuring of sites where these thermal-electric power plants are constructed.

In 2002, 28% of Canada's electricity was generated by thermal-electric plants powered by fossil fuels such as coal, natural gas and oil.¹

2.2 Energy consumption

Air pollution is generated when fossil fuels are consumed. Carbon dioxide (CO₂), carbon monoxide (CO), nitrogen oxides (NO_x), volatile organic compounds (VOCs), and particulate matter (PM), as well as other pollutants, are among the pollutants generated from fossil fuels.

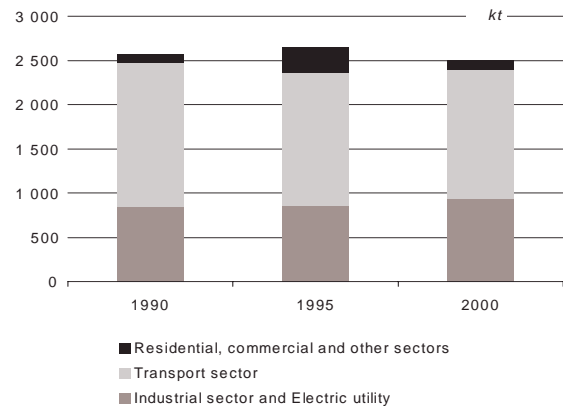
From 1990 to 2000, the transportation sector was the largest emitter of NO_x (Figure 2.1). Formed mainly by the combustion of fossil fuels, NO_x are important precursors in the formation of ground-level ozone (a key component of smog), acid rain and fine airborne PM.

Although burning natural gas produces CO₂ and various other pollutants, it burns cleaner than either coal or oil, producing virtually no sulphur dioxide (SO₂), and less CO₂, CO and NO_x.²

1. Statistics Canada, 2003, *Report on Energy Supply and Demand in Canada 2002*, Catalogue no. 57-003-XIB, Ottawa.

2. United States Environmental Protection Agency, n.d., *Electricity from Natural Gas*, www.epa.gov/cleanenergy/natgas.htm (accessed May 15, 2004).

Figure 2.1
Nitrogen oxide emissions, 1990, 1995 and 2000

**Source:**

Environment Canada, Pollution Data Branch, *Criteria Air Contaminants Emissions Inventory, 1990, 1995, 2000*, Ottawa.

Coal, on the other hand, contains many trace elements, such as arsenic, cadmium, chromium, lead, nickel and mercury, which are released when it is burned.³ Some contaminants, such as mercury, persist in the environment and can bioaccumulate in fish and wildlife. SO₂ and NO_x released from burning coal can form acid rain and, along with PM, contribute to the production of smog with its attendant human health effects.

From 1990 to 2000, most SO₂ emissions in Canada were generated by industrial fuel combustion and electric power generation (Figure 2.2).

2.3 Greenhouse gas emissions

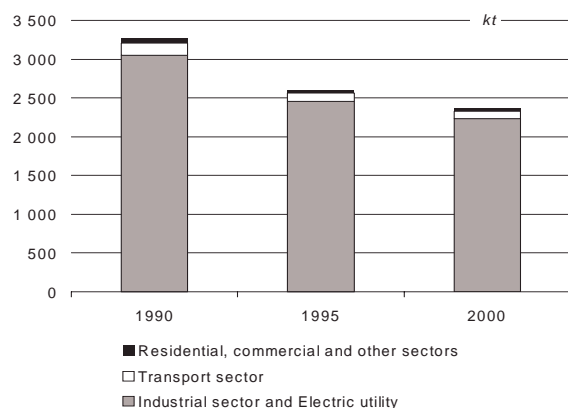
Burning fossil fuels releases large amounts of carbon dioxide (CO₂) into the atmosphere. This gas has been targeted by governments for its contribution to the greenhouse effect. Many countries have taken steps to reduce their output of this and other greenhouse gases (GHGs). In 2001, CO₂ contributed the largest share of Canada's GHG emissions.⁴ Other GHGs associated with energy production and consumption are methane (CH₄) and nitrous oxide (N₂O).

From 1990 to 2001, total GHG emissions increased by 18.4% (112 megatonnes), with energy-related emissions being responsible for 99.1% (111 megatonnes) of this increase (Table 2.9). The largest contributors to this increase were the electricity and heat generation (37.6%), vehicle (24.3%) and fossil fuel production industries

3. Clean Air Task Force, n.d., *Cradle to Grave: The Environmental Impacts from Coal*, www.catf.us/publications/index.php (accessed May 11, 2004).

4. Environment Canada, 2003, *Canada's Greenhouse Gas Inventory 1990-2001: Executive Summary*, www.ec.gc.ca/pdb/ghg/1990_01_report/executive_e.cfm (accessed April 6, 2004).

Figure 2.2
Sulphur dioxide emissions, 1990, 1995 and 2000



Source:
Environment Canada, Pollution Data Branch, Criteria Air Contaminants Emissions Inventory, 1990, 1995, 2000, Ottawa.

(14.2%). The increase in emissions from electricity and heat generation is primarily the result of the use of more GHG-intensive fossil fuels to produce electricity, as well as an increased demand for electricity.

From 1990 to 2001, the emissions of GHGs attributable to the electricity and heat generation and fossil fuel industries increased by 43.8% and 30.7%, respectively. In 2001, these industries contributed 204 megatonnes, an increase of 58 megatonnes from 1990. This accounted for 28% of Canada's GHG emissions in 2001.

The Canadian consumer's preference for minivans and sport-utility vehicles is evident in the 81% increase in emissions from light-duty gasoline trucks from 1990 to

2001. Emissions from gasoline automobiles declined by 9% during the same period.

Table 2.10 presents some indicators of CO₂ emissions. From 1990 to 2001, emissions increased in both absolute and per-capita terms. There was a slight downward trend in emissions per dollar of real GDP from 1990 to 2001.

2.4 Alternative renewable energy sources

Various renewable, low-impact types of energy are attracting greater interest as a way of reducing the demand for non-renewable energy, reducing emissions associated with burning fossil fuels, and profiting from underdeveloped energy sources. While these offer obvious benefits, they also have some environmental effects.

Wind energy

Wind energy, used to power turbines and generate electricity, is a clean, pollution-free energy source. No fossil fuels are used and no greenhouse gases (GHGs) are emitted in the production of electricity from the wind.

Some concerns have been raised over the use of productive land and the aesthetics of wind turbines, which are mounted on towers to catch the best winds. However, turbines are often widely spaced, leaving land for other uses, such as cropping and grazing.¹

1. Natural Resources Canada, n.d., *Canadian Renewable Energy Network: Wind Energy*, www.canren.gc.ca/wind/index.asp (accessed April 28, 2004).

Table 2.9
Greenhouse gas emissions by source, 1990 and 2001

Source	Carbon dioxide (CO ₂)		Methane (CH ₄)		Nitrous oxide (N ₂ O)		CO ₂ -equivalents ¹		
	1990	2001	1990	2001	1990	2001	1990	2001	Change 1990 to 2001
	kt								
Energy	432 000	528 000	1 600.0	2 100.0	27.0	36.0	473 000	584 000	23.5
Stationary combustion sources	276 000	335 000	180.0	220.0	6.0	8.0	282 000	342 000	21.3
Electricity and heat generation	94 700	136 000	2.0	5.0	1.8	2.0	95 300	137 000	43.8
Fossil fuel industries	49 500	64 500	78.0	120.0	1.0	1.0	51 500	67 300	30.7
Petroleum refining	26 000	29 000	0.0	0.4	0.3	0.3	26 100	29 100	11.5
Fossil fuel production	23 600	35 500	78.0	110.0	0.7	1.1	25 400	38 200	50.4
Mining	6 150	10 200	0.0	0.2	0.1	0.3	6 190	10 200	64.8
Manufacturing industries	54 100	48 500	2.0	2.0	1.0	1.0	54 500	48 900	-10.3
Iron and steel	6 420	5 830	0.2	0.2	0.2	0.2	6 490	5 890	-9.2
Non ferrous metals	3 210	3 480	0.1	0.1	0.0	0.1	3 230	3 500	8.4
Chemical	7 060	6 440	0.2	0.1	0.1	0.1	7 100	6 470	-8.9
Pulp and paper	13 400	9 500	0.8	0.8	0.4	0.4	13 500	9 630	-28.7
Cement	3 370	3 270	0.1	0.1	0.0	0.0	3 390	3 290	-2.9
Other manufacturing	20 600	20 000	0.4	0.4	0.4	0.4	20 800	20 100	-3.4
Construction	1 860	1 000	0.0	0.0	0.1	0.0	1 880	1 010	-46.3
Commercial and institutional	25 700	32 700	0.0	0.6	0.0	0.7	25 800	32 900	27.5
Residential	41 300	39 400	100.0	94.0	1.7	1.7	44 000	41 900	-4.8
Agriculture and forestry	2 403	2 190	0.0	0.0	0.1	0.1	2 420	2 210	-8.7
Transportation combustion sources	146 000	178 000	31.0	31.0	21.0	29.0	153 000	187 000	22.2
Domestic aviation	10 407	11 800	0.7	0.6	1.0	1.2	10 700	12 100	13.1

Table 2.9
Greenhouse gas emissions by source, 1990 and 2001 (continued)

Source	Carbon dioxide (CO ₂)		Methane (CH ₄)		Nitrous oxide (N ₂ O)		CO ₂ -equivalents ¹		
	1990	2001	1990	2001	1990	2001	1990	2001	Change 1990 to 2001 %
	kt								
Road transportation	103 000	127 000	16.0	14.0	12.0	19.0	107 000	134 000	25.2
Gasoline automobile	51 600	46 400	9.0	4.6	6.3	7.3	53 700	48 700	-9.3
Light duty gasoline trucks	20 400	36 400	4.0	4.8	4.2	9.0	21 800	39 400	80.7
Heavy duty gasoline vehicles	2 990	3 930	0.4	0.6	0.4	0.6	3 140	4 130	31.5
Motorcycles	225	236	0.2	0.2	0.0	0.0	230	242	5.2
Diesel automobiles	657	583	0.0	0.0	0.0	0.0	672	596	-11.3
Light duty diesel trucks	577	629	0.0	0.0	0.0	0.0	591	643	8.8
Heavy duty diesel vehicles	24 300	38 200	1.2	1.9	0.7	1.1	24 500	38 600	57.6
Propane and natural gas vehicles	2 160	1 100	1.7	1.7	0.0	0.0	2 210	1 140	-48.4
Railways	6 320	5 820	0.4	0.3	2.5	2.3	7 110	6 550	-7.9
Domestic marine	4 730	5 180	0.4	0.4	1.0	1.1	5 050	5 510	9.1
Others	21 800	27 600	13.0	16.0	4.0	6.0	23 400	29 700	26.9
Off road	15 100	17 700	6.1	6.0	4.2	5.4	16 500	19 500	18.2
Pipelines	6 700	9 970	6.7	10.0	0.2	0.3	6 900	10 300	49.3
Fugitive sources²	9 830	15 300	1 300.0	1 900.0	0.0	0.0	37 900	54 800	44.6
Coal mining	0	0	91.0	47.0	0.0	0.0	1 910	990	-48.2
Oil and natural gas	9 830	15 300	1 200.0	1 800.0	0.0	0.0	36 000	53 800	49.4
Oil	27	78	410.0	660.0	0.0	0.0	8 570	14 000	63.4
Natural gas	19	29	820.0	1 100.0	0.0	0.0	17 200	23 900	39.0
Venting	4 500	7 820	0.0	0.0	0.0	0.0	4 500	7 820	73.8
Flaring	5 290	7 380	24.0	31.0	0.0	0.0	5 780	8 030	38.9
Industrial processes	32 600	38 300	0.0	0.0	37.0	5.0	52 900	49 000	-7.4
Mineral production	8 160	8 650	0.0	0.0	0.0	0.0	8 160	8 650	6.0
Cement	5 870	6 490	0.0	0.0	0.0	0.0	5 870	6 490	10.6
Lime	1 850	1 750	0.0	0.0	0.0	0.0	1 850	1 750	-5.4
Limestone and soda use	439	403	0.0	0.0	0.0	0.0	439	403	-8.2
Chemical industry	5 010	5 920	0.0	0.0	37.0	5.0	16 500	7 520	-54.4
Ammonia production	5 010	5 920	0.0	0.0	0.0	0.0	5 010	5 920	18.2
Nitric acid production	0	0	0.0	0.0	2.5	2.6	777	795	2.3
Adipic acid production	0	0	0.0	0.0	35.0	2.6	10 700	802	-92.5
Metal production	10 200	12 100	0.0	0.0	0.0	0.0	19 100	20 300	6.3
Iron and steel production	7 590	7 920	0.0	0.0	0.0	0.0	7 590	7 920	4.3
Aluminum production	2 640	4 160	0.0	0.0	0.0	0.0	8 610 ³	10 300 ⁴	20.0
SF ₆ used in magnesium smelters	0	0	0.0	0.0	0.0	0.0	2 870 ³	2 020 ⁴	-30.0
Consumption of halocarbons	0	0	0.0	0.0	0.0	0.0	0	936	...
Other and undifferentiated production	9 220	11 700	0.0	0.0	0.0	0.0	9 220	11 700	26.9
Solvent and other product use	0	0	0.0	0.0	1.3	1.5	417	468	12.2
Agriculture	7 550	299	980.0	1 200.0	100.0	120.0	59 200	60 000	1.4
Enteric fermentation ⁵	0	0	760.0	900.0	0.0	0.0	16 000	18 800	17.5
Manure management	0	0	220.0	260.0	12.0	15.0	8 270	10 100	22.1
Agricultural soils	8 000	300	0.0	0.0	90.0	100.0	30 000	30 000	0.0
Direct sources	8 000	300	0.0	0.0	70.0	79.0	30 000	20 000	-33.3
Indirect sources	0	0	0.0	0.0	20.0	23.0	5 000	7 000	40.0
Land use change and forestry (non-CO₂ only)⁶	0	0	62.0	50.0	3.0	3.0	2 256	2 080	-7.8
Prescribed burns	0	0	47.0	17.0	1.9	0.7	1 560	575	-63.1
Wildfires in the wood production forest	0	0	15.0	33.0	1.2	2.6	698	1 510	116.3
Waste	254	284	900.0	1 100.0	3.0	3.0	20 100	24 800	23.4
Solid waste disposal on land	0	0	880.0	1 100.0	0.0	0.0	18 500	23 100	24.9
Wastewater handling	0	0	17.0	19.0	2.8	3.1	1 220	1 370	12.3
Waste incineration	254	284	0.4	0.3	0.2	0.2	317	350	10.4
Land use change and forestry (CO₂ only)⁶	-100 000	-40 000	0.0	0.0	0.0	0.0	-100 000	-40 000	-60.0
Changes in forest and woody biomass stocks	-100 000	-40 000	0.0	0.0	0.0	0.0	-100 000	-40 000	-60.0
Forest and grassland conversion	1 000	4 000	0.0	0.0	0.0	0.0	1 000	4 000	300.0
Abandonment of managed lands	-3 000	-3 000	0.0	0.0	0.0	0.0	-3 000	-3 000	0.0
CO ₂ emissions and removals from soil	4 000	2 000	0.0	0.0	0.0	0.0	4 000	2 000	-50.0
Total	472 000	566 000	3 500.0	4 500.0	170.0	170.0	608 000	720 000	18.4

Notes:

Figures may not add up to totals due to rounding or varying degrees of uncertainty in individual estimates.

1. CO₂-equivalent emissions are the weighted sum of all greenhouse gas emissions. The following global warming potentials are used as the weights: CO₂ = 1; CH₄ = 21; N₂O = 310; HFCs = 140-11 700; PFCs = 6 500-9 200; SF₆ = 23 900.

2. Includes intentional and unintentional emissions from production, processing, transmission, storage and delivery of fuels, including those from flaring of natural gas at oil and gas production facilities.

3. 1990 CO₂-equivalent emissions for this industry include 6 000 kilotonnes of PFC emissions and 3 000 kilotonnes of SF₆ emissions.

4. 2001 CO₂-equivalent emissions for this industry include 6 000 kilotonnes of PFC emissions and 2 000 kilotonnes of SF₆ emissions.

5. Emissions from livestock digestive processes.

6. CO₂ emissions and removals in the Land use change and forestry sector are not included in the national totals.

Source:

Environment Canada, 2003, *Canada's Greenhouse Gas Inventory, 1990-2001*, Ottawa.

Table 2.10
Carbon dioxide emissions from fossil fuel combustion and production, 1990 to 2001

Year	CO ₂ emissions	CO ₂ emissions per capita	CO ₂ emissions per dollar of real GDP
	Mt	t/person	kg/\$ chained 1997
1990	432	15.60	0.56
1991	422	15.04	0.56
1992	436	15.36	0.58
1993	434	15.13	0.56
1994	448	15.45	0.55
1995	461	15.73	0.55
1996	473	15.97	0.56
1997	485	16.22	0.55
1998	494	16.38	0.54
1999	513	16.87	0.53
2000	537	17.50	0.53
2001	528	17.02	0.51

Sources:

Environment Canada, 2003, *Canada's Greenhouse Gas Inventory, 1990-2001*, Ottawa.
 Statistics Canada, CANSIM, tables 051-0001 and 380-0017.

In some cases, wind turbines have been associated with bird kills; however, newer tubular towers lack bird perches, reducing the opportunity for contact.

Solar energy

Solar energy is also a clean, non-polluting source of power that is well suited to isolated applications. Photovoltaic (PV) cells can make use of built space such as roofs and building façades, reducing the need for additional land to support energy production. However, large-scale solar power plants would need additional land.

Solar power collection does not emit pollutants; the impacts to be considered include the amount of energy required to manufacture and install PV solar cells, as well as disposal issues once older systems reach the end of their life span.

Biomass energy

Biomass energy makes use of the solar energy stored by plants through photosynthesis. Biomass includes organic matter such as wood, peat and charcoal; agricultural, municipal and forest wastes; and energy crops—fast growing plants and trees grown for energy production. Biomass is normally burned to produce heat, steam or electricity. However, technologies exist to convert it into fuels such as ethanol or capture gases created through its decomposition.¹

Incineration of biomass produces air pollutants, including particulate matter (PM), nitrogen oxides (NO_x) and others, depending on the type of material being burned. Raw municipal waste, for example, can contain metals, plastics, and other materials that produce emissions when burned. On the other hand, wastes that would otherwise go to landfills can be productively used to produce energy from biomass.

1. Natural Resources Canada, n.d., *Canadian Renewable Energy Network: Bioenergy*, www.canren.gc.ca/bio/index.asp (accessed April 28, 2004).

Capturing waste decomposition gases and using the methane collected for energy generation can have a beneficial impact on the environment. Methane is a potent GHG, with 21 times the impact of carbon dioxide (CO₂) (Table 2.9). Using it as a fuel reduces its impact on the atmosphere as it is converted into less damaging CO₂ when it is burned.

Earth energy and geothermal energy

Earth energy systems make use of water bodies or earth to cool or heat buildings. While these systems require some outside energy to power a heat pump, they produce significantly fewer GHG emissions than conventional heating and cooling units.

Most geothermal energy systems use hot water or steam from below the earth's surface to provide heat to buildings and industry. With high enough temperatures, geothermal energy can also be used to produce electricity.

While most geothermal systems operate in a closed loop that returns geothermal fluids underground, those that do not can generate solid waste and fumes. Earth subsidence may be a problem where materials are extracted and are not returned to the earth.

Small-scale hydro

Small-scale hydro facilities use small dams or other structures to divert water to a generating station. Like conventional hydro-electric production, small-scale hydro does not produce any air emissions or pollutants. However, depending on the type of development, small-scale hydro can have impacts similar to that of larger hydro-electric developments.²

Small-scale hydro developments can make use of existing dams, water-level control systems for rivers and lakes, and irrigation works, as well as waterfalls and steeply falling watercourses. Run-of-river projects, which do not store water in reservoirs and which have downstream water flows unchanged from predevelopment levels, will have relatively little impact on the environment.

Tidal power

Tidal power, like hydro-electric power, is a renewable energy source that does not cause air pollution or GHGs. However, damming or barring estuaries to run turbines can have environmental consequences that will vary with the site. Some possible impacts include changed water circulation patterns, increased turbidity and sedimentation. Fisheries and migration routes for marine mammals can also be affected.

2. International Small-hydro Atlas, n.d., www.small-hydro.com (accessed April 20, 2004).

3 Response

3.1 Government response

Energy policy in Canada has changed focus considerably over the last 20 years. In the 1970s and early 1980s, policy focussed on security, with Canadian ownership being encouraged. Beginning in the mid-1980s, the focus shifted to prosperity, with an emphasis on market-based policies. These policies were generally successful in promoting a competitive Canadian energy sector, especially in oil and natural gas. Today, Canada's energy policy balances three important and at times conflicting objectives:

- security (to access reliable, affordable and secure sources of energy)
- prosperity (to contribute to the prosperity and quality of life of all Canadians)
- environment (to balance energy demand with environmental objectives)

Despite these changes in policy, Canada's federal, provincial and territorial governments continue to play a role in regulating energy markets (Table 3.1). Jurisdiction is divided between the federal and provincial governments. Provincial governments have responsibility for resource management, including intraprovincial trade, commerce and environmental impacts. The federal government has responsibility for the movements of energy among the provinces and internationally. It also has ownership of all oil and gas resources on Canada's north and offshore frontier lands and regulates all aspects of uranium production, transportation and distribution.

Energy use and efficiency

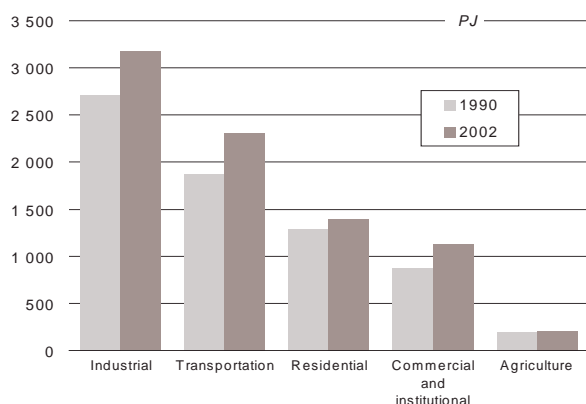
Several factors contribute to how much energy is consumed by businesses and households and how efficiently it is used. Increased activity, such as higher output in an industry or more kilometres driven by motor vehicles, results in higher energy consumption. Fluctuations in weather affect the amount of energy used to heat and cool buildings. Long-term shifts in the economy—for example, from energy-intensive heavy industries to lighter industries

Table 3.1
Selected federal, provincial and territorial legislation related to energy

Jurisdiction	Legislation
Federal	Alternative Fuels Act; Canada-Newfoundland Atlantic Accord Implementation Act; Canada-Nova Scotia Offshore Petroleum Resources Accord Implementation Act; Canada Oil and Gas Operations Act; Canada Petroleum Resources Act; Co-operative Energy Act; Dominion Water Power Act; Electricity and Gas Inspection Act; Energy Administration Act; Energy Efficiency Act; Energy Monitoring Act; Energy Supplies Emergency Act; Hibernia Development Project Act; Indian Oil and Gas Act; National Energy Board Act; Northern Pipeline Act; Nuclear Energy Act; Nuclear Fuel Waste Act; Nuclear Liability Act; Nuclear Safety and Control Act; Oil Substitution and Conservation Act; Petroleum and Gas Revenue Tax Act
Newfoundland and Labrador	Canada-Newfoundland and Labrador Atlantic Accord Implementation (Newfoundland and Labrador) Act; Electrical Power Control Act, 1994; Environmental Protection Act; Gasoline Tax Act; Hydro Corporation Act; Lower Churchill Development Act; Mineral Act; Mineral Holdings Impost Act; Mining Act; Mining and Mineral Rights Tax Act, 2002; Petroleum and Natural Gas Act; Petroleum Products Act; Public Utilities Act; Public Utilities Acquisition of Land Act; Undeveloped Minerals Area Act; Water Resources Act
Prince Edward Island	Electric Power Act; Electrical Inspection Act; Energy Corporation Act; Gasoline Tax Act; Mineral Resources Act; Oil and Natural Gas Act; Petroleum Products Act
Nova Scotia	Canada-Nova Scotia Offshore Petroleum Resources Accord Implementation (Nova Scotia) Act; Coal Mines Regulation Act; Electrical Installation and Inspection Act; Energy Resources Conservation Act; Energy-Efficient Appliances Act; Environment Act; Gas Distribution Act; Mineral Resources Act; Nova Scotia Power Finance Corporation Act; Nova Scotia Power Privatization Act; Nova Scotia Power Reorganization (1998) Act; Petroleum Resources Act; Petroleum Resources Removal Permit Act; Pipeline Act; Public Utilities Act; Underground Hydrocarbons Storage Act
New Brunswick	Bituminous Shale Act; Electrical Installation and Inspection Act; Electricity Act; Electric Power Act; Energy Efficiency Act; Gas Distribution Act, 1999; Gasoline and Motive Fuel Tax Act; Gasoline, Diesel Oil and Home Energy Oil Pricing Act; Mining Act; Oil and Natural Gas Act; Ownership of Minerals Act; Pipe Line Act; Public Utilities Act;
Quebec	Building Act; Gas, Water and Electricity Companies Act; Mining Companies Act; Mining Duties Act; Act respecting the conservation of energy in buildings; Act respecting the energy efficiency of electrical and hydrocarbon-fuelled appliances; Act respecting the exportation of electric power; Hydro-Québec Act; Mining Act; Act respecting petroleum products and equipment; Environment Quality Act; Act respecting the Régie de l'énergie; Act respecting municipal and private electric power systems; Fuel Tax Act
Ontario	Electricity Act, 1998; Energy Efficiency Act; Environmental Protection Act; Fuel Tax Act; Gas and Oil Leases Act; Gasoline Tax Act; Mining Act; Mining Tax Act; Ministry of Energy Act; Oil, Gas and Salt Resources Act; Ontario Energy Board Act, 1998; Ontario Mineral Exploration Program Act; Power Corporation Act; Public Utilities Act
Manitoba	Energy Act; Energy Rate Stabilization Act; Environment Act; Gas and Oil Burner Act; Gasoline Tax Act; Gas Pipe Line Act; Gas Allocation Act; High-Level Radioactive Waste Act; Manitoba Natural Resources Development Act; Mines and Minerals Act; Mining and Metallurgy Compensation Act; Mining Claim Tax Act; Mining Tax Act; Motive Fuel Tax Act; Natural Gas Supply Act; Oil and Gas Act; Oil and Gas Production Tax Act; Public Utilities Board Act; Water Power Act
Saskatchewan	Crown Minerals Act; Department of Energy and Mines Act; Electrical Inspection Act, 1993; Electrical Licensing Act; Environmental Assessment Act; Environmental Management and Protection Act, 2002; Ethanol Fuel Act; Freehold Oil and Gas Production Tax Act; Fuel Tax Act, 2000; Gas Inspection Act, 1993; Home Energy Loan Act; Mineral Resources Act, 1985; Oil and Gas Conservation Act; Pipelines Act, 1998; Power Corporation Act; Public Utilities Easements Act; Rural Electrification Act; SaskEnergy Act
Alberta	Alberta Energy and Utilities Board Act; Coal Conservation Act; Coal Sales Act; Electric Utilities Act; Energy Resources Conservation Act; Freehold Mineral Rights Tax Act; Fuel Tax Act; Gas Distribution Act; Gas Resources Preservation Act; Gas Utilities Act; Hydro and Electric Energy Act; Mines and Minerals Act; Natural Gas Marketing Act; Natural Gas Price Administration Act; Natural Gas Price Protection Act; Oil and Gas Conservation Act; Oil Sands Conservation Act; Petroleum Marketing Act; Pipeline Act; Public Utilities Board Act; Rural Electrification Long-term Financing Act; Rural Utilities Act; Small Power Research and Development Act; Water, Gas, and Electric Companies Act
British Columbia	Coal Act; Coalbed Gas Act; Electrical Safety Act; Energy Efficiency Act; Environment Management Act; Environmental Assessment Act; Gas Safety Act; Gas Utility Act; Geothermal Resources Act; Hydro and Power Authority Act; Hydro and Power Authority Privatization Act; Hydro Powers Measure Act; Mineral Land Tax Act; Mineral Tax Act; Mineral Tenure Act; Mines Act; Mining Right of Way Act; Mining Tax Act; Natural Gas Price Act; Oil and Gas Commission Act; Petroleum and Natural Gas Act; Pipeline Act; Utilities Commission Act; Vancouver Island Natural Gas Pipeline Act
Yukon Territory	Energy Conservation Assistance Act; Fuel Oil Tax Act; Gas Burning Devices Act; Gasoline Handling Act; Oil and Gas Act; Public Utilities Act; Yukon Development Corporation
Northwest Territories	Electrical Protection Act; Environmental Protection Act; Environmental Rights Act; Gas Protection Act; Natural Resources Conservation Trust Act; Northwest Territories Power Corporation Act; NWT Energy Corporation Ltd. Loan Guarantee Act; Petroleum Products Tax Act; Public Utilities Act; Public Utilities Income Tax and Rebates Act
Nunavut	Electrical Protection Act; Environmental Protection Act (Nunavut); Environmental Rights Act; Gas Protection Act; Natural Resources Conservation Trust Act; Nunavut Power Utilities Act; NWT Energy Corporation Ltd. Loan Guarantee Act; Petroleum Products Tax Act (Nunavut); Public Utilities Act (Nunavut); Public Utilities Income Tax Rebates Act

Source:
Department of Justice of Canada, n.d., www.legis.ca/en/index.html (accessed April 20, 2004).

Figure 3.1
Energy use by end-use sector, 1990 and 2002



Source:
Natural Resources Canada, 2004, *Energy Efficiency Trends in Canada, 1990 to 2002*, Catalogue no. M141-1/2002, Ottawa.

that use less energy—can profoundly alter consumption over time.

Adopting more energy-efficient heating systems, automobiles or manufacturing processes can help reduce energy consumption. All levels of government offer programs and services to help improve the efficiency of energy use by households and businesses.

Government programs

The federal government's key programs to promote energy efficiency are administered by the Office of Energy Efficiency at Natural Resources Canada.¹ Programs are directed at improving the energy efficiency of homes, as well as of commercial, industrial and federal buildings; improving the energy efficiency of equipment and appliances; and helping keep Canadians informed about energy-efficient transportation options.

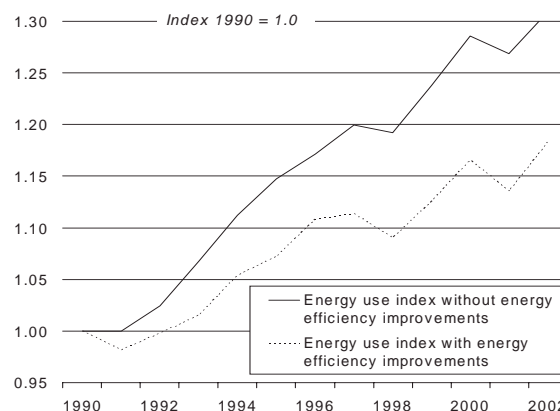
Popular programs include the EnerGuide labels affixed to household appliances and vehicles, showing the amount of fuel or energy used; it allows for easy comparison of different models. The international ENERGY STAR® logo identifies the most energy-efficient products in their class.

Various programs provide financial incentives to building owners who incorporate energy-efficient features into the design of new commercial, institutional and industrial buildings, while the Energy Innovators Initiative helps businesses and institutions improve existing buildings.

The R-2000 Standard encourages the construction of energy-efficient new homes. As well, homeowners can have their homes evaluated for energy efficiency and can

1. Natural Resources Canada, 2004, *The Office of Energy Efficiency (OEE)*, oee.nrcan.gc.ca/english/index.cfm (accessed July 8, 2004).

Figure 3.2
Energy end-use, with and without energy efficiency improvements, 1990 to 2002



Note:
Variations in energy efficiency by sector are aggregated into a single index of energy efficiency for Canada called the OEE Energy Efficiency Index. For more information on this index see source listed below.

Source:
Natural Resources Canada, 2004, *Energy Efficiency Trends in Canada, 1990 to 2002*, Catalogue no. M141-1/2002, Ottawa.

apply for grants under the EnerGuide for Houses Retrofit Incentive.

Trends

Industrial energy use accounted for 38.6% of total energy use in 2002 (Figure 3.1). The transportation, residential, and commercial and institutional sectors are other large end users of energy.

From 1990 to 2002, total end-use² energy consumption increased 18%, mainly as a result of rising activity.³ Residential energy consumption increased 9% as the number and size of homes increased and Canadians used more and more home appliances and electrical devices. However, without improvements in energy efficiency, total energy consumption would have been an additional 13% higher by 2002 (Figure 3.2).⁴

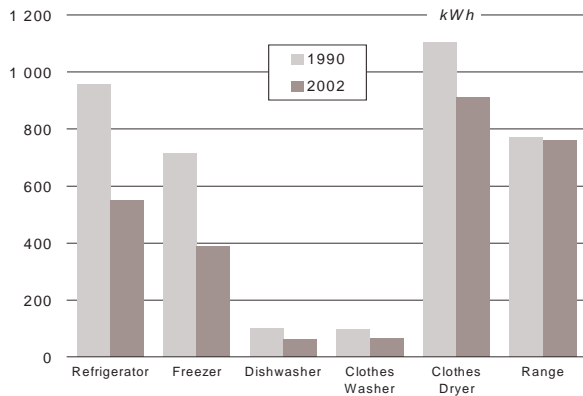
Household energy efficiency gains have come from improvements in the insulation, heating and cooling of homes. Other gains came from improvements in the efficiency of water-heating equipment and major appliances. As shown in Figure 3.3, the energy efficiency of most major electrical household appliances improved between 1990 and 2002. The household use of a selection

2. Any specific activity that requires energy (e.g., refrigeration, space heating, water heating, manufacturing, feeding stock).

3. Natural Resources Canada, 2004, *The State of Energy Efficiency in Canada: Office of Energy Efficiency Report 2003*, Catalogue no. M92-167/2003, Ottawa.

4. Natural Resources Canada, 2004, *Energy Efficiency Trends in Canada, 1990 to 2002*, Catalogue no. M141-1/2002, Ottawa.

Figure 3.3
Energy use of major electrical household appliances, 1990 and 2002



Source:
 Natural Resources Canada, 2004, *Energy Efficiency Trends in Canada, 1990 to 2002*, Catalogue no. M141-1/2002, Ottawa.

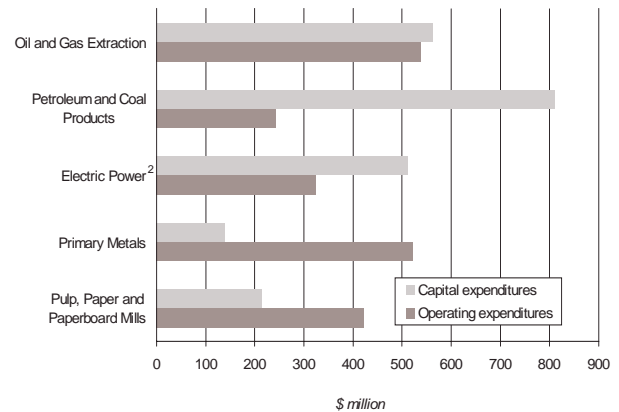
Table 3.2
Selected appliances and energy-related practices in households, 1993 and 1997

Practice	1993	1997
	% of households	
Households with second refrigerator	18	33
Households with freezer	60	72
Households with microwave	79	92
Households with dishwasher	44	59
Dishdrying:		
With heat	44	43
Without heat	56	57
Households with washing machine	79	93
Water temperature used for washing:		
Hot	7	6
Warm	62	66
Cold	32	29
Water temperature used for rinsing:		
Hot	1	1
Warm	23	21
Cold	76	79
Households with clothes dryer	74	93
Average number of loads per week in winter:		
1 or fewer	13	11
2 or 3	28	27
4 or 5	22	22
6 or 7	16	17
8 to 13	15	16
14 or more	5	8
Average number of loads per week in summer:		
1 or fewer	36	38
2 or 3	26	24
4 or 5	17	16
6 or 7	10	10
8 to 13	8	9
14 or more	3	4

Note:
 This table is based on the 1997 and 1993 Surveys of Household Energy Use. Both surveys were conducted using a sample of the Labour Force Survey; however, the 1997 survey was limited to residents of houses whereas the 1993 survey included both home and apartment dwellers. This difference limits comparability between the two surveys.

Sources:
 Natural Resources Canada, 2000, *1997 Survey of Household Energy Use: Summary Report*, Catalogue no. M92-85/1997-1, Ottawa.
 Natural Resources Canada, 1994, *1993 Survey of Household Energy Use: National Results*, Catalogue no. M92-85/1994E, Ottawa.

Figure 3.4
Environmental protection expenditures by top five industries, 2002



Notes:
 1. The top five biggest spenders, in order, on environmental protection in 2002.
 2. 'Electric Power' refers to the Electric Power Generation, Transmission and Distribution Industry.

Source:
 Statistics Canada, Environment Accounts and Statistics Division.

of these appliances and energy-related practices is presented in Table 3.2.

3.2 Business response

Environmental protection expenditures

Businesses are the source of much of Canada's pollution; they also play a major role in controlling it. Since 1994, Statistics Canada has collected information on how much money businesses spend on environmental protection. The Survey of Environmental Protection Expenditures also collects information on environmental management practices and technologies used by industry¹ for the purpose of preventing, abating or controlling pollution (Text Box 3.1).

The five industries that spent the most on environmental protection in 2002 invested \$4.3 billion (Figure 3.4), over 60% of the \$6.8 billion spent by all industries. The top three of these five industries were in the energy sector: Oil and Gas Extraction, Petroleum and Coal Products, and Electric Power, Generation, Transmission and Distribution. Total energy sector expenditures on environmental protection reached \$3.2 billion in 2002 (Table 3.3).

The petroleum and coal products industry spent \$499.9 million on capital projects for pollution prevention

1. The Survey of Environmental Protection Expenditures collects information from 16 industry groups in the primary and manufacturing industry sectors. Environmental protection expenditures (see Text Box 3.1) include all capital and operating expenditures incurred by businesses in order to comply with or anticipate Canadian and international environmental regulations, conventions or voluntary agreements.

Text Box 3.1

Environmental protection expenditures

Environmental monitoring: expenditures for purchase of equipment, supplies, labour and services required to monitor pollutant emissions that would affect air, water or soil quality

Environmental assessments and audits: expenditures made to review current operations' compliance with regulations and to evaluate the environmental impact of proposed projects

Site reclamation and decommissioning: expenditures for cleaning up of environmental damage and closing a site

Wildlife and habitat protection: expenditures made to protect wildlife and habitat from the effects of economic activity and to restore stocks that have been adversely affected by such activity

Pollution abatement and control (end-of-pipe processes): expenditures related to funding of separately identifiable processes whose sole purpose is to abate or control undesirable substances emitted during normal production activities, without any incidence on the production process itself; expenditures on waste and sewage management and treatment

Pollution prevention processes: expenditures made to develop a new or significantly modified production process (integrated processes) in order to prevent or reduce pollutants and waste before they are generated; expenditures on leak and spill prevention; expenditures on energy and water conservation; expenditures on on-site recirculation, recovery, reuse and recycling of materials and substances

Fees, fines and licences: permits, fees, levies, fines, penalties or damage awards paid to government agencies or to individuals, or any other charges paid to regulating bodies

Other: expenditures for administration of environmental projects, for training, and for other initiatives not elsewhere specified.

Source:
Statistics Canada, Environment Accounts and Statistics Division.

systems and equipment in 2002, a \$409.6 million increase over 2000 (Table 3.4). It also spent \$226.7 million on pollution abatement and control equipment or processes, an increase of \$107.6 million. The higher investment in environmental protection occurred as firms in this industry reported large increases in overall capital expenditures, primarily for the purpose of upgrading refineries in order to meet new sulphur reduction regulations, the first phase of which came into effect in July 2002.

Table 3.3

Energy sector expenditures on environmental protection by industry, 2002

Industry	Capital	Operating	Total
	expenditures	expenditures	
	\$ million		
Oil and Gas Extraction	562.4	539.5	1 101.9
Coal Mining	30.9	55.9	86.8
Electric Power Generation, Transmission and Distribution	511.9	325.8	837.7
Natural Gas Distribution	18.0	9.9	27.9
Petroleum and Coal Products	811.3	244.3	1 055.6
Pipeline Transportation	49.7	58.3	108.0
Total	1 984.2	1 233.7	3 217.9

Note:

Figures may not add up to totals due to rounding.

Source:

Statistics Canada, Environment Accounts and Statistics Division.

Energy conservation and efficiency

Statistics Canada collects specific information on the types of environmental processes or technologies businesses are using to prevent, abate or control pollution (Text Box 3.2). In 2002, of the establishments that responded to the Survey of Environmental Protection Expenditures, 40% reported using at least one form of energy conservation (Table 3.5).

The most popular reported energy conservation technologies were waste-to-energy systems or equipment (14%), cogeneration (9%), and fuel substitution (8%). The industries with the highest percentage of establishments using at least one energy conservation process or technology were Pulp, Paper and Paperboard Mills (81%), Oil and Gas Extraction (75%), Pipeline Transportation (74%), and Natural Gas Distribution (69%). Almost half of the Oil and Gas Extraction establishments reported using solar energy systems or equipment, and 58% of those in Pulp, Paper and Paperboard Mills used waste-to-energy systems or equipment.

3.3 Industrial development

Better awareness of the economic and environmental benefits of energy conservation has led many Canadian businesses to adopt processes that limit the impact their operations have on the environment. This has given rise to a new breed of businesses that produce goods and services to help improve energy conservation and efficiency.

Energy-related goods and services

In 2002, Canadian environmental businesses earned \$370.3 million in revenues from the sale of technologies to reduce greenhouse gas emissions, which include industrial equipment, systems and processes that reduce or prevent the release of greenhouse gases into the earth's

Table 3.4

Energy sector expenditures on environmental protection by industry and type of activity, 2000 and 2002

Industry	Environmental monitoring		Environmental assessments and audits		Reclamation and decommissioning		Wildlife and habitat protection		Pollution abatement and control processes (end-of-pipe) ¹		Pollution prevention processes		Fees, fines and licences		Other		Total		
	2000	2002	2000	2002	2000	2002	2000	2002	2000	2002	2000	2002	2000	2002	2000	2002	2000	2002	
	\$ million																		
Operating expenditures																			
Oil and Gas Extraction	19.7	32.5	15.0	18.2	117.4	155.9	3.0	9.6	81.2	177.1	35.7	53.7	12.9	15.4	39.7	77.1	324.7	539.5	
Coal Mining	1.8	1.6	0.9	1.8	22.4	30.3	0.7	1.3	10.8	9.8	5.3	3.3	1.1	0.7	4.0	7.1	47.0	55.9	
Electric Power Generation, Transmission and Distribution	9.1	17.1	16.4	20.7	23.0	28.6	6.8	12.0	106.3	83.7	28.9	88.1	10.5	10.3	54.9	65.3	255.8	325.8	
Natural Gas Distribution ²	0.2	1.2	0.3	0.8	0.5	0.8	..	0.6	1.7	1.9	0.4	2.0	0.1	0.1	3.0	2.4	6.1	9.9	
Petroleum and Coal Products	7.3	7.1	7.0	3.0	11.2	76.4	0.9	0.1	85.6	80.1	75.5	68.0	9.6	2.6	15.9	7.1	212.9	244.3	
Pipeline Transportation	5.2	3.1	6.8	3.9	18.2	13.0	3.9	1.6	6.4	17.1	10.1	10.3	3.8	1.5	6.5	7.6	61.0	58.3	
Total	43.2	62.6	46.3	48.4	192.7	305.0	15.3	25.2	292.0	369.7	155.9	225.4	38.0	30.6	124.1	166.6	907.5	1 233.5	
Capital expenditures																			
Oil and Gas Extraction	11.8	111.3	14.1	23.7	73.8	92.4	5.9	5.5	244.8	85.9	114.8	243.7	...	...	...	...	465.1	562.4
Coal Mining	0.1	x	0.1	x	0.9	10.9	0.3	0.2	1.3	7.6	2.4	x	...	...	...	...	5.0	30.9
Electric Power Generation, Transmission and Distribution ³	7.8	9.3	36.5	26.9	..	15.7	4.0	13.5	56.0	218.3	78.1	228.2	...	...	...	...	182.4	511.9
Natural Gas Distribution	0.2	x	1.0	x	0.3	0.8	0.2	x	0.5	x	0.6	x	...	...	...	...	2.8	18.0
Petroleum and Coal Products	1.6	30.7	0.3	7.2	3.0	39.8	0.3	7.0	119.1	226.7	90.3	499.9	...	...	...	...	214.6	811.3
Pipeline Transportation	1.3	x	1.9	x	3.0	4.7	0.6	x	9.9	x	17.4	32.0	...	...	...	...	33.9	49.7
Total	22.7	x	53.9	x	81.0	164.3	11.2	x	431.5	x	303.6	x	...	...	...	...	903.9	1 984.2

Notes:

Figures may not add up to totals due to rounding.

1. With respect to operating expenditures, purchased waste management and sewerage services are included in this category.

2. Operating expenditures on wildlife and habitat protection are included with expenditures on 'other.'

3. Capital expenditures on reclamation and decommissioning are included with expenditures on environmental assessments and audits.

Source:

Statistics Canada, Environment Accounts and Statistics Division.

Table 3.5

Energy conservation processes and technologies by industry, 2002

Industry	Cogeneration	Small, mini, or micro hydro electric facility	Solar energy systems or equipment	Wind energy systems or equipment	Waste-to-energy systems or equipment	Other renewable energy systems or equipment	Alternative fuel systems or equipment	Fuel substitution	Other ¹	Total ²
Logging	1.6	6.3	3.1	0.0	18.8	1.7	6.3	6.3	10.2	35.9
Oil and Gas Extraction	19.4	11.1	48.6	8.3	11.6	5.7	12.7	11.1	34.3	74.7
Mining	2.8	6.5	17.3	0.0	9.2	5.7	3.8	7.5	24.2	47.7
Electric Power Generation, Transmission and Distribution	21.6	23.9	11.1	14.1	14.7	13.0	12.5	14.1	30.6	57.9
Natural Gas Distribution	10.0	0.0	27.3	0.0	10.0	0.0	40.0	41.7	33.3	69.2
Food	2.5	0.0	0.0	0.0	5.0	0.6	2.5	5.0	17.8	20.4
Beverage and Tobacco Products	1.6	0.0	0.0	0.0	3.3	0.0	0.0	1.6	16.7	21.3
Wood Products	8.3	0.0	0.7	0.0	41.1	8.1	2.8	11.2	15.6	52.3
Pulp, Paper and Paperboard Mills	32.2	8.9	0.0	0.0	57.8	15.6	10.2	18.3	29.0	80.8
Petroleum and Coal Products	12.5	0.0	3.1	0.0	9.4	3.1	3.1	21.9	32.3	53.1
Chemicals	11.5	0.0	0.5	0.0	4.7	1.9	3.7	5.6	15.0	25.6
Non-Metallic Mineral Products	0.0	0.0	0.0	0.0	6.9	1.4	2.8	8.3	13.4	8.3
Primary Metals	1.8	1.8	0.0	0.0	3.6	1.2	3.6	4.2	25.0	31.6
Fabricated Metal Products	2.6	0.0	0.0	1.3	1.3	0.0	0.0	0.0	6.8	10.3
Transportation Equipment	2.2	0.0	3.2	0.0	1.1	1.1	1.1	5.4	33.7	33.0
Pipeline Transportation	9.5	0.0	28.6	0.0	4.8	2.5	7.5	7.5	47.5	73.8
Total	8.6	3.3	5.7	1.1	13.8	4.1	4.7	8.0	21.7	40.2

Notes:

This table includes reported data only.

1. Includes establishments that reported using other energy conservation processes or technologies not elsewhere specified.

2. Refers to number of establishments that indicated they used at least one energy conservation process or technology as a percentage of the total number of establishments that provided a response.

3. Number of establishments indicating they used the process or technology as a percentage of all establishments that provided a response.

Source:

Statistics Canada, Environment Accounts and Statistics Division.

Text Box 3.2

Energy conservation technologies

Cogeneration: systems and equipment used to produce both heat and electricity from biomass (organic matter from forest and agricultural sources), waste and industrial residues, and other fuel sources

Micro, mini or small hydro-electric facility: micro = less than 100 kilowatts; mini = 100 to 1000 kilowatts (1 megawatt); small hydro = 1 to 30 megawatts

Solar energy systems or equipment: active and passive solar systems; photovoltaics; solar generators; solar water and space heating systems

Wind energy systems or equipment: horizontal- and vertical-axis turbines; towers and other types of equipment used to generate energy and electricity by harnessing wind power

Waste-to-energy systems or equipment: systems and equipment (turbines, boilers, process equipment) that use organic matter such as forest and agricultural residues, to produce electricity, steam or heat

Other renewable energy systems or equipment: systems and equipment for energy production from wave, tidal and ocean thermal energy conversion systems, and geothermal energy

Alternative fuel systems or equipment: equipment for production or use of biofuels (ethanol, biodiesel); clean fuel systems (reformulated fuel and oxygenated fuels); fuel cell technologies; hydrogen (production, storage, distribution and use, infrastructure); and advanced batteries; industrial equipment and engine systems that use alternative fuels

Fuel substitution: switching from a carbon fuels (such as coal or petroleum) to a lower-carbon fuels (such as natural gas) or a carbon-free fuel

Other systems, equipment or employee training that improved energy efficiency: examples are energy management equipment or systems; installation of more efficient equipment such as boilers, turbines and furnaces; process control equipment; energy efficient engines and motors; low NO_x burners.

Source:

Statistics Canada, Environment Accounts and Statistics Division.

atmosphere (Table 3.6). This represents an increase of 29.8% from 2000.

Fuel cells and alternative fuel technology revenues accounted for \$118.1 million in sales, or close to one-third of the total in 2002. Solar and wind energy systems and equipment sales reached \$112.0 million.

Table 3.6

Revenues of technologies to reduce greenhouse gas emissions by category, 2000 and 2002

Category	2000 ¹	2002
	\$ million	
Solar and wind energy systems or equipment	77.3	112.0
Cogeneration, methane capture and use, waste-to-energy systems or equipment	5.9	8.6
Small, mini, micro hydro and other renewable energy	x	x
Fuel cells and alternative fuel technologies	115.9	118.1
Clean technologies and related components	14.5	13.1
Other systems or equipment for energy conservation and efficiency	x	x
Total	285.3	370.3

Notes:

Figures may not add up to totals due to rounding.

1. The 2000 estimates have been adjusted in order to be comparable with 2002 data.

Source:

Statistics Canada, Environment Accounts and Statistics Division.

New technologies

Governments and industry help improve the environment by conducting research and development (R&D) on the following energy technologies: energy conservation, fossil fuel recovery, renewable energy, nuclear power and other fuel systems. Expenditures on energy R&D, while not specifically aimed at climate change, may contribute to a reduction in greenhouse gases through lower consumption of fossil fuels.

Energy R&D expenditures declined from almost \$1.3 billion in 1983 to approximately \$900 million in 2001. Industry provided 70% of the total R&D expenditures on energy in 2001, while the federal and provincial governments contributed 27% and 2.5%, respectively. This is a significant change from 1983 when the government portion of total R&D spending was 54% (Tables 3.7 and 3.8).

Fossil fuels remained the area of technology with the largest amount of energy R&D between 1983 and 2001, although their proportion over the period diminished from 39% to 26%.

The proportion of total government and business R&D devoted to renewable energy sources remained relatively stable at approximately 10%. The majority of R&D spending on renewable energy technologies, however, shifted from government to business. In 1983, 77.5% of spending was provided by government, while in 2001, 75.1% came from business.

Table 3.7
Spending on energy-related research and development by federal and provincial governments, 1983 to 2001

Year	Area of technology						Total
	Renewable	Conservation	Electricity	Fossil fuel	Nuclear	Others	
	\$ million 1997						
1983	88.8	102.2	12.4	191.7	266.1	28.3	689.5
1984	87.1	116.0	14.1	305.0	279.7	26.1	827.8
1985	45.4	107.3	12.7	226.5	269.9	12.2	674.1
1986	26.3	43.2	10.2	301.2	255.4	11.0	647.4
1987	22.5	43.7	6.9	216.9	224.3	9.4	523.7
1988	20.4	46.1	6.6	208.4	194.0	7.4	482.9
1989	16.9	44.6	6.1	158.6	181.3	21.6	429.1
1990	14.1	44.4	5.1	166.0	182.5	14.1	426.4
1991	13.4	40.1	4.4	154.1	169.8	14.2	396.0
1992	15.5	34.0	12.0	126.0	184.3	24.7	396.6
1993	13.9	37.9	3.3	100.4	175.1	19.7	350.3
1994	15.9	43.2	1.8	77.5	175.2	33.4	347.0
1995	13.9	37.5	1.0	87.1	169.1	22.8	331.3
2000	27.9	45.1	18.4	54.0	68.8	38.7	252.8
2001	24.7	57.3	21.9	65.3	58.0	48.4	275.5

Source:

Natural Resources Canada, Office of Energy Research and Development.

Table 3.8
Spending on energy research and development by businesses, 1983 to 2001

Year	Area of technology						Total
	Renewable	Conservation	Electricity	Fossil fuel	Nuclear	Others	
	\$ million 1997						
1983	25.8	101.0	59.8	309.3	64.6	28.5	589.0
1984	29.4	93.5	82.0	299.1	75.9	28.8	608.6
1985	35.9	104.4	84.7	354.8	65.3	26.4	671.5
1986	80.7	116.3	90.1	245.5	84.8	31.5	648.9
1987	30.7	86.2	134.5	201.2	66.2	64.7	583.5
1988	26.4	100.6	162.4	211.1	54.4	73.2	628.1
1989	21.7	126.0	160.7	215.0	54.3	55.0	632.7
1990	26.6	135.1	140.1	240.2	68.5	44.8	655.4
1991	29.5	151.8	133.7	220.2	85.9	43.5	664.6
1992	27.9	125.4	128.6	190.3	80.9	45.6	598.7
1993	27.3	121.7	131.6	211.2	67.5	62.3	621.7
1994	33.4	120.1	139.6	215.2	59.1	48.6	616.2
1995	36.8	153.2	175.6	182.0	40.5	44.2	632.3
2000	63.5	186.1	125.1	173.6	41.3	57.6	647.1
2001	74.4	124.9	76.3	183.6	47.4	149.4	656.1

Source:

Natural Resources Canada, Office of Energy Research and Development.

Annual Statistics



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www.statcan.ca



Annual statistics

Human Activity and the Environment 2004 makes use of a pressure-state-response framework, in which the presented data are classified as measuring either the pressure placed on the environment by human activities, the state of the environment at a point in time or the socio-economic response to environmental conditions. This appendix serves as a general reference compendium for environmental statistics in Canada, pointing readers to available data on environmental-human interactions.

A) State

Physiography

Physiography, or physical geography, is the study of the physical features of the earth's surface. This section covers two of the key elements that make up Canada's physiography: land cover and hydrology.

Land Cover

Land cover represents the surface properties of the land. Land cover information is a basic requirement for the determination of land use and, ultimately, of land value. Canada's land area totals nearly 10 million km². The three most extensive land cover types in Canada include: forest cover (30%); barren or sparsely vegetated land (27%); and snow, ice and water (16%), representing over 70% of land cover (Table A.1). Map A.1 shows the distribution of the land cover types across Canada.

Table A.1
Land cover by ecozone, 2000

Ecozone	Evergreen	Deciduous	Mixed forest	Closed shrubland	Open shrubland	Woody savanna	Grassland	Permanent		Barren or sparsely vegetated	Snow, ice and water bodies	Other ¹	Total
	needleleaf forest	broadleaf forest						wetland	Cropland				
km ²													
Arctic Cordillera	0	0	0	0	77	1 017	152	0	0	76 378	160 141	7 578	245 343
Northern Arctic	0	0	0	0	207	8 959	145	48	201	1 071 104	404 731	38 002	1 523 398
Southern Arctic	2 399	0	0	6 514	25 764	80 731	2 093	0	0	623 706	101 949	8 124	851 281
Taiga Plains	158 718	1 435	34 066	8 436	104 677	217 123	34	63	1 030	43 912	86 098	353	655 946
Taiga Shield	183 897	0	63	673	162 599	442 589	714	0	0	406 688	190 045	3 345	1 390 613
Boreal Shield	826 909	111 538	289 908	30 060	139 321	196 208	23	5 183	12 319	40 133	261 820	8 414	1 921 837
Atlantic Maritime	3 855	33 843	135 345	0	3 291	551	74	1 549	8 745	197	9 326	5 490	202 265
Mixed Wood Plains	971	25 782	9 332	0	315	663	43	207	67 512	150	59 765	3 949	168 690
Boreal Plains	227 178	37 704	166 217	4 513	66 724	50 517	55	2 564	106 232	6 725	72 620	213	741 261
Prairies	10 549	4 893	13 537	675	20 658	12 045	101 474	3 455	281 896	7 172	9 586	946	466 885
Taiga Cordillera	7 489	0	114	14 649	13 031	73 679	1 104	0	257	142 271	14 354	172	267 119
Boreal Cordillera	103 276	792	6 983	3 604	30 388	137 695	405	2 069	2 063	111 607	71 465	221	470 567
Pacific Maritime	70 216	903	17 024	352	1 389	3 466	0	9 952	2 183	49 787	46 508	4 564	206 344
Montane Cordillera	251 397	11 428	45 787	262	23 165	35 037	854	6 522	6 198	72 001	37 488	111	490 251
Hudson Plains	187 301	0	2 699	440	41 308	92 316	0	5 803	0	14 220	29 046	1 251	374 383
Canada	2 034 154	228 317	721 076	70 178	632 914	1 352 596	107 170	37 415	488 636	2 666 050	1 554 943	82 733	9 976 182

Notes:

Figures may not add up to totals due to rounding.

1. Other consists of Evergreen broadleaf forest, Urban and built-up and statistical error.

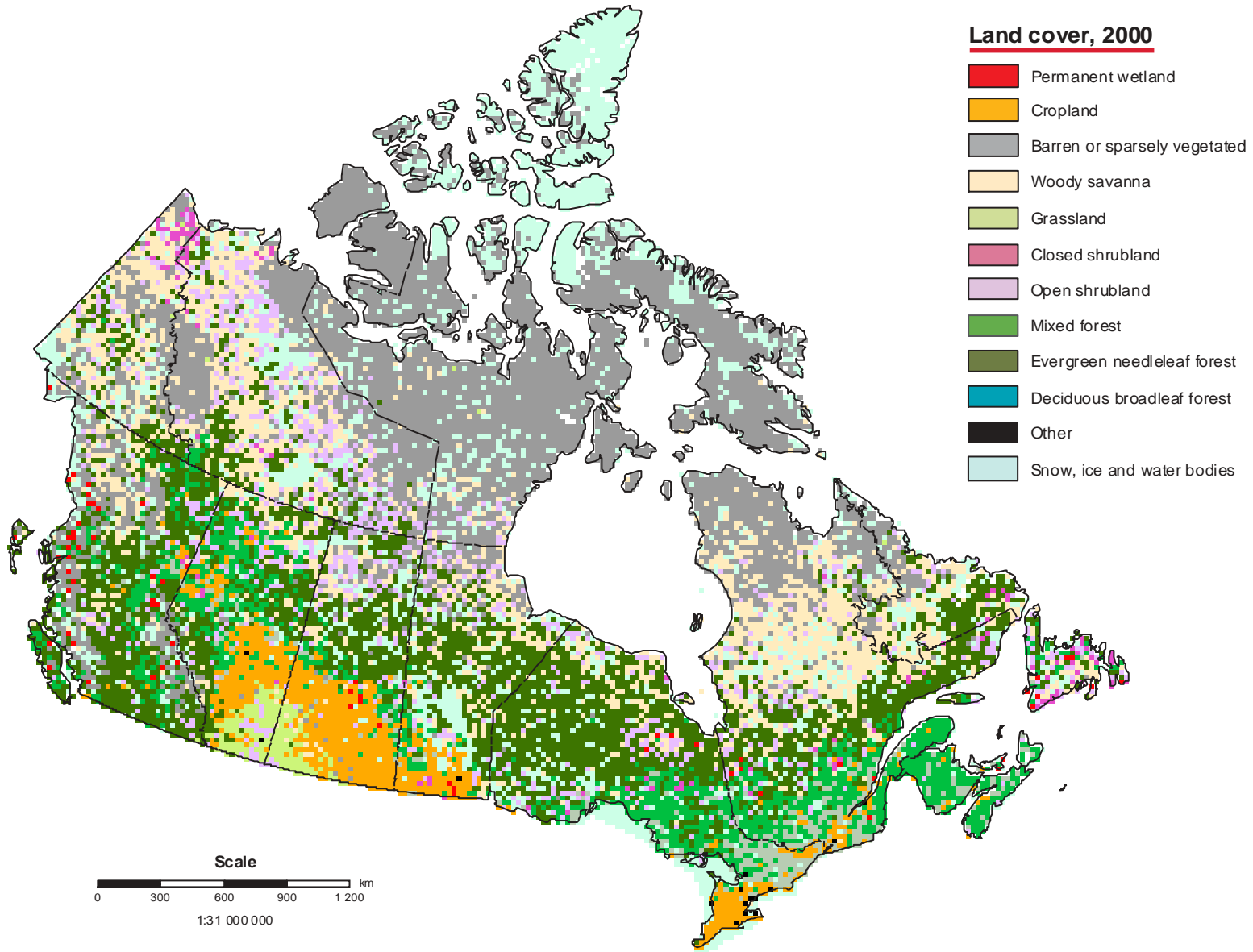
Sources:

Statistics Canada, Environment Accounts and Statistics Division, Spatial Environmental Information System.

Agriculture and Agri-Food Canada and Environment Canada, 2003, Framework Data - National Resolution - Ecological Units, www.geoconnections.org/CGDI.cfm/fuseaction/dataFrameworkData.ecoUnits/gcs.cfm (accessed May 13, 2003).

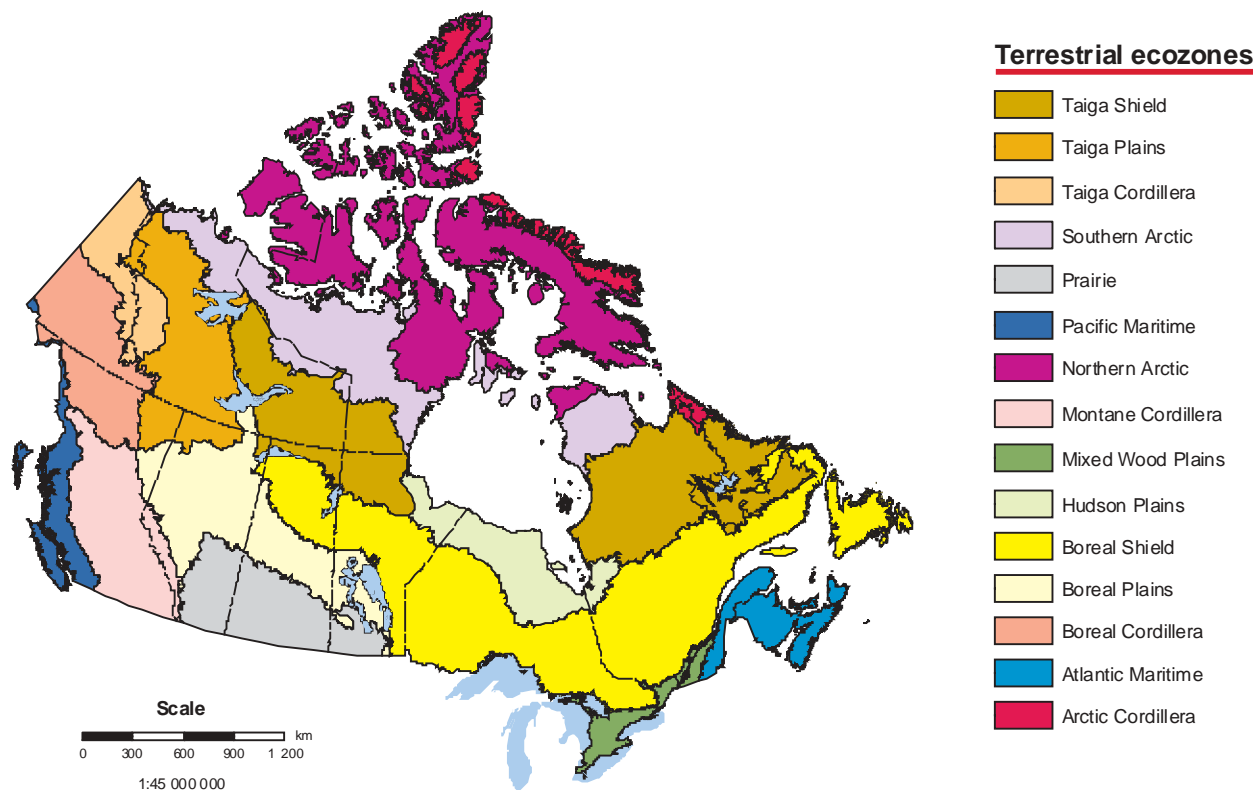
Latifovic, R., Z.-L. Zhu, J. Cihlar, C. Giri, and I. Olthof, 2004, "Land cover mapping of North and Central America - Global Land Cover 2000," in *Remote Sensing of Environment*, 89, pp 116-127.

Map A.1 Land cover, 2000



Sources:
 Latifovic, R., Z.-L. Zhu, J. Cihlar, C. Giri, and I. Olthof, 2004, "Land cover mapping of North and Central America - Global Land Cover 2000," in *Remote Sensing of Environment*, 89, pp 116-127.
 Statistics Canada, Environment Accounts and Statistics Division.

Map A.2
Terrestrial ecozones, 2003



Source:
 Wiken, E.B. et al., 1996, *A Perspective on Canada's Ecosystems: An Overview of the Terrestrial and Marine Ecozones*, Canadian Council on Ecological Areas, Occasional Paper, No. 14, Ottawa.

Ecozones

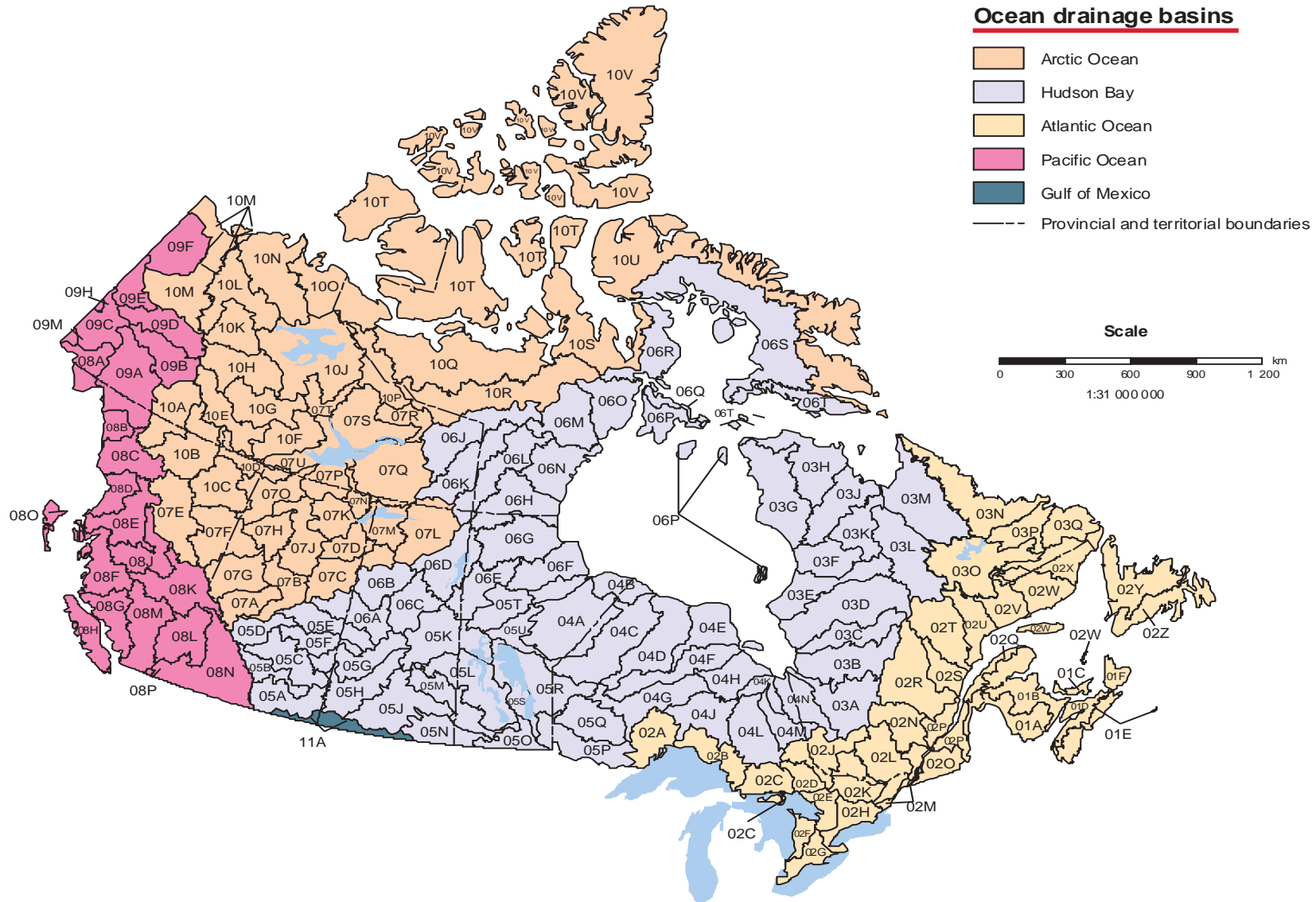
The desire for a national approach to ecosystem classification and mapping in Canada led to the development of a hierarchical ecological classification framework. The objective of the approach was to delineate, classify and describe ecologically distinct areas of the earth's surface at different levels of generalization. The ecological framework was developed by identifying distinct areas of non-living (abiotic) and living (biotic) factors that are ecologically related. From the broadest to the smallest, the hierarchical classification consists of seven levels of generalization: ecozones, ecoprovinces, ecoregions, ecodistricts, ecosections, ecosites and ecoelements. Map A.2 illustrates the boundary delineations of the country's 15 terrestrial ecozones.

Hydrology

An estimated 12% of Canada, or 1.2 million km², is covered by lakes and rivers. While many provinces have a substantial amount of water in comparison with their population, only 3% of the area covered by water in Canada is located in inhabited regions. Most of the land area of Canada drains to one of four water bodies: the Pacific, Arctic and Atlantic oceans and Hudson Bay. A small area in southern Alberta and Saskatchewan (0.3% of Canada's land area) drains into the Gulf of Mexico. Map A.3 and Table A.2 outline Canada's sub-drainage areas by ocean basin.

Canada's major river basins and their water resource characteristics are outlined in Map A.4 and Table A.3 respectively. Table A.4 shows the distribution of streamflow, water area and population for each province and territory.

Map A.3
Sub-drainage areas by ocean basin



Note:
The sub-drainage area codes on this map are used in Table A.2.

Sources:
Natural Resources Canada, 2003, *National Scale Frameworks Hydrology - Drainage Areas, Canada, Version 5.0*, www.geogratis.cgdi.gc.ca (accessed September 16, 2003).
Statistics Canada, Environment Accounts and Statistics Division, Spatial Environmental Information System.

Table A.2
Sub-drainage area names and areas by ocean basin

Sub-drainage area code	Ocean basin and sub-drainage area	Area ² (km ²)	Sub-drainage area code	Ocean basin and sub-drainage area	Area ² (km ²)
Arctic Ocean			04K	Moose (Ont.)	17 949
07A	Upper Athabasca	34 856	04L	Missinaibi-Mattagami	60 593
07B	Central Athabasca - Upper	40 496	04M	Abitibi	29 291
07C	Central Athabasca - Lower	57 030	04N	Harricanaw - Coast	43 509
07D	Lower Athabasca	29 745	05A	Upper South Saskatchewan	46 466
07E	Williston Lake	72 362	05B	Bow	25 572
07F	Upper Peace	67 824	05C	Red Deer	50 316
07G	Smoky	51 508	05D	Upper North Saskatchewan	27 983
07H	Central Peace - Upper	35 412	05E	Central North Saskatchewan	42 275
07J	Central Peace - Lower	59 401	05F	Battle	30 241
07K	Lower Peace	36 510	05G	Lower North Saskatchewan	49 652
07L	Fond-du-Lac	70 650	05H	Lower South Saskatchewan	55 268
07M	Lake Athabasca - Shores	32 017	05J	Qu'Appelle	74 589
07N	Slave	17 057	05K	Saskatchewan	81 194
07O	Hay	51 405	05L	Lake Winnipegosis and Lake Manitoba	82 719
07P	Southern Great Slave Lake	33 916	05M	Assiniboine	51 259
07Q	Great Slave Lake - East Arm South Shore	96 331	05N	Souris	39 413
07R	Lockhart	27 124	05O	Red	25 444
07S	Northeastern Great Slave Lake	68 826	05P	Winnipeg	55 104
07T	Marian	24 262	05Q	English	52 550
07U	Western Great Slave Lake	30 955	05R	Eastern Lake Winnipeg	56 277
10A	Upper Liard	61 858	05S	Western Lake Winnipeg	24 650
10B	Central Liard	72 031	05T	Grass and Burntwood	42 390
10C	Fort Nelson	54 771	05U	Nelson	49 119
10D	Central Liard - Petitot	30 563	06A	Beaver (Alta.-Sask.)	49 940
10E	Lower Liard	55 571	06B	Upper Churchill (Man.)	44 288
10F	Upper Mackenzie - Mills Lake	51 042	06C	Central Churchill (Man.) - Upper	45 892
10G	Upper Mackenzie - Camsell Bend	57 858	06D	Reindeer	67 357
10H	Central Mackenzie - Blackwater Lake	67 210	06E	Central Churchill (Man.) - Lower	51 295
10J	Great Bear	158 140	06F	Lower Churchill (Man.)	54 799
10K	Central Mackenzie - The Ramparts	46 736	06G	Seal - Coast	75 970
10L	Lower Mackenzie	77 259	06H	Western Hudson Bay - Southern	73 301
10M	Peel and Southwestern Beaufort Sea	106 934	06J	Thelon	85 479
10N	Southern Beaufort Sea	99 387	06K	Dubawnt	68 911
10O	Amundsen Gulf	91 070	06L	Kazan	70 690
10P	Coppermine	50 741	06M	Chesterfield Inlet	67 783
10Q	Coronation Gulf - Queen Maud Gulf	174 677	06N	Western Hudson Bay - Central	63 743
10R	Back	135 956	06O	Western Hudson Bay - Northern	54 523
10S	Gulf of Boothia	114 748	06P	Hudson Bay - Southampton Island	48 764
10T	Southern Arctic Islands	373 194	06Q	Foxe Basin - Southampton Island	13 285
10U	Baffin Island - Arctic Drainage	299 813	06R	Foxe Basin - Melville Peninsula	59 726
10V	Northern Arctic Islands	424 817	06S	Foxe Basin - Baffin Island	211 083
	Lakes ¹	37 968	06T	Hudson Strait - Baffin and Southampton Islands	46 469
	Arctic Ocean total	3 580 030		Lakes ¹	24 534
Hudson Bay			Hudson Bay total		
03A	Nottaway - Coast	67 938	Atlantic Ocean		
03B	Broadback and Rupert	77 195	01A	Saint John and Southern Bay of Fundy (N.B.)	41 904
03C	Eastmain	45 930	01B	Gulf of St. Lawrence and Northern Bay of Fundy (N.B.)	60 778
03D	La Grande - Coast	112 203	01C	Prince Edward Island	5 943
03E	Grande rivière de la Baleine - Coast	62 752	01D	Bay of Fundy and Gulf of St. Lawrence (N.S.)	21 547
03F	Eastern Hudson Bay	46 383	01E	Southeastern Atlantic Ocean (N.S.)	23 132
03G	Northeastern Hudson Bay	100 054	01F	Cape Breton Island	10 685
03H	Western Ungava Bay	78 164	02A	Northwestern Lake Superior	43 729
03J	Aux Feuilles - Coast	63 722	02B	Northeastern Lake Superior	39 679
03K	Koksoak	45 542	02C	Northern Lake Huron	34 670
03L	Caniapiscau	90 094	02D	Wanipitei and French (Ont.)	19 225
03M	Eastern Ungava Bay	106 707	02E	Eastern Georgian Bay	21 958
04A	Hayes (Man.)	109 482	02F	Eastern Lake Huron	14 775
04B	Southwestern Hudson Bay	28 384	02G	Northern Lake Erie	22 621
04C	Severn	99 533	02H	Lake Ontario and Niagara Peninsula	28 734
04D	Winisk - Coast	79 224	02J	Upper Ottawa	50 786
04E	Ekwan - Coast	50 484	02K	Central Ottawa	40 678
04F	Attawapiskat - Coast	57 243	02L	Lower Ottawa	54 839
04G	Upper Albany	64 914	02M	Upper St. Lawrence	5 108
04H	Lower Albany - Coast	42 345	02N	Saint-Maurice	42 249

Table A.2
Sub-drainage area names and areas by ocean basin (continued)

Sub-drainage area code	Ocean basin and sub-drainage area	Area ² (km ²)	Sub-drainage area code	Ocean basin and sub-drainage area	Area ² (km ²)
04J	Kenogami	52 370	02O	Central St. Lawrence	34 567
02P	Lower St. Lawrence	37 161	08G	Southern coastal waters of B.C.	41 986
02Q	Northern Gaspé Peninsula	13 383	08H	Vancouver Island	34 882
02R	Saguenay	88 072	08J	Nechako	47 332
02S	Betsiamites - Coast	27 473	08K	Upper Fraser	67 088
02T	Manicouagan and aux Outardes	65 221	08L	Thompson	55 777
02U	Moisie and St. Lawrence Estuary	39 589	08M	Lower Fraser	61 880
02V	Gulf of St. Lawrence - Romaine	36 416	08N	Columbia - U.S.A.	102 925
02W	Gulf of St. Lawrence - Natashquan	53 841	08O	Queen Charlotte Islands	10 049
02X	Petit Mécatina and Strait of Belle Isle	50 320	08P	Skagit	1 027
02Y	Northern Newfoundland	66 102	09A	Headwaters Yukon	94 018
02Z	Southern Newfoundland	44 492	09B	Pelly	50 485
03N	Northern Labrador	92 911	09C	Upper Yukon	44 206
03O	Churchill (N.L.)	95 003	09D	Stewart	51 360
03P	Central Labrador	35 682	09E	Central Yukon	29 820
03Q	Southern Labrador	37 889	09F	Porcupine	61 566
	Lakes ¹	92 194	09H	Tanana	1 470
	Atlantic Ocean total	1 493 352	09M	Copper	4 112
	Pacific Ocean			Pacific Ocean total	1 003 385
08A	Alsek	31 192		Gulf of Mexico	
08B	Northern coastal waters of B.C.	22 767	11A	Missouri	27 097
08C	Stikine - Coast	49 997		Gulf of Mexico total	27 097
08D	Nass - Coast	29 036			
08E	Skeena - Coast	55 751		Canada total	9 976 182
08F	Central coastal waters of B.C.	54 658			

Notes:

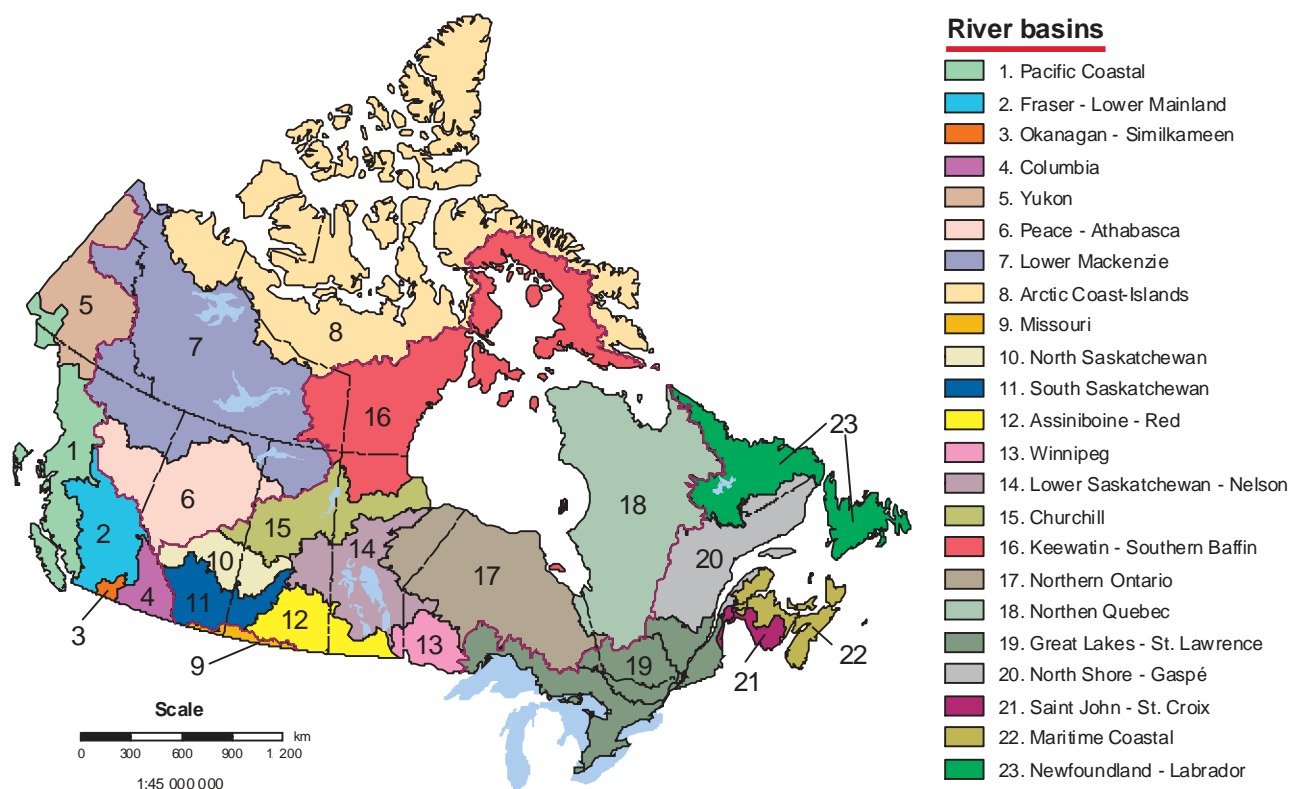
1. 'Lakes' in this table refer to those internal lakes shown on Map A.3 as well as the Canadian portion of the Great Lakes.

2. Areas were calculated using an Albers Equal Area (NAD83) projection.

Sources:

Natural Resources Canada, 2003, National Scale Frameworks Hydrology - Drainage Areas, Canada, Version 5.0, www.geogratis.cgdi.gc.ca (accessed September 16, 2003).
 Statistics Canada, Environment Accounts and Statistics Division, Spatial Environmental Information System.

Map A.4
Major river basins



Note:

The river basin codes in this map are used in Tables A.3, B.4 and B.45.

Sources:

Pearse, P.H., F. Bertrand and J.W. MacLaren, 1985, *Currents of Change: Final Report of the Inquiry on Federal Water Policy*, Environment Canada, Ottawa.
Statistics Canada, Environment Accounts and Statistics Division, Spatial Environmental Information System.

Table A.3
Water resource characteristics by major river basin¹

Code	River basin name	Water area ³		Mean annual						Dams			
		Total area ² km ²	As a share		Streamflow ⁴		Precipitation ⁵		Number units	Generating capacity ⁶ MW			
			Total	of total	Per capita	Rate	Total	Per			As a share	Rate	Volume
			%	m ²	m ³ /s	km ³	thousand m ³ /km ²	%	mm	km ³			
1	Pacific Coastal	334 452	15 041	4.5	10 944	16 390	516.9	1 545	15.6	1 354	451	50	1 648
2	Fraser - Lower Mainland	233 105	9 015	3.9	4 462	3 972	125.3	537	3.8	670	156	24	848
3	Okanagan - Similkameen	15 603	650	4.2	2 279	74	2.3	150	0.1	466	7	3	594
4	Columbia	87 321	2 482	2.8	15 457	2 009	63.4	726	1.9	776	68	56	5 153
5	Yukon	332 906	9 329	2.8	343 653	2 506	79.0	237	2.4	346	115	10	76
6	Peace - Athabasca	485 146	16 725	3.4	48 306	2 903	91.5	189	2.8	497	241	17	3 427
7	Lower Mackenzie	1 330 481	176 937	13.3	3 623 373	7 337	231.4	174	7.0	365	486	18	83
8	Arctic Coast - Islands	1 764 279	177 906	10.1	10 617 432	8 744	275.8	156	8.3	189	333	0	0
9	Missouri	27 097	1 129	4.2	120 359	12	0.4	14	0.0	390	11	2	13
10	North Saskatchewan	150 151	7 245	4.8	5 539	234	7.4	49	0.2	443	67	6	504
11	South Saskatchewan	177 623	6 243	3.5	3 522	239	7.5	42	0.2	419	74	21	310
12	Assiniboine - Red	190 705	9 098	4.8	6 665	50	1.6	8	0.0	450	86	3	168
13	Winnipeg	107 654	20 599	19.1	247 350	758	23.9	222	0.7	683	74	98	905
14	Lower Saskatchewan - Nelson	360 883	67 612	18.7	309 699	1 911	60.3	167	1.8	508	183	60	4 941
15	Churchill	313 572	51 858	16.5	593 728	701	22.1	70	0.7	480	151	12	119
16	Keewatin - Southern Baffin Island	939 568	161 438	17.2	13 416 290	5 383	169.8	181	5.1	330	310	0	0
17	Northern Ontario	691 811	55 952	8.1	391 174	5 995	189.1	273	5.7	674	466	60	1 116
18	Northern Quebec	940 194	148 986	15.8	1 426 559	16 830	530.8	565	16.0	698	656	66	15 238
19	Great Lakes - St. Lawrence	582 945	134 928	23.1	7 624	7 197	227.0	389	6.8	957	556	623	12 515

Table A.3
Water resource characteristics by major river basin¹ (continued)

Code	River basin name	Water area ³		Mean annual						Dams			
		As a share		Streamflow ⁴			Precipitation ⁵		Generating capacity ⁶				
		Total area ² km ²	Total %	Per capita m ²	Rate m ³ /s	Total km ³	Per unit area thousand m ³ /km ²	As a share %	Rate mm	Volume km ³	Number units	Generating capacity ⁶ MW	
20	North Shore - Gaspé	369 094	37 363	10.1	74 117	8 159	257.3	697	7.8	994	367	129	10 785
21	Saint John - St. Croix	41 904	1 800	4.3	4 481	779	24.6	586	0.7	1 147	48	54	1 864
22	Maritime Coastal	122 056	6 728	5.5	4 469	3 628	114.4	937	3.5	1 251	153	60	411
23	Newfoundland - Labrador	380 355	55 388	14.6	107 731	9 324	294.0	773	8.9	1 030	392	90	6 693
	Canada	9 978 904	1 174 452	11.8	39 139	105 135	3 315.5	332	100.0	545	5 451	1 462	67 411

Notes:

- These major river basins and associated flow measures are adapted from "Laycock (1987) (see full reference below). Some of these river basin aggregates have more than one outflow.
- Area includes the Canadian portion of the Great Lakes.
- Water area figures are calculated from the Canada-wide 1-km water fraction derived from National Topographic Database maps.
- Basins at the US-Canada border exclude inflow from U.S. portion of basin region.
- Precipitation has been estimated from an Inverse Distance Weighted (IDW) interpolation of the 1971 to 2000 normals.
- The generating capacity refers to the maximum power capability from hydro plants. The survey coverage for those plants is limited to those utilities and companies which have at least one plant with a total generating capacity of over 500 KW.

Sources:

Environment Canada, 2003, *Canadian Climate Normals, 1971 to 2000*, Meteorological Service of Canada, www.msc-smc.ec.gc.ca/climate/climate_normals/index_e.cfm (accessed February 21, 2003).

Pearse, P.H., F. Bertrand and J.W. MacLaren, 1985, *Currents of Change: Final Report of the Inquiry on Federal Water Policy*, Environment Canada, Ottawa.

Fernandes, R., G. Pavlic, W. Chen and R. Fraser, 2001, Canada-wide 1-km water fraction, National Topographic Database, Natural Resources Canada, www.nrcan.gc.ca/ess/_portal_esst.cache/gc_ccrs_e (accessed April 29, 2002).

Laycock, A.H., 1987, "The Amount of Canadian Water and its Distribution," in *Canadian Aquatic Resources*, no. 215 of *Canadian Bulletin of Fisheries and Aquatic Sciences*, M.C. Healey and R.R. Wallace (eds.), 13-42, Fisheries and Oceans Canada, Ottawa.

Natural Resources Canada, GeoAccess Division, 2003, 1:1 Million Digital Drainage Area Framework, version 4.8b.

Statistics Canada, 2001 Census of Population.

Statistics Canada, 2000, *Electric Power Generating Stations*, Catalogue no. 57-206-XIB.

Table A.4
Distribution of streamflow, water area and 2001 population, by province and territory

Province/Territory	Streamflow	Water area		Population
		%		
Newfoundland and Labrador	8.6	5.0		1.7
Prince Edward Island	0.1	0.1		0.5
Nova Scotia	1.2	0.5		3.0
New Brunswick	1.3	0.2		2.4
Quebec	21.6	18.6		24.1
Ontario	8.9	8.8		38.0
Manitoba	2.6	10.0		3.7
Saskatchewan	1.5	7.0		3.3
Alberta	1.9	2.6		9.9
British Columbia	24.0	3.0		13.0
Yukon Territory	4.2	1.0		0.1
Northwest Territories and Nunavut	24.0	43.3		0.2
Canada	100.0	100.0		100.0

Sources:

Laycock, A.H., 1987, "The Amount of Canadian Water and its Distribution," in *Canadian Aquatic Resources*, no. 215 of *Canadian Bulletin of Fisheries and Aquatic Sciences*, M.C. Healey and R.R. Wallace (eds.), 13-42, Fisheries and Oceans Canada, Ottawa.

Fernandes, R., G. Pavlic, W. Chen and R. Fraser, 2001, Canada-wide 1-km water fraction, National Topographic Database, Natural Resources Canada, www.nrcan.gc.ca/ess/_portal_esst.cache/gc_ccrs_e (accessed April 29 2002).

Statistics Canada, 2001 Census of Population.

Climate

Climate can be defined as the average weather that occurs in a specific area over a period of time. Humans rely heavily on the regularity of climate patterns for almost all of their activities. Climate is measured using various weather elements as indicators. The two essential indicators, temperature and precipitation, are measured systematically at a site over time, accumulating an archive of observations from which climatic summaries can be derived for that location. Daily stations provide readings once or twice daily for temperature and precipitation while principal stations provide hourly readings of more detailed weather information for forecasting purposes. A selection of these weather stations is displayed on Map A.5.

Table A.5 lists some of the more extreme weather events that affected areas of Canada in 2003.

Map A.5 Selected weather stations



Source:
Environment Canada, Atmospheric Environment Service, 1993, *Canadian Climate Normals, 1961-1990*, Vols. 1-6, Ottawa.

Table A.5
Top 10 Canadian weather stories of 2003

Rank ¹	Event	Location	Event length
1	BC's Year of Disastrous Weather (fires, floods and freezes)	British Columbia	all year
2	Hurricane Juan and Hurricane "Juannabes"	Atlantic Canada	September to December
3	A Long, Cold Winter Grips Eastern Canada	Eastern Canada	winter
4	Canada Ablaze from Ontario to the Okanagan	Canada	summer
5	Endless Drought in the Prairies	Prairies	summer
6	Atlantic Canada's Most Expensive Rainstorm	Atlantic Canada	March
7	New Brunswick's Ice Storm of A Century	New Brunswick	February
8	A Record Year of Deadly Avalanches	Canadian Rockies	January to March
9	Alberta Spring Whitewashers	Alberta	spring
10	Ice Age in Badger	Newfoundland and Labrador	February

Note:

1. Canada's Top Weather Stories for 2003 are rated from one to ten based on the degree to which Canada and Canadians were impacted, the extent of the area affected, economic effects and longevity as a top news story.

Source:

Environment Canada, *Environment Canada's Top Weather Stories for 2003*, Meteorological Service of Canada, www.msc.ec.gc.ca/media/top10/2003_e.html (accessed January 6, 2004).

Temperature

Drastic changes in temperature signal the change from one season to the next in Canada. Although winters can be bitterly cold, summers can be hot and dry, or hot and humid, depending on the region. Table A.6 summarizes the mean daily temperatures by month as recorded at selected weather stations across Canada and averaged over the period 1971 to 2000.

Figure A.1 shows the trend in average air temperature in Canada over the last half-century. Like the rest of the world, Canada appears to be experiencing warmer weather. Table A.7 presents temperature trends and departures for the climate regions shown in Map A.6.

Table A.6
Average daily temperatures by month for selected weather stations, 1971 to 2000¹

Station	Average daily temperature												Annual
	January	February	March	April	May	June	July	August	September	October	November	December	
	°C												
Goose Bay, N.L.	-18.1	-16.3	-9.6	-1.7	5.1	11.0	15.4	14.5	9.2	2.4	-4.5	-13.9	-0.5
Gander, N.L.	-7.4	-7.9	-4.0	1.3	6.7	11.6	16.0	15.7	11.4	5.8	1.0	-4.3	3.8
St. John's, N.L.	-4.8	-5.4	-2.5	1.6	6.2	10.9	15.4	15.5	11.8	6.9	2.6	-2.2	4.7
Charlottetown, P.E.I.	-8.0	-7.8	-3.1	2.7	9.1	14.6	18.5	18.1	13.6	7.8	2.3	-4.1	5.3
Sydney, N.S.	-5.7	-6.5	-2.7	2.1	7.8	13.3	17.7	17.7	13.4	8.0	3.3	-2.1	5.5
Halifax, N.S.	-6.0	-5.6	-1.4	4.0	9.8	15.0	18.6	18.4	14.1	8.3	3.1	-2.8	6.3
Yarmouth, N.S.	-3.0	-3.0	0.3	4.9	9.7	13.7	16.5	16.9	13.8	9.1	4.8	-0.2	7.0
Moncton, N.B.	-8.9	-8.0	-2.9	3.2	9.9	15.1	18.6	17.9	13.0	7.1	1.4	-5.5	5.1
Saint John, N.B.	-8.1	-7.3	-2.5	3.6	9.4	14.0	17.1	16.9	12.8	7.3	2.0	-4.7	5.0
Chapais 2, Que.	-18.8	-16.6	-9.5	-0.5	7.9	14.0	16.3	14.9	9.3	2.9	-5.4	-14.8	0.0
Kuujuuaq, Que.	-24.3	-23.6	-18.3	-9.1	0.3	7.2	11.5	10.6	5.6	-0.7	-8.4	-19.3	-5.7
Kuujuarapik, Que.	-23.4	-23.2	-17.3	-7.6	1.3	7.0	10.6	11.4	7.4	2.1	-5.0	-16.2	-4.4
Québec, Que.	-12.8	-11.1	-4.6	3.3	11.2	16.5	19.2	17.9	12.5	6.2	-0.7	-9.1	4.0
Sept-Îles, Que.	-15.3	-13.4	-7.1	0.0	5.9	11.7	15.3	14.2	9.3	3.4	-3.1	-11.3	0.8
Montréal, Que.	-10.4	-9.0	-2.5	5.5	12.9	17.7	20.5	19.2	13.9	7.5	1.0	-6.8	5.8
Ottawa, Ont.	-10.8	-8.7	-2.5	5.7	13.4	18.3	20.9	19.5	14.3	7.8	1.0	-7.1	6.0
Kapuskasing, Ont.	-18.7	-15.5	-8.6	0.5	9.0	14.4	17.2	15.7	10.1	3.8	-4.8	-14.3	0.7
Thunder Bay, Ont.	-14.8	-12.0	-5.5	2.9	9.5	14.0	17.6	16.6	11.0	5.0	-3.0	-11.6	2.5
Toronto, Ont.	-6.3	-5.4	-0.4	6.3	12.9	17.8	20.8	19.9	15.3	8.9	3.2	-2.9	7.5
Windsor, Ont.	-4.5	-3.2	2.0	8.2	14.9	20.1	22.7	21.6	17.4	11.0	4.6	-1.5	9.4
The Pas, Man.	-20.6	-16.1	-8.9	1.0	9.0	14.8	17.7	16.5	10.0	3.1	-7.8	-17.4	0.1
Winnipeg, Man.	-17.8	-13.6	-6.1	4.0	12.0	17.0	19.5	18.5	12.3	5.3	-5.3	-14.4	2.6
Churchill, Man.	-26.7	-24.6	-19.5	-9.7	-0.7	6.6	12.0	11.7	5.6	-1.7	-12.6	-22.8	-6.9
Regina, Sask.	-16.2	-11.9	-5.0	4.5	11.7	16.4	18.8	18.0	11.7	4.8	-5.5	-13.2	2.8
Saskatoon, Sask.	-17.0	-13.0	-5.8	4.4	11.5	16.0	18.2	17.3	11.2	4.5	-6.2	-14.3	2.2
Calgary, Alta.	-8.9	-6.1	-1.9	4.6	9.8	13.8	16.2	15.6	10.8	5.4	-3.1	-7.4	4.1
Edmonton, Alta.	-13.5	-10.5	-4.5	4.3	10.4	14.1	15.9	15.1	10.1	4.3	-5.7	-11.3	2.4
Victoria, B.C.	3.8	4.9	6.4	8.8	11.8	14.4	16.4	16.4	14.0	9.8	6.1	4.0	9.7
Penticton, B.C.	-1.7	0.7	4.7	9.0	13.6	17.4	20.4	20.1	14.9	8.7	3.1	-1.1	9.2
Vancouver, B.C.	3.3	4.8	6.6	9.2	12.5	15.2	17.5	17.6	14.6	10.1	6.0	3.5	10.1
Prince Rupert, B.C.	1.3	2.5	3.9	6.0	8.7	11.1	13.1	13.5	11.3	7.9	4.1	2.2	7.1
Prince George, B.C.	-9.6	-5.4	-0.3	5.2	9.9	13.3	15.5	14.8	10.1	4.6	-2.9	-7.8	4.0
Mayo, Y.T.	-25.7	-19.0	-9.6	0.9	8.4	14.0	16.0	13.1	6.4	-2.9	-15.9	-22.3	-3.1
Whitehorse, Y.T.	-17.7	-13.7	-6.6	0.9	6.9	11.8	14.1	12.5	7.1	0.6	-9.4	-14.9	-0.7
Inuvik, N.W.T.	-27.6	-26.9	-23.2	-12.8	0.2	11.3	14.2	11.0	3.7	-8.2	-21.0	-25.7	-8.8
Yellowknife, N.W.T.	-26.8	-23.4	-17.3	-5.3	5.6	13.5	16.8	14.2	7.1	-1.7	-13.8	-23.7	-4.6
Resolute, Nvt.	-32.4	-33.1	-30.7	-22.8	-10.9	-0.1	4.3	1.5	-4.7	-14.9	-23.6	-29.2	-16.4
Alert, Nvt.	-32.3	-33.4	-32.4	-24.3	-11.8	-0.8	3.3	0.8	-9.2	-19.3	-26.4	-30.0	-18.0
Clyde, Nvt.	-28.1	-29.6	-27.2	-19.0	-8.5	0.7	4.4	3.9	0.0	-7.6	-17.5	-24.8	-12.8
Iqaluit, Nvt.	-26.6	-28.0	-23.7	-14.8	-4.4	3.6	7.7	6.8	2.2	-4.9	-12.8	-22.7	-9.8
Baker Lake, Nvt.	-32.3	-31.5	-27.2	-17.4	-5.8	4.9	11.4	9.5	2.6	-7.5	-20.1	-28.4	-11.8

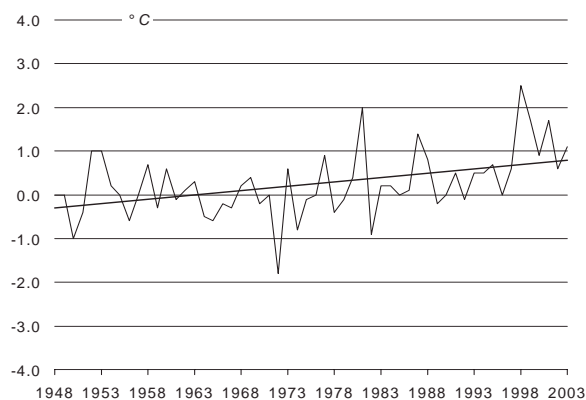
Note:

1. Averaged over the period 1971 to 2000.

Source:

Environment Canada, National Climate Archive, *Canadian Climate Normals or Averages, 1971-2000*, www.climate.weatheroffice.ec.gc.ca/climate_normals/index_e.html (accessed June 14, 2004).

Figure A.1
Annual national temperature departures and long-term trends, 1948 to 2003



Note:
 Departures from 1951 to 1980 average.

Source:
 Environment Canada, 2004, *Climate Trends and Variations Bulletin for Canada, Annual 2003*, Meteorological Service of Canada, Climate Research Branch, Ottawa, www.msc-smc.ec.gc.ca/crcm/bulletin/annual03/national_e.cfm (accessed July 25, 2004).

Table A.7
Annual regional temperature departures, trends and extremes, 1948 to 2003

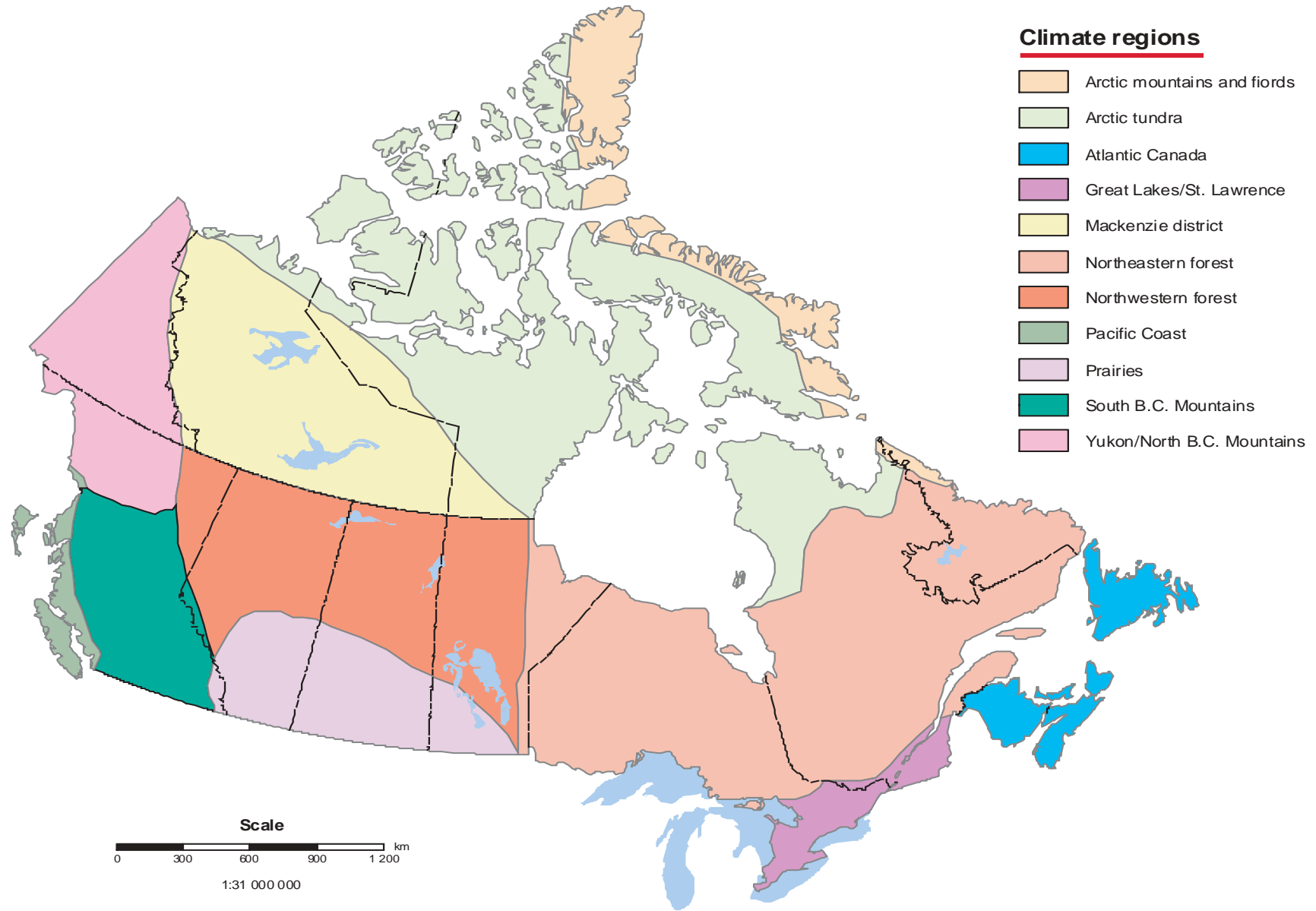
Climate region ²	Trend ³ °C	Extreme years				Annual 2003 ¹	
		Coldest		Warmest		Rank ⁵	Departure ⁴ °C
		Year on record	Departure ⁴ °C	Year on record	Departure ⁴ °C		
Atlantic Canada	0.0	1972	-1.4	1999	2.0	20	0.2
Great Lakes/St. Lawrence Lowlands	0.4	1978	-1.0	1998	2.3	35	-0.1
Northeastern Forest	0.5	1972	-1.9	1998	2.1	15	0.5
Northwestern Forest	1.6	1950	-2.1	1987	3.0	17	0.9
Prairies	1.3	1950	-2.1	1987	3.1	22	0.6
South British Columbia Mountains	1.3	1955	-1.8	1998	2.0	7	1.1
Pacific Coast	1.1	1955	-1.2	1958	1.6	9	0.9
North British Columbia Mountains/Yukon	1.9	1972	-2.1	1981	2.8	15	1.3
Mackenzie District	2.0	1982	-1.5	1998	3.9	8	1.4
Arctic Tundra	1.3	1972	-2.4	1998	3.3	5	1.8
Arctic Mountains and Fiords	0.7	1972	-1.9	1981	2.2	2	2.0
Canada	1.1	1972	-1.8	1998	2.5	6	1.1

Notes:

- The 2003 data are preliminary.
- The climate regions of Canada are illustrated in Map A.6.
- A linear (least square) trend over the period of record.
- Difference from the normal temperature.
- This column ranks 2003 temperature departures over a 56 year period between 1948 and 2003. For example, on the first line of the table, the Atlantic Canada Climate Region had a departure that was .02 degrees C warmer than the long term temperature average, which ranked the 2003 season as the 20th warmest over the 56 year period.

Source:
 Environment Canada, 2004, *Climate Trends and Variations Bulletin for Canada, Annual 2003*, Meteorological Service of Canada, Climate Research Branch, Ottawa.

Map A.6
Canadian climate regions

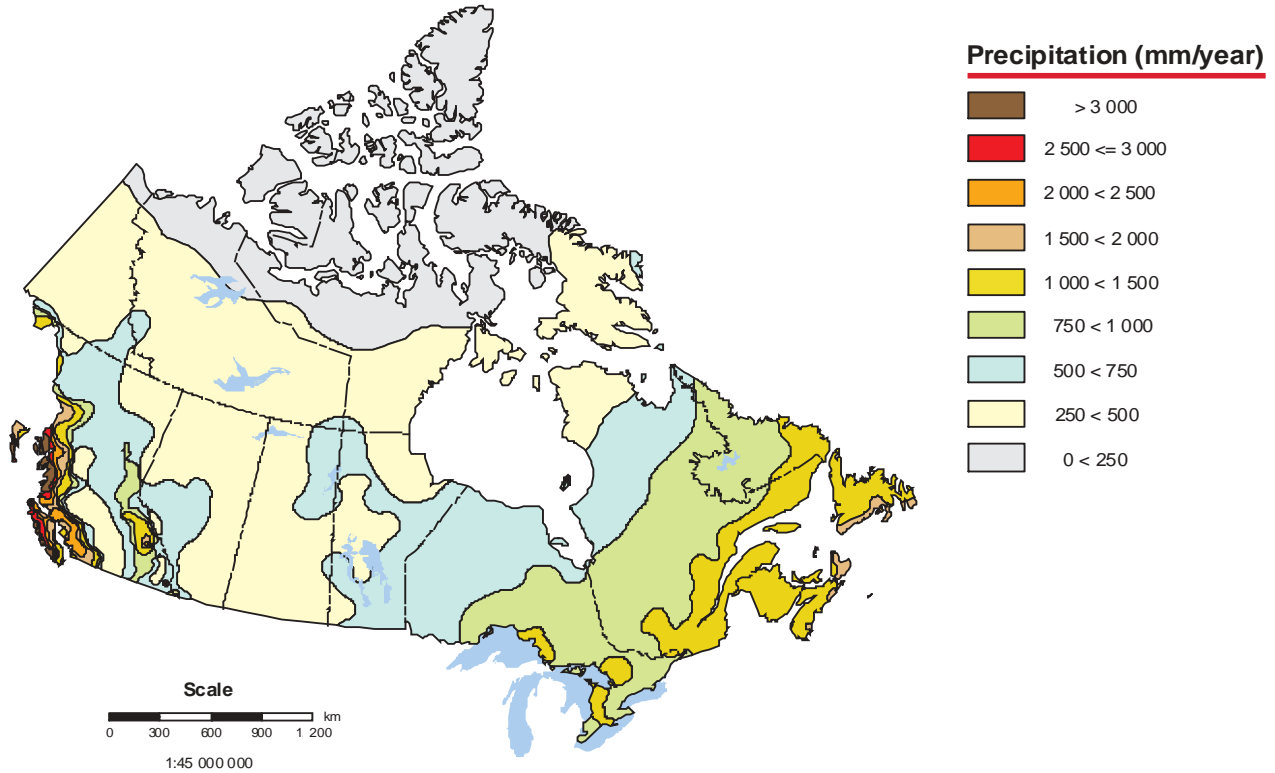


Source:
 Environment Canada, Atmospheric Environment Service, Climate Research Branch, 1998, *Climate Trends and Variations Bulletin for Canada*, Ottawa.

Precipitation

Some 5 500 km³ of precipitation falls on Canada every year, mainly in the form of rain and snow. Air masses that carry this precipitation generally circulate from west to east (Map A.7). Figure A.2 shows the average annual precipitation as recorded at selected weather stations.

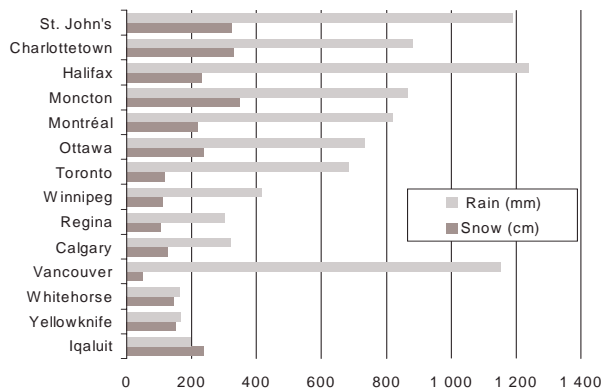
Map A.7
Normal precipitation, 1971 to 2000



Note:
 The data for this map were estimated using a two-pass inverse distance-weighted interpolation of the 1971 to 2000 normal precipitation data from the Meteorological Service of Canada, using the Albers Equal Area Conic projection (Statistics Canada, Environment Accounts and Statistics Division).

Sources:
 Environment Canada, Meteorological Service of Canada.
 Statistics Canada, Environment Accounts and Statistics Division.

Figure A.2
Average annual precipitation, 1971 to 2000



Source:
 Environment Canada, *Canadian Climate Normals, 1971-2000*,
www.climate.weatheroffice.ec.gc.ca/climate_normals/index_e.html (accessed July 25, 2004).

B) Pressure

Driving forces

Driving forces are the conditions and activities that shape the relationship between human activities and the environment. Topics covered in this section include population, economic conditions and transportation.

Population

Population growth, distribution and density are major factors in determining the impacts that human activities have on the environment. Canada's population has expanded considerably since 1901, when there were 5.4 million Canadians (Table B.1). By 2001, the population had grown almost six-fold, reaching over 31 million people. However, growth rates have not been consistent over time. Two historical periods were characterized by high annual population growth rates. The first was from 1901 to 1911, when massive immigration resulted in annual growth rates of up to 3%. The second period of high growth followed the end of the Second World War and is generally referred to as the 'baby boom'. In contrast to these two periods of population growth, two periods of slow economic activity (1891 to 1901 and 1931 to 1941) coincided with a slump in population growth rates.

The growth of Canada's population is the result of two factors: natural increase and net migration. Since the 1960s, the population growth rate has slowed (Table B.2). In the early 1960s, natural increase accounted for over 90% of population growth. From 1960 to 2003, the number of births per year decreased and the number of deaths per year increased. By 2003, net migration had become a more important component of population growth, accounting for over half the annual increase.

Tables B.3 and B.4 present population by ecozone, illustrating the unevenness of Canada's population distribution. Although the average population density for Canada was only three persons per km² in 2001, over 30 persons per km² inhabited the Great Lakes - St. Lawrence river basin (Table B.5).

In 2001, 80% of the Canadian population lived in urban areas compared to 75% two decades earlier. Table B.6 breaks down urban and rural population by sub-drainage area.

Table B.1
Total population by province and territory, 1901 to 2001, selected years

Province/Territory	Total population											Change	
	1901	1911	1921	1931	1941	1951	1961	1971	1981	1991	2001	1901 to 1951	1951 to 2001
	thousands											%	
Newfoundland and Labrador	...	...	...	...	...	361.4	457.9	530.9	574.8	579.5	522.0	...	44
Prince Edward Island	103.3	93.7	88.6	88.0	95.0	98.4	104.6	112.6	123.7	130.3	136.7	-5	39
Nova Scotia	459.6	492.3	523.8	512.8	578.0	642.6	737.0	797.3	854.6	915.1	932.4	40	45
New Brunswick	331.1	351.9	387.9	408.2	457.4	515.7	597.9	642.5	706.3	745.5	749.9	56	45
Quebec	1 648.9	2 005.8	2 360.5	2 874.7	3 331.9	4 055.7	5 259.2	6 137.3	6 547.7	7 064.6	7 397.0	146	82
Ontario	2 182.9	2 527.3	2 933.7	3 431.7	3 787.7	4 597.5	6 236.1	7 849.0	8 811.3	10 428.1	11 897.6	111	159
Manitoba	255.2	461.4	610.1	700.1	729.7	776.5	921.7	998.9	1 036.4	1 109.6	1 151.3	204	48
Saskatchewan	91.3	492.4	757.5	921.8	896.0	831.7	925.2	932.0	975.9	1 002.7	1 000.1	811	20
Alberta	73.0	374.3	588.5	731.6	796.2	939.5	1 332.0	1 665.7	2 294.2	2 592.6	3 056.7	1 187	225
British Columbia	178.7	392.5	524.6	694.3	817.8	1 165.2	1 629.1	2 240.5	2 823.9	3 373.5	4 078.4	552	250
Yukon Territory	27.2	8.5	4.1	4.2	5.0	9.1	14.6	19.0	23.9	28.9	30.1	-67	231
Northwest Territories	20.1 ¹	6.5 ¹	8.1 ¹	9.3 ¹	12.0 ¹	16.0 ¹	23.0 ¹	36.4 ¹	47.6 ¹	38.7	40.8	-20	158
Nunavut	...	...	...	...	...	...	...	...	...	22.2	28.1	...	...
Canada	5 371.3	7 206.6	8 787.8	10 376.7	11 506.7	14 009.4	18 238.3	21 962.0	24 820.4	28 031.4	31 021.3	161	121

Notes:

Figures may not add up to totals due to rounding.

1. Includes Nunavut.

Sources:

Statistics Canada, 1983, *Historical Statistics of Canada, Second Edition*, F.H. Leacy (ed.), Catalogue no. 11-516-XPE, Ottawa.
Statistics Canada, CANSIM, tables 051-0001 and 051-0024.

Table B.2
Components of population growth, 1960 to 2003

Year	Population			Natural increase			Net migration		
	Total	Growth	Growth rate	Births	Deaths	Natural increase	Immigration	Emigration	Net migration
	thousands		%	thousands			thousands		
1960	17 909	...	...	478.6	139.7	338.9	104.1	..	..
1961	18 271	362	2.0	475.7	141.0	334.7	71.7	..	..
1962	18 614	343	1.8	469.7	143.7	326.0	74.6	..	..
1963	18 964	350	1.8	465.8	147.4	318.4	93.2	..	..
1964	19 325	361	1.9	452.9	145.9	307.0	112.6	..	..
1965	19 678	353	1.8	418.6	148.9	269.7	146.8	..	..
1966	20 048	370	1.8	387.7	149.9	237.8	194.7	..	..
1967	20 412	364	1.8	370.9	150.3	220.6	222.9	..	..
1968	20 729	317	1.5	364.3	153.2	211.1	184.0	..	..
1969	21 028	299	1.4	369.7	154.5	215.2	161.5	..	..
1970	21 324	296	1.4	372.0	156.0	216.0	147.7	..	..
1971	21 962	638	2.9	362.2	157.3	204.9	121.9	..	..
1972	22 218	256	1.2	351.3	159.5	191.7	117.0	26.6	90.5
1973	22 492	273	1.2	345.8	162.6	183.2	138.5	27.7	110.8
1974	22 808	316	1.4	342.4	166.3	176.2	217.5	46.8	170.7
1975	23 143	335	1.4	356.0	168.8	187.2	209.3	40.5	168.8
1976	23 450	307	1.3	364.3	166.4	197.9	170.0	30.3	139.7
1977	23 726	276	1.2	357.9	165.7	192.1	130.9	25.1	105.9
1978	23 963	237	1.0	359.8	169.0	190.8	101.0	31.4	69.5
1979	24 202	238	1.0	362.4	165.8	196.6	84.5	30.9	53.7
1980	24 516	314	1.3	367.3	171.5	195.8	143.8	20.5	123.3
1981	24 820	304	1.2	372.1	170.5	201.6	127.2	17.8	109.4
1982	25 117	297	1.2	372.5	172.4	200.1	135.3	29.1	106.2
1983	25 367	250	1.0	373.6	176.5	197.1	101.4	31.1	70.3
1984	25 608	241	0.9	374.5	174.2	200.4	88.6	31.8	56.8
1985	25 843	235	0.9	376.3	179.1	197.2	83.9	28.1	55.8
1986	26 101	258	1.0	375.4	183.4	192.0	88.7	24.8	63.9
1987	26 449	348	1.3	373.0	182.6	190.4	130.9	31.0	99.9
1988	26 795	347	1.3	370.0	189.9	180.1	152.2	26.7	125.5
1989	27 282	486	1.8	384.0	188.4	195.6	177.6	26.3	151.3
1990	27 698	416	1.5	403.3	192.6	210.7	203.4	25.8	177.5
1991	28 031	334	1.2	402.9	192.4	210.5	221.4	28.5	192.9
1992	28 367	335	1.2	403.1	197.0	206.1	244.3	49.5	194.8
1993	28 682	315	1.1	392.2	201.8	190.4	266.9	48.5	218.4
1994	28 999	317	1.1	386.2	206.5	179.7	235.4	52.8	182.5
1995	29 302	303	1.0	382.0	209.4	172.6	220.7	53.4	167.3
1996	29 611	309	1.0	372.5	209.8	162.7	217.5	49.1	168.4
1997	29 907	296	1.0	357.3	217.2	140.1	224.9	59.4	165.4
1998	30 157	250	0.8	345.1	217.7	127.4	194.5	58.7	135.8
1999	30 404	247	0.8	338.3	217.6	120.7	173.2	56.1	117.1
2000	30 689	285	0.9	336.9	217.2	119.7	205.7	56.0	149.7
2001	31 021	332	1.1	327.1	219.1	108.0	252.5	55.4	197.1
2002	31 362	340	1.1	332.8	222.8	110.0	256.3	55.3	201.0
2003	31 630	268	0.8	331.5	227.6	103.9	199.2	55.6	143.6

Note:

Population growth figures do not equal the sum of the natural increase and net migration. The balance of non-permanent residents and the number of returning Canadians, as well as a residual need to be added.

Sources:

Statistics Canada, 1992, *Report on the Demographic Situation in Canada 1992*, Catalogue no. 91-209, Ottawa.

Statistics Canada, *Quarterly Estimates*, Catalogue no. 91-002, Ottawa, various issues.

Statistics Canada, Census of Population and Demography Division.

Statistics Canada, CANSIM, tables 051-0001 and 051-0004.

Table B.3
Population by ecozone, 1981 and 2001

Ecozone	Area km ²	Population			Density	
		1981	2001	Change 1981 to 2001	1981	2001
Arctic Cordillera	234 708	821	1 304	483	0.35	0.56
Northern Arctic	1 371 340	11 872	20 451	8 579	0.87	1.49
Southern Arctic	702 542	8 137	14 470	6 333	1.16	2.06
Taiga Plains	569 363	18 358	20 726	2 368	3.22	3.64
Taiga Shield	1 122 504	30 859	38 116	7 257	2.75	3.40
Boreal Shield	1 640 949	2 731 344	2 821 808	90 464	166.45	103.31
Atlantic Maritime	192 017	2 428 735	2 537 685	108 950	1 264.86	1 321.60
Mixed Wood Plains	107 017	12 187 952	15 631 830	3 443 878	11 388.75	14 606.81
Boreal Plains	668 664	673 775	771 205	97 430	100.76	115.34
Prairie	443 159	3 499 494	4 222 569	723 075	789.67	952.83
Taiga Cordillera	264 213	563	370	-193	0.21	0.14
Boreal Cordillera	459 864	26 507	30 690	4 183	5.76	6.67
Pacific Maritime	196 200	2 014 790	3 027 206	1 012 416	1 026.91	1 542.92
Montane Cordillera	474 753	701 014	859 134	158 120	147.66	180.96
Hudson Plains	359 546	8 960	9 530	570	2.49	2.65
Canada Total	8 806 839	24 343 181	30 007 094	5 663 913	276.41	340.72

Notes:

The area figures are for land area only and are calculated by taking the total ecozone area and subtracting the surface water area in the ecozone derived from the 1-km water fraction digital coverage.

The total area of Canada excluding the Great Lakes is 9 886 215 km². Including the Canadian portion of the Great Lakes the total area of Canada is 9 976 182 km².

The population figures presented here are the census counts and are not adjusted for net undercoverage and non-permanent residents.

Sources:

Statistics Canada, Environment Accounts and Statistics Division, Spatial Environmental Information System and Censuses of Population, 1981 and 2001.

Agriculture and Agri-Food Canada, and Environment Canada, 2003, Framework Data - National Resolution - Ecological Units, www.geoconnections.org/CGDI.cfm/fuseaction/dataFrameworkData.ecoUnits/gcs.cfm (accessed May 13, 2003).

Fernandes, R., G. Pavlic, W. Chen and R. Fraser, 2001, Canada-wide 1-km water fraction, National Topographic Database, Natural Resources Canada, www.nrncan.gc.ca/ess/_portal_esst.cache/gc_ccrs_e (accessed April 29, 2002).

Table B.4
Population by provincial and territorial ecozone, 1981, 1991 and 2001

Provincial/Territorial ecozone	Area		Population					Density				
	1981 to 1999	1999 to 2001	1981	1991	2001	Change 1981 to 2001	Change 1991 to 2001	1981	1991	2001	Change 1981 to 2001	Change 1991 to 2001
Newfoundland and Labrador												
Arctic Cordillera	17 318	17 318	0	0	0	0	0	0.000	0.000	0.000	0.0	0.0
Boreal Shield	139 813	139 813	563 063	563 897	508 197	-54 866	-55 700	4.027	4.033	3.635	-10.8	-11.0
Taiga Shield	194 228	194 228	4 618	4 577	4 733	115	156	0.024	0.024	0.024	2.4	3.3
Total	351 359	351 359	567 681	568 474	512 930	-54 751	-55 544	1.616	1.618	1.460	-10.7	-10.8
Prince Edward Island												
Atlantic Maritime	5 402	5 402	122 506	129 765	135 294	12 788	5 529	22.679	24.023	25.047	9.5	4.1
Total	5 402	5 402	122 506	129 765	135 294	12 788	5 529	22.679	24.023	25.047	9.5	4.1
Nova Scotia												
Atlantic Maritime	50 633	50 633	847 442	899 942	908 007	60 565	8 065	16.737	17.774	17.933	6.7	0.9
Total	50 633	50 633	847 442	899 942	908 007	60 565	8 065	16.737	17.774	17.933	6.7	0.9
New Brunswick												
Atlantic Maritime	70 602	70 602	696 403	723 900	729 498	33 095	5 598	9.864	10.253	10.333	4.5	0.8
Total	70 602	70 602	696 403	723 900	729 498	33 095	5 598	9.864	10.253	10.333	4.5	0.8
Quebec												
Arctic Cordillera	12 360	12 360	0	0	0	0	0	0.000	0.000	0.000	0.0	0.0
Atlantic Maritime	65 380	65 380	762 384	758 879	764 886	2 502	6 007	11.661	11.607	11.699	0.3	0.8
Boreal Shield	573 556	573 556	1 159 520	1 227 015	1 292 746	133 226	65 731	2.022	2.139	2.254	10.3	5.1
Hudson Plains	34 724	34 724	1 342	1 788	2 312	970	524	0.039	0.051	0.067	42.0	22.7
Mixed Wood Plains	27 220	27 220	4 501 391	4 894 723	5 160 906	659 515	266 183	165.373	179.823	189.602	12.8	5.2
Northern Arctic	33 599	33 599	932	1 461	1 842	910	381	0.028	0.043	0.055	49.4	20.7
Southern Arctic	123 968	123 968	2 156	3 257	4 017	1 861	760	0.017	0.026	0.032	46.3	18.9
Taiga Shield	437 194	437 194	10 678	8 840	10 770	92	1 930	0.024	0.020	0.025	0.9	17.9
Total	1 308 002	1 308 002	6 438 403	6 895 963	7 237 479	799 076	341 516	4.922	5.272	5.533	11.0	4.7
Ontario												
Boreal Shield	559 603	559 603	933 099	952 438	933 908	809	-18 530	1.667	1.702	1.669	0.1	-2.0
Hudson Plains	254 963	254 963	5 447	5 789	5 214	-233	-575	0.021	0.023	0.020	-4.5	-11.0
Mixed Wood Plains	79 798	79 798	7 686 561	9 126 658	10 470 924	2 784 363	1 344 266	96.326	114.372	131.218	26.6	12.8

Table B.4
Population by provincial and territorial ecozone, 1981, 1991 and 2001 (continued)

Provincial/Territorial ecozone	Area		Population					Density				
	1981 to 1999	1999 to 2001	1981	1991	2001	Change 1981 to 2001	Change 1991 to 2001	1981	1991	2001	Change 1981 to 2001	Change 1991 to 2001
	km ²		persons					persons/km ²				
								%				
Total	894 364	894 364	8 625 107	10 084 885	11 410 046	2 784 939	1 325 161	9.644	11.276	12.758	24.4	11.6
Manitoba												
Boreal Plains	83 667	83 667	104 579	110 298	116 672	12 093	6 374	1.250	1.318	1.394	10.4	5.5
Boreal Shield	216 334	216 334	65 707	68 052	72 277	6 570	4 225	0.304	0.315	0.334	9.1	5.8
Hudson Plains	66 685	66 685	2 171	2 361	2 004	-167	-357	0.033	0.035	0.030	-8.3	-17.8
Prairie	64 234	64 234	852 832	910 069	927 172	74 340	17 103	13.277	14.168	14.434	8.0	1.8
Southern Arctic	1 142	1 142	0	0	0	0	0	0.000	0.000	0.000	0.0	0.0
Taiga Shield	109 048	109 048	952	1 162	1 458	506	296	0.009	0.011	0.013	34.7	20.3
Total	541 110	541 110	1 026 241	1 091 942	1 119 583	93 342	27 641	1.897	2.018	2.069	8.3	2.5
Saskatchewan												
Boreal Plains	163 274	163 274	161 945	158 821	160 484	-1 461	1 663	0.992	0.973	0.983	-0.9	1.0
Boreal Shield	147 484	147 484	9 955	12 086	14 680	4 725	2 594	0.067	0.082	0.100	32.2	17.7
Prairie	229 248	229 248	792 946	816 283	801 806	8 860	-14 477	3.459	3.561	3.498	1.1	-1.8
Taiga Shield	37 460	37 460	3 467	1 738	1 963	-1 504	225	0.093	0.046	0.052	-76.6	11.5
Total	577 467	577 467	968 313	988 928	978 933	10 620	-9 995	1.677	1.713	1.695	1.1	-1.0
Alberta												
Boreal Plains	367 431	367 431	354 030	387 592	438 155	84 125	50 563	0.964	1.055	1.192	19.2	11.5
Boreal Shield	4 159	4 159	0	4	0	0	-4	0.000	0.001	0.000	0.0	0.0
Montane Cordillera	46 336	46 336	27 961	31 481	39 813	11 852	8 332	0.603	0.679	0.859	29.8	20.9
Prairie	149 676	149 676	1 853 716	2 123 916	2 493 591	639 875	369 675	12.385	14.190	16.660	25.7	14.8
Taiga Plains	60 663	60 663	2 017	2 560	2 938	921	378	0.033	0.042	0.048	31.3	12.9
Taiga Shield	7 932	7 932	0	0	310	310	310	0.000	0.000	0.039	100.0	100.0
Total	636 199	636 199	2 237 724	2 545 553	2 974 807	737 083	429 254	3.517	4.001	4.676	24.8	14.4
British Columbia												
Boreal Cordillera	188 728	188 728	3 598	3 351	2 396	-1 202	-955	0.019	0.018	0.013	-50.2	-39.9
Boreal Plains	39 073	39 073	48 582	49 126	53 174	4 592	4 048	1.243	1.257	1.361	8.6	7.6
Montane Cordillera	428 417	428 417	673 053	720 713	819 321	146 268	98 608	1.571	1.682	1.912	17.9	12.0
Pacific Maritime	192 107	192 107	2 014 790	2 503 960	3 027 206	1 012 416	523 246	10.488	13.034	15.758	33.4	17.3
Taiga Plains	66 853	66 853	4 444	4 911	5 641	1 197	730	0.066	0.073	0.084	21.2	12.9
Total	915 178	915 178	2 744 467	3 282 061	3 907 738	1 163 271	625 677	2.999	3.586	4.270	29.8	16.0
Yukon Territory												
Boreal Cordillera	266 546	266 546	22 909	27 488	28 294	5 385	806	0.086	0.103	0.106	19.0	2.8
Pacific Maritime	4 093	4 093	0	0	0	0	0	0.000	0.000	0.000	0.0	0.0
Southern Arctic	4 496	4 496	1	0	0	-1	0	0.000	0.000	0.000	0.0	0.0
Taiga Cordillera	180 170	180 170	243	309	370	127	61	0.001	0.002	0.002	34.3	16.5
Taiga Plains	18 110	18 110	0	0	10	10	10	0.000	0.000	0.001	100.0	100.0
Total	473 415	473 415	23 153	27 797	28 674	5 521	877	0.049	0.059	0.061	19.3	3.1
Northwest Territories												
Arctic Cordillera	205 053	0	821	1 047	...	...	...	0.004	0.005	...	...	...
Boreal Cordillera	4 589	4 589	0	0	0	0	0	0.000	0.000	0.000	0.0	0.0
Boreal Plains	15 218	15 218	4 639	3 008	2 720	-1 919	-288	0.305	0.198	0.179	-70.6	-10.6
Hudson Plains	3 174	0	0	0	...	...	...	0.000	0.000	...	...	...
Northern Arctic	1 337 719	198 761	10 940	14 867	512	-10 428	-14 355	0.008	0.075	0.003	-217.5	-2 803.7
Southern Arctic	572 936	158 124	5 980	7 057	3 109	-2 871	-3 948	0.010	0.045	0.020	46.9	-127.0
Taiga Cordillera	84 043	84 043	320	0	0	-320	0	0.004	0.000	0.000	0.0	0.0
Taiga Plains	423 737	423 737	11 897	13 958	12 137	240	-1 821	0.028	0.033	0.029	2.0	-15.0
Taiga Shield	336 641	257 638	11 144	17 712	18 882	7 738	1 170	0.033	0.069	0.073	54.8	6.2
Total	2 983 143	1 142 110	45 741	57 649	37 360	-8 381	-20 289	0.015	0.050	0.033	53.1	-54.3
Nunavut												
Arctic Cordillera	...	205 053	...	...	1 304	...	...	...	...	0.006	...	...
Hudson Plains	...	3 174	...	...	0	...	...	...	...	0.000	...	...
Northern Arctic	...	1 138 957	...	...	18 097	...	...	...	...	0.016	...	...
Southern Arctic	...	414 811	...	...	7 344	...	...	...	...	0.018	...	...
Taiga Shield	...	79 003	...	...	0	...	...	...	...	0.000	...	...
Total	...	1 841 032	...	...	26 745	...	...	...	...	0.015	...	...
Canada	8 806 839	8 806 839	24 343 181	27 296 859	30 007 094	5 663 913	2 710 235	2.764	3.099	3.407	18.9	9.0

Notes:

The area figures are for land area only and are calculated by taking the total ecozone area and subtracting the surface water area in the ecozone derived from the 1 km water fraction digital coverage.

The total area of Canada excluding the Great Lakes is 9 886 215 km². Including the Great Lakes the total area of Canada is 9 976 182 km².

As Nunavut was created on April 1, 1999, population data is not available for 1981 and 1991. Population for 1981 and 1991 for Nunavut is included in the Northwest Territories data.

The population figures presented here are the census counts and are not adjusted for net undercoverage and non-permanent residents.

Sources:

Statistics Canada, Environment Accounts and Statistics Division, Spatial Environmental Information System and Censuses of Population, 1981, 1991 and 2001.

Agriculture and Agri-Food Canada, and Environment Canada, 2003, Framework Data - National Resolution - Ecological Units, www.geoconnections.org/CGDI.cfm/fuseaction/dataFrameworkData.ecoUnits/gcs.cfm (accessed May 13, 2003).

Fernandes, R., G. Pavlic, W. Chen and R. Fraser, 2001, Canada-wide 1-km water fraction, National Topographic Database, Natural Resources Canada, www.nrncan.gc.ca/ess/_portal_esst.cache/gc_ccrs_e (accessed April 29, 2002).

Table B.5
Population characteristics by major river basin,¹ 1971 and 2001

Code	River basin name	Total population ²		Population	Population	Population density in 2001		Mean annual streamflow per capita thousand m ³ /person
		1971	2001	as a share of total 2001	change 1971 to 2001	By total area ³	By water area ⁴	
		persons		%		persons/km ²		
1	Pacific Coastal	916 210	1 374 422	4.58	50.0	4.1	91.4	376
2	Fraser - Lower Mainland	967 851	2 020 656	6.73	108.8	8.7	224.1	62
3	Okanagan - Similkameen	120 553	285 145	0.95	136.5	18.3	438.7	8
4	Columbia	131 462	160 605	0.54	22.2	1.8	64.7	394
5	Yukon	17 204	27 148	0.09	57.8	0.1	2.9	2 911
6	Peace - Athabasca	206 564	346 234	1.15	67.6	0.7	20.7	264
7	Lower Mackenzie	34 182	48 832	0.16	42.9	0.0	0.3	4 738
8	Arctic Coast - Islands	7 690	16 756	0.06	117.9	0.0	0.1	16 457
9	Missouri	14 349	9 378	0.03	-34.6	0.3	8.3	40
10	North Saskatchewan	844 730	1 307 959	4.36	54.8	8.7	180.5	6
11	South Saskatchewan	948 446	1 772 288	5.91	86.9	10.0	283.9	4
12	Assiniboine - Red	1 250 804	1 365 079	4.55	9.1	7.2	150.0	1
13	Winnipeg	84 685	83 277	0.28	-1.7	0.8	4.0	287
14	Lower Saskatchewan - Nelson	237 276	218 315	0.73	-8.0	0.6	3.2	276
15	Churchill	61 711	87 343	0.29	41.5	0.3	1.7	253
16	Keewatin - Southern Baffin Island	6 271	12 033	0.04	91.9	0.0	0.1	14 107
17	Northern Ontario	149 112	143 036	0.48	-4.1	0.2	2.6	1 322
18	Northern Quebec	87 805	104 437	0.35	18.9	0.1	0.7	5 082
19	Great Lakes - St. Lawrence	12 759 943	17 698 641	58.98	38.7	30.4	131.2	13
20	North Shore - Gaspé	503 796	504 113	1.68	0.1	1.4	13.5	510
21	Saint John - St. Croix	365 294	401 681	1.34	10.0	9.6	223.2	61
22	Maritime Coastal	1 329 135	1 505 585	5.02	13.3	12.3	223.8	76
23	Newfoundland - Labrador	523 238	514 131	1.71	-1.7	1.4	9.3	572
	Canada	21 568 311	30 007 094	100.00	39.1	3.0	25.5	110

Notes:

- These major river basins and associated flow measures are adapted from "Laycock (1987) (see full reference below). Some of these river basin aggregates have more than one outflow.
- Numbers based on the 2001 Census of Population.
- Area includes the Canadian portion of the Great Lakes.
- Water area figures are calculated from the Canada-wide 1-km water fraction derived from National Topographic Database maps.

Sources:

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Table B.6
Rural and urban population by provincial and territorial sub-drainage area, 1981, 1991 and 2001

Province/Territory and sub-drainage area	Total population			Rural population			Urban population			Urban population as a share of total		
	1981	1991	2001	1981	1991	2001	1981	1991	2001	1981	1991	2001
	persons						%					
Canada	24 343 181	27 296 859	30 007 094	5 907 254	6 389 985	6 098 883	18 435 927	20 906 874	23 908 211	75.7	76.6	79.7
Newfoundland and Labrador												
Petit Mécatina and Strait of Belle Isle	2 459	2 181	1 996	2 459	2 181	1 996	0	0	0	0.0	0.0	0.0
Northern Newfoundland	217 670	208 475	178 576	108 398	114 128	95 175	109 272	94 347	83 401	50.2	45.3	46.7
Southern Newfoundland	318 693	329 620	306 490	115 106	136 495	110 091	203 587	193 125	196 399	63.9	58.6	64.1
Northern Labrador	2 173	2 650	2 897	2 173	2 650	2 897	0	0	0	0.0	0.0	0.0
Churchill (Nfld.)	19 707	17 075	13 966	941	1 763	744	18 766	15 312	13 222	95.2	89.7	94.7
Central Labrador	4 314	5 511	6 288	3 041	3 844	3 114	1 273	1 667	3 174	29.5	30.2	50.5
Southern Labrador	2 665	2 962	2 717	2 665	2 962	2 717	0	0	0	0.0	0.0	0.0
Total	567 681	568 474	512 930	234 783	264 023	216 734	332 898	304 451	296 196	58.6	53.6	57.7
Prince Edward Island												
Prince Edward Island	122 506	129 765	135 294	77 991	77 952	74 619	44 515	51 813	60 675	36.3	39.9	44.8
Total	122 506	129 765	135 294	77 991	77 952	74 619	44 515	51 813	60 675	36.3	39.9	44.8
Nova Scotia												
Bay of Fundy and Gulf of St. Lawrence (N.S.)	290 513	315 814	316 125	181 909	198 959	193 198	108 604	116 855	122 927	37.4	37.0	38.9

Table B.6
Rural and urban population by provincial and territorial sub-drainage area, 1981, 1991 and 2001 (continued)

Province/Territory and sub-drainage area	Total population			Rural population			Urban population			Urban population as a share of total		
	1981	1991	2001	1981	1991	2001	1981	1991	2001	1981	1991	2001
	persons						%					
Southeastern Atlantic Ocean (N.S.)	386 841	422 442	444 428	131 472	150 451	148 173	255 369	271 991	296 255	66.0	64.4	66.7
Cape Breton Island	170 088	161 686	147 454	67 219	69 024	59 627	102 869	92 662	87 827	60.5	57.3	59.6
Total	847 442	899 942	908 007	380 600	418 434	400 998	466 842	481 508	507 009	55.1	53.5	55.8
New Brunswick												
Saint John and Southern Bay of Fundy (N.B.)	345 581	363 107	368 440	149 479	174 257	167 403	196 102	188 850	201 037	56.7	52.0	54.6
Gulf of St. Lawrence and Northern Bay of Fundy (N.B.)	350 822	360 793	361 058	193 704	204 429	194 193	157 118	156 364	166 865	44.8	43.3	46.2
Total	696 403	723 900	729 498	343 183	378 686	361 596	353 220	345 214	367 902	50.7	47.7	50.4
Quebec												
Saint John and Southern Bay of Fundy (N.B.)	38 940	36 463	35 468	31 329	29 647	27 868	7 611	6 816	7 600	19.5	18.7	21.4
Gulf of St. Lawrence and Northern Bay of Fundy (N.B.)	100 914	93 776	86 339	65 463	68 616	58 108	35 451	25 160	28 231	35.1	26.8	32.7
Upper Ottawa	57 888	61 617	58 469	28 135	30 517	30 225	29 753	31 100	28 244	51.4	50.5	48.3
Central Ottawa	43 263	49 196	52 498	15 950	17 126	16 823	27 313	32 070	35 675	63.1	65.2	68.0
Lower Ottawa	364 220	419 520	483 061	133 440	156 820	177 074	230 780	262 700	305 987	63.4	62.6	63.3
Upper St. Lawrence	70 180	73 043	79 071	22 676	24 127	20 999	47 504	48 916	58 072	67.7	67.0	73.4
Saint-Maurice	131 619	126 960	126 415	21 778	25 202	20 271	109 841	101 758	106 144	83.5	80.1	84.0
Central St. Lawrence	3 895 362	4 253 609	4 516 239	533 625	587 749	525 820	3 361 737	3 665 860	3 990 419	86.3	86.2	88.4
Lower St. Lawrence	1 052 259	1 118 660	1 155 135	325 544	343 054	309 200	726 715	775 606	845 935	69.1	69.3	73.2
Northern Gaspé Peninsula	140 055	132 853	129 521	69 063	64 602	59 021	70 992	68 251	70 500	50.7	51.4	54.4
Saguenay	287 272	287 217	279 079	89 640	90 657	79 165	197 632	196 560	199 914	68.8	68.4	71.6
Betsiamites - Coast	16 203	15 158	14 583	10 638	10 050	7 437	5 565	5 108	7 146	34.3	33.7	49.0
Manicouagan and aux Outardes	23 659	20 236	19 667	4 349	4 078	5 090	19 310	16 158	14 577	81.6	79.8	74.1
Moisie and St. Lawrence Estuary	61 199	53 056	49 334	11 994	7 939	6 758	49 205	45 117	42 576	80.4	85.0	86.3
Gulf of St. Lawrence - Romaine	2 065	2 148	1 802	2 065	2 148	1 802	0	0	0	0.0	0.0	0.0
Gulf of St. Lawrence - Natashquan	20 757	19 965	19 631	16 050	15 234	15 054	4 707	4 731	4 577	22.7	23.7	23.3
Petit Mécatina and Strait of Belle Isle	4 110	4 723	3 712	4 110	4 723	3 712	0	0	0	0.0	0.0	0.0
Nottaway - Coast	32 308	27 009	25 339	6 774	5 870	6 549	25 534	21 139	18 790	79.0	78.3	74.2
Broadback and Rupert	2 959	3 381	4 867	2 959	3 381	3 053	0	0	1 814	0.0	0.0	37.3
Eastmain	328	444	613	328	444	613	0	0	0	0.0	0.0	0.0
La Grande - Coast	5 410	4 213	4 967	5 410	4 213	1 500	0	0	3 467	0.0	0.0	69.8
Grande rivière de la Baleine - Coast	1 067	1 113	1 333	1 067	1 113	1 333	0	0	0	0.0	0.0	0.0
Eastern Hudson Bay	0	284	348	0	284	348	0	0	0	0.0	0.0	0.0
Northeastern Hudson Bay	1 662	2 510	3 053	1 662	2 510	3 053	0	0	0	0.0	0.0	0.0
Western Ungava Bay	1 324	2 077	2 647	1 324	2 077	2 647	0	0	0	0.0	0.0	0.0
Aux Feuilles - Coast	179	283	387	179	283	387	0	0	0	0.0	0.0	0.0
Koksoak	805	1 405	1 932	805	1 405	1 932	0	0	0	0.0	0.0	0.0
Caniapiscau	3 170	1 144	1 252	1 173	1 144	1 252	1 997	0	0	63.0	0.0	0.0
Eastern Ungava Bay	149	529	710	149	529	710	0	0	0	0.0	0.0	0.0
Abitibi	24 628	23 758	22 324	15 680	14 801	13 701	8 948	8 957	8 623	36.3	37.7	38.6
Harricaw - Coast	54 449	59 613	57 683	21 205	24 666	18 825	33 244	34 947	38 858	61.1	58.6	67.4
Total	6 438 403	6 895 963	7 237 479	1 444 564	1 545 009	1 420 330	4 993 839	5 350 954	5 817 149	77.6	77.6	80.4
Ontario												
Northwestern Lake Superior	133 444	136 791	132 416	20 596	26 383	29 201	112 848	110 408	103 215	84.6	80.7	77.9
Northeastern Lake Superior	55 593	51 072	46 240	13 642	13 656	14 114	41 951	37 416	32 126	75.5	73.3	69.5
Northern Lake Huron	263 667	266 295	253 414	50 210	49 309	48 148	213 457	216 986	205 266	81.0	81.5	81.0
Wanipitei and French (Ont.)	91 667	91 311	90 066	30 059	32 326	33 109	61 608	58 985	56 957	67.2	64.6	63.2
Eastern Georgian Bay	410 132	540 304	682 624	178 345	222 239	228 519	231 787	318 065	454 105	56.5	58.9	66.5
Eastern Lake Huron	263 421	302 160	307 409	143 474	155 685	152 782	119 947	146 475	154 627	45.5	48.5	50.3
Northern Lake Erie	1 649 123	1 838 281	2 032 283	381 437	389 840	381 715	1 267 686	1 448 441	1 650 568	76.9	78.8	81.2
Lake Ontario and Niagara Peninsula	4 560 423	5 477 416	6 368 255	404 134	535 516	439 404	4 156 289	4 941 900	5 928 851	91.1	90.2	93.1
Upper Ottawa	54 624	58 455	53 097	21 538	24 525	23 391	33 086	33 930	29 706	60.6	58.0	55.9
Central Ottawa	300 424	334 531	376 026	74 479	94 586	98 251	225 945	239 945	277 775	75.2	71.7	73.9
Lower Ottawa	493 691	624 619	709 610	123 890	135 268	151 036	369 801	489 351	558 574	74.9	78.3	78.7
Upper St. Lawrence	152 764	173 594	176 848	58 399	69 670	72 128	94 365	103 924	104 720	61.8	59.9	59.2
Severn	4 291	3 590	5 763	4 291	3 590	5 763	0	0	0	0.0	0.0	0.0
Winisk - Coast	1 572	1 946	2 615	1 572	1 946	2 615	0	0	0	0.0	0.0	0.0
Attawapiskat - Coast	1 403	1 949	1 962	1 403	1 949	669	0	0	1 293	0.0	0.0	65.9
Upper Albany	2 774	1 554	2 106	2 774	1 554	2 106	0	0	0	0.0	0.0	0.0
Lower Albany - Coast	1 202	1 199	441	1 202	1 199	441	0	0	0	0.0	0.0	0.0
Kenogami	11 043	9 062	8 144	3 808	2 753	2 860	7 235	6 309	5 284	65.5	69.6	64.9
Moose (Ont.)	2 977	2 851	2 886	1 745	1 848	936	1 232	1 003	1 950	41.4	35.2	67.6

Table B.6
Rural and urban population by provincial and territorial sub-drainage area, 1981, 1991 and 2001 (continued)

Province/Territory and sub-drainage area	Total population			Rural population			Urban population			Urban population as a share of total		
	1981	1991	2001	1981	1991	2001	1981	1991	2001	1981	1991	2001
	persons									%		
Missinaibi-Mattagami	71 356	68 267	62 046	19 419	21 411	14 825	51 937	46 856	47 221	72.8	68.6	76.1
Abitibi	26 502	26 248	23 685	9 574	9 256	8 310	16 928	16 992	15 375	63.9	64.7	64.9
Harricana - Coast	1	0	0	1	0	0	0	0	0	0.0	0.0	0.0
Winnipeg	43 134	43 515	43 245	17 148	18 874	19 604	25 986	24 641	23 641	60.2	56.6	54.7
English	28 900	28 301	28 487	13 956	16 090	17 194	14 944	12 211	11 293	51.7	43.1	39.6
Eastern Lake Winnipeg	979	1 574	378	979	1 574	378	0	0	0	0.0	0.0	0.0
Total	8 625 107	10 084 885	11 410 046	1 578 075	1 831 047	1 747 499	7 047 032	8 253 838	9 662 547	81.7	81.8	84.7
Manitoba												
Hayes (Man.)	5 142	7 366	10 442	5 142	7 366	10 442	0	0	0	0.0	0.0	0.0
Southwestern Hudson Bay	0	5	0	0	5	0	0	0	0	0.0	0.0	0.0
Qu'Appelle	0	338	43	0	338	43	0	0	0	0.0	0.0	0.0
Saskatchewan	22 252	19 853	19 823	7 728	6 320	7 793	14 524	13 533	12 030	65.3	68.2	60.7
Lake Winnipegosis and Lake Manitoba	79 806	74 797	71 832	58 125	54 656	52 686	21 681	20 141	19 146	27.2	26.9	26.7
Assiniboine	297 306	282 505	279 358	49 371	49 614	48 652	247 935	232 891	230 706	83.4	82.4	82.6
Souris	20 059	16 345	15 033	16 036	12 504	11 203	4 023	3 841	3 830	20.1	23.5	25.5
Red	528 217	612 804	640 410	109 953	122 642	123 790	418 264	490 162	516 620	79.2	80.0	80.7
Winnipeg	10 696	12 649	13 024	8 690	9 770	10 435	2 006	2 879	2 589	18.8	22.8	19.9
Eastern Lake Winnipeg	4 430	3 779	4 803	4 430	3 779	4 803	0	0	0	0.0	0.0	0.0
Western Lake Winnipeg	24 662	25 456	29 318	20 650	20 205	24 616	4 012	5 251	4 702	16.3	20.6	16.0
Grass and Burntwood	18 234	19 833	17 841	2 107	3 330	3 447	16 127	16 503	14 394	88.4	83.2	80.7
Nelson	7 457	9 856	10 773	7 457	8 716	10 773	0	1 140	0	0.0	11.6	0.0
Reindeer	573	929	1 142	573	929	1 142	0	0	0	0.0	0.0	0.0
Central Churchill (Man.) - Lower	5 724	4 015	4 462	3 637	3 181	3 158	2 087	834	1 304	36.5	20.8	29.2
Lower Churchill (Man.)	1 441	1 179	963	1 441	1 179	963	0	0	0	0.0	0.0	0.0
Seal - Coast	242	233	316	242	233	316	0	0	0	0.0	0.0	0.0
Total	1 026 241	1 091 942	1 119 583	295 582	304 767	314 262	730 659	787 175	805 321	71.2	72.1	71.9
Saskatchewan												
Upper South Saskatchewan	652	451	582	652	451	582	0	0	0	0.0	0.0	0.0
Red Deer	71	4	50	71	4	50	0	0	0	0.0	0.0	0.0
Central North Saskatchewan	42 945	43 519	44 183	20 526	18 394	20 208	22 419	25 125	23 975	52.2	57.7	54.3
Battle	7 054	7 106	6 899	5 844	6 245	5 917	1 210	861	982	17.2	12.1	14.2
Lower North Saskatchewan	95 063	94 457	92 619	48 340	42 591	40 233	46 723	51 866	52 386	49.1	54.9	56.6
Lower South Saskatchewan	247 581	277 064	289 707	63 735	56 679	58 872	183 846	220 385	230 835	74.3	79.5	79.7
Qu'Appelle	323 503	330 068	317 601	101 871	91 042	78 785	221 632	239 026	238 816	68.5	72.4	75.2
Saskatchewan	48 814	45 364	44 031	31 234	30 915	29 835	17 580	14 449	14 196	36.0	31.9	32.2
Lake Winnipegosis and Lake Manitoba	18 349	15 797	14 388	14 964	12 838	11 603	3 385	2 959	2 785	18.4	18.7	19.4
Assiniboine	77 599	70 605	62 979	42 241	34 985	30 152	35 358	35 620	32 827	45.6	50.4	52.1
Souris	59 354	57 080	53 072	36 337	32 787	28 707	23 017	24 293	24 365	38.8	42.6	45.9
Beaver (Alta.-Sask.)	18 694	19 909	22 071	14 837	14 618	17 489	3 857	5 291	4 582	20.6	26.6	20.8
Upper Churchill (Man.)	6 794	7 072	8 203	5 162	7 072	8 203	1 632	0	0	24.0	0.0	0.0
Central Churchill (Man.) - Upper	6 568	8 010	10 427	6 568	5 432	7 140	0	2 578	3 287	0.0	32.2	31.5
Reindeer	881	1 567	2 017	881	1 567	2 017	0	0	0	0.0	0.0	0.0
Central Churchill (Man.) - Lower	758	770	1 092	758	770	1 092	0	0	0	0.0	0.0	0.0
Central Athabasca - Lower	17	41	24	17	41	24	0	0	0	0.0	0.0	0.0
Fond-du-Lac	856	1 701	1 946	856	1 701	1 946	0	0	0	0.0	0.0	0.0
Lake Athabasca - Shores	3 290	242	187	783	242	187	2 507	0	0	76.2	0.0	0.0
Missouri	9 470	8 101	6 855	9 470	7 157	6 855	0	944	0	0.0	11.7	0.0
Total	968 313	988 928	978 933	405 147	365 531	349 897	563 166	623 397	629 036	58.2	63.0	64.3
Alberta												
Upper South Saskatchewan	193 205	209 242	232 499	55 464	56 453	60 872	137 741	152 789	171 627	71.3	73.0	73.8
Bow	670 162	805 825	1 024 550	38 617	43 626	57 920	631 545	762 199	966 630	94.2	94.6	94.3
Red Deer	167 549	188 285	223 791	82 460	85 302	95 953	85 089	102 983	127 838	50.8	54.7	57.1
Upper North Saskatchewan	295 406	303 688	345 670	39 806	38 425	43 439	255 600	265 263	302 231	86.5	87.3	87.4
Central North Saskatchewan	533 508	639 621	702 226	106 973	105 091	107 360	426 535	534 530	594 866	79.9	83.6	84.7
Battle	100 597	99 182	111 186	54 552	47 646	54 468	46 045	51 536	56 718	45.8	52.0	51.0
Lower North Saskatchewan	7 438	8 167	7 229	5 793	6 391	5 249	1 645	1 776	1 980	22.1	21.7	27.4
Lower South Saskatchewan	434	391	343	434	391	343	0	0	0	0.0	0.0	0.0
Beaver (Alta.-Sask.)	27 656	32 587	35 816	13 773	15 697	18 327	13 883	16 890	17 489	50.2	51.8	48.8
Upper Athabasca	34 185	37 479	40 805	8 660	8 463	9 958	25 525	29 016	30 847	74.7	77.4	75.6
Central Athabasca - Upper	50 446	53 530	57 292	32 068	34 420	34 277	18 378	19 110	23 015	36.4	35.7	40.2
Central Athabasca - Lower	32 610	26 977	35 484	8 587	7 324	10 727	24 023	19 653	24 757	73.7	72.9	69.8

Table B.6
Rural and urban population by provincial and territorial sub-drainage area, 1981, 1991 and 2001 (continued)

Province/Territory and sub-drainage area	Total population			Rural population			Urban population			Urban population as a share of total		
	1981	1991	2001	1981	1991	2001	1981	1991	2001	1981	1991	2001
	persons						%					
Lower Athabasca	9 088	18 115	17 310	104	513	599	8 984	17 602	16 711	98.9	97.2	96.5
Upper Peace	21 716	22 607	21 006	12 733	13 955	12 969	8 983	8 652	8 037	41.4	38.3	38.3
Smoky	61 186	65 285	78 080	25 322	23 419	25 540	35 864	41 866	52 540	58.6	64.1	67.3
Central Peace - Upper	15 180	12 550	14 607	9 669	8 371	9 587	5 511	4 179	5 020	36.3	33.3	34.4
Central Peace - Lower	10 289	14 850	19 294	8 095	12 001	14 440	2 194	2 849	4 854	21.3	19.2	25.2
Lower Peace	822	1 233	1 623	822	1 233	1 623	0	0	0	0.0	0.0	0.0
Lake Athabasca - Shores	944	1 008	1 106	944	1 008	1 106	0	0	0	0.0	0.0	0.0
Slave	27	30	21	27	30	21	0	0	0	0.0	0.0	0.0
Hay	1 874	2 536	2 383	1 874	2 536	2 383	0	0	0	0.0	0.0	0.0
Central Liard - Petitot		23	0	0	23	0	0	0	0	0.0	0.0	0.0
Missouri	3 402	2 342	2 486	3 402	2 342	2 486	0	0	0	0.0	0.0	0.0
Total	2 237 724	2 545 553	2 974 807	510 179	514 660	569 647	1 727 545	2 030 893	2 405 160	77.2	79.8	80.9
British Columbia												
Williston Lake	7 441	7 464	6 223	1 644	1 900	1 267	5 797	5 564	4 956	77.9	74.5	79.6
Upper Peace	49 542	52 099	54 428	21 725	19 506	23 228	27 817	32 593	31 200	56.1	62.6	57.3
Smoky		290	153	0	290	153	0	0	0	0.0	0.0	0.0
Hay	473	251		473	251		0	0	0	0.0	0.0	0.0
Northern Coastal Waters of B.C.		38		0	38		0	0	0	0.0	0.0	0.0
Stikine - Coast	610	875	912	610	875	912	0	0	0	0.0	0.0	0.0
Nass - Coast	3 628	2 950	2 587	3 628	2 950	2 587	0	0	0	0.0	0.0	0.0
Skeena - Coast	59 264	60 695	60 688	24 003	20 628	20 965	35 261	40 067	39 723	59.5	66.0	65.5
Central Coastal Waters of B.C.	18 242	17 226	16 280	5 780	6 433	6 047	12 462	10 793	10 233	68.3	62.7	62.9
Southern Coastal Waters of B.C.	473 827	531 144	620 090	28 796	29 050	25 311	445 031	502 094	594 779	93.9	94.5	95.9
Vancouver Island	496 692	590 844	665 695	128 239	146 691	136 674	368 453	444 153	529 021	74.2	75.2	79.5
Nechako	59 565	59 877	63 123	21 654	22 234	22 023	37 911	37 643	41 100	63.6	62.9	65.1
Upper Fraser	68 559	70 244	76 008	27 789	27 203	29 414	40 770	43 041	46 594	59.5	61.3	61.3
Thompson	143 162	149 300	172 640	64 667	60 967	65 358	78 495	88 333	107 282	54.8	59.2	62.1
Lower Fraser	1 008 559	1 347 658	1 712 430	131 958	149 007	119 605	876 601	1 198 651	1 592 825	86.9	88.9	93.0
Columbia - U.S.A.	341 572	378 996	444 638	134 482	145 593	136 686	207 090	233 403	307 952	60.6	61.6	69.3
Queen Charlotte Islands	5 621	5 316	4 935	5 621	5 316	4 935	0	0	0	0.0	0.0	0.0
Skagit	992	83	169	992	83	169	0	0	0	0.0	0.0	0.0
Headwaters Yukon	402	479	578	402	479	578	0	0	0	0.0	0.0	0.0
Upper Liard	1 691	1 435	379	1 691	1 435	379	0	0	0	0.0	0.0	0.0
Central Liard	40	137	141	40	137	141	0	0	0	0.0	0.0	0.0
Fort Nelson	4 585	4 660	5 641	861	856	1 453	3 724	3 804	4 188	81.2	81.6	74.2
Total	2 744 467	3 282 061	3 907 738	605 055	641 922	597 885	2 139 412	2 640 139	3 309 853	78.0	80.4	84.7
Yukon Territory												
Alsek	367	651	634	367	651	634	0	0	0	0.0	0.0	0.0
Headwaters Yukon	16 898	21 462	22 900	2 084	5 127	6 057	14 814	16 335	16 843	87.7	76.1	73.6
Pelly	2 152	1 772	988	2 152	1 772	988	0	0	0	0.0	0.0	0.0
Upper Yukon	396	292	247	396	292	247	0	0	0	0.0	0.0	0.0
Stewart	934	535	450	934	535	450	0	0	0	0.0	0.0	0.0
Central Yukon	916	1 487	1 679	916	1 487	1 679	0	0	0	0.0	0.0	0.0
Porcupine	243	256	299	243	256	299	0	0	0	0.0	0.0	0.0
Upper Liard	1 247	1 334	1 406	1 247	1 334	1 406	0	0	0	0.0	0.0	0.0
Peel and Southwestern Beaufort Sea	0	8	71	0	8	71	0	0	0	0.0	0.0	0.0
Total	23 153	27 797	28 674	8 339	11 462	11 831	14 814	16 335	16 843	64.0	58.8	58.7
Northwest Territories												
Thelon	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0
Chesterfield Inlet	954	1 186	...	954	1 186	...	0	0	...	0.0	0.0	...
Western Hudson Bay - Central	2 568	3 580	...	2 568	3 580	...	0	0	...	0.0	0.0	...
Western Hudson Bay - Northern	24	0	0	24	0	0	0	0	0	0.0	0.0	0.0
Hudson Bay - Southampton Island	812	1 104	...	812	1 104	...	0	0	...	0.0	0.0	...
Foxe Basin - Melville Peninsula	1 447	1 950	...	1 447	1 950	...	0	0	...	0.0	0.0	...
Foxe Basin - Baffin Island	78	47	...	78	47	...	0	0	...	0.0	0.0	...
Hudson Strait - Baffin and Southampton Islands	1 089	1 402	...	1 089	1 402	...	0	0	...	0.0	0.0	...
Slave	2 298	2 484	2 185	0	2 484	2 185	2 298	0	0	100.0	0.0	0.0
Hay	2 957	3 518	3 561	94	849	669	2 863	2 669	2 892	96.8	75.9	81.2
Southern Great Slave Lake	2 341	717	809	480	717	809	1 861	0	0	79.5	0.0	0.0
Great Slave Lake - East Arm South Shore	253	296	248	253	296	248	0	0	0	0.0	0.0	0.0
Northeastern Great Slave Lake	10 856	17 164	18 195	1 373	5 304	2 140	9 483	11 860	16 055	87.4	69.1	88.2

Table B.6
Rural and urban population by provincial and territorial sub-drainage area, 1981, 1991 and 2001 (continued)

Province/Territory and sub-drainage area	Total population			Rural population			Urban population			Urban population as a share of total		
	1981	1991	2001	1981	1991	2001	1981	1991	2001	1981	1991	2001
	persons						%					
Marian	268	392	453	268	392	453	0	0	0	0.0	0.0	0.0
Western Great Slave Lake	406	39	261	406	39	261	0	0	0	0.0	0.0	0.0
Lower Liard	844	570	988	844	570	988	0	0	0	0.0	0.0	0.0
Upper Mackenzie - Mills Lake	733	760	873	733	760	873	0	0	0	0.0	0.0	0.0
Upper Mackenzie - Camsell Bend	980	1 189	812	980	1 189	812	0	0	0	0.0	0.0	0.0
Central Mackenzie - Blackwater Lake	438	549	638	438	549	638	0	0	0	0.0	0.0	0.0
Great Bear	818	803	810	818	803	810	0	0	0	0.0	0.0	0.0
Central Mackenzie - The Ramparts	420	644	666	420	644	666	0	0	0	0.0	0.0	0.0
Lower Mackenzie	3 730	3 952	3 638	583	774	754	3 147	3 178	2 884	84.4	80.4	79.3
Peel and Southwestern Beaufort Sea	1 353	1 560	1 393	1 353	1 560	1 393	0	0	0	0.0	0.0	0.0
Southern Beaufort Sea	829	1 029	1 032	829	1 029	1 032	0	0	0	0.0	0.0	0.0
Amundsen Gulf	624	255	286	624	255	286	0	0	0	0.0	0.0	0.0
Coppermine	371	0	0	371	0	0	0	0	0	0.0	0.0	0.0
Coronation Gulf - Queen Maud Gulf	86	1 130	...	86	1 130	...	0	0	...	0.0	0.0	...
Back	0	0	...	0	0	...	0	0	...	0.0	0.0	...
Gulf of Boothia	688	989	...	688	989	...	0	0	...	0.0	0.0	...
Southern Arctic Islands	1 832	2 494	512	1 832	2 494	512	0	0	0	0.0	0.0	0.0
Baffin Island - Arctic Drainage	5 334	7 545	...	3 001	4 095	...	2 333	3 450	...	43.7	45.7	...
Northern Arctic Islands	310	301	...	310	301	...	0	0	...	0.0	0.0	...
Total	45 741	57 649	37 360	23 756	36 492	15 529	21 985	21 157	21 831	48.1	36.7	58.4
Nunavut												
Chesterfield Inlet	...	...	1 507	...	...	1 507	...	...	0	...	...	0.0
Western Hudson Bay - Central	...	...	4 726	...	...	2 549	...	...	2 177	...	...	46.1
Hudson Bay - Southampton Island	...	...	1 396	...	...	1 396	...	...	0	...	...	0.0
Foxe Basin - Melville Peninsula	...	...	2 507	...	...	2 507	...	...	0	...	...	0.0
Foxe Basin - Baffin Island	...	...	0	...	...	0	...	...	0	...	...	0.0
Hudson Strait - Baffin and Southampton Islands	...	...	1 581	...	...	1 581	...	...	0	...	...	0.0
Great Bear	...	...	0	...	...	0	...	...	0	...	...	0.0
Amundsen Gulf	...	...	1 212	...	...	1 212	...	...	0	...	...	0.0
Coronation Gulf - Queen Maud Gulf	...	...	10	...	...	10	...	...	0	...	...	0.0
Back	...	...	0	...	...	0	...	...	0	...	...	0.0
Gulf of Boothia	...	...	1 325	...	...	1 325	...	...	0	...	...	0.0
Southern Arctic Islands	...	...	2 269	...	...	2 269	...	...	0	...	...	0.0
Baffin Island - Arctic Drainage	...	...	9 759	...	...	3 247	...	...	6 512	...	...	66.7
Northern Arctic Islands	...	...	453	...	...	453	...	...	0	...	...	0.0
Total	...	...	26 745	...	...	18 056	...	...	8 689	...	...	32.5
Canada	24 343 181	27 296 859	30 007 094	5 907 254	6 389 985	6 098 883	18 435 927	20 906 874	23 908 211	75.7	76.6	79.7

Notes:

See Map A.3 and Table A.2 for classification codes and area figures for these sub-drainage areas.

The population figures presented here are not adjusted for net undercoverage and non-permanent residents.

Sources:

Statistics Canada, Environment Accounts and Statistics Division, Spatial Environmental Information System and Censuses of Population, 1981, 1991 and 2001.

Economy

Since 1961, there has been a shift away from resource-based industries to service-based industries. Between 1961 and 2000, the share of GDP held by the business and personal services industry almost doubled, from 8% in 1961 to 15% in 2000 (Table B.7).

Employment shows a similar picture, with employment in the agricultural, forest and metal and mineral products industries dropping from 23% in 1961 to 9% in 2002, while employment in the business and personal services industry increased from 11% in 1961 to 29% in 2002 (Table B.8)

Table B.9 outlines the changes in the composition of exports and imports over time. In 1961, the agricultural, forest, and metal and mineral products industries accounted for 63% of total exports. By 2000, these industries accounted for only a quarter of total exports. In contrast, the fuel and energy industry increased from 4% to 11%, while the transportation equipment industry increased its share from 2% to 23%.

Table B.7
Gross domestic product by industry, 1961 to 2000, selected years

Industry ¹	1961	1966	1971	1976	1981	1986	1991	1996	2000
	%								
Agricultural products ²	8.6	9.1	6.6	6.5	5.9	5.5	4.8	4.6	3.8
Forest products ²	4.8	4.3	3.5	3.6	3.7	3.5	2.7	3.9	3.8
Metal and mineral products ²	7.2	7.3	6.2	5.4	5.1	4.1	3.4	3.6	3.9
Fuel and energy ²	5.1	4.7	5.0	6.7	8.7	7.8	6.6	7.4	8.5
Chemicals and chemical products	2.2	2.2	1.8	1.5	1.7	1.8	1.7	2.0	1.6
Textiles, fabrics and clothing	1.9	1.8	1.5	1.3	1.2	1.0	0.8	0.7	0.8
Electrical and electronic products	1.7	2.0	1.7	1.5	1.4	1.3	1.2	1.2	1.6
Machinery and equipment	1.2	1.6	1.2	1.2	1.4	1.1	0.9	1.2	1.4
Transportation equipment	1.8	2.4	2.6	2.1	1.7	2.2	2.0	2.8	3.4
Miscellaneous goods	1.0	1.0	1.0	1.0	1.1	1.2	1.1	1.3	1.6
Construction	7.5	7.6	7.4	8.3	7.7	6.1	6.3	5.0	5.0
Transportation and communications	9.2	8.7	8.4	7.7	7.4	7.5	6.9	6.7	6.9
Distributive trades	12.0	11.4	11.6	11.4	10.4	11.2	11.0	10.4	10.2
Finance and insurance	8.3	7.9	8.6	8.1	5.0	5.8	6.1	6.7	6.9
Real estate	6.0	5.4	5.9	5.4	9.5	10.4	12.1	12.0	10.7
Business and personal services	7.8	8.2	9.1	9.7	10.4	11.3	12.8	13.1	14.5
Government services	12.9	13.8	17.1	17.9	17.0	17.1	18.5	16.4	14.4
Other services	0.7	0.6	0.7	0.7	0.8	0.9	1.1	1.2	1.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Notes:

1. The industry groupings in this table are a special aggregation based on the 1997 North American Industry Classification System (NAICS).

2. Includes both extraction and downstream manufacturing industries.

Sources:

Statistics Canada, Input-Output Division and Environment Accounts and Statistics Division.

Table B.8
Employment by industry, 1961 to 2002, selected years

Industry ¹	1961	1971	1981	1991	2001	2002
	%					
Agricultural products ²	14.0	9.0	6.8	5.7	4.0	4.0
Forest products ²	4.2	3.6	3.4	2.7	2.4	2.2
Metal and mineral products ²	4.8	4.7	3.7	2.6	2.5	2.4
Fuel and energy ²	1.2	1.2	1.7	1.5	1.5	1.5
Chemicals and chemical products	1.6	1.5	1.2	1.0	0.8	0.8
Textiles, fabrics and clothing	3.3	2.6	1.9	1.3	1.0	1.0
Electrical and electronic products	1.7	1.8	1.3	1.0	0.8	0.8
Machinery and equipment	1.1	1.2	1.3	0.9	1.0	1.0
Transportation equipment	1.6	2.0	1.7	1.6	1.5	1.5
Miscellaneous goods	1.3	1.4	1.4	1.4	1.7	1.7
Construction	9.1	8.3	7.1	6.6	6.0	6.1
Transportation and communications	8.1	7.1	6.7	6.2	6.5	6.4
Distributive trades	15.3	16.2	17.0	17.5	16.3	16.4
Finance and insurance	3.4	4.1	4.8	4.9	6.2	6.3
Real estate	0.0	0.0	0.6	0.8	0.7	0.7
Business and personal services	11.0	13.6	17.2	21.2	28.2	28.5
Government services	16.7	20.5	20.4	20.9	16.4	16.3
Other services	1.4	1.2	1.8	2.2	2.6	2.5
Total	100.0	100.0	100.0	100.0	100.0	100.0

Notes:

1. The industry groupings in this table are a special aggregation based on the 1997 North American Industry Classification System (NAICS).

2. Includes both extraction and downstream manufacturing industries.

Sources:

Statistics Canada, Input-Output Division and Environment Accounts and Statistics Division.

Table B.9
Exports and imports by commodity group, 1961 to 2000, selected years

Commodity group ¹	Exports					Imports				
	1961	1971	1981	1991	2000	1961	1971	1981	1991	2000
	% of total exports					% of total imports				
Agricultural products ²	17.1	10.3	10.9	7.3	5.7	12.5	8.0	7.2	6.5	5.1
Forest products ²	21.7	13.9	12.7	11.3	10.4	4.0	3.3	2.9	3.7	3.5
Metal and mineral products ²	24.3	17.1	16.8	12.8	8.4	12.0	10.2	11.8	8.0	8.9
Fuel and energy ²	3.8	6.3	11.0	8.1	11.0	7.9	5.9	10.9	4.5	4.8
Chemicals and chemical products	3.1	2.6	4.2	4.9	5.9	6.1	6.0	6.0	7.2	8.8
Textiles, fabrics and clothing	1.1	1.1	1.8	1.7	2.6	6.7	5.6	4.4	5.0	4.1
Electrical and electronic products	1.0	2.2	2.4	4.1	6.8	5.6	5.6	6.3	9.3	12.3
Machinery and equipment	2.7	4.0	5.5	5.6	5.9	14.3	15.6	15.4	14.0	14.6
Transportation equipment	2.3	21.4	16.7	21.7	23.4	11.7	21.9	20.0	21.3	22.0
Miscellaneous goods	0.2	0.5	0.6	0.8	2.1	2.2	1.9	2.5	3.5	3.3
Construction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transportation and communications	9.5	7.8	8.2	8.2	6.0	1.7	1.4	2.4	3.2	2.5
Distributive trades	1.9	2.7	2.4	3.6	3.4	0.1	0.4	0.2	0.2	0.2
Finance and insurance	0.9	0.8	1.2	2.4	1.6	1.3	1.9	1.9	3.4	3.0
Real estate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Business and personal services	1.0	1.4	4.3	6.1	6.7	2.0	2.7	6.4	8.1	6.9
Government services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unallocated imports and exports	9.5	7.9	1.3	1.3	0.0	11.9	9.8	1.6	1.9	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Notes:

For statistical reasons, it was impossible to allocate up to 10% of total exports and imports to the appropriate categories prior to 1981. The table therefore underestimates the trade in certain commodities before 1981.

1. The commodity groupings in this table are a special aggregation.

2. Includes both extraction and downstream manufacturing industries.

Sources:

Statistics Canada, Input-Output Division and Environment Accounts and Statistics Division.

Transportation

Ground, water and air transportation are essential to the economy. Bringing goods to market and getting people from place to place, transportation refers to the transport of goods and commercial passengers, as well as private transport.

Tables B.10 through B.13 outline the tonnage of goods transported by water, rail, truck and air transport. In 2001, 341 million tonnes of goods were transported by water compared to 330 million tonnes by rail and 288 million tonnes by truck. Truck transport has seen the largest increase since 1997, rising by 29%.

In 2002, 40.5 million passengers were transported by Canadian air transport carriers, an 11% decline since 2001 (Table B.13). Trains carried 4.2 million passengers in 2001 (Table B.11). Close to 57 thousand passenger buses were in use in 2001, 60% of which were used to transport students to school and employees to work. Urban transit vehicles made up a further 27% of passenger buses. Urban transit vehicles used half the diesel fuel consumed compared to 31% for school and employee buses (Table B.15).

Motor vehicle registration increased 6% from 1999 to 2002, to over 18.6 million vehicles. Vehicles weighing less than 4 500 kg made up 94% of all vehicles registered. Motorcycles and mopeds showed the largest increase in registration with 350 thousand registered in 2002 compared to 274 thousand in 1999 (Table B.14).

The majority (70%) of petroleum products used by the transportation industry were sold through retail pump sales. The road transport and urban transit industries used another 12% of petroleum products, compared to 10% by the airlines (Table B.16).

Table B.10
Water transport, 1988 to 2002

Year	Freight loaded		Freight unloaded		Net tonnage	Containerized freight		Movement of freight t-km [†]	Passengers transported by ferry passengers
	Domestic	International	Domestic	International		Domestic	International		
	t				millions				
1988	70.0	171.1	70.0	78.9	320.0	1.6	12.6	1 535 267	..
1989	62.0	159.1	62.0	80.3	301.4	1.4	12.1	1 440 267	38.7
1990	60.4	159.0	60.4	73.3	292.7	1.3	12.3	1 614 653	40.8
1991	57.9	168.0	57.9	66.1	292.0	0.8	12.2	1 708 444	40.4
1992	52.3	153.8	52.3	69.3	275.4	1.0	12.6	1 578 406	40.0
1993	50.4	152.6	50.4	71.6	274.6	0.9	13.3	1 561 381	41.2
1994	52.2	170.0	52.2	76.9	299.1	0.8	14.7	1 697 540	43.2
1995	50.4	176.5	50.4	83.2	310.1	0.8	15.6	1 775 601	42.0
1996	48.8	174.3	48.8	85.6	308.7	0.8	17.1	1 780 975	39.8
1997	46.7	187.9	46.7	94.7	329.3	1.0	18.8	1 967 331	38.2
1998	48.3	179.0	48.3	100.4	327.7	0.9	19.7	1 876 721	37.3
1999	52.2	179.6	52.2	101.6	333.4	0.9	22.5	1 881 478	39.2
2000	54.5	187.8	54.5	105.9	348.2	0.9	24.0	1 969 341	38.5
2001	53.9	174.7	53.9	112.1	340.7	0.9	23.5	1 873 113	39.0
2002	62.6	174.3	62.6	108.5	345.4	1.0	25.6	1 766 477	39.4

Note:

1. The movement of one tonne over a distance of one kilometre.

Sources:

Statistics Canada, *Shipping in Canada*, Catalogue no. 54-205-XIE, Ottawa, various issues.
Transport Canada, Surface and Marine Statistics and Forecasts.

Table B.11
Rail transport¹, 1997 to 2001

Year	Freight movement		Passenger movement		Locomotives	Passenger cars	Freight cars	Fuel consumed ⁴	Track operated
	t	t-km ²	passengers	passenger-km ³					
	millions					number		million L	km
1997	319.1	306 198	4.1	1 515	3 143	426	107 976	2 258	74 949
1998	325.2	298 797	4.0	1 458	3 142	430	105 676	2 129	73 360
1999	328.4	297 504	4.1	1 510	3 115	435	102 917	1 979	70 346
2000	348.8	319 769	4.2	1 533	2 956	464	102 200	1 989	72 201
2001	330.1	317 904	4.2	1 553	2 889	449	100 110	1 997	69 410

Notes:

1. Private railways, that transport goods solely for parent companies and do not operate on a for-hire basis, are excluded.

2. The movement of one tonne over a distance of one kilometre.

3. The movement of a passenger over a distance of one kilometre. Passenger-kilometres are derived by multiplying the number of passengers by the distance travelled.

4. Diesel and heavy fuel oil in 1997. Diesel only from 1998 to 2001.

Source:

Statistics Canada, *Rail in Canada*, Catalogue no. 52-216-XIE, Ottawa, various issues.

Table B.12
Truck transport, 1989 to 2001

Year	Freight carried		Shipments		
	t	t-km [†]	Number of shipments	Weight per shipment	Distance per shipment
	millions					kg
1989	189.6	77 383	34.9	5 431	621
1990	174.2	77 069	30.0	5 816	647
1991	150.6	70 048	29.1	5 178	648
1992	149.5	72 276	27.6	5 410	656
1993	173.4	83 968	27.9	6 208	659
1994	195.6	101 873	30.5	6 418	641
1995	210.9	109 434	32.3	6 523	685
1996	229.0	120 459	35.2	6 509	709
1997	223.3	130 141	32.0	6 962	792
1998	233.9	137 552	33.8	6 914	776
1999	269.3	158 104	36.4	7 396	771
2000	278.4	164 720	35.6	7 830	798
2001	288.0	170 569	36.9	7 800	795

Notes:

These figures pertain only to Canada-based for-hire trucking carriers.

1. The movement of one tonne over a distance of one kilometre.

Source:

Statistics Canada, *Trucking in Canada*, Catalogue no. 53-222-XIB, Ottawa, various issues.

Table B.13
Air transport, 1988 to 2002

Year	Freight carried		Passengers		
	weight	t-km ¹	passengers	passenger-km ²	
	t	millions			
1988	591 250	1 516	34.8	62 141	
1989	603 828	1 552	35.7	65 628	
1990	628 180	1 727	36.3	66 608	
1991	603 267	1 565	31.3	57 953	
1992	596 812	1 493	31.9	62 117	
1993	624 561	1 636	31.1	60 985	
1994	653 444	1 791	32.5	65 636	
1995	692 579	2 034	36.0	73 506	
1996	721 260	2 168	39.6	82 270	
1997	789 146	2 353	43.6	92 104	
1998	822 185	2 280	45.2	96 643	
1999	833 363	2 365	46.4	99 619	
2000	851 196	2 329	46.8	104 881	
2001	785 380	2 172	45.3	102 535	
2002	811 679	2 234	40.5	95 161	

Notes:

Figures include all Canadian carriers that earned more than 1 million dollars in revenue during each of the previous two years.

1. The movement of one tonne over a distance of one kilometre.

2. The movement of a passenger over a distance of one kilometre. Passenger-kilometres are derived by multiplying the number of passengers by distance travelled.

Source:

Statistics Canada, *Canadian Civil Aviation*, Catalogue no. 51-206-XIB, Ottawa, various issues.

Statistics Canada, Transportation Division.

Statistics Canada, *Service Bulletin, Aviation, Aviation Statistics Centre*, Catalogue no. 51-004-XIB, Vol. 36, No. 2, Ottawa.

Table B.14
Motor vehicle registrations, 1999 to 2002

Year	Road motor vehicles						Trailers	Off-road, construction and farm vehicles
	Vehicles weighing less than 4 500 kg	Vehicles weighing 4 500 to 14 999 kg	Vehicles weighing 15 000 kg or more	Buses	Motorcycles and mopeds	Total		
	thousands							
1999	16 538	387	262	73	274	17 534	4 145	1 957
2000	16 832 ^f	391 ^f	270 ^f	77 ^f	311 ^f	17 881	3 989 ^f	1 756 ^f
2001	17 055	387	267	74	318	18 102	4 023	1 302
2002	17 544	367	277	79	350	18 617	4 161	1 419

Note:

In 1999, Statistics Canada implemented a revised methodology for Motor Vehicle Registration Data in Canada. These data are not comparable with motor vehicle registrations prior to 1999.

Source:

Statistics Canada, CANSIM, table 405-0004.

Table B.15
Fuel consumption and number of vehicles by passenger bus and urban transit industries, 2001

Industry	Fuel consumed				Electricity thousand kw	Number of vehicles number
	Diesel	Gasoline	Propane	Natural gas		
	thousand L					
Urban transit systems	362 827	1 322	0	15 843	729 415	15 335
Interurban and rural bus transportation	64 551	52	0	0	0	1 704
School and employee bus transportation	225 630	9 011	7 235	544	234	34 075
Charter bus	46 294	146	0	0	9	2 527
Other transit - shuttle	14 872	1 159	2 631	0	0	2 150
Sight-seeing	3 054	154	0	0	0	181
Other ¹	22 474	0	0	0	23 266	799
Total	739 702	11 844	9 866	16 387	752 924	56 771

Note:

1. Comprised mostly of municipal transit operations that are part of municipal budgets rather than separate operating entities.

Source:

Statistics Canada, 2004, *Service Bulletin, Surface and Marine Transport*, Catalogue no. 50-0002-XIB, Vol. 20, No. 2, Ottawa.

Table B.16
Consumption of refined petroleum products¹ by transportation industry, 1990 to 2002

Year	Industry						Total
	Railways	Airlines ²	Marine ²	Road transport and urban transit	Retail pump sales	Pipelines ³	
	thousand m ³						
1990	2 313	4 078	2 640	4 419	32 541	16	46 007
1991	2 143	3 687	2 733	4 474	31 447	15	44 499
1992	2 241	3 921	2 711	4 657	32 067	12	45 608
1993	2 233	3 756	2 397	5 104	33 048	8	46 545
1994	2 310	4 015	2 574	5 979	34 208	30	49 116
1995	2 092	4 244	2 523	6 450	34 251	36	49 596
1996	2 046	4 941	2 480	6 690	34 849	57	51 062
1997	2 074	5 082	2 481	7 147	35 778	13	52 574
1998	1 999	5 227	2 919	7 197	36 817	24	54 182
1999	2 116	5 583	2 741	7 345	37 902	24	55 711
2000	2 169	5 634	2 801	7 175	38 101	21	55 901
2001	2 132	5 015	3 016	6 721	38 448	12	55 344
2002	1 934	5 299	2 718	6 871	38 665	11	55 497

Notes:

Figures may not add up to totals due to rounding.

1. Refined petroleum products refers to motor gasoline, diesel fuel oil, light fuel oil, heavy fuel oil, aviation gasoline and aviation turbo fuel.

2. Includes both domestic and foreign.

3. The volume used to operate and run the pumps at the pumping stations.

Source:

Statistics Canada, CANSIM, table 128-0003.

Natural resources

This section examines one of the main sources of impacts on the environment – natural resource consumption. This section looks at agriculture, fisheries, forestry, minerals and energy. The statistics presented here provide an indication as to the role that Canada's environment plays as a source of natural resources.

Agriculture

From 1941 to 2001, the number of farms decreased by 66%, from 732 832 to 246 923 farms (Table B.17). Figure B.1 illustrates that while the total area of agricultural land remained stable at 68 million hectares, the area of cropland increased to 36 million hectares. The average farm size increased from 50 hectares in 1901 to 273 hectares in 2001.

Figures B.2 and B.3 present the production of selected field crops and small grains, while figure B.4 presents livestock inventories.

Table B.17
Number of farms by province, 1871 to 2001, selected years

Year	N.L.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Total
	number										
1871	...	...	46 316	31 202	118 086	172 258	...	...	...	...	367 862
1881	...	13 629	55 873	36 837	137 863	206 989	9 077	1 014 ²	...	2 743	464 025
1891 ¹	...	14 549	60 122	38 577	174 996	216 195	22 008	9 244 ³	...	6 490	542 181
1901 ¹	...	13 748	54 478	37 006	140 110	204 054	32 252	13 445	9 479	6 501	511 073
1911 ¹	...	14 113	52 491	37 755	149 701	212 108	43 631 ⁴	95 013 ⁴	60 559 ⁴	16 958	682 329
1921	...	13 701	47 432	36 655	137 619	198 053	53 252 ⁴	119 451 ⁴	82 954 ⁴	21 973	711 090
1931	...	12 865	39 444	34 025	135 957	192 174	54 199	136 472	97 408	26 079	728 623
1941	...	12 230	32 977	31 889	154 669	178 204	58 024	138 713	99 732	26 394	732 832
1951	3 626	10 137	23 515	26 431	134 336	149 920	52 383	112 018	84 315	26 406	623 087
1961	1 752	7 335	12 518	11 786	95 777	121 333	43 306	93 924	73 212	19 934	480 877
1971	1 042	4 543	6 008	5 485	61 257	94 722	34 981	76 970	62 702	18 400	366 110
1981	679	3 154	5 045	4 063	48 144	82 448	29 442	67 318	58 056	20 012	318 361
1991	725	2 361	3 980	3 252	38 076	68 633	25 706	60 840	57 245	19 225	280 043
1996	742	2 217	4 453	3 405	35 991	67 520	24 383	56 995	59 007	21 835	276 548
2001	643	1 845	3 923	3 034	32 139	59 728	21 071	50 598	53 652	20 290	246 923

Notes:

1. Excludes plots under one acre, to attain comparability with data for later years.

2. Data comprise the portion of the Northwest Territories located west of Manitoba.

3. Data comprise the districts of Assiniboia, Saskatchewan and Alberta.

4. Data exclude farms located on Indian reserves.

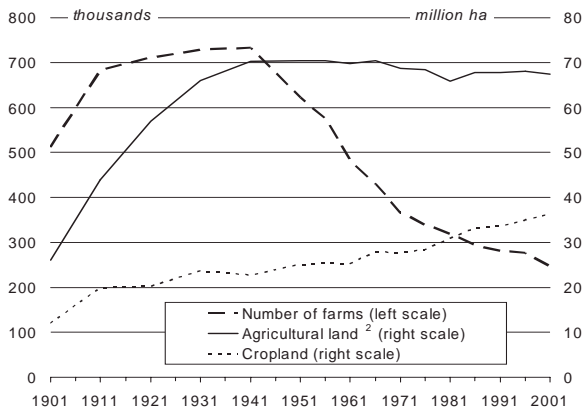
Sources:

Statistics Canada, 1983, *Historical Statistics of Canada, Second Edition*, F.H. Leacy (ed.), Catalogue no. 11-516-XPE, Ottawa.

Statistics Canada, 1997, *Historical Overview of Canadian Agriculture*, Catalogue no. 93-358-XPB, Ottawa.

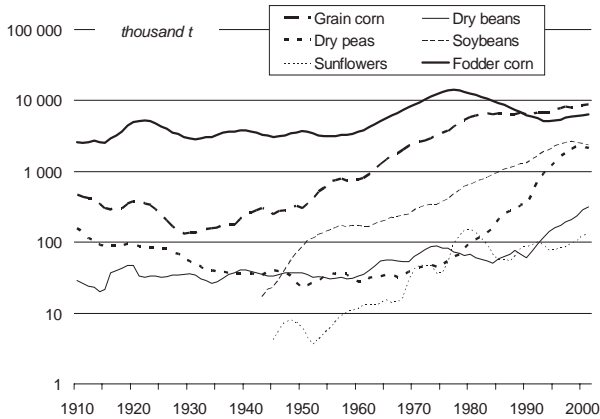
Statistics Canada, 2001, Census of Agriculture, www.statcan.ca/english/freepub/95F0301XIE/tables/html/Table3Can.htm (accessed May 18, 2004).

Figure B.1
Number of farms, agricultural land and cropland, 1901 to 2001¹



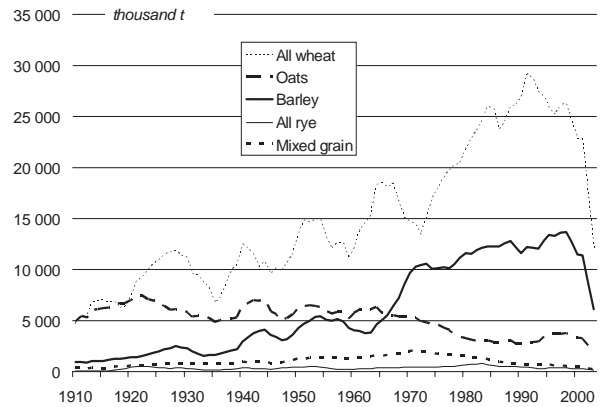
Notes:
 1. The definition of a census farm changed over the years, affecting the comparability of data among censuses.
 2. Data for 1901 and 1911 includes all improved land.
Sources:
 Statistics Canada, 1983, *Historical Statistics of Canada, Second Edition*, F.H. Leacy (ed.), Catalogue no. 11-516E, Ottawa.
 Statistics Canada, 1997, *Historical Overview of Canadian Agriculture*, Catalogue no. 93-358_XPB, Ottawa.
 Statistics Canada, *Canadian Statistics*, www.statcan.ca/english/Pgdb/econ124a.htm (accessed May 25, 2004).

Figure B.2
Selected field crop production, 1911 to 2001¹ (five-year averages)



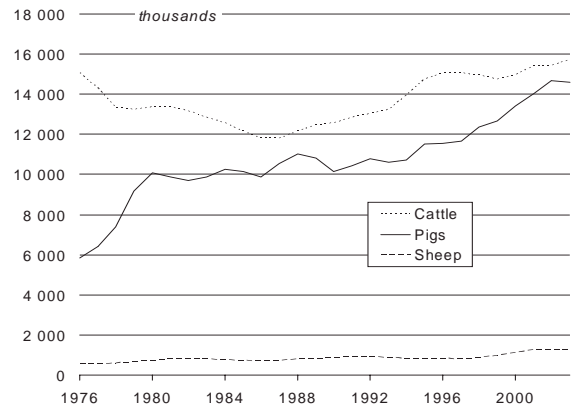
Note:
 1. Data from 1908 to 1911 are used to create the five-year averages.
Source:
 Statistics Canada, CANSIM, table 001-0010.

Figure B.3
Production of major small grains, 1911 to 2001¹ (five-year averages)



Note:
 1. Data from 1908 to 2003 are used to create the five-year averages.
Source:
 Statistics Canada, CANSIM, table 001-0010.

Figure B.4
Selected livestock populations, 1976 to 2002



Source:
 Statistics Canada, CANSIM, tables 003-0032, 003-0031 and 003-0004.

Fisheries

Despite declines in fish stocks during the last part of the twentieth century, Canadian fisheries continue to play an important role in communities in Atlantic Canada and British Columbia. Fishing industries contributed 0.2% or \$1.8 billion to total GDP in 2003 (Table B.18). Employment in the fishing industries declined to 0.36% of total employment in 2003, down from 0.56% in 1987 (Table B.19).

Exports and imports of fish and fish products are presented in Table B.20. Canada continues to be a net exporter of these products, with exports representing 1.25% of all exports, and imports accounting for 0.53% of total imports in 2003.

While the total catch of fish in 2003 is down compared to the early 1990s, the total value is up 48% from \$1.4 to over \$2.1 billion (Table B.21). Aquaculture production increased more than five-fold since 1989 with the value increasing from \$139 million to \$639 million in 2002 (Table B.22).

Table B.18
Gross domestic product of fishing industries, 1997 to 2003

Year	Total GDP	Fishing industries		Total	Share of total GDP %
		Fishing, hunting and trapping	Seafood product preparation and packaging		
\$ million chained 1997					
1997	816 756	847	721	1 568	0.19
1998	848 414	821	715	1 536	0.18
1999	896 069	807	843	1 650	0.18
2000	943 716	835	889	1 724	0.18
2001	961 140	869	850	1 719	0.18
2002	993 844	903	921	1 824	0.18
2003	1 012 975	842	926	1 768	0.17

Source:

Statistics Canada, CANSIM, table 379-0017.

Table B.19
Employment in the fishing industries, 1987 to 2003

Year	Total employment	Fishing industries			Total	Share of total employment %
		Fishing	Animal aquaculture	Seafood product preparation and packaging		
thousand persons						
1987	12 321	34.3	2.2	32.4	68.9	0.56
1988	12 710	37.5	1.6	35.9	75.0	0.59
1989	12 986	36.8	2.1	34.0	72.9	0.56
1990	13 084	37.5	2.5	31.1	71.1	0.54
1991	12 851	40.6	3.1	29.5	73.2	0.57
1992	12 760	35.1	3.3	29.0	67.4	0.53
1993	12 858	36.0	2.8	25.4	64.2	0.50
1994	13 112	34.8	2.5	24.9	62.2	0.47
1995	13 357	28.8	2.2	22.7	53.7	0.40
1996	13 463	30.1	3.1	20.6	53.8	0.40
1997	13 774	30.0	3.8	23.2	57.0	0.41
1998	14 140	30.5	2.4	23.0	55.9	0.40
1999	14 531	29.9	3.4	25.5	58.8	0.40
2000	14 910	30.2	4.8	24.1	59.1	0.40
2001	15 077	27.9	4.2	25.2	57.3	0.38
2002	15 412	27.3	3.4	29.6	60.3	0.39
2003	15 746	28.4	3.0	25.8	57.2	0.36

Source:

Statistics Canada, Labour Force Survey.

Table B.20
Exports and imports of fish and fish products, 1971 to 2003

Year	Exports			Imports		
	Total exports	Fish, fresh, frozen, preserved and canned	Share of total exports	Total imports	Fish and marine animals	Share of total imports
	\$ million		%	\$ million		%
1971	17 782	276	1.55	15 314	60	0.39
1972	20 222	340	1.68	18 272	81	0.44
1973	25 649	484	1.89	22 726	110	0.48
1974	32 738	418	1.28	30 903	119	0.38
1975	33 616	451	1.34	33 962	134	0.39
1976	38 166	590	1.54	36 608	182	0.50
1977	44 495	795	1.79	41 523	219	0.53
1978	53 361	1 111	2.08	49 048	248	0.51
1979	65 582	1 271	1.94	61 157	310	0.51
1980	76 681	1 265	1.65	67 903	355	0.52
1981	84 432	1 494	1.77	77 140	360	0.47
1982	84 393	1 591	1.89	66 739	352	0.53
1983	90 556	1 563	1.73	73 098	418	0.57
1984	111 330	1 595	1.43	91 493	488	0.53
1985	119 061	1 849	1.55	102 669	494	0.48
1986	125 172	2 580	2.06	115 195	613	0.53
1987	131 484	2 957	2.25	119 324	691	0.58
1988	143 534	2 818	1.96	132 715	679	0.51
1989	146 963	2 530	1.72	139 217	738	0.53
1990	152 056	2 817	1.85	141 000	679	0.48
1991	147 669	2 636	1.79	140 658	736	0.52
1992	163 464	2 736	1.67	154 430	777	0.50
1993	190 213	2 868	1.51	177 123	996	0.56
1994	228 167	3 259	1.43	207 873	1 126	0.54
1995	265 334	3 496	1.32	229 937	1 287	0.56
1996	280 079	3 444	1.23	237 689	1 470	0.62
1997	303 378	3 498	1.15	277 727	1 434	0.52
1998	327 162	3 665	1.12	303 399	1 636	0.54
1999	369 035	4 261	1.15	327 026	1 870	0.57
2000	429 372	4 561	1.06	362 337	1 929	0.53
2001	420 657	4 722	1.12	350 682	1 645	0.47
2002	413 795	5 236	1.27	356 581	1 935	0.54
2003	400 010	4 981	1.25	341 833	1 811	0.53

Source:
Statistics Canada, CANSIM, table 228-0003.

Table B.21
Landed catch and value, 1990 to 2002

Year	Groundfish ¹		Pelagic fish ²		Shellfish ³		Total ⁴	
	Catch	Value	Catch	Value	Catch	Value	Catch	Value
	t (live weight)	\$ thousand	t (live weight)	\$ thousand	t (live weight)	\$ thousand	t (live weight)	\$ thousand
1990	791 276	474 251	559 741	422 607	251 498	519 831	1 645 909	1 433 625
1991	791 620	499 530	429 975	292 995	251 368	583 448	1 509 032	1 394 200
1992	630 122	415 092	389 712	314 912	269 751	649 930	1 322 206	1 400 322
1993	431 413	297 818	419 620	364 165	288 999	732 220	1 164 880	1 424 056
1994	332 767	252 388	350 690	402 280	318 258	1 012 237	1 034 177	1 699 372
1995	218 652	229 018	301 952	242 071	310 369	1 275 569	860 650	1 782 957
1996	277 991	230 190	311 542	265 716	313 053	1 028 868	933 178	1 565 642
1997	268 690	261 374	323 866	241 734	351 931	1 090 091	985 273	1 634 285
1998	287 207	292 497	327 252	159 610	372 511	1 135 795	1 019 447	1 610 678
1999	300 995	332 471	302 357	143 018	399 829	1 423 569	1 039 219	1 924 589
2000	227 309	311 058	294 178	167 429	434 129	1 562 164	973 890	2 061 194
2001 ^P	273 555	297 923	306 890	168 703	448 603	1 639 071	1 066 689	2 131 687
2002 ^P	257 217	287 692	312 655	184 827	469 840	1 646 412	1 059 126	2 153 854

Notes:

1. Species that are usually caught near the ocean bottom, including cod, haddock, pollock, redfish, halibut, flounder, and many others.

2. The pelagic species live in midwater or close to the surface. They include herring, capelin, swordfish, tuna, and many others.

3. Aquatic shelled molluscs (e.g., oysters) and crustaceans (eg. crabs, shrimp).

4. Data do not add up because total also includes marine plants, lumpfish roe and miscellaneous other marine products.

Source:

Department of Fisheries and Oceans, Statistical Services, www.dfo-mpo.gc.ca/communic/statistics/commercial/landings/seafisheries/index_e.htm (accessed July 8, 2004).

Table B.22
Aquaculture production, 1989 to 2002

Year	Trout		Oysters		Salmon		Mussels		Total ¹	
	Weight	Value	Weight	Value	Weight	Value	Weight	Value	Weight	Value
	t	\$ thousand	t	\$ thousand	t	\$ thousand	t	\$ thousand	t	\$ thousand
1989	3 888	22 655	6 489	9 015	16 276	102 018	3 391	4 148	30 263	139 137
1990	4 677	26 714	6 774	8 462	21 167	155 059	3 598	3 964	36 462	195 955
1991	4 660	24 127	6 218	6 287	29 001	220 159	4 046	4 981	44 567	257 087
1992	5 424	27 824	6 107	6 477	30 020	218 281	4 964	5 860	46 885	259 957
1993	5 670	29 637	6 528	6 773	32 523	244 957	5 175	5 802	50 375	289 274
1994	6 000	33 468	7 767	9 133	32 426	244 337	6 898	7 645	53 582	296 678
1995	5 326	26 317	7 735	9 718	42 515	286 852	8 626	9 891	66 296	342 076
1996	5 654	28 940	7 946	11 340	45 502	290 116	9 832	11 936	71 191	353 343
1997	6 178	31 617	6 649	13 658	60 862	323 324	11 463	13 658	87 211	387 869
1998	8 316	41 072	8 137	11 321	58 618	349 043	15 018	18 985	91 411	429 507
1999	12 583	60 801	8 785	13 278	72 890	450 084	17 397	23 244	113 228	557 904
2000	11 930	56 549	9 624	16 515	82 195	483 755	21 287	27 213	127 234	600 372
2001	11 221	51 624	10 713	16 991	105 306	468 971	21 666	30 499	152 523	597 143
2002	9 114	44 013	11 520	14 876	132 021	520 736	20 540	31 341	176 696	639 035

Note:

1. Data do not add up because total also includes char, cod, clams and scallops.

Source:

Department of Fisheries and Oceans, Statistical Services, www.dfo-mpo.gc.ca/communic/statistics/aqua/index_e.htm (accessed July 8, 2004).

Forestry

Production of forest products has increased steadily since 1922 (Table B.23). Pulpwood production has decreased since the mid-eighties, falling from 40 million m³ to 23 million m³ (Table B.23). The production of logs and bolts has followed an upward trend for several decades, but suffered a decline in 2001 to 156 million m³. Gross domestic product of forest products industries reached \$26 billion in 2003, accounting for 2.5% of total GDP (Table B.24).

In 2002 and 2003, employment in the forest products industries was significantly lower compared to previous years (Table B.25). A major contributor to this decrease was the softwood lumber dispute with the United States, which particularly affected employment in British Columbia.

Although the value of forest products exports followed an upward trend from 1978 to 2000, they declined from \$44 billion in 2000 to \$35 billion in 2003. Forest products' share of total exports has also declined, from 17.9% in 1978 to a low of 9.2% in 2003 (Table B.26).

Table B.23
Production of selected forest products, 1922 to 2001, selected years

Year	Logs and bolts ¹	Pulpwood	Sawn lumber
	thousand m ³		
1922	19 082	11 779	..
1925	24 092	15 286	..
1930	29 142	17 942	..
1935	17 721	18 296	..
1940	32 639	26 165	..
1945	30 610	32 938	..
1950	40 112	40 296	14 512
1955	44 282	48 292	18 598
1960	51 141	42 307	18 829
1965	62 643	42 607	23 745
1970	75 645	40 553	26 401
1975	73 542 ²	37 270 ^f	26 645
1980	109 952	38 909	44 597
1985	119 317 ^f	40 620 ^f	54 587
1990	118 950 ^f	35 876 ²	54 544
1995	150 150 ^f	30 926 ³	62 577
2000	165 135 ^f	28 404 ^f	x
2001	155 902 ^f	23 192 ^f	74 517

Notes:

1. Logs are defined as the stem of a tree after it has been felled; the raw material from which lumber, plywood, and other wood products are processed. Bolts are defined as raw material used in the manufacture of shingles and shakes; short logs to be sawn for lumber or peeled for veneer.

2. Estimated by provincial or territorial forestry agency.

3. Estimated by the Canadian Forest Service or by Statistics Canada.

Sources:

Statistics Canada, 1983, *Historical Statistics of Canada, Second Edition*, F.H. Leacy (ed.), Catalogue no. 11-516-XPE, Ottawa.

Canadian Council of Forest Ministers, National Forestry Database Program, nfdp.ccfm.org (accessed December 8, 2003).

Statistics Canada, CANSIM, table 303-0009.

Table B.24
Gross domestic product of forest products industries, 1997 to 2003

Year	Industries					Industries as share of total GDP				
	Forestry and logging	Sawmills and wood preservation	Other wood product manufacturing	Pulp, paper and paperboard mills	Total	Forestry and logging	Sawmills and wood preservation	Other wood product manufacturing	Pulp, paper and paperboard mills	Total
	\$ million chained 1997					%				
1997	5 564	6 240	1 554	8 294	21 652	0.68	0.76	0.19	1.02	2.65
1998	5 641	6 562	1 588	7 893	21 684	0.66	0.77	0.19	0.93	2.56
1999	5 849	6 688	1 841	8 890	23 268	0.65	0.75	0.21	0.99	2.60
2000	6 201	7 377	2 183	9 438	25 199	0.66	0.78	0.23	1.00	2.67
2001	5 882	7 139	2 116	8 831	23 968	0.61	0.74	0.22	0.92	2.49
2002	5 786	7 608	2 490	9 028	24 912	0.58	0.77	0.25	0.91	2.51
2003	5 955	7 800	2 691	9 061	25 507	0.59	0.77	0.27	0.89	2.52

Source:
 Statistics Canada, CANSIM, table 379-0017.

Table B.25
Employment in forest products industries¹ by province and territory, 1991 to 2003

Year	N.L.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Y.T., N.W.T. and Nvt.	Canada
1991	1 456	.	3 766	14 831	65 168	42 018	1 704	860	9 003	74 402	.	218 480
1992	1 471	.	3 634	13 226	58 029	40 130	1 491	976	8 586	69 401	.	202 215
1993	1 448	.	3 625	13 423	57 788	39 462	1 656	1 167	10 478	69 590	.	204 053
1994	1 908	.	4 650	12 805	59 942	40 031	2 235	1 359	10 144	74 324	.	213 819
1995	2 116	.	3 957	13 722	62 321	39 881	2 304	1 502	10 918	71 274	.	214 688
1996	2 004	.	4 024	13 691	63 044	39 608	2 247	1 338	12 391	73 087	.	218 358
1997	2 305	.	4 451	14 237	66 734	43 000	2 409	1 620	12 759	70 836	.	225 356
1998	1 863	.	4 511	14 725	66 508	43 348	2 744	2 017	13 518	65 662	.	221 511
1999	1 639	.	4 447	14 636	67 666	44 379	2 958	1 787	14 395	69 431	.	228 248
2000	1 730	.	4 867	16 553	72 222	45 495	3 385	1 559	13 452	72 531	.	238 707
2001	1 729	.	4 099	15 727	67 715	44 971	3 861	1 556	13 454	62 584	.	222 244
2002	1 667	.	3 586	15 238	62 761	42 638	x	1 407	12 766	51 247	.	201 461
2003	x	.	3 385	x	63 264	39 512	x	1 180	11 790	49 790	.	196 828

Notes:
 Data do not add up to Canada total because of unavailable data for some provinces or territories.
 1. Includes the following industries: forestry and logging; pulp, paper and paperboard mills; sawmills and wood preservation; and other wood product manufacturing.
 Source:
 Statistics Canada, CANSIM, table 281-0024.

Table B.26
Export of forest products, 1978 to 2003

Year	Pulpwood	Pulpwood chips	Other crude wood products	Lumber	Veneer and plywood	Wood pulp and similar pulp	Paper and paperboard	Shingles and shakes	Other ¹	Total	Total as share of
											Canadian exports
\$ million											
%											
1978	14.4	48.9	52.9	3 228.9	211.6	2 180.9	3 459.5	185.7	166.1	9 534.5	17.9
1979	15.0	53.5	77.3	3 901.2	248.0	3 083.3	3 984.5	191.6	212.3	11 751.7	17.9
1980	26.0	90.9	88.5	3 353.2	236.7	3 873.0	4 630.5	178.8	191.7	12 643.3	16.6
1981	24.7	97.7	76.7	2 989.2	221.2	3 818.7	5 216.9	169.7	213.1	12 803.2	15.3
1982	8.2	97.9	119.5	2 912.7	214.8	3 221.4	5 008.2	157.5	202.8	11 934.7	14.1
1983	11.5	89.3	173.9	3 964.5	257.0	3 048.7	4 985.8	231.1	289.5	13 039.8	14.4
1984	10.6	85.4	262.0	4 257.1	269.9	3 906.5	6 054.2	264.5	406.4	15 506.0	13.8
1985	8.4	83.2	201.7	4 594.9	246.5	3 405.5	6 700.6	257.4	480.8	15 970.6	13.4
1986	12.4	76.8	227.6	4 980.3	237.5	4 072.1	7 213.2	268.3	520.1	17 595.9	14.6
1987	21.6	73.4	368.0	5 858.6	265.9	5 473.0	7 963.1	217.4	604.8	20 824.4	16.6
1988	30.4	94.5	344.8	5 415.1	289.1	6 495.8	8 688.9	211.2	581.7	22 121.0	16.0
1989	21.5	164.7	246.6	5 516.1	286.4	6 940.3	8 249.0	214.8	554.1	22 171.9	16.0
1990	7.6	140.2	174.1	5 371.9	292.5	6 121.0	8 660.8	226.2	552.3	21 539.0	14.5
1991	3.4	112.1	162.8	5 150.7	255.6	4 937.3	8 695.7	211.3	486.9	20 012.4	13.7
1992	3.5	113.1	249.7	6 548.1	343.2	5 067.6	8 820.3	264.8	753.4	22 160.2	13.6
1993	8.4	103.4	272.4	9 451.3	412.8	4 640.8	9 442.8	267.4	1 099.3	25 690.2	13.7
1994	19.9	83.6	210.1	11 400.7	546.9	6 755.3	10 387.9	244.6	1 527.4	31 156.6	13.8
1995	35.3	93.0	209.1	10 940.5	718.5	10 933.9	14 236.2	248.8	1 763.5	39 143.4	14.9
1996	19.1	97.2	219.3	12 555.5	709.1	6 922.2	13 254.2	261.4	1 994.5	36 013.3	13.1
1997	3.5	102.2	214.3	13 041.9	788.6	6 916.5	12 626.4	288.3	2 401.0	36 379.3	12.2
1998	8.9	74.8	328.0	11 721.4	803.2	6 720.3	13 490.5	303.8	3 427.2	36 869.2	11.6
1999	2.3	57.3	464.4	13 367.8	962.1	7 474.1	14 004.3	349.2	4 632.9	41 312.3	11.6

Table B.26
Export of forest products, 1978 to 2003 (continued)

Year	Pulpwood	Pulpwood chips	Other crude wood products	Lumber	Veneer and plywood	Wood pulp and similar pulp	Paper and paperboard	Shingles and shakes	Other ¹	Total	Total as share of
											Canadian exports
\$ million											
%											
2000	5.3	84.8	575.5	12 257.8	979.1	9 905.9	15 335.8	352.4	4 248.8	43 740.1	10.6
2001	2.8	82.0	582.0	11 679.0	985.9	7 354.7	15 613.3	400.0	3 972.6	40 669.6	10.1
2002	5.3	71.5	742.2	10 977.5	856.6	6 999.9	13 972.0	372.9	4 387.3	38 379.8	9.7
2003	7.7	53.4	646.7	9 031.8	747.9	6 796.7	12 278.4	297.8	5 274.1	35 126.7	9.2

Notes:

Figures may not add up to totals due to rounding.

1. Includes other sawmill products and other wood fabricated materials.

Source:

Statistics Canada, CANSIM, table 226-0001.

Minerals

The mineral industries include the extraction and production of metallic minerals such as copper, gold, iron, nickel, silver and zinc; mineral fuels including coal, crude petroleum and natural gas; and other minerals including potash, sand, and gravel. In 2003, mining and oil and gas extraction industries contributed 3.6% to GDP while petroleum and coal products and selected primary mineral manufacturing contributed another 1.1% (Tables B.27 and B.29).

In 2003, total employment in mining and oil and gas extraction industries reached its highest point since 1991 with 149 750 persons employed (Table B.28). Since 1991, Alberta's share of total employment in the mining and oil and gas extraction industries has risen from 45% to 57%.

In 2002, crude petroleum production was worth close to \$31 billion and natural gas production close to \$27 billion. Metal production totalled over \$10 billion (Table B.30). Tables B.31 and B.32 detail reserves and production of selected minerals.

Table B.27
Gross domestic product of mining and oil and gas extraction industries, 1997 to 2003

Year	Oil and gas extraction	Coal mining	Metal ore mining	Non-metallic mineral mining and quarrying	Support activities for mining and oil and gas extraction	Total	Total as share of GDP
							%
\$ million chained 1997							
1997	21 203	1 209	5 027	2 464	4 032	33 935	4.2
1998	21 947	1 185	5 252	2 402	3 761	34 547	4.1
1999	22 058	1 166	5 057	2 839	3 345	34 465	3.8
2000	20 981	1 242	5 319	2 763	4 528	34 833	3.7
2001	21 293	1 278	5 392	2 899	4 708	35 570	3.7
2002	22 060	1 131	5 119	3 144	3 685	35 139	3.5
2003	22 298	941	4 727	4 252	4 555	36 773	3.6

Source:

Statistics Canada, CANSIM, table 379-0017.

Table B.28
Employment in mining and oil and gas extraction industries by province and territory, 1991 to 2003

Year	N.L.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Y.T., N.W.T.	Canada
											and Nvt.	
persons												
1991	.	.	.	3 390	16 654	25 261	4 226	8 328	68 206	16 053	.	152 742
1992	.	.	.	3 395	15 067	23 039	4 230	8 312	58 766	12 664	.	135 330
1993	.	.	.	3 113	13 344	23 767	3 992	8 106	54 546	10 542	.	126 664
1994	.	.	.	2 966	13 052	21 413	3 766	8 527	63 907	12 297	.	135 304
1995	.	.	.	3 544	12 311	22 785	3 442	9 992	58 743	13 061	.	132 204
1996	.	.	.	3 606	11 872	22 723	2 927	10 124	57 110	11 862	.	128 240
1997	.	.	.	3 520	14 090	22 690	3 762	10 910	63 173	12 781	.	138 972
1998	.	.	.	3 373	14 066	20 066	3 657	10 539	65 936	13 010	.	138 040
1999	.	.	.	3 637	13 908	19 618	2 854	10 254	63 813	10 665	.	132 392
2000	.	.	.	3 840	14 064	18 872	3 190	11 153	66 960	10 618	.	136 269
2001	.	.	.	3 490	11 143	18 426	2 720	11 334	73 614	10 546	.	138 685
2002	.	.	.	3 004	11 649	17 312	2 324	9 982	77 782	10 311	.	139 827
2003	.	.	.	x	11 882	17 345	x	10 191	86 032	10 517	.	149 750

Note:

Data do not add up to Canada total because of unavailable data for some provinces or territories.

Source:

Statistics Canada, CANSIM, table 281-0024.

Table B.29

Gross domestic product of petroleum and coal products and selected primary metal manufacturing, 1997 to 2003

Year	Petroleum and coal products manufacturing	Iron and steel mills and ferro-alloy manufacturing	Alumina and aluminum production and processing	Non-ferrous metal (except aluminum) production and processing	Total	Total as share of GDP
1997	1 657	3 142	2 088	1 865	8 752	1.07
1998	1 805	3 416	2 452	2 063	9 736	1.15
1999	1 737	3 419	2 607	2 149	9 912	1.11
2000	1 716	3 558	3 127	2 266	10 667	1.13
2001	1 781	3 363	3 334	2 267	10 745	1.12
2002	1 836	3 611	3 560	2 226	11 233	1.13
2003	1 905	3 565	3 706	2 077	11 253	1.11

Source:

Statistics Canada, CANSIM, table 379-0017.

Table B.30

Production of leading minerals by province and territory, 2002¹

Province/Territory	Selected metallic minerals						Mineral fuels			Selected other minerals		Total production		
	Copper	Gold	Iron ore	Nickel	Silver	Zinc	Crude petroleum	Natural gas ²	Potash	Sand and gravel	Metals	Fuels	Others	
														\$ million
Newfoundland and Labrador	0.00	22.90	895.48	0.00	0.05	0.00	0.00	4 086.03	0.00	0.00	9.53	918.43	4 086.03	48.16
Prince Edward Island	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.76	0.00	0.00	3.52
Nova Scotia	0.00	0.00	0.00	0.00	0.00	0.00	x	x	x	0.00	15.98	0.00	1 062.97	247.44
New Brunswick	22.12	3.82	0.00	0.00	46.59	313.68	22.09	0.00	0.00	x	9.58	440.92	22.09	189.27
Quebec	213.24	505.71	x	245.84	56.80	287.86	0.00	0.00	0.00	0.00	76.36	2 349.32	0.00	1 342.22
Ontario	466.61	1 180.57	0.00	1 239.81	43.71	123.15	0.00	x	x	0.00	438.24	3 518.12	106.27	2 234.61
Manitoba	92.85	83.56	0.00	397.60	7.74	109.00	0.00	152.64	0.00	0.00	33.30	734.01	152.64	95.39
Saskatchewan	24.79	22.74	0.00	0.00	0.35	6.32	x	4 633.59	x	x	45.72	662.75	5 642.66	1 640.89
Alberta	0.00	0.60	0.00	0.00	0.00	0.00	386.70	20 700.07	20 934.99	0.00	235.50	0.60	42 021.76	593.56
British Columbia	599.33	336.47	x	0.00	154.29	54.85	1 024.31	x	x	0.00	175.87	1 248.06	5 438.76	541.90
Yukon Territory	0.00	31.30	0.00	0.00	0.12	0.00	0.00	0.00	43.88	0.00	3.64	31.41	43.88	3.64
Northwest Territories	0.00	52.44	0.00	0.00	0.24	0.00	0.00	289.27	107.93	0.00	2.91	52.68	397.20	811.23
Nunavut	0.00	52.28	0.00	0.00	4.62	195.07	0.00	0.00	0.00	0.00	0.00	268.76	0.00	0.00
Canada	1 418.92	2 292.37	1 391.69	1 883.25	314.50	1 089.93	1 593.09	30 794.49	26 586.68	1 597.76	1 047.39	10 225.06	58 974.26	7 751.82

Notes:

Figures may not add up to totals due to rounding.

1. Preliminary data.

2. Includes natural gas by-products.

Source:Statistics Canada, 2003, *Canada's Mineral Production, Preliminary Estimates, 2002*, Catalogue no. 26-202-XIB, Ottawa.

Table B.31

Reserves of selected major metals, 1977 to 2001

Year	Copper	Nickel	Lead	Zinc	Gold	Silver
1977	16 914	7 749	8 954	26 953	0.5	31
1978	16 184	7 843	8 930	26 721	0.5	31
1979	16 721	7 947	8 992	26 581	0.6	32
1980	16 714	8 348	9 637	27 742	0.8	34
1981	15 511	7 781	9 380	26 833	0.9	32
1982	16 889	7 546	9 139	26 216	0.8	31
1983	16 214	7 393	9 081	26 313	1.2	31
1984	15 530	7 191	9 180	26 000	1.2	31
1985	14 201	7 041	8 503	24 553	1.4	29
1986	12 918	6 780	7 599	22 936	1.5	26
1987	12 927	6 562	7 129	21 471	1.7	25
1988	12 485	6 286	6 811	20 710	1.8	26
1989	12 082	6 092	6 717	20 479	1.6	24
1990	11 261	5 776	5 643	17 847	1.5	20
1991	11 040	5 691	4 957	16 038	1.4	18
1992	10 755	5 605	4 328	14 584	1.3	16
1993	9 740	5 409	4 149	14 206	1.3	16
1994	9 533	5 334	3 861	14 514	1.5	19

Table B.31
Reserves of selected major metals, 1977 to 2001 (continued)

Year	Copper	Nickel	Lead	Zinc	Gold	Silver
thousand t						
1995	9 250	5 832	3 660	14 712	1.5	19
1996	9 667	5 623	3 450	13 660	1.7	19
1997	9 032	5 122	2 344	10 588	1.5	17
1998	8 402	5 683	1 845	10 159	1.4	16
1999	7 763	4 983	1 586	10 210	1.3	15
2000	7 419	4 782	1 315	8 876	1.1	14
2001	6 666	4 335	970	7 808	1.1	13

Source:

Natural Resources Canada, *Canadian Minerals Yearbook, 2002*, www.nrcan.gc.ca/mms/cm/pref_e.htm (accessed February 23, 2004).

Table B.32
Annual production¹ of metals and non-fuel minerals, 1948 to 2003

Year	Copper	Nickel	Lead	Zinc	Iron ore	Gold	Potash	Salt	Gypsum
thousand t									
1948	218	119	152	212	1 213	0.11	0	672	2 916
1949	239	117	145	262	3 334	0.13	0	679	2 735
1950	240	112	150	284	3 271	0.14	0	779	3 325
1951	245	125	144	309	4 246	0.14	0	875	3 450
1952	234	127	153	337	4 783	0.14	0	882	3 255
1953	230	130	176	364	5 906	0.13	0	866	3 483
1954	275	146	198	342	6 679	0.14	0	880	3 584
1955	296	159	184	393	14 772	0.14	0	1 129	4 234
1956	322	162	171	384	20 274	0.14	0	1 443	4 440
1957	326	170	165	375	20 205	0.14	0	1 607	4 151
1958	313	127	169	386	14 267	0.14	0	2 155	3 596
1959	359	169	169	359	22 215	0.14	0	2 985	5 335
1960	398	195	186	369	19 550	0.14	0	3 007	4 722
1961	398	211	209	377	18 469	0.14	0	2 945	4 478
1962	415	211	195	420	24 820	0.13	0	3 301	4 836
1963	416	200	184	424	27 300	0.12	0	3 377	5 409
1964	444	207	185	611	34 857	0.12	0	3 618	5 770
1965	463	242	268	747	36 181	0.11	1 335	4 159	5 718
1966	461	203	276	872	36 914	0.10	1 979	3 746	5 421
1967	547	224	285	994	37 788	0.09	2 389	4 532	4 549
1968	575	240	309	1 052	43 040	0.09	2 576	4 413	5 378
1969	520	194	289	1 096	36 337	0.08	3 161	4 199	5 782
1970	610	278	353	1 136	47 458	0.07	3 108	4 919	5 733
1971	654	267	368	1 134	42 957	0.07	3 558	5 061	6 081
1972	720	235	335	1 129	38 736	0.06	3 495	4 902	7 349
1973	824	249	342	1 227	47 499	0.06	4 454	5 047	7 610
1974	821	269	294	1 127	46 784	0.05	5 776	5 447	7 226
1975	721	240	315	1 004	44 742	0.05	4 726	5 123	5 746
1976	731	241	256	982	55 416	0.05	5 215	5 994	6 003
1977	759	233	281	1 071	53 621	0.05	5 764	6 039	7 231
1978	659	128	320	1 067	42 931	0.05	6 344	6 452	8 074
1979	636	126	311	1 100	59 617	0.05	7 074	6 881	8 099
1980	710	188	280	920	50 224	0.05	7 225	7 226	7 285
1981	691	160	269	911	49 551	0.05	6 549	7 239	7 025
1982	613	89	272	966	33 198	0.06	5 309	7 930	5 986
1983	653	125	272	988	32 959	0.07	6 294	8 602	7 507
1984	722	174	264	1 063	39 930	0.08	7 527	10 235	7 775
1985	739	170	268	1 049	39 502	0.09	6 661	10 085	7 761
1986	699	164	334	988	36 167	0.10	6 753	10 740	8 802
1987	794	189	373	1 158	37 804	0.12	7 668	10 129	9 095
1988	758	199	351	1 370	39 934	0.13	8 154	10 687	9 513
1989	704	196	269	1 273	39 445	0.16	7 014	11 158	8 195
1990	771	195	233	1 179	35 670	0.17	7 345	11 191	7 977
1991	780	188	248	1 083	35 917	0.18	7 087	11 871	6 729
1992	762	178	340	1 196	32 137	0.16	7 040	11 088	7 293
1993	711	178	183	991	33 774	0.15	6 880	10 993	7 564
1994	591	142	168	976	36 728	0.15	8 517	12 244	8 586
1995	701	172	204	1 095	37 024	0.15	8 855	10 957	8 055
1996	653	182	242	1 163	34 709	0.16	8 120	12 248	8 201
1997	648	181	171	1 027	39 293	0.17	9 235	13 497	8 628

Table B.32
Annual production¹ of metals and non-fuel minerals, 1948 to 2003 (continued)

Year	Copper	Nickel	Lead	Zinc	Iron ore	Gold	Potash	Salt	Gypsum
thousand t									
1998	691	198	150	992	36 847	0.16	8 884	13 034	8 307
1999	582	177	155	963	33 990	0.16	8 475	12 686	9 347
2000	622	181	143	936	35 247	0.15	9 033	12 164	8 527
2001	614	184	150	1 012	27 119	0.16	8 237	13 725	7 820
2002	584	180	101	924	30 902	0.15	8 361	12 736	8 810
2003	543	153	78	757	33 215	0.14	9 131	13 471	8 381

Note:

1. Refers to the recoverable metal in concentrates shipped, with the exception of iron ore where the quantity of ore mined is the determining factor.

Source:

Statistics Canada, CANSIM, tables 152-0001 and 152-0004.

Energy

Energy resources such as coal, crude oil, natural gas, hydro power and uranium have transformed society, fueling economic growth and industrial activity. They have provided the means to heat and light our homes, travel and transport goods with ease. In 2002, Canadians consumed 353 gigajoules of energy per person, more than double the rate of energy consumption less than half a century ago (Table B.33).

Table B.34 outlines Canadian energy resource reserves of coal, crude oil, crude bitumen, natural gas and uranium. Table B.35 shows hydro-electric generation by province and territory, while tables B.36 to B.38 look at thermal-electric power stations by fuel type.

In 2002, Canada produced 16 million terajoules of energy, of which 11 million were available for consumption in the Canadian economy (Table B.39).

Table B.33
Basic energy indicators, 1958 to 2002

Year	Consumption ¹ of	Population	Real GDP	Energy consumption	Energy consumption
	primary energy			per capita	per dollar of real GDP
	PJ	thousands	\$ million chained 1997	GJ/person	MJ/\$ chained 1997
1958	2 852.5	17 120	..	166.6	..
1959	3 037.5	17 522	..	173.4	..
1960	3 133.7	17 909	..	175.0	..
1961	3 294.0	18 271	245 230	180.3	13.43
1962	3 491.3	18 614	262 382	187.6	13.31
1963	3 740.3	18 964	276 306	197.2	13.54
1964	3 926.4	19 325	294 196	203.2	13.35
1965	4 131.3	19 678	312 930	209.9	13.20
1966	4 407.9	20 048	333 724	219.9	13.21
1967	4 524.2	20 412	343 454	221.6	13.17
1968	4 877.9	20 729	360 214	235.3	13.54
1969	5 141.3	21 028	378 344	244.5	13.59
1970	5 545.5	21 324	389 809	260.1	14.23
1971	5 889.7	21 962	405 860	268.2	14.51
1972	6 411.2	22 218	427 962	288.6	14.98
1973	6 937.4	22 492	457 766	308.4	15.15
1974	7 208.9	22 808	474 663	316.1	15.19
1975	7 080.7	23 143	483 316	306.0	14.65
1976	7 183.0	23 450	508 445	306.3	14.13
1977	7 295.6	23 726	526 028	307.5	13.87
1978	7 641.3	23 963	546 825	318.9	13.97
1979	8 176.0	24 202	567 631	337.8	14.40
1980	8 214.9	24 516	579 907	335.1	14.17
1981	7 862.6	24 820	600 253	316.8	13.10
1982	7 381.5	25 117	583 089	293.9	12.66
1983	7 299.9	25 367	598 941	287.8	12.19
1984	7 737.5	25 608	633 756	302.2	12.21
1985	7 908.8	25 843	664 059	306.0	11.91
1986	7 834.4	26 101	680 144	300.2	11.52
1987	8 122.2	26 449	709 058	307.1	11.45
1988	8 660.1	26 795	744 333	323.2	11.63

Table B.33
Basic energy indicators, 1958 to 2002 (continued)

Year	Consumption ¹ of primary energy		Population thousands	Real GDP \$ million chained 1997	Energy consumption	
	PJ				per capita GJ/person	per dollar of real GDP MJ/\$ chained 1997
1989	8 945.2		27 282	763 837	327.9	11.71
1990	9 229.9		27 698	765 311	333.2	12.06
1991	9 091.0		28 031	749 294	324.3	12.13
1992	9 176.3		28 367	755 848	323.5	12.14
1993	9 314.1		28 682	773 528	324.7	12.04
1994	9 564.3		28 999	810 695	329.8	11.80
1995	9 695.2		29 302	833 456	330.9	11.63
1996	10 097.2		29 611	846 952	341.0	11.92
1997	10 200.1		29 907	882 733	341.1	11.56
1998	10 194.9		30 157	918 910	338.1	11.09
1999	10 518.3		30 404	969 750	346.0	10.85
2000	10 831.0		30 689	1 020 786	352.9	10.61
2001	10 950.4		31 021	1 040 388	353.0	10.53
2002	11 076.0		31 362	1 074 516	353.2	10.31

Note:

1. Defined as the amount which was available for use in the Canadian economy. Includes the use of energy resources for non-energy purposes (e.g., petrochemical feedstocks in fertilizer production). Excludes the use of wood and wastes as energy sources.

Source:

Statistics Canada, CANSIM, tables 051-0005, 128-0002 and 380-0017.

Table B.34
Established energy resource reserves, 1976 to 2001

Year	Coal ¹		Crude oil		Crude bitumen		Natural gas ²		Uranium	
	Reserves	Reserve life	Reserves	Reserve life	Reserves	Reserve life	Reserves	Reserve life	Reserves	Reserve life
	Mt	years	million m ³	years	million m ³	years	billion m ³	years	kt	years
1976	4 310.7	169.2	1 014.6	13.9	150.7	39.7	1 738.7	26.5	405	74.5
1977	4 117.0	144.3	969.1	13.3	111.2	32.7	1 790.8	24.9	415	71.7
1978	4 092.6	134.3	942.7	13.0	321.5	68.4	1 911.8	25.2	438	53.3
1979	4 021.8	121.1	903.3	11.2	353.1	47.7	1 977.6	24.1	468	71.7
1980	4 192.5	114.3	860.7	11.4	333.9	32.4	2 028.9	27.9	444	65.9
1981	4 159.9	103.8	827.8	12.4	325.0	36.5	2 085.5	27.0	340	45.3
1982	5 704.0	133.2	780.6	12.1	315.6	33.6	2 148.4	31.1	376	49.2
1983	5 981.0	133.5	792.4	11.6	310.4	17.9	2 126.6	28.7	333	48.8
1984	6 120.6	106.6	776.3	10.6	328.8	28.3	2 106.7	27.4	260	25.3
1985	6 011.8	99.5	790.5	11.2	343.4	22.3	2 080.5	24.9	263	25.2
1986	6 338.9	109.7	774.6	11.4	574.4	30.4	2 032.8	25.7	265	23.0
1987	6 583.5	107.6	753.6	10.9	572.5	28.5	1 956.0	24.6	258	19.0
1988	6 542.3	92.6	739.2	10.2	566.5	26.5	1 931.9	19.0	248	20.6
1989	6 472.6	91.8	707.8	10.3	542.2	23.4	1 957.8	19.0	249	22.6
1990	6 580.7	96.3	657.3	9.6	524.0	23.1	1 979.2	18.0	295	30.3
1991	6 545.2	92.0	614.9	9.2	501.7	22.2	1 965.8	19.9	305	37.4
1992	6 522.1	99.4	590.4	8.5	482.2	20.3	1 929.8	15.3	309	33.9
1993	6 449.4	93.4	526.5	6.7	457.6	18.6	1 860.5	13.1	313	36.0
1994	6 372.2	87.5	532.2	6.7	565.0	23.5	1 833.3	12.8	300	26.8
1995	6 293.4	83.9	553.0	7.2	574.0	20.4	1 841.5	12.3	484	47.3
1996	6 210.7	81.9	526.5	6.7	660.8	23.5	1 726.4	11.1	430	37.9
1997	6 132.0	77.9	532.2	6.7	614.0	18.7	1 620.9	10.2	419	37.7
1998	6 056.9	80.6	528.4	6.9	1 336.0	35.2	1 562.6	9.6	433	43.3
1999	5 502.1	75.9	504.0	7.0	1 891.1	52.5	1 527.2	9.1	417	41.1
2000	4 722.8	68.3	507.7	7.1	1 860.0	47.7	1 536.9	9.1	437	44.1
2001	4 555.4	66.6	493.7	7.0	1 830.0	43.6	1 529.1	8.7	452	34.8

Notes:

1. Includes bituminous, sub-bituminous and lignite coal.

2. Includes natural gas liquids (ethane, butane, propane and pentanes plus).

Source:

Statistics Canada, Environment Accounts and Statistics Division.

Table B.35
Hydro-electric power generation by province and territory, 1994 and 2002

Province/Territory	1994			2002		
	Hydro	Total	Hydro as	Hydro	Total	Hydro as
	GWh	electric power	share of total	GWh	electric power	share of total
			%			%
Newfoundland and Labrador	37 606.7	38 482.6	97.7	41 415.9	44 124.5	93.9
Prince Edward Island	0.0	40.0	0.0	0.0	38.9	0.0
Nova Scotia	1 020.4	9 767.4	10.4	1 032.2	12 126.9	8.5
New Brunswick	2 772.2	15 891.2	17.4	2 250.7	17 882.7	12.6
Quebec	157 850.7	163 600.7	96.5	170 539.8	177 148.7	96.3
Ontario	39 080.7	152 429.2	25.6	38 415.7	154 334.7	24.9
Manitoba	28 146.2	28 443.4	99.0	28 820.5	29 437.1	97.9
Saskatchewan	3 392.5	15 478.1	21.9	2 835.7	17 969.7	15.8
Alberta	1 806.3	52 361.3	3.4	1 719.0	61 609.1	2.8
British Columbia	54 304.1	62 070.4	87.5	58 877.9	65 334.9	90.1
Yukon Territory	266.1	299.3	88.9	273.2	312.1	87.5
Northwest Territories	188.2	578.1	32.6	281.5 ¹	743.5 ¹	37.9 ¹
Canada	326 434.1	539 441.7	60.5	346 462.1	581 062.9	59.6

Notes:

Figures may not add up to totals due to rounding.

1. Includes Nunavut

Sources:

Statistics Canada, *Electric Power Annual Statistics*, Catalogue no. 57-202, Ottawa, various issues.

Statistics Canada, *Quarterly Report on Energy Supply-Demand in Canada*, Catalogue no. 57-003, Ottawa, various issues.

Table B.36
Energy consumed in thermal-electric power stations by fuel type, 1980 to 2002

Year	Coal				Lignite	Fuel oil		Natural gas	Wood
	Canadian	Imported	Canadian	Imported		Heavy	Light and diesel		
	bituminous	bituminous	sub-bituminous	sub-bituminous		TJ			
1980	108 955	249 422	183 478	..	77 541	105 286	12 619	71 159	..
1981	123 737	261 758	196 493	..	83 624	70 106	11 105	51 057	..
1982	114 238	283 650	227 007	..	102 310	77 043	10 724	42 124	..
1983	126 315	279 586	254 165	..	121 137	45 627	9 559	33 454	..
1984	139 267	297 373	290 931	..	131 173	42 030	9 210	23 619	..
1985	145 449	227 090	317 016	..	134 416	47 958	9 104	23 259	..
1986	119 666	188 934	321 289	..	117 393	43 598	9 175	17 316	..
1987	151 508	229 026	340 572	..	142 376	75 702	9 987	20 619	..
1988	162 522	244 213	364 652	..	170 660	99 195	8 504	40 419	..
1989	163 602	245 290	369 774	..	155 005	154 053	12 136	102 753	..
1990	150 746	183 215	384 276	..	134 968	137 048	12 158	50 530	..
1991	170 019	212 996	430 106	..	131 390	112 131	11 813	41 525	..
1992	159 353	195 313	392 792	..	141 328	132 502	10 346	99 820	..
1993	141 190	118 909	436 468	..	144 378	93 734	11 104	126 992	..
1994	123 014	131 018	478 936	..	150 410	70 834	9 909	154 846	..
1995	122 419	146 541	477 598	..	153 209	79 934	11 088	149 890	..
1996	132 402	169 149	458 122	..	159 646	61 305	10 418	105 074	..
1997	112 114	216 821	475 008	22 193	169 137	99 336	8 691	154 899	..
1998	90 160	281 115	468 503	40 004	177 657	147 675	8 015	200 450	14 959
1999	84 148	300 861	445 127	63 881	170 501	119 554	7 782	204 930	17 112
2000	47 231	381 795	437 491	126 800	166 262	108 955	7 632	273 301	21 024
2001	51 580	351 178	450 912	140 385	169 140	127 541	8 172	333 946	27 293
2002	45 823	305 444	465 280	143 415	166 599	111 800	7 178	278 613	27 620

Sources:

Statistics Canada, *Electric Power Generation, Transmission and Distribution*, Catalogue no. 57-202-XPB, Ottawa, various issues.

Statistics Canada, *Electric Power Generation, Transmission and Distribution*, Catalogue no. 57-202-XIB, Ottawa, various issues.

Table B.37
Net energy generation in thermal-electric power stations by fuel type, 1980 to 2002

Year	Coal				Lignite	Fuel oil			Natural gas	Wood
	Canadian bituminous	Imported bituminous	Canadian sub-bituminous	Imported sub-bituminous		Heavy	Light and diesel	TJ		
1980	34 102	89 540	58 612	..	21 133	34 564	3 102	19 175	..	
1981	36 693	92 867	62 547	..	22 972	22 451	3 256	13 097	..	
1982	37 070	100 930	71 820	..	27 892	25 852	3 062	11 030	..	
1983	40 109	100 592	80 439	..	33 222	14 658	2 791	8 615	..	
1984 ¹	46 928	106 065	90 662	..	38 555	13 554	2 735	5 777	..	
1985	48 576	80 331	98 869	..	38 025	15 419	2 710	5 773	..	
1986 ¹	42 038	69 406	109 398	..	36 947	15 385	2 865	4 349	..	
1987 ¹	53 808	84 830	116 663	..	45 297	27 065	2 995	5 649	..	
1988 ¹	58 411	90 953	125 044	..	52 989	35 833	2 463	11 727	..	
1989 ¹	58 285	91 097	123 637	..	48 603	54 493	3 913	32 494	..	
1990 ¹	53 613	66 888	132 608	..	42 661	49 113	3 715	14 887	..	
1991 ¹	57 684	74 519	139 965	..	40 808	39 965	3 434	12 327	..	
1992 ¹	56 474	71 853	145 984	..	44 792	46 861	3 193	30 620	..	
1993 ¹	50 148	42 944	150 070	..	46 265	33 537	3 541	42 180	..	
1994	41 040	44 603	152 382	..	44 731	23 307	3 097	45 040	..	
1995	41 244	49 124	152 976	..	45 861	26 223	3 895	52 634	..	
1996	44 809	58 752	148 520	..	46 909	19 591	3 327	35 011	..	
1997	38 510	76 698	153 122	7 745	49 155	33 222	2 724	54 897	..	
1998	30 623	104 460	152 275	13 959	52 801	48 659	2 581	69 600	5 987	
1999	28 498	107 224	145 601	22 418	49 652	39 708	2 367	72 474	6 055	
2000	14 770	132 830	143 509	42 042	49 995	36 002	2 159	95 844	6 590	
2001	16 727	115 049	146 051	40 027	50 929	42 052	2 398	114 738	7 313	
2002	13 844	103 636	152 767	47 306	50 257	37 481	2 111	100 130	7 487	

Note:

1. The years 1984 and 1986 to 1993 are gross generation. This means that station service was not deducted to get net generation.

Sources:

Statistics Canada, *Electric Power Generation, Transmission and Distribution*, Catalogue no. 57-202-XPB, Ottawa, various issues.
 Statistics Canada, *Electric Power Generation, Transmission and Distribution*, Catalogue no. 57-202-XIB, Ottawa, various issues.

Table B.38
Efficiency¹ of thermal-electric power stations by fuel type, 1980 to 2002

Year	Coal				Lignite	Fuel oil			Natural gas	Wood
	Canadian bituminous	Imported bituminous	Canadian sub-bituminous	Imported sub-bituminous		Heavy	Light and diesel	%		
1980	31.3	35.9	31.9	..	27.3	32.8	24.6	26.9	..	
1981	29.7	35.5	31.8	..	27.5	32.0	29.3	25.7	..	
1982	32.5	35.6	31.6	..	27.3	33.6	28.6	26.2	..	
1983	31.8	36.0	31.6	..	27.4	32.1	29.2	25.8	..	
1984	33.7	35.7	31.2	..	29.4	32.2	29.7	24.5	..	
1985	33.4	35.4	31.2	..	28.3	32.2	29.8	24.8	..	
1986	35.1	36.7	34.0	..	31.5	35.3	31.2	25.1	..	
1987	35.5	37.0	34.3	..	31.8	35.8	30.0	27.4	..	
1988	35.9	37.2	34.3	..	31.0	36.1	29.0	29.0	..	
1989	35.6	37.1	33.4	..	31.4	35.4	32.2	31.6	..	
1990	35.6	36.5	34.5	..	31.6	35.8	30.6	29.5	..	
1991	33.9	35.0	32.5	..	31.1	35.6	29.1	29.7	..	
1992	35.4	36.8	37.2	..	31.7	35.4	30.9	30.7	..	
1993	35.5	36.1	34.4	..	32.0	35.8	31.9	33.2	..	
1994	33.4	34.0	31.8	..	29.7	32.9	31.3	29.1	..	
1995	33.7	33.5	32.0	..	29.9	32.8	35.1	35.1	..	
1996	33.8	34.7	32.4	..	29.4	32.0	31.9	33.3	..	
1997	34.3	35.4	32.2	34.9	29.1	33.4	31.3	35.4	..	
1998	34.0	37.2	32.5	34.9	29.7	33.0	32.2	34.7	40.0	
1999	33.9	35.6	32.7	35.1	29.1	33.2	30.4	35.4	35.4	
2000	31.3	34.8	32.8	33.2	30.1	33.0	28.3	35.1	31.3	
2001	32.4	32.8	32.4	28.5	30.1	33.0	29.3	34.4	26.8	
2002	30.2	33.9	32.8	33.0	30.2	33.5	29.4	35.9	27.1	

Note:

1. Efficiency is the electrical energy output as a percentage of primary energy input.

Sources:

Statistics Canada, *Electric Power Generation, Transmission and Distribution*, Catalogue no. 57-202-XPB, Ottawa, various issues.
 Statistics Canada, *Electric Power Generation, Transmission and Distribution*, Catalogue no. 57-202-XIB, Ottawa, various issues.

Table B.39
Production and consumption¹ of primary energy resources, 1958 to 2002

Year	Coal		Crude oil		Natural gas ²		Electricity ³		Total	
	Production	Consumption	Production	Consumption	Production	Consumption	Production	Consumption	Production	Consumption
	TJ									
1958	263 975	637 271	1 020 859	1 490 275	437 088	366 256	325 683	358 649	2 047 605	2 852 451
1959	240 377	625 320	1 144 630	1 644 153	517 304	433 488	350 028	334 498	2 252 338	3 037 459
1960	244 418	559 287	1 192 301	1 715 098	624 773	496 872	381 003	362 454	2 442 495	3 133 711
1961	234 489	547 655	1 404 934	1 802 978	774 922	579 330	373 937	363 994	2 788 282	3 293 957
1962	229 599	556 731	1 601 832	1 903 300	1 044 080	661 570	374 490	369 691	3 250 001	3 491 293
1963	239 665	598 128	1 709 818	2 049 921	1 127 634	720 897	373 937	371 316	3 451 054	3 740 263
1964	253 348	620 641	1 835 513	2 091 638	1 255 120	809 498	408 360	404 624	3 752 340	3 926 401
1965	255 521	647 683	1 955 978	2 167 589	1 356 473	894 794	421 667	421 274	3 989 639	4 131 339
1966	247 496	634 962	2 136 681	2 327 897	1 466 721	981 519	467 769	463 525	4 318 667	4 407 903
1967	247 777	629 097	2 332 727	2 371 570	1 568 068	1 044 722	478 186	478 859	4 626 758	4 524 248
1968	234 133	683 468	2 520 354	2 544 142	1 776 261	1 159 897	488 768	490 434	5 019 516	4 877 941
1969	227 407	659 869	2 746 152	2 653 888	2 047 114	1 294 439	538 818	533 133	5 559 491	5 141 328
1970	354 634	708 448	3 087 416	2 860 028	2 349 711	1 418 190	567 381	558 794	6 359 142	5 545 461
1971	405 139	673 351	3 297 078	3 118 881	2 566 442	1 518 032	593 628	579 442	6 862 288	5 889 706
1972	460 770	635 417	3 803 963	3 424 584	2 899 986	1 710 604	671 751	640 604	7 836 470	6 411 208
1973	496 434	654 390	4 385 206	3 770 655	3 108 262	1 817 662	745 212	694 703	8 735 114	6 937 409
1974	526 092	664 922	4 120 340	3 930 715	3 041 698	1 850 945	808 912	762 283	8 497 041	7 208 865
1975	633 668	657 563	3 528 342	3 805 636	3 092 605	1 873 331	770 960	744 198	8 025 575	7 080 727
1976	619 975	709 029	3 235 522	3 769 982	3 107 651	1 912 329	824 819	791 664	7 787 967	7 183 004
1977	685 448	772 789	3 240 618	4 003 822	2 977 742	1 699 212	881 594	819 730	7 785 402	7 295 553
1978	743 553	788 597	3 194 640	4 017 147	3 106 827	1 957 312	948 475	878 300	7 993 495	7 641 356
1979	811 421	876 372	3 600 201	4 327 941	3 382 338	2 059 052	1 019 185	912 675	8 813 145	8 176 040
1980	891 070	928 409	3 444 041	4 216 120	3 180 730	2 116 374	1 052 072	953 991	8 567 913	8 214 894
1981	969 542	947 942	3 093 450	3 911 507	3 080 003	2 010 520	1 114 624	992 669	8 257 619	7 862 638
1982	1 028 279	1 001 681	3 052 121	3 359 122	3 163 161	2 040 386	1 093 191	980 277	8 336 572	7 381 466
1983	1 066 011	1 048 015	3 232 271	3 201 037	2 980 532	2 027 274	1 150 257	1 020 347	8 429 071	7 296 673
1984	1 396 400	1 167 377	3 430 899	3 183 745	3 311 332	2 292 108	1 235 057	1 094 325	9 373 688	7 737 555
1985	1 487 132	1 122 086	3 516 525	3 085 568	3 622 687	2 532 461	1 313 821	1 168 658	9 940 165	7 908 773
1986	1 382 118	1 039 979	3 531 205	3 055 190	3 458 952	2 480 595	1 381 010	1 258 688	9 753 285	7 834 452
1987	1 393 936	1 117 744	3 690 859	3 172 058	3 766 024	2 574 349	1 416 413	1 258 110	10 267 232	8 122 261
1988	1 614 195	1 200 307	3 877 941	3 359 461	4 313 054	2 809 862	1 390 669	1 290 430	11 195 859	8 660 060
1989	1 718 400	1 197 786	3 769 304	3 423 980	4 552 627	3 025 526	1 331 644	1 297 953	11 371 975	8 945 245
1990	1 673 101	1 136 171	3 765 187	3 874 090	4 574 109	2 899 032	1 321 912	1 320 656	11 334 309	9 229 949
1991	1 747 976	1 099 786	3 765 443	3 726 587	4 805 528	2 922 760	1 408 181	1 341 838	11 727 128	9 090 971
1992	1 553 530	1 120 353	3 931 692	3 615 091	5 298 028	3 116 689	1 414 322	1 324 135	12 197 572	9 176 268
1993	1 651 313	994 715	4 116 941	3 741 690	5 832 901	3 196 872	1 479 535	1 380 835	13 080 690	9 314 112
1994	1 735 269	1 054 689	4 299 874	3 808 804	6 331 888	3 312 684	1 546 239	1 388 145	13 913 270	9 564 322
1995	1 800 811	1 056 083	4 457 769	3 801 848	6 711 568	3 434 306	1 532 656	1 402 976	14 502 804	9 695 213
1996	1 832 286	1 099 131	4 590 726	3 984 463	6 932 462	3 563 509	1 585 629	1 450 067	14 941 103	10 097 170
1997	1 897 322	1 168 601	4 842 646	4 087 294	7 012 563	3 540 975	1 531 890	1 403 258	15 284 421	10 200 128
1998	1 651 482	1 287 709	5 021 730	4 090 494	7 269 299	3 488 847	1 426 237	1 327 829	15 368 748	10 194 879
1999	1 589 310	1 278 044	4 788 758	4 167 500	7 498 476	3 695 016	1 481 669	1 377 703	15 358 213	10 518 263
2000	1 509 905	1 330 940	4 999 607	4 251 781	7 734 303	3 852 022	1 524 557	1 396 249	15 768 372	10 830 992
2001	1 532 994	1 421 952	5 056 168	4 388 726	7 857 807	3 775 073	1 447 914	1 364 650	15 894 883	10 950 401
2002	1 429 897	1 324 975	5 204 851	4 325 400	7 882 243	3 992 363	1 505 402	1 433 295	16 022 393	11 076 033

Notes:

1. Defined as the amount that was available for use in the Canadian economy. Includes the use of energy resources for non-energy purposes (e.g., petrochemical feedstocks in fertilizer production). Excludes the use of wood and wastes as energy sources.

2. Includes natural gas liquids (ethane, butane, propane and pentanes plus).

3. Includes primary steam.

Source:

Statistics Canada, CANSIM, table 128-0002.

Ecosystems

Human activity has had a profound impact on the structure and function of many ecosystems. Natural areas are altered by human activities which contributed to loss of habitats and extinction of animal and plant species. This section focuses on the impacts human activities have on air, land, water and wildlife.

Air

The atmosphere, an envelope of gases surrounding the earth, is made up of nitrogen (78%), oxygen (21%) argon (0.9%) and other gases. The atmosphere provides the air we breathe, shields us from ultraviolet radiation, affects air circulation and weather patterns and keeps the earth warm.

Human activities can affect both the air and the atmosphere. Traffic emissions affect urban air quality; industrial emissions of sulphur oxides and nitrogen oxides produce acid rain; chlorofluorocarbons, hydrochlorofluorocarbons and other substances deplete the ozone layer; and carbon dioxide, methane and nitrous oxide contribute to global warming. Because air circulates, air pollution and emissions produced locally can travel across international boundaries and affect the entire world.

Table B.40 compares emissions of common greenhouse gases: carbon dioxide, methane, nitrous oxide by source for 1990 and 2001. Changes in the atmospheric concentration of these and other greenhouse gases have been linked to increases in the earth's temperature.

Criteria air contaminants are those for which ambient air quality standards have been established by government. In 2002, criteria air contaminants including sulphur dioxide, carbon monoxide, nitrogen oxides, volatile organic compounds and particulate matter made up more than 90% of pollutants released by industrial facilities to air (Table B.41).

Table B.40
Greenhouse gas emissions by source, 1990 and 2001

Source	Carbon dioxide (CO ₂)		Methane (CH ₄)		Nitrous oxide (N ₂ O)		CO ₂ -equivalents ¹		Change 1990 to 2001 %
	1990	2001	1990	2001	1990	2001	1990	2001	
	kt								
Energy	432 000	528 000	1 600.0	2 100.0	27.0	36.0	473 000	584 000	23.5
Stationary combustion sources	276 000	335 000	180.0	220.0	6.0	8.0	282 000	342 000	21.3
Electricity and heat generation	94 700	136 000	2.0	5.0	1.8	2.0	95 300	137 000	43.8
Fossil fuel industries	49 500	64 500	78.0	120.0	1.0	1.0	51 500	67 300	30.7
Petroleum refining	26 000	29 000	0.0	0.4	0.3	0.3	26 100	29 100	11.5
Fossil fuel production	23 600	35 500	78.0	110.0	0.7	1.1	25 400	38 200	50.4
Mining	6 150	10 200	0.0	0.2	0.1	0.3	6 190	10 200	64.8
Manufacturing industries	54 100	48 500	2.0	2.0	1.0	1.0	54 500	48 900	-10.3
Iron and steel	6 420	5 830	0.2	0.2	0.2	0.2	6 490	5 890	-9.2
Non ferrous metals	3 210	3 480	0.1	0.1	0.0	0.1	3 230	3 500	8.4
Chemical	7 060	6 440	0.2	0.1	0.1	0.1	7 100	6 470	-8.9
Pulp and paper	13 400	9 500	0.8	0.8	0.4	0.4	13 500	9 630	-28.7
Cement	3 370	3 270	0.1	0.1	0.0	0.0	3 390	3 290	-2.9
Other manufacturing	20 600	20 000	0.4	0.4	0.4	0.4	20 800	20 100	-3.4
Construction	1 860	1 000	0.0	0.0	0.1	0.0	1 880	1 010	-46.3
Commercial and institutional	25 700	32 700	0.0	0.6	0.0	0.7	25 800	32 900	27.5
Residential	41 300	39 400	100.0	94.0	1.7	1.7	44 000	41 900	-4.8
Agriculture and forestry	2 403	2 190	0.0	0.0	0.1	0.1	2 420	2 210	-8.7
Transportation combustion sources	146 000	178 000	31.0	31.0	21.0	29.0	153 000	187 000	22.2
Domestic aviation	10 407	11 800	0.7	0.6	1.0	1.2	10 700	12 100	13.1
Road transportation	103 000	127 000	16.0	14.0	12.0	19.0	107 000	134 000	25.2
Gasoline automobile	51 600	46 400	9.0	4.6	6.3	7.3	53 700	48 700	-9.3
Light duty gasoline trucks	20 400	36 400	4.0	4.8	4.2	9.0	21 800	39 400	80.7
Heavy duty gasoline vehicles	2 990	3 930	0.4	0.6	0.4	0.6	3 140	4 130	31.5
Motorcycles	225	236	0.2	0.2	0.0	0.0	230	242	5.2
Diesel automobiles	657	583	0.0	0.0	0.0	0.0	672	596	-11.3
Light duty diesel trucks	577	629	0.0	0.0	0.0	0.0	591	643	8.8
Heavy duty diesel vehicles	24 300	38 200	1.2	1.9	0.7	1.1	24 500	38 600	57.6
Propane and natural gas vehicles	2 160	1 100	1.7	1.7	0.0	0.0	2 210	1 140	-48.4
Railways	6 320	5 820	0.4	0.3	2.5	2.3	7 110	6 550	-7.9
Domestic marine	4 730	5 180	0.4	0.4	1.0	1.1	5 050	5 510	9.1

Table B.40
Greenhouse gas emissions by source, 1990 and 2001 (continued)

Source	Carbon dioxide (CO ₂)		Methane (CH ₄)		Nitrous oxide (N ₂ O)		CO ₂ -equivalents ¹		
	1990	2001	1990	2001	1990	2001	1990	2001	Change 1990 to 2001 %
	kt								
Others	21 800	27 600	13.0	16.0	4.0	6.0	23 400	29 700	26.9
Off road	15 100	17 700	6.1	6.0	4.2	5.4	16 500	19 500	18.2
Pipelines	6 700	9 970	6.7	10.0	0.2	0.3	6 900	10 300	49.3
Fugitive sources²	9 830	15 300	1 300.0	1 900.0	0.0	0.0	37 900	54 800	44.6
Coal mining	0	0	91.0	47.0	0.0	0.0	1 910	990	-48.2
Oil and natural gas	9 830	15 300	1 200.0	1 800.0	0.0	0.0	36 000	53 800	49.4
Oil	27	78	410.0	660.0	0.0	0.0	8 570	14 000	63.4
Natural gas	19	29	820.0	1 100.0	0.0	0.0	17 200	23 900	39.0
Venting	4 500	7 820	0.0	0.0	0.0	0.0	4 500	7 820	73.8
Flaring	5 290	7 380	24.0	31.0	0.0	0.0	5 780	8 030	38.9
Industrial processes	32 600	38 300	0.0	0.0	37.0	5.0	52 900	49 000	-7.4
Mineral production	8 160	8 650	0.0	0.0	0.0	0.0	8 160	8 650	6.0
Cement	5 870	6 490	0.0	0.0	0.0	0.0	5 870	6 490	10.6
Lime	1 850	1 750	0.0	0.0	0.0	0.0	1 850	1 750	-5.4
Limestone and soda use	439	403	0.0	0.0	0.0	0.0	439	403	-8.2
Chemical industry	5 010	5 920	0.0	0.0	37.0	5.0	16 500	7 520	-54.4
Ammonia production	5 010	5 920	0.0	0.0	0.0	0.0	5 010	5 920	18.2
Nitric acid production	0	0	0.0	0.0	2.5	2.6	777	795	2.3
Adipic acid production	0	0	0.0	0.0	35.0	2.6	10 700	802	-92.5
Metal production	10 200	12 100	0.0	0.0	0.0	0.0	19 100	20 300	6.3
Iron and steel production	7 590	7 920	0.0	0.0	0.0	0.0	7 590	7 920	4.3
Aluminum production	2 640	4 160	0.0	0.0	0.0	0.0	8 610 ³	10 300 ⁴	20.0
SF ₆ used in magnesium smelters	0	0	0.0	0.0	0.0	0.0	2 870 ³	2 020 ⁴	-30.0
Consumption of halocarbons	0	0	0.0	0.0	0.0	0.0	0	936	...
Other and undifferentiated production	9 220	11 700	0.0	0.0	0.0	0.0	9 220	11 700	26.9
Solvent and other product use	0	0	0.0	0.0	1.3	1.5	417	468	12.2
Agriculture	7 550	299	980.0	1 200.0	100.0	120.0	59 200	60 000	1.4
Enteric fermentation ⁵	0	0	760.0	900.0	0.0	0.0	16 000	18 800	17.5
Manure management	0	0	220.0	260.0	12.0	15.0	8 270	10 100	22.1
Agricultural soils	8 000	300	0.0	0.0	90.0	100.0	30 000	30 000	0.0
Direct sources	8 000	300	0.0	0.0	70.0	79.0	30 000	20 000	-33.3
Indirect sources	0	0	0.0	0.0	20.0	23.0	5 000	7 000	40.0
Land use change and forestry (non-CO₂ only)⁶	0	0	62.0	50.0	3.0	3.0	2 256	2 080	-7.8
Prescribed burns	0	0	47.0	17.0	1.9	0.7	1 560	575	-63.1
Wildfires in the wood production forest	0	0	15.0	33.0	1.2	2.6	698	1 510	116.3
Waste	254	284	900.0	1 100.0	3.0	3.0	20 100	24 800	23.4
Solid waste disposal on land	0	0	880.0	1 100.0	0.0	0.0	18 500	23 100	24.9
Wastewater handling	0	0	17.0	19.0	2.8	3.1	1 220	1 370	12.3
Waste incineration	254	284	0.4	0.3	0.2	0.2	317	350	10.4
Land use change and forestry (CO₂ only)⁶	-100 000	-40 000	0.0	0.0	0.0	0.0	-100 000	-40 000	-60.0
Changes in forest and woody biomass stocks	-100 000	-40 000	0.0	0.0	0.0	0.0	-100 000	-40 000	-60.0
Forest and grassland conversion	1 000	4 000	0.0	0.0	0.0	0.0	1 000	4 000	300.0
Abandonment of managed lands	-3 000	-3 000	0.0	0.0	0.0	0.0	-3 000	-3 000	0.0
CO ₂ emissions and removals from soil	4 000	2 000	0.0	0.0	0.0	0.0	4 000	2 000	-50.0
Total	472 000	566 000	3 500.0	4 500.0	170.0	170.0	608 000	720 000	18.4

Notes:

Figures may not add up to totals due to rounding or varying degrees of uncertainty in individual estimates.

1. CO₂-equivalent emissions are the weighted sum of all greenhouse gas emissions. The following global warming potentials are used as the weights: CO₂ = 1; CH₄ = 21; N₂O = 310; HFCs = 140-11 700; PFCs = 6 500-9 200; SF₆ = 23 900.

2. Includes intentional and unintentional emissions from production, processing, transmission, storage and delivery of fuels, including those from flaring of natural gas at oil and gas production facilities.

3. 1990 CO₂-equivalent emissions for this industry include 6 000 kilotonnes of PFC emissions and 3 000 kilotonnes of SF₆ emissions.

4. 2001 CO₂-equivalent emissions for this industry include 6 000 kilotonnes of PFC emissions and 2 000 kilotonnes of SF₆ emissions.

5. Emissions from livestock digestive processes.

6. CO₂ emissions and removals in the Land use change and forestry sector are not included in the national totals.

Source:

Environment Canada, 2003, *Canada's Greenhouse Gas Inventory, 1990-2001*, Ottawa.

Table B.41
Top ten substances released to air, 2002

Substance	Releases		Share of total %
	t		
Sulphur dioxide	1 977 329.4		46.1
Carbon monoxide	943 658.1		22.0
Oxides of nitrogen (expressed as NO ₂)	577 986.2		13.5
Volatile organic compounds (VOCs)	266 381.4		6.2
PM - Total particulate matter	228 112.4		5.3
Methanol	22 285.5		0.5
Ammonia (total) ¹	17 073.8		0.4
Hydrochloric acid	15 726.9		0.4
Sulphuric acid	11 587.1		0.3
Toluene	6 890.9		0.2

Note:

1. Refers to the total of both ammonia (NH₃) and ammonium ion (NH₄⁺) in solution.

Source:

Environment Canada, Pollution Data Branch, National Pollutant Release Inventory Database, www.ec.gc.ca/pdb/npri/npri_dat_rep_e.cfm (accessed April 20, 2004).

Land

Canada is the second largest country in the world, with 9 975 162 km² of land. This land supports many uses, from agriculture and forestry to urban development, parks and recreation.

Table B.42 presents the volumes of wood harvested by province from 1980 to 2001, while table B.43 shows the area of timber-productive forest land burned from 1980 to 2002.

In 2001, farmers in Canada applied fertilizer to over 24 million hectares of land to improve crop yield. Sales of commercial fertilizer have levelled-off in Eastern Canada, while in Western Canada sales declined in 2001 and 2002 (Figure B.5).

Pesticides, including herbicides, insecticides and fungicides are used to control weeds, insects and crop diseases. The risk to the environment is determined by the mobility, persistence and toxicity of the pesticide to organisms other than its target, as well as the amount used. The area of farmland treated with pesticides is illustrated in figures B.6 and B.7.

The National Pollutant Release Inventory Database measures the volume of pollutants released on-site by 4 956 industrial facilities. In 2002, calcium fluoride, zinc and manganese made up more than two-thirds of the tonnage of substances released to land (Table B.44).

Table B.42
Volume of roundwood harvested by province and territory, 1980 to 2001

Year	N.L.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Y.T.	N.W.T. ¹	Canada
thousand m ³													
1980	2 795 ^f	381	4 686	8 387	31 686	21 322	2 335	3 330	5 933	74 654	115	..	155 624 ^f
1981	2 568	371 ^f	4 112	7 795	34 234	22 808	1 803	3 555	6 586	60 780	124	..	144 736 ^f
1982	2 379	357 ^f	3 105	6 320	29 133	19 778	1 498	2 526	5 714	56 231	161	..	127 202 ^f
1983	2 429	381 ^f	2 596	7 442	36 288	23 736	1 520	2 612	7 344	71 443	192	..	155 983 ^f
1984	2 889	400 ^f	3 894	8 378	36 519	28 130	1 698	2 726	8 457	74 556	177	..	167 824 ^f
1985	2 509	411 ^f	3 515	7 896	35 400	28 225	1 717	3 016	8 979	76 868	186	..	168 722 ^f
1986	2 408	424 ^f	4 004	8 720	38 127	30 186	1 703	3 529	10 387	77 503	199	..	177 190 ^f
1987	2 524	480	4 789	7 869	39 503	29 692	1 887	3 666	10 496	90 591	188	..	191 685
1988	2 513	476 ^f	5 039	9 199	39 381	29 338	1 883	3 818	11 990	86 807	172	..	190 616 ^f
1989	2 535	416 ^f	4 772	9 281	36 192	29 642	1 848	3 685	12 293	87 414	176	..	188 254 ^f
1990	2 876 ²	448 ^f	4 639 ²	8 824 ²	30 148 ²	25 420 ²	1 563 ²	2 758 ²	11 911	73 861	82	46	162 576 ^f
1991	2 680	452 ^f	4 348	8 643	28 943 ²	23 829 ³	1 278	2 957 ²	12 926 ²	74 706	79	46	160 887 ^f
1992	2 821 ²	510 ²	4 248 ²	9 205	31 002 ²	24 286 ³	1 598	3 081 ²	14 594 ²	78 579	162	49	170 134 ²
1993	3 131 ²	534 ²	4 585 ²	8 959	34 091 ^f	25 432 ³	1 539	4 433 ^f	14 897	78 004	193	203	175 999 ^f
1994	2 445	519 ²	5 106 ²	9 269	38 231 ^f	25 952 ³	1 786	4 468	19 790	75 093	421	181	183 261 ^f
1995	2 983	638	5 483 ²	10 055	41 438 ^f	26 260 ³	1 987	4 258	20 287	74 622 ³	357 ^f	127 ²	188 497 ^f
1996	2 742 ²	557 ³	6 012 ²	10 902 ³	38 267 ^f	25 871 ³	2 148	4 126	20 037	72 252 ³	254 ^f	202 ²	183 369 ^f
1997	2 558 ²	514 ^f	6 989 ²	11 253 ³	42 543 ^f	26 595 ³	2 183	4 205	22 217 ^f	69 298 ³	253 ^f	123	188 730 ^f
1998	2 398 ²	520	5 903 ^f	11 534 ²	43 427 ^f	24 126 ²	2 328	3 348	17 172 ^f	65 938 ²	110 ^f	142	176 944 ^f
1999	2 720 ²	693	6 164	11 294	45 646 ^f	24 814 ²	2 171	3 882	19 395 ^p	76 933	145 ^f	71	193 928 ^f
2000	2 868 ²	716 ²	6 470 ^f	11 872	43 485 ²	28 118 ²	2 188	4 197	21 927 ^p	78 457 ^f	33	22	200 354 ^f
2001	2 556 ²	626 ²	6 182 ^f	10 186	40 579	24 099	2 188 ²	4 119	23 392 ^p	73 637	39	22 ²	187 625 ^f

Notes:

1. Includes Nunavut.

2. Estimated by provincial or territorial forestry agency.

3. Estimated by the Canadian Forest Service or by Statistics Canada.

Source:

Canadian Council of Forest Ministers, National Forestry Database Program, nfdp.ccfm.org (accessed May 3, 2004).

Table B.43
Area of stocked timber-productive forest land burned, 1980 to 2002

Year	N.L.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Y.T.	N.W.T. ¹	National Parks	Canada
ha														
1980	680	..	559	2 116 ^f	4 902	330 825	304 049	89 237	465 451 ^f	32 743	111 537	12 975	..	1 355 074 ^f
1981	2 893	22	169	92	2 170	40 817	220 336 ^f	..	944 494 ^f	57 277	12 735	25 643	..	1 306 648 ^f
1982	4 392	25	359	5 407	7 202	297	7 094	..	462 674 ^f	280 676	68 127	2 536	..	838 789 ^f
1983	107	50	92	1 129	206 952	74 663	66 962	9 478	1 215 ^f	32 848	14 805	1 188	..	409 489 ^f
1984	1 565	8	193	270	2 397	2 219	51 099	47 281	35 259	12 227	6 995	134	21 366	181 013
1985	40 457	4	220	1 348 ^f	1 952	127	5 367	9 020	3 820	54 231	11 407	6	4 927	132 886 ^f
1986	23 511	85	268	37 216	173 296	50 598	5 495	4 031	1 587	9 474	3 132	11	2 663	311 367
1987	10 622	16	312	895	27 849	5 461	84 266	129 332	24 295	22 308	1 150	10	..	306 516
1988	7	2	89 ^f	1 778	273 066	35 994	295 930	24 187	5 149 ^f	3 284	288	3	..	639 777 ^f
1989	2 651	2	159	280	2 108 206	4 990	1 539 180	137 404	2 994 ^f	11 089	70 439	..	..	3 877 394 ^f
1990	2 601	4	477	5 198	76 825	3 200	6 728	71 198	22 143	52 575	16 704	0	25 041	282 694
1991	9 576	23	1 022	2 732	356 234	4 971	55 266	118 850	1 357	11 249	61 227	0	1 224	623 731
1992	1 014	8	805	4 668	24 295	10 331	185 299	12 768	720	17 212	3 785	0	1 941	262 846
1993	21	6	120	534	125 211	2 116	43 400	227 208	12 894	1 376	..	0	2 999	415 885
1994	692	7	67	239	2 830	410	552 571	79 641	8 610	20 737	..	0	76 436	742 240
1995	128	14	149	395	407 299 ^f	60 739	445 425	320 993	163 376	26 888	..	0	7 082	1 432 488 ^f
1996	8 519	0	172	1 591	410 342	179 207	..	4 755 ²	430	2 670	..	0	..	607 686 ²
1997	153	..	184	145	147 417	16 010	..	1 110	3 046	286	..	0	339	168 690
1998	4 630	..	168	275	16 721	57 659	..	..	234 095	..	..	0	..	313 548
1999	20 779	..	1 174	1 135	88 472	72 481	..	..	52 887	..	..	0	..	236 928
2000	68	..	359	269	603	613	..	..	3 802 ^f	14 376 ^f	..	0	..	20 090 ^f
2001	184	..	333	565	1 274	1 610	..	..	74 538 ^f	5 467	..	..	..	83 971
2002	1 238 ³	..	149	230	405 375	18 468	..	..	361 091	..	..	..	..	..

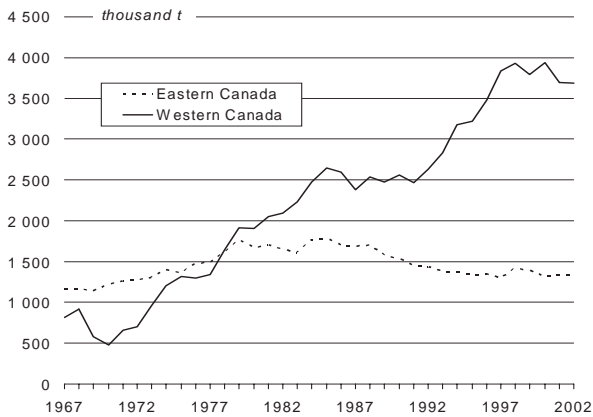
Notes:

- 1. Includes Nunavut.
- 2. Estimated by the Canadian Forest Service or by Statistics Canada.
- 3. Estimated by provincial or territorial forestry agency

Source:

Canadian Council of Forest Ministers, National Forestry Database Program, nfdp.ccfm.org (accessed July 12, 2004).

Figure B.5
Fertilizers sold in Eastern and Western Canada¹, 1967 to 2002



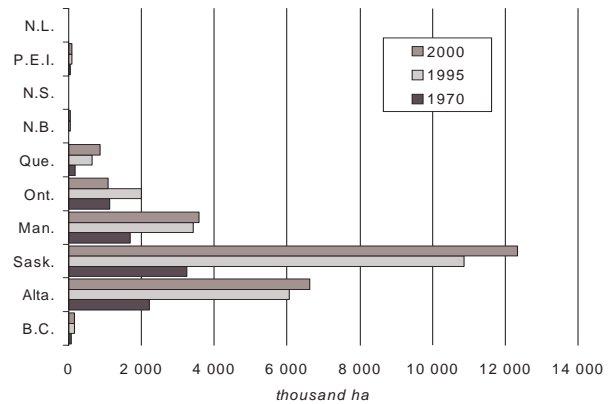
Note:

- 1. Eastern Canada corresponds to provinces east of Manitoba, while western Canada corresponds to provinces west of Ontario.

Source:

Korol, M. and G. Rattray, 2003, *Canadian Fertilizer Consumption, Shipments and Trade, 2001/2002*, Farm Inputs Markets Unit, Farm Income Policy and Programs Directorate, Agriculture and Agri-Food Canada, Ottawa.

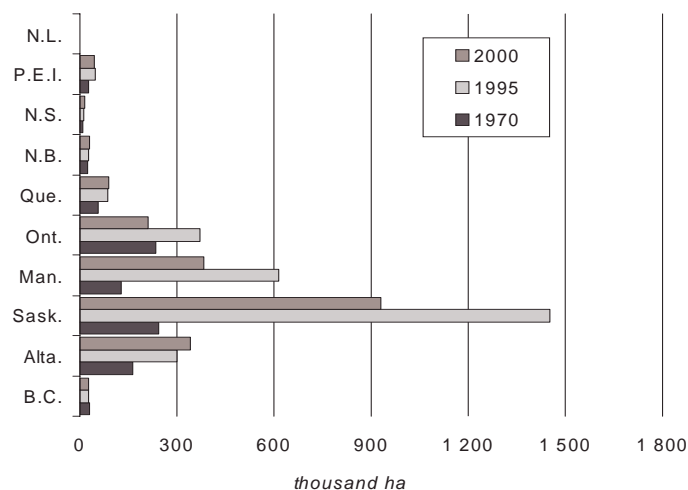
Figure B.6
Area of farmland treated with herbicides by province, 1970, 1995 and 2000



Source:

Statistics Canada, Census of Agriculture.

Figure B.7
**Area of farmland treated with insecticides by province,
 1970¹, 1995 and 2000**

**Note:**

1. Fungicides were also included.

Source:

Statistics Canada, Census of Agriculture.

Table B.44
Top ten substances released to land, 2002

Substance	Releases		Share of total
	t	%	%
Calcium fluoride	10 333.6		31.8
Zinc (and its compounds)	6 719.9		20.7
Manganese (and its compounds)	4 745.7		14.6
Ethylene glycol	1 980.4		6.1
Lead (and its compounds)	1 738.7		5.4
Ammonia (total) ¹	1 358.8		4.2
Vanadium (except when in an alloy) and its compounds	957.7		3.0
Chromium (and its compounds)	917.5		2.8
Sulphuric acid	791.7		2.4
Phthalic anhydride	610.0		1.9

Note:

1. Refers to the total of both ammonia (NH₃) and ammonium ion (NH₄⁺) in solution.

Source:

Environment Canada, Pollution Data Branch, National Pollutant Release Inventory Database, www.ec.gc.ca/pdb/npri/npri_dat_rep_e.cfm (accessed April 20, 2004).

Water

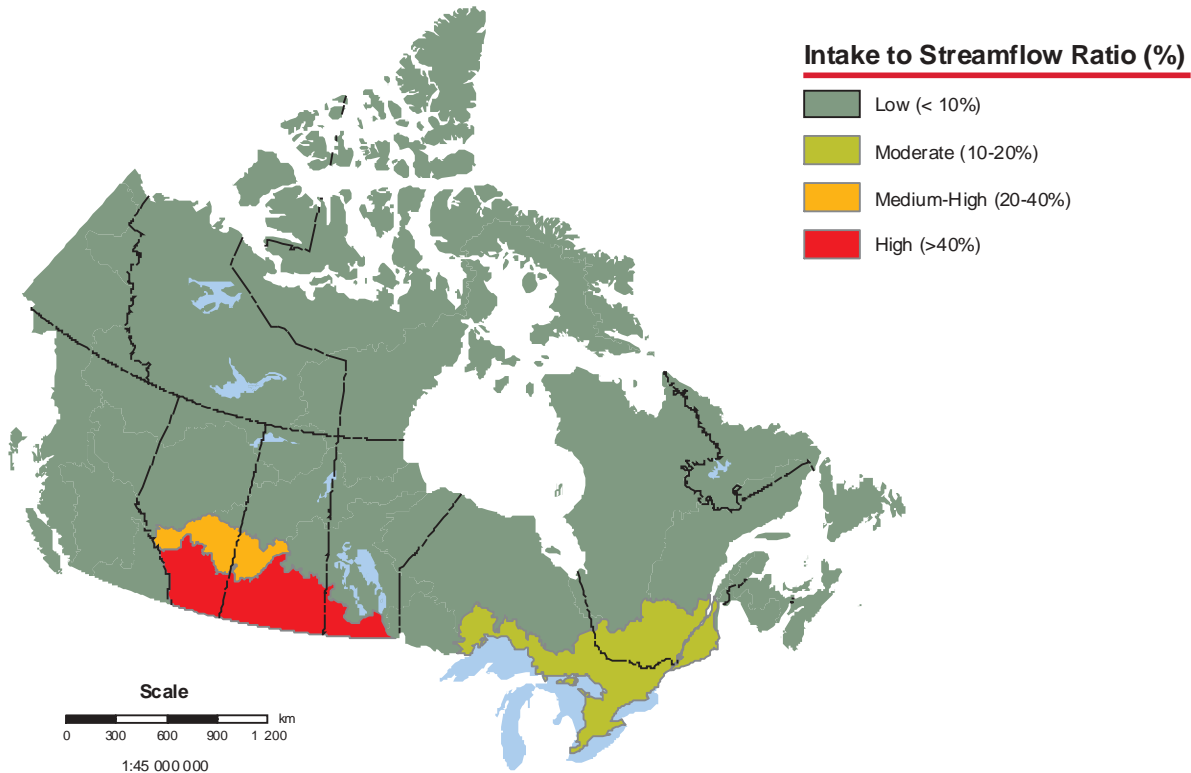
With 20% of the world's fresh water resources and 7% of the world's total renewable water flow, water remains a precious part of Canada's natural wealth. Used for power generation, transportation, recreation, irrigation, manufacturing, agriculture and drinking water, Canadian water use per capita is the second highest in the world. We also use our rivers, lakes and marine areas to dispose of municipal wastewater and wastes from industry. Some activities for which water is used can make it unfit for use by humans or wildlife.

Map B.1 illustrates the proportion of surface fresh water that is used by Canadians within each of Canada's major drainage areas. Although responsible for only 14% of total water intake, the South Saskatchewan, Missouri and Assiniboine-Red and the North Saskatchewan drainage areas have the highest ratios of water intake to streamflow (Table B.45).

The Great Lakes - St. Lawrence drainage area also stands out with water intake of 30.6 billion m³, used mainly for industrial (89%) and municipal (10%) uses. In contrast, 71% of total surface fresh water intake in the South Saskatchewan, Missouri and Assiniboine-Red drainage area, 2.9 billion m³, was for agricultural use (Table B.45).

In 2002, ammonia and nitrate made up 94% of the total tonnage of substances released by industrial facilities into water (Table B.46).

Map B.1
Water use and availability, by drainage area



Source:
 Statistics Canada, Environment Accounts and Statistics Division.

Table B.45
Streamflow and surface fresh water intake in Canada, by drainage area

Code	Drainage area ¹	Total streamflow ² km ³	Surface fresh water intake			Total	Water intake as share of streamflow %
			Municipal ³	Industrial ⁴	Agricultural ⁵		
1	Pacific Coastal and Yukon	595.90	192.68	597.69	78.73	869.10	0.15
2	Fraser - Lower Mainland	125.26	428.61	219.81	467.98	1 116.40	0.89
3	Columbia and Okanagan - Similkameen	65.69	71.54	109.38	228.17	409.10	0.62
4	Peace - Athabasca	91.55	28.01	169.82	21.69	219.49	0.24
5	Lower Mackenzie and Arctic Coast - Islands	507.13	6.57	5.62	0.00	12.22	0.00
6	North Saskatchewan	7.38	142.20	1 457.41	86.57	1 686.19	22.85
7	South Saskatchewan, Missouri and Assiniboine - Red	9.50	435.73	753.62	2 891.82	4 081.17	42.96
8	Winnipeg	23.90	11.48	197.23	1.14	209.85	0.88
9	Lower Saskatchewan - Nelson	60.27	14.09	31.90	24.10	70.09	0.12
10	Churchill	22.11	6.34	3.28	8.36	17.97	0.08
11	Keewatin - Southern Baffin	169.75	0.16	0.00	0.00	0.16	0.00
12	Northern Ontario	189.06	12.47	86.68	0.00	99.54	0.05
13	Northern Quebec	530.75	5.87	59.94	0.00	65.83	0.01
14	Great Lakes - St. Lawrence	226.96	3 087.12	27 229.02	271.64	30 587.41	13.48
15	North Shore - Gaspé	257.32	78.41	134.29	4.39	216.45	0.08
16	Saint John - St. Croix	24.57	97.39	109.78	2.77	209.93	0.85
17	Maritime Coastal	114.40	139.74	132.07	10.83	282.63	0.25
18	Newfoundland - Labrador	294.04	114.40	193.48	0.00	308.51	0.10
Canada		3 315.54	4 872.83	31 491.03	4 098.19	40 462.05	1.22

Notes:

- These major drainage areas and associated flow measures are adapted from Laycock (1987) (see full reference below). Some of these drainage area aggregates have more than one outflow. Drainage areas at the US-Canada border exclude inflow from United States.
- Streamflow is represented by the long-term annual average.
- Municipal water intake data is derived from the Municipal Water Use Database, Environment Canada, 1998.
- Industrial water intake data is derived from the Industrial Water Use Survey, Statistics Canada and Environment Canada, 1996.
- Agricultural water use estimates are from Statistics Canada.

Source:

Laycock, A.H., 1987, "The Amount of Canadian Water and its Distribution," in *Canadian Aquatic Resources*, no. 215 of *Canadian Bulletin of Fisheries and Aquatic Sciences*, M.C. Healey and R.R. Wallace (eds.), 13-42, Fisheries and Oceans Canada, Ottawa.

Table B.46
Top ten substances released to water, 2002

Substance	Releases	Share of total
	t	%
Ammonia (total) ¹	39 068.8	51.7
Nitrate ion in solution at pH >= 6.0	32 087.1	42.5
Sulphuric acid	1 455.3	1.9
Manganese (and its compounds)	1 205.4	1.6
Methanol	553.4	0.7
Chlorine	319.0	0.4
Zinc (and its compounds)	312.3	0.4
Copper (and its compounds)	119.2	0.2
Nickel (and its compounds)	52.7	0.1
Ethylene glycol	50.8	0.1

Note:

1. Refers to the total of both ammonia (NH₃) and ammonium ion (NH₄⁺) in solution.

Source:

Environment Canada, Pollution Data Branch, National Pollutant Release Inventory Database, www.ec.gc.ca/pdb/npri/npri_dat_rep_e.cfm (accessed April 20, 2004).

Wildlife

In the past, wildlife represented a major source of food, clothing and income for fur traders, settlers and First Nations peoples. Today, while many people prefer to simply view wildlife in a natural setting, hunting remains a popular recreational activity. Some continue to hunt and trap for their livelihood.

Table B.47 lists the number of Canada geese, American black ducks and mallards harvested in Canada from 1975 to 2002. While the number of Canada geese harvested in 2002 rose 82% since 1975, the number of American black ducks and mallards harvested dropped 60% and 68% respectively.

Tables B.48 and B.49 show the number and value of pelts harvested in 2001/02. Facing reduced demand for furs, the total number and value of pelts harvested decreased substantially in the late-1980s, although the drop in wild pelts was more pronounced (Figure B.8 and B.9).

As of 2003, 33 species of plants and animals were extinct or extirpated in Canada (Tables B.50 and B.51). Habitat alteration, whether through deforestation, conversion of wetlands, or land clearing for agriculture and urban development, is believed to have contributed to the loss of numerous species. Hunting and trapping activities led to the extinction and extirpation of several species before hunting laws were adopted.

Table B.47
Selected migratory game bird harvest in Canada, 1975 to 2002

Year	Canada geese	American black ducks	Mallards
	number		
1975	357 107	307 360	1 730 981
1976	317 772	335 983	1 935 165
1977	331 376	337 459	1 556 264
1978	396 397	371 782	1 523 053
1979	413 260	317 026	1 611 007
1980	454 686	363 863	1 533 583
1981	364 755	321 954	1 296 847
1982	405 068	337 060	1 213 913
1983	475 627	309 087	1 327 601
1984	420 537	306 523	1 059 245
1985	455 692	300 001	911 524
1986	452 378	296 168	879 145
1987	540 480	295 442	1 020 605
1988	395 214	301 222	668 420
1989	512 424	261 088	744 066
1990	507 953	243 537	734 534
1991	473 955	225 938	629 139
1992	380 480	206 511	579 810
1993	434 257	203 313	536 999
1994	414 220	175 459	625 412

Table B.47
Selected migratory game bird harvest in Canada, 1975 to 2002 (continued)

Year	Canada geese		American black ducks		Mallards
	number				
1995	396 004		187 161		603 342
1996	500 105		163 601		641 090
1997	489 478		165 469		718 698
1998	531 353		158 379		663 919
1999	565 242		174 943		633 196
2000	612 056		154 918		676 376
2001	636 997		124 068		591 749
2002	650 258		122 635		546 582

Source:

Environment Canada, Canadian Wildlife Services, *Population Status of Migratory Game Birds in Canada (and Regulation Proposals for Overabundant Species) - November 2003*, www.cws-scf.ec.gc.ca/publications/AbstractTemplate.cfm?lang=e&id=1043 (accessed June 28, 2004).

Table B.48
Pelts harvested by province and territory, 2001/02

Species	N.L.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Y.T.	N.W.T.	Nvt.	Canada
Wild¹														
Badger	0	0	0	0	0	0	120	237	133	0	0	0	0	490
Bear	63	0	286	17	1 604	109	867	151	64	105	0	26	103	3 395
Beaver	3 076	613	5 792	12 425	69 134	80 023	28 345	28 836	19 513	4 777	286	1 576	0	254 396
Coyote (prairie wolf)	45	459	1 587	1 893	4 301	1 253	4 537	18 843	21 321	982	12	2	0	55 235
Ermine (weasel)	1 116	30	1 075	1 755	14 054	3 485	2 983	1 862	1 505	2 056	36	76	0	30 033
Fisher	0	0	128	831	7 388	8 027	2 291	2 737	1 535	307	1	6	0	23 251
Fox	7 155	851	797	1 574	19 166	3 773	1 857	3 401	1 729	306	28	1 576	5 952	48 165
Lynx	633	0	0	0	3 588	1 343	575	1 763	1 667	864	214	579	0	11 226
Marten	2 507	0	0	3 324	39 568	23 570	13 959	2 823	4 549	12 342	1 646	8 336	2	112 626
Mink	4 308	414	1 889	1 118	9 585	9 560	3 347	2 017	600	695	37	682	0	34 252
Muskrat	1 491	3 219	18 779	23 472	70 231	85 258	40 513	22 559	8 021	2 214	451	3 905	0	280 113
Otter	1 168	0	625	657	4 442	6 709	2 337	1 433	226	542	9	7	0	18 155
Raccoon	0	999	2 725	3 432	13 670	33 818	2 568	1 182	39	117	0	0	0	58 550
Skunk	0	0	96	24	132	273	0	25	25	8	0	0	0	583
Squirrel	2 669	39	4 251	474	5 402	2 045	5 849	9 924	39 059	6 879	289	57	0	76 937
Wildcat or bobcat	0	0	1 394	530	0	0	11	10	11	114	0	0	0	2 070
Wolf	47	0	0	0	356	463	272	387	246	160	141	167	465	2 704
Wolverine	0	0	0	0	0	2	39	14	19	183	110	111	33	511
Other ²	76	0	0	0	0	211	0	3	0	0	0	1 339	5 077	6 706
Total wild	24 354	6 624	39 424	51 526	262 621	259 922	110 470	98 207	100 262	32 651	3 260	18 445	11 632	1 019 398
Ranch-raised³														
Fox	1 800	1 190	2 200	1 690	1 900	910	150	230	x	x	.	.	.	13 160
Mink	x	27 000	465 000	x	50 100	268 900	35 500	0	x	238 200	.	.	.	1 133 900
Total ranch-raised	x	28 190	467 200	x	52 000	269 810	35 650	230	33 530	x	.	.	.	1 147 060

Notes:

1. Data on wildlife furs are on a "fur year basis" which is from July 1 to June 30.
2. Includes hair seals and other fur-bearing animals.
3. The ranched fur estimates operate on a calendar year basis, with most ranch peltings occurring in the fall.

Source:

Statistics Canada, 2003, *Fur Statistics*, Vol. 1, No. 2, Catalogue no. 23-013-XIE, Ottawa.

Table B.49
Value of pelts harvested by province and territory, 2001/02

Species	N.L.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Y.T.	N.W.T.	Nvt.	Canada
Wild¹														
Badger	0	0	0	0	0	0	5 876	9 928	4 100	0	0	0	0	19 904
Bear	8 688	0	33 542	1 604	203 080	11 568	93 792	16 263	8 733	16 478	0	5 311	91 217	490 276
Beaver	75 331	16 376	158 006	333 238	1 695 857	1 600 460	744 907	631 931	486 654	128 645	7 722	30 452	0	5 909 579
Coyote (prairie wolf)	1 367	14 850	49 721	55 484	144 040	23 293	131 074	711 065	849 429	30 678	444	25	0	2 011 470
Ermine (weasel)	4 654	135	4 117	8 652	66 616	13 104	12 648	8 832	7 992	12 315	198	349	0	139 612
Fisher	0	0	5 644	36 672	321 082	318 190	80 620	100 349	69 075	13 336	45	223	0	945 236
Fox	326 871	50 405	30 150	76 040	896 941	130 351	47 473	103 976	68 736	11 343	1 288	46 006	159 620	1 949 200
Lynx	63 192	0	0	0	385 064	112 664	56 540	155 788	211 309	95 325	23 754	67 587	0	1 171 223
Marten	158 668	0	0	134 655	1 781 747	919 230	710 234	105 310	256 564	564 276	88 884	508 093	82	5 227 743

Table B.49
Value of pelts harvested by province and territory, 2001/02 (continued)

Species	N.L.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Y.T.	N.W.T.	Nvt.	Canada
	\$													
Mink	64 060	7 746	32 113	19 151	161 795	135 465	57 702	34 128	11 442	11 648	703	14 120	0	550 073
Muskrat	4 607	20 016	104 787	115 717	332 895	345 295	135 719	75 122	21 897	6 177	1 804	11 050	0	1 175 086
Otter	122 955	0	69 738	62 514	415 949	531 957	265 694	142 551	35 066	58 959	819	606	0	1 706 808
Raccoon	0	18 234	52 810	65 997	234 987	515 048	48 766	21 934	732	1 438	0	0	0	959 946
Skunk	0	0	807	191	998	1 731	0	154	175	25	0	0	0	4 081
Squirrel	3 977	70	8 417	711	8 157	2 393	7 604	15 531	83 977	14 308	636	127	0	145 908
Wildcat or bobcat	0	0	178 990	66 266	0	0	1 721	2 865	1 721	11 473	0	0	0	263 036
Wolf	7 948	0	0	0	30 637	40 272	31 737	71 617	27 923	18 574	31 161	49 904	114 298	424 071
Wolverine	0	0	0	0	0	421	7 915	3 505	4 861	54 245	37 070	35 334	9 724	153 075
Other ²	2 194	0	0	0	0	449	0	38	0	0	0	80 340	167 286	250 307
Total wild	844 512	127 832	728 842	976 892	6 679 845	4 701 891	2 440 022	2 210 887	2 150 386	1 049 243	194 528	849 527	542 227	23 496 634
Ranch-raised³														
Fox	89 424	59 119	109 296	83 960	94 392	45 209	7 452	11 426	x	x	.	.	.	653 789
Mink	x	1 007 732	21 108 384	x	2 172 858	11 354 310	1 628 851	0	x	9 847 144	.	.	.	49 317 550
Total ranch-raised	x	1 066 851	21 217 680	x	2 267 250	11 399 519	1 636 303	11 426	1 552 210	x	.	.	.	49 971 339

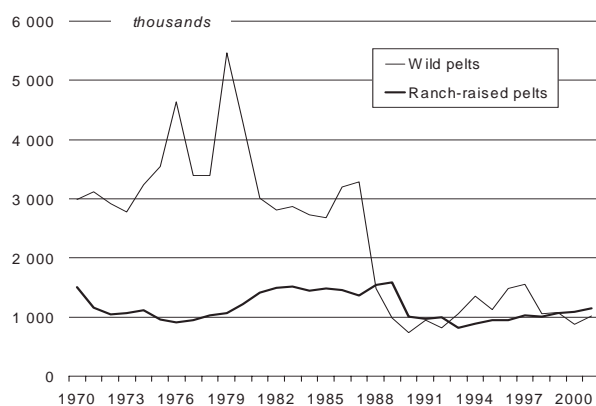
Notes:

1. Data on wildlife furs are on a "fur year basis" which is from July 1 to June 30.
2. Includes hair seals and other fur-bearing animals.
3. The ranched fur estimates operate on a calendar year basis, with most ranch peltings occurring in the fall.

Source:

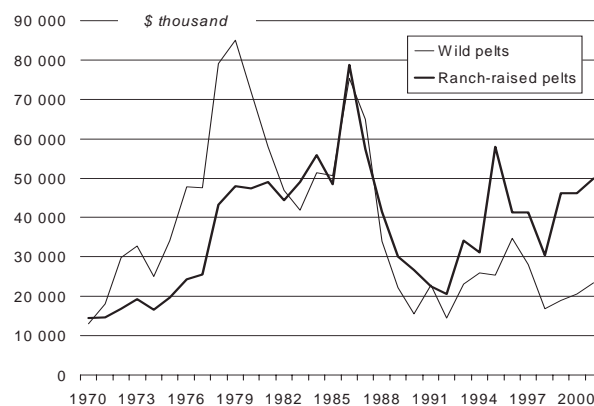
Statistics Canada, 2003, *Fur Statistics*, Vol. 1, No. 2, Catalogue no. 23-013-XIE, Ottawa.

Figure B.8
Number of pelts harvested, 1970 to 2001

**Source:**

Statistics Canada, CANSIM, table 003-0013.

Figure B.9
Value of pelts harvested, 1970 to 2001

**Source:**

Statistics Canada, CANSIM, table 003-0013.

Table B.50
Species extinct and extirpated in Canada, 2003

Species ¹	Group	Extinction date	Probable cause(s) of extinction ² or extirpation ³
Extinct²			
Benthic Hadley Lake stickleback	fish	1999	introduced predators
Limnetic Hadley Lake stickleback	fish	1999	introduced predators
Banff longnose dace	fish	1986	introduced predators; habitat alteration
Blue walleye	fish	1965	commercial fishing; introduced predators
Deepwater cisco	fish	1952	commercial fishing; introduced predators
Eelgrass limpet	mollusc	1929	loss of food source
Caribou (<i>dawsoni</i> subspecies)	mammal (terrestrial)	1920s	unknown
Passenger pigeon	bird	1914	hunting and predation
Sea mink	mammal (marine)	1894	trapping
Labrador duck	bird	1875	hunting; habitat alteration
Macoun's shining moss	moss	1864	habitat alteration
Great auk	bird	1844	hunting
Extirpated³			
Karner blue	arthropods	1991	loss of food source; habitat alteration
Frosted elfin	arthropods	1988	successional change
Greater prairie-chicken	bird	1987	habitat alteration
Black-footed ferret	mammal (terrestrial)	1974	loss of food source
Dwarf wedgemussel	mollusc	1968	habitat alteration
Greater sage grouse (<i>phaios</i> subspecies)	bird	1960s	hunting; habitat alteration
Pacific pond turtle	reptile	1959	commercial harvesting; habitat alteration
Gravel chub	fish	1958	habitat alteration
Pacific gophersnake	reptile	1957	habitat alteration
Spring blue-eyed Mary	plant	1954	habitat alteration
Timber rattlesnake	reptile	1941	hunting; habitat alteration
Paddlefish	fish	1917	habitat alteration; over-fishing
Tiger salamander (Great Lakes population)	amphibian	1915	habitat alteration
Island marble	arthropods	before 1910	loss of food source; habitat alteration
Puget Oregonian snail	mollusc	1905	unknown
Pygmy short-horned lizard (British Columbia population)	reptile	1898	habitat alteration
Illinois tick-trefoil	plant	1888	habitat alteration
Grizzly bear (Prairie population)	mammal (terrestrial)	1880s	hunting
Atlantic walrus (northwest Atlantic population)	mammal (marine)	mid 19th century	hunting
Incurved grizzled moss	moss	1828	unknown
Grey whale (Atlantic population)	mammal (marine)	1800s	hunting

Notes:

1. Any indigenous species, subspecies, variety, or geographically or genetically distinct population of wild fauna and flora.

2. A species that no longer exists.

3. A species no longer existing in the wild in Canada, but occurring elsewhere.

Source:

Environment Canada, 2003, *Canadian Species at Risk*, Canadian Wildlife Service, Committee on the Status of Endangered Wildlife in Canada, Ottawa.

Table B.51
Species¹ extinct and at risk in Canada, 2003

Group	Status assessment					Total
	Extinct ²	Extirpated ³	Endangered ⁴	Threatened ⁵	Special concern ⁶	
	number					
Mammals						
Terrestrial	1	2	10	7	16	36
Marine	1	2	12	6	8	29
Birds	3	2	22	9	22	58
Fish	5	2	20	22	29	78
Amphibians	0	1	5	5	8	19
Reptiles	0	4	5	11	11	31
Molluscs	1	2	11	2	3	19
Arthropods⁷	0	3	6	5	2	16
Vascular plants	0	2	62	39	37	140
Lichens	0	0	2	0	4	6
Mosses	1	1	5	2	0	9
Total	12	21	160	108	140	441

Notes:

1. Any indigenous species, subspecies, variety, or geographically or genetically distinct population of wild fauna and flora.

2. A species that no longer exists.

3. A species no longer existing in the wild in Canada, but occurring elsewhere.

4. A species facing imminent extirpation or extinction.

5. A species likely to become endangered if limiting factors are not reversed.

6. A species whose characteristics make it particularly sensitive to human activities or natural events.

7. Formerly described as lepidopterans.

Source:

Environment Canada, 2003, *Canadian Species at Risk*, Canadian Wildlife Service, Committee on the Status of Endangered Wildlife in Canada, Ottawa.

C) Response

Legislation

The Canadian Environmental Protection Act (CEPA) provides enforcement officers with the authority to address cases of alleged non-compliance with the Act. Enforcement activities include inspection to verify compliance, investigation of alleged violations, measures to compel compliance without resorting to formal court action, and measures to compel compliance through court action.

Enforcement activities declined steadily between 1991/92 and 1996/97 but have since risen significantly due to an increase in the number of inspections conducted and warnings issued (Table C.1). The number of prosecutions varies considerably from year to year with as many as 27 handed down in 2001/02, to only 4 in 2002/03.

Table C.1
Canadian Environmental Protection Act enforcement activities, 1991/92 to 2002/03¹

Enforcement activity	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03
Inspections ²	1 616	1 278	1 571	1 335	963	708	1 523	1 555	779	1 446	1 628	1 934
Investigations	115	96	55	64	45	33	56	77	64	20	57	36
Warnings	82	105	133	127	85	30	204	249	468	450	517	345
Directions	6	4	1	1	0	2	0	9	9	22	5	3
Prosecutions	17	26	3	9	13	5	8	3	26	11	27	4
Convictions	10	18	11	12	6	7	3	1	1	7	7	3
Total	1 846	1 527	1 774	1 548	1 112	785	1 794	1 894	1 347	1 956	2 241	2 325

Notes:

1. This date is based upon a fiscal year.

2. This number represents the number of on-site inspections (field/site inspections). It does not include off-site inspections (administrative verifications).

Source:

Environment Canada, *Canadian Environmental Protection Act* annual reports, www.ec.gc.ca/ele-ale/stats/stats_e.asp/ (accessed April 26, 2004).

Protected areas

From 1989 to 2003, Canada's total protected land area increased from 29 million hectares to 82 million hectares (Table C.2). The share of total land protected varies provincially; in 2003, for example, it ranged from 2.6% in Prince Edward Island to 13.0% in British Columbia.

Table C.2
Total area protected by province and territory, 1989 and 2003

Province/Territory	1989		2003		Change in protected area as a share of total land 1989 to 2003
	Total area protected ¹	Protected area as a share of total land	Total area protected ¹	Protected area as a share of total land	
	ha	%	ha	%	
Newfoundland and Labrador	367 500	0.9	1 701 412	4.3	3.4
Prince Edward Island	6 000	1.0	14 780	2.6	1.5
Nova Scotia	138 700	2.4	465 363	8.2	5.7
New Brunswick	88 800	1.2	233 443	3.1	1.9
Quebec	622 800	0.4	5 217 586	3.5	3.1
Ontario	5 152 900	5.2	9 142 039	9.2	4.0
Manitoba	315 400	0.5	5 402 416	8.5	8.0
Saskatchewan	1 936 000	3.0	2 243 230	3.5	0.5
Alberta	5 642 000	8.7	8 009 229	12.3	3.6
British Columbia	4 958 300	5.4	12 017 617	13.0	7.6
Yukon Territory	3 218 300	6.8	5 678 119	12.0	5.2
Northwest Territories and Nunavut	6 978 550	2.0	31 752 615	9.3	7.2
Canada	29 425 250	3.0	81 877 849	8.4	5.4

Note:

1. Defined by World Wildlife Fund Canada as those areas that are permanently protected through legislation and that prohibit industrial uses such as logging, mining, hydro-electric development, oil and gas and other large scale developments. For the 2003 values, only those areas that contribute to ecological representation were considered.

Sources:

World Wildlife Fund Canada, 2000, *Endangered Spaces; The Wilderness Campaign that Changed the Canadian Landscape 1989-2000*, Toronto.

World Wildlife Fund Canada, 2003, *The Nature Audit: Setting Canada's Conservation Agenda for the 21st Century*, Toronto.

Environmental protection expenditures

Total environmental protection expenditures by Canadian businesses reached \$6.8 billion in 2002, up from \$5.4 billion in 2000 (Tables C.3 and C.4). Operating expenditures on environmental protection by industry totalled \$3.8 billion in 2002, up from almost \$3.3 billion in 2000, representing an 18% increase. Business capital expenditures made for the purpose of protecting the environment increased 36%, from \$2.2 billion in 2000 to \$3.0 billion in 2002. The industry with the highest total environmental protection expenditures in 2002 was the Oil and Gas Extraction Industry (\$1.1 billion).

Approximately 50% of the total capital expenditures on pollution prevention were directed towards processes aimed at preventing the release of substances to air (Table C.5) in 2000. Capital expenditures on pollution abatement and control (PAC) projects were also directed largely at mitigating the release of air pollutants, accounting for 64% of PAC capital spending in 2000 (Table C.6). Pollution prevention and pollution abatement and control expenditures on water totalled \$249 and \$195 million respectively, representing 26% and 22% of total capital expenditures by these types of activities in 2000.

Table C.7 outlines expenditures on PAC and water purification and supply from 1990/91 to 2000/01 for all levels of government in Canada. Of the \$6.2 billion spent on PAC in 2000/01 by government, 43%, or \$2.7 billion, was allocated to sewage collection and disposal, and 24% (\$1.5 billion) to waste collection and disposal. A further 10% were spent on other pollution control activities and 23% on other environmental services. Expenditures allocated to water purification and supply at the federal government level increased from \$7 million in 1990/91 to \$325 million in 2000/01.

In 2001, total expenditures on forest management in Canada were estimated at approximately \$1.3 billion. Table C.8 outlines government expenditures on forest management by activity. Government spending on silviculture has dropped significantly since 1990 (from \$551 thousand to \$193 thousand) while spending on other forest management activities has remained relatively stable.

Table C.3

Operating expenditures on environmental protection by industry and type of activity, 1995 to 2002, selected years

Year/Industry	Environmental monitoring	Environmental assessments and audits	Reclamation and decommissioning	Wildlife and habitat protection	Pollution abatement and control processes (end-of-pipe), waste management and sewerage services	Pollution prevention processes	Fees, fines and licences	Other	Total
1995									
Logging	3.2	10.8	21.2	44.4	8.7	0.2	8.8	2.6	99.8
Crude petroleum and natural gas	7.9	4.1	47.7	1.1	97.6	9.5	2.3	19.7	189.8
Mining	23.5	8.8	68.3	7.4	105.5	9.5	3.8	12.2	239.0
Electric power systems	8.7	19.3	25.7	x	45.0	x	x	79.8	283.6
Food	7.6	3.2	2.0	0.5	61.3	2.3	3.4	2.0	82.3
Beverage	1.1	0.5	0.9	0.0	12.7	0.2	0.8	2.0	18.3
Pulp and paper	68.9	7.5	8.0	6.1	145.0	31.3	12.3	23.3	302.5
Refined petroleum and coal products	4.4	0.6	34.7	x	58.0	x	x	3.8	102.1
Chemicals	26.6	7.7	23.4	0.7	80.3	5.7	1.4	9.8	155.4
Non-metallic mineral products	4.1	1.3	9.0	0.3	13.6	3.9	1.5	2.3	36.0
Primary metals	35.5	4.1	27.6	4.0	208.9	84.1	4.5	10.8	379.4
Pipeline transport and gas distribution systems	5.5	1.9	3.4	0.3	8.8	1.1	1.6	8.5	31.1
Operating expenditures, excluding "other manufacturing"	197.1	69.6	271.7	88.5	845.4	210.1	60.1	176.9	1 919.5
Other manufacturing ^{1,2}	..	..	..	..	..	..	..	..	466.6
Total	..	..	..	..	..	..	..	..	2 386.1
1996									
Logging	3.5	8.5	24.8	84.3	13.4	0.1	6.0	1.8	142.5
Crude petroleum and natural gas	18.2	5.1	85.2	7.6	98.2	3.6	3.8	34.3	256.0
Mining	29.5	7.4	68.6	5.6	117.2	14.9	5.3	22.8	271.3
Electric power systems	8.8	22.5	13.4	x	95.7	x	42.0	23.5	297.6
Food and tobacco products	9.3	2.7	4.9	1.5	69.9	3.1	4.8	4.6	100.7
Beverage	1.1	0.4	0.4	0.0	14.0	0.1	2.4	2.3	20.6
Pulp and paper	92.1	12.6	7.6	18.0	236.8	31.8	9.6	21.3	429.8
Refined petroleum and coal products	22.7	2.6	5.1	x	114.8	42.1	x	22.2	212.5
Chemicals	37.5	9.1	38.3	x	102.3	x	x	15.4	216.5
Non-metallic mineral products	4.2	1.5	5.3	0.1	14.3	0.3	2.5	3.3	31.5

Table C.3

Operating expenditures on environmental protection by industry and type of activity, 1995 to 2002, selected years (continued)

Year/Industry	Environmental monitoring	Environmental assessments and audits	Reclamation and decommissioning	Wildlife and habitat protection	Pollution abatement and control processes	Pollution prevention processes	Fees, fines and licences	Other	Total
					(end-of-pipe), waste management and sewerage services				
\$ million									
Primary metals	33.2	5.3	40.7	6.9	293.3	80.0	6.8	19.6	485.8
Transportation equipment	5.2	2.1	4.7	0.1	99.5	3.7	0.8	9.7	125.8
Pipeline transport and gas distribution systems	1.4	2.6	5.7	x	11.4	0.0	x	12.6	35.7
Operating expenditures, excluding "other manufacturing"	266.8	82.3	304.6	142.7	1 280.9	265.8	89.7	193.3	2 626.0
Other manufacturing ²	..	..	..	..	..	..	..	..	357.7
Total	..	..	..	..	..	..	..	..	2 983.8
1997									
Logging	1.6	3.1	10.5	68.8	7.9	1.7	0.5	2.0	96.1
Crude petroleum and natural gas	17.4	13.4	107.4	1.6	61.1	15.2	6.8	26.0	248.8
Mining	20.4	7.5	54.9	3.2	122.4	39.0	4.1	20.0	271.6
Electric power systems	6.4	x	x	25.6	70.2	x	30.2	28.7	240.3
Food and tobacco products	8.3	x	x	0.6	70.6	x	9.7	3.4	115.8
Beverage	0.6	0.5	1.4	0.0	13.4	1.3	2.8	2.2	22.2
Wood products ³	5.9	2.2	5.9	10.4	28.9	8.9	6.6	2.8	71.7
Pulp and paper	52.6	11.9	6.4	25.4	251.1	95.7	9.2	26.1	478.3
Refined petroleum and coal products	7.3	3.8	32.8	0.5	111.2	66.0	0.2	13.5	235.3
Chemicals	31.9	7.0	30.6	1.3	104.7	34.1	2.2	15.1	226.9
Non-metallic mineral products	1.8	3.2	6.2	0.0	17.6	5.5	1.4	3.4	39.1
Primary metals	44.0	5.6	28.5	6.0	319.0	60.5	4.9	16.9	485.4
Transportation equipment	6.5	2.7	2.8	3.8	101.7	12.0	1.4	8.7	139.5
Pipeline transport and gas distribution systems	1.4	2.6	5.0	0.3	13.4	2.9	0.9	8.3	34.8
Operating expenditures, excluding "other manufacturing"	206.1	81.0	298.2	147.4	1 293.2	421.8	80.9	177.2	2 705.9
Other manufacturing ²	..	..	..	..	..	..	..	..	291.2
Total	..	..	..	..	..	..	..	..	2 997.1
1998⁴									
Logging	3.0	5.0	19.1	70.4	5.4	4.4	1.4	7.8	116.5
Oil and gas extraction	16.0	8.6	110.2	1.3	55.0	26.4	9.2	31.7	258.4
Mining	20.6	4.8	55.8	2.3	104.9	38.7	4.6	17.2	248.8
Electric power generation, transmission and distribution	6.6	34.2	5.7	12.0	x	5.3	32.7	x	295.6
Natural gas distribution	0.3	1.6	0.6	0.1	2.4	0.7	0.1	3.2	8.9
Food	11.0	2.6	0.2	3.7	78.4	14.2	9.6	4.0	123.7
Beverage and tobacco products ⁵	0.8	0.5	0.9	..	13.3	1.6	2.3	1.8	21.2
Wood products	8.5	2.4	15.8	29.4	x	21.4	5.6	x	137.6
Pulp, paper and paperboard mills	43.7	3.6	3.3	11.4	241.9	62.8	8.0	12.8	387.5
Petroleum and coal products ⁵	7.3	2.4	4.2	..	101.5	56.4	1.1	14.4	187.3
Chemicals	25.0	6.5	42.3	1.3	101.5	34.5	2.5	18.3	231.9
Non-metallic mineral products	2.5	3.3	2.8	1.0	20.8	5.9	2.8	4.1	43.2
Primary metals	37.2	5.8	16.9	5.8	275.7	61.4	2.7	13.6	419.2
Transportation equipment	5.8	2.3	18.0	0.1	89.8	10.8	0.9	11.7	139.4
Pipeline transportation ⁶	2.0	0.7	4.2	0.3	8.1	4.4	1.4	11.2	32.2
Operating expenditures, excluding "other manufacturing"	190.2	84.3	300.1	139.2	1 304.8	348.8	84.9	199.1	2 651.4
Other manufacturing ²	..	..	..	..	..	..	..	..	338.8
Total	..	..	..	..	..	..	..	..	2 990.2
2000⁷									
Logging	3.8	9.4	29.6	106.4	3.8	3.8	1.2	3.4	161.4
Oil and gas extraction	19.7	15.0	117.4	3.0	81.2	35.7	12.9	39.7	324.7
Mining	25.5	14.4	53.2	4.1	99.9	44.1	8.7	17.7	267.6
Electric power generation, transmission and distribution	9.1	16.4	23.0	6.8	106.3	28.9	10.5	54.9	255.8
Natural gas distribution ⁸	0.2	0.3	0.5	..	1.7	0.4	0.1	3.0	6.1
Food	15.5	3.6	7.6	0.5	84.8	11.1	13.4	4.2	140.7
Beverage and tobacco products ⁸	1.1	1.1	0.0	..	14.0	1.1	4.7	1.3	23.4
Wood products	8.5	5.0	18.8	17.5	69.1	11.2	7.7	5.9	143.7
Pulp, paper and paperboard mills	51.1	5.1	12.2	6.8	263.3	67.7	6.0	13.3	425.4
Petroleum and coal products	7.3	7.0	11.2	0.9	85.6	75.5	9.6	15.9	212.9
Chemicals	29.9	6.3	22.5	1.1	106.9	42.4	1.8	21.3	232.0
Non-metallic mineral products	2.9	1.9	5.0	0.7	21.4	6.1	2.8	2.8	43.6

Table C.3

Operating expenditures on environmental protection by industry and type of activity, 1995 to 2002, selected years (continued)

Year/Industry	Environmental monitoring	Environmental assessments and audits	Reclamation and decommissioning	Wildlife and habitat protection	Pollution abatement and control processes	Pollution prevention processes	Fees, fines and licences	Other	Total
					(end-of-pipe), waste management and sewerage services				
\$ million									
Primary metals	40.4	8.6	28.4	2.0	327.2	64.4	4.3	15.3	490.6
Fabricated metal products ⁹	3.1	1.5	1.5	0.1	52.8	5.2	0.4	5.0	69.6
Transportation equipment	6.5	4.6	2.5	0.1	119.3	15.8	1.5	19.9	170.2
Pipeline transportation ⁶	5.2	6.8	18.2	3.9	6.4	10.1	3.8	6.5	61.0
Operating expenditures, excluding 'other manufacturing'	229.8	106.8	351.7	153.8	1 443.8	423.6	89.3	230.0	3 028.9
Other manufacturing ²	..	..	..	..	..	..	..	..	241.7
Total	..	..	..	..	..	..	..	..	3 270.6
2002⁷									
Logging	3.6	8.9	21.5	82.2	5.3	6.4	2.8	5.0	135.6
Oil and gas extraction	32.5	18.2	155.9	9.6	177.1	53.7	15.4	77.1	539.5
Mining	27.0	11.3	73.7	3.3	91.5	34.8	7.7	28.8	278.1
Electric power generation, transmission and distribution	17.1	20.7	28.6	12.0	83.7	88.1	10.3	65.3	325.8
Natural gas distribution ⁸	1.2	0.8	0.8	0.6	1.9	2.0	0.1	2.4	9.9
Food	22.9	12.5	19.5	0.6	97.3	33.8	17.1	7.9	211.6
Beverage and tobacco products ⁸	1.0	0.4	2.0	0.0	9.3	1.2	4.3	1.3	19.5
Wood products	8.9	4.0	21.0	27.4	42.2	10.1	3.8	8.3	125.9
Pulp, paper and paperboard mills	41.6	6.5	12.9	1.8	265.1	69.2	8.2	16.5	421.8
Petroleum and coal products	7.1	3.0	76.4	0.1	80.1	68.0	2.6	7.1	244.3
Chemicals	41.2	6.9	20.4	5.2	133.0	69.8	3.0	23.0	302.5
Non-metallic mineral products	5.3	2.0	20.7	0.1	27.1	6.0	5.4	10.2	76.9
Primary metals	38.1	11.1	11.2	5.6	366.1	69.2	5.1	16.2	522.5
Fabricated metal products ⁹	4.6	6.8	0.1	2.6	57.2	4.9	0.6	7.5	84.4
Transportation equipment	7.4	4.5	11.9	0.1	134.2	14.8	0.8	28.3	201.9
Pipeline transportation ⁶	3.1	3.9	13.0	1.6	17.1	10.3	1.5	7.6	58.3
Operating expenditures, excluding 'other manufacturing'	262.8	121.7	489.8	153.8	1 558.0	542.3	88.6	312.4	3 558.4
Other manufacturing ²	..	..	..	..	..	..	..	..	288.5
Total	..	..	..	..	..	..	..	..	3 846.9

Notes:

Figures may not add up to totals due to rounding.

1. In 1995, transportation equipment is included in 'other manufacturing' because of data quality constraints.

2. Detail of the expenditure breakdown by type of environmental protection activity is only available for the listed industries.

3. Before 1997 the wood products industry was included with 'other manufacturing'.

4. Before the 1998 reference year establishments were selected based on the 1980 Standard Industrial Classification System (SIC). However, beginning with reference year 1998, industry selection was based on the North American Industry Classification System (NAICS). For further information, see *Environmental Protection Expenditures in Business Sector 1998*, (Catalogue no. 16F0006XIE).

5. Operating expenditures on wildlife and habitat protection are included with operating expenditures on reclamation and decommissioning.

6. Includes the two following industries: pipeline transport and gas distribution systems.

7. As of reference year 1998, the Survey of Environmental Protection Expenditures is being conducted every two years. The survey was not conducted for reference year 1999.

8. Operating expenditures on wildlife and habitat protection are included with operating expenditures on other.

9. Before 2000 the fabricated metal products industry was included with 'other manufacturing'.

Source:

Statistics Canada, Environment Accounts and Statistics Division.

Table C.4

Capital expenditures on environmental protection by industry and type of activity, 1995 to 2002, selected years

Year/Industry	Environmental monitoring	Environmental assessments and audits	Reclamation and decommissioning	Wildlife and habitat protection	Pollution abatement and control processes	Pollution prevention processes	Total
					(end-of-pipe)		
\$ million							
1995							
Logging	0.1	x	0.2	x	3.3	0.6	7.9
Crude petroleum and natural gas	3.2	5.9	82.1	1.1	209.1	16.5	317.9
Mining	11.0	0.6	21.7	0.1	45.6	5.4	84.5
Electric power systems	9.4	x	10.4	x	47.4	16.1	146.0
Pipeline transport and gas distribution systems	2.8	2.1	4.1	1.7	13.4	5.5	29.7
Food	2.4	x	0.8	x	13.1	7.8	24.4

Table C.4
Capital expenditures on environmental protection by industry and type of activity, 1995 to 2002, selected years (continued)

Year/Industry	Environmental monitoring	Environmental assessments and audits	Reclamation and decommissioning	Wildlife and habitat protection	Pollution abatement and control processes (end-of-pipe)	Pollution prevention processes	Total
Beverage	1.4	0.1	0.7	0.0	1.6	3.7	7.5
Pulp and paper	11.3	2.2	6.6	3.8	670.0	128.5	822.3
Refined petroleum and coal products	16.1	0.5	0.3	0.0	67.1	12.4	96.5
Chemicals	10.5	0.2	16.8	0.9	34.7	20.2	83.3
Non-metallic mineral products	2.3	0.2	0.9	0.4	42.6	6.4	52.8
Primary metals	7.2	0.5	0.3	0.1	55.6	45.8	109.5
Capital expenditures, excluding 'other manufacturing'	77.7	38.0	144.9	49.3	1 203.5	268.9	1 782.3
Other manufacturing ^{1,2}	..	..	..	..	..	..	308.0
Total	..	..	..	..	..	..	2 090.3
1996							
Logging	0.4	0.3	1.4	1.9	10.1	1.3	15.4
Crude petroleum and natural gas	6.7	3.8	79.5	3.7	158.4	18.5	270.6
Mining	1.7	1.5	11.1	0.4	49.2	13.6	77.5
Electric power systems	7.0	22.4	6.4	16.9	37.0	7.9	97.6
Pipeline transport and gas distribution systems	0.8	2.8	7.4	2.3	20.6	11.6	45.6
Food and tobacco products	1.7	x	0.1	x	37.4	29.1	68.8
Beverage	2.1	0.2	0.7	0.0	3.5	1.6	8.0
Pulp and paper	16.9	2.4	13.7	1.4	297.4	319.0	650.8
Refined petroleum and coal products	3.1	3.6	4.5	0.0	42.1	44.4	97.7
Chemicals	24.6	0.4	6.5	0.1	45.1	17.2	93.9
Non-metallic mineral products	2.0	x	1.3	x	33.6	6.3	43.5
Primary metals	5.3	x	0.7	x	61.8	180.5	250.0
Transportation equipment	0.8	0.2	3.3	0.7	25.3	31.0	61.4
Capital expenditures, excluding 'other manufacturing'	73.3	40.1	136.5	27.6	821.4	681.8	1 780.7
Other manufacturing ²	..	..	..	..	..	..	135.0
Total	..	..	..	..	..	..	1 915.8
1997							
Logging	0.0	0.6	0.8	0.8	0.9	4.6	7.6
Crude petroleum and natural gas	7.7	8.7	63.4	3.2	59.2	40.7	183.0
Mining	2.3	5.2	7.7	0.8	31.0	33.4	80.4
Electric power systems	x	18.9	x	17.5	57.4	9.8	113.9
Pipeline transport and gas distribution systems	0.6	6.2	5.0	1.3	14.1	43.3	70.6
Food and tobacco products	x	0.1	x	x	39.5	31.5	73.8
Beverage	0.8	0.1	0.8	0.0	3.4	1.4	6.5
Wood products ³	3.4	1.0	x	x	49.3	21.6	77.4
Pulp and paper	6.2	1.9	3.5	3.0	180.0	136.8	331.5
Refined petroleum and coal products	2.8	3.1	13.4	3.8	38.7	63.2	124.8
Chemicals	7.4	5.3	9.4	0.8	64.5	65.0	152.5
Non-metallic mineral products	0.3	0.7	1.9	0.0	19.8	9.4	32.1
Primary metals	18.5	0.4	x	x	107.7	161.9	290.4
Transportation equipment	0.8	0.2	x	x	24.8	93.2	121.2
Capital expenditures, excluding 'other manufacturing'	60.9	52.3	113.8	32.3	690.3	716.0	1 665.7
Other manufacturing ²	..	..	..	..	..	..	82.9
Total	..	..	..	..	..	..	1 748.6
1998⁴							
Logging	0.5	0.1	0.2	3.0	1.5	2.1	7.4
Oil and gas extraction	4.3	9.9	69.4	0.9	55.5	46.5	186.5
Mining	2.1	5.8	8.1	3.8	33.4	28.1	81.2
Electric power generation, transmission and distribution	4.9	19.2	1.7	20.7	56.5	21.0	124.0
Natural gas distribution	0.1	0.6	0.6	0.2	1.0	14.5	16.8
Food	2.5	0.9	1.3	5.8	37.6	12.7	60.8
Beverage and tobacco products	1.0	0.2	0.1	0.2	2.6	1.5	5.5
Wood products	3.1	0.6	6.4	2.4	66.0	17.8	96.3
Pulp, paper and paperboard mills	13.2	0.5	4.6	1.1	89.1	179.2	287.7
Petroleum and coal products	0.5	3.0	5.4	1.2	82.2	48.6	141.0
Chemicals	18.6	3.3	7.0	0.4	65.7	94.3	189.2
Non-metallic mineral products ⁵	4.0	0.1	2.5	..	32.6	15.1	54.3
Primary metals	4.6	0.4	1.4	1.3	102.9	73.4	184.0
Transportation equipment	0.7	0.2	1.0	0.2	16.3	30.4	48.7

Table C.4

Capital expenditures on environmental protection by industry and type of activity, 1995 to 2002, selected years (continued)

Year/Industry	Environmental monitoring	Environmental assessments and audits	Reclamation and decommissioning	Wildlife and habitat protection	Pollution abatement and control processes (end-of-pipe)	Pollution prevention processes	Total
Pipeline transportation ⁶	0.6	6.4	2.9	0.5	41.6	63.7	115.6
Capital expenditures, excluding 'other manufacturing'	60.7	51.0	112.5	41.6	684.6	648.7	1 599.1
Other manufacturing ²	..	..	..	..	..	..	135.0
Total	..	..	..	..	..	..	1 734.2
2000⁷							
Logging	0.0	0.1	0.1	3.4	0.1	1.2	4.8
Oil and gas extraction	11.8	14.1	73.8	5.9	244.8	114.8	465.1
Mining	1.5	0.8	5.0	2.9	65.0	67.4	142.6
Electric power generation, transmission and distribution ⁸	7.8	36.5	..	4.0	56.0	78.1	182.4
Natural gas distribution	0.2	1.0	0.3	0.2	0.5	0.6	2.8
Food	3.3	4.8	4.7	0.2	45.5	27.8	86.3
Beverage and tobacco products	0.2	0.0	0.2	0.5	0.9	2.5	4.4
Wood products ³	1.3	6.7	..	1.0	51.2	63.1	123.3
Pulp, paper and paperboard mills	3.2	0.9	2.7	1.8	85.8	140.4	234.8
Petroleum and coal products	1.6	0.3	3.0	0.3	119.1	90.3	214.6
Chemicals	4.5	1.1	13.4	0.4	60.6	67.5	147.6
Non-metallic mineral products	2.0	2.4	3.3	0.0	85.5	13.2	106.3
Primary metals	1.9	0.5	1.8	0.4	37.1	63.6	105.3
Fabricated metal products ⁹	0.6	0.1	0.5	0.1	5.7	7.9	14.9
Transportation equipment	0.2	0.5	0.8	0.0	13.7	187.9	203.1
Pipeline transportation ⁶	1.3	1.9	3.0	0.6	9.9	17.4	33.9
Capital expenditures, excluding 'other manufacturing'	41.4	71.7	112.5	21.8	881.4	943.7	2 072.5
Other manufacturing ²	..	..	..	..	..	..	105.4
Total	..	..	..	..	..	..	2 177.9
2002⁷							
Logging	0.0	0.0	0.1	x	x	0.6	5.8
Oil and gas extraction	111.3	23.7	92.4	5.5	85.9	243.7	562.4
Mining	2.5	3.9	21.8	1.6	36.3	31.1	97.3
Electric power generation, transmission and distribution ⁸	9.3	26.9	15.7	13.5	218.3	228.2	511.9
Natural gas distribution	x	x	0.8	x	x	x	18.0
Food	10.3	2.6	4.0	2.7	59.5	46.4	125.4
Beverage and tobacco products	0.7	0.1	3.3	0.0	1.9	6.4	12.3
Wood products ³	x	0.4	0.2	0.6	x	29.0	62.7
Pulp, paper and paperboard mills	3.8	0.1	0.8	0.3	57.4	152.9	215.3
Petroleum and coal products	30.7	7.2	39.8	7.0	226.7	499.9	811.3
Chemicals	x	x	10.7	x	26.4	x	94.5
Non-metallic mineral products	1.5	0.1	1.1	3.2	38.7	24.4	69.0
Primary metals	8.8	1.1	11.2	0.7	87.4	31.1	140.1
Fabricated metal products ⁹	x	x	0.2	x	x	x	14.9
Transportation equipment	0.5	0.3	0.7	0.5	29.7	27.3	58.9
Pipeline transportation ⁶	x	x	4.7	x	x	32.0	49.7
Capital expenditures, excluding 'other manufacturing'	192.3	75.1	207.4	40.0	907.7	1 427.2	2 849.7
Other manufacturing ²	..	..	..	..	..	..	112.5
Total	..	..	..	..	..	..	2 962.2

Notes:

Figures may not add up to totals due to rounding.

1. In 1995, transportation equipment is included in 'other manufacturing' because of data quality constraints.

2. Detail of the expenditure breakdown by type of environmental protection activity is only available for the listed industries.

3. Before 1997 the wood products industry was included with 'other manufacturing'.

4. Before the 1998 reference year establishments were selected based on the 1980 Standard Industrial Classification System (SIC). However, beginning with reference year 1998, industry selection was based on the North American Industry Classification System (NAICS). For further information, see *Environmental Protection Expenditures in Business Sector 1998*, (Catalogue No. 16F0006XIE).

5. Capital expenditures on wildlife and habitat protection are included with capital expenditures on reclamation and decommissioning.

6. Includes the two following industries: pipeline transport and gas distribution systems.

7. As of reference year 1998, the Survey of Environmental Protection Expenditures is being conducted every two years. The survey was not conducted for reference year 1999.

8. Capital expenditures on reclamation and decommissioning are included with capital expenditures on environmental assessments and audits.

9. Before 2000 the fabricated metal products industry was included with 'other manufacturing'.

Source:

Statistics Canada, Environment Accounts and Statistics Division.

Table C.5
Distribution of capital expenditures on pollution prevention by medium and by industry, 2000

Industry	Air	Surface water	On-site contained solid and liquid waste	Noise, radiation and vibration	Other	Total
	\$ million					
Logging	x	0.5	0.4	0.0	x	1.2
Oil and gas extraction	62.0	29.5	17.5	3.2	2.5	114.8
Mining	21.5	23.8	21.8	x	x	67.4
Electric power generation, transmission and distribution	52.6	20.7	3.9	x	x	78.1
Natural gas distribution	x	x	x	x	x	0.6
Food	14.5	8.2	2.4	1.0	1.8	27.8
Beverage and tobacco products	0.1	0.8	1.4	0.0	0.2	2.5
Wood products	16.4	3.2	40.4	0.2	2.9	63.1
Pulp, paper and paperboard mills	65.7	42.5	21.0	0.0	11.3	140.4
Petroleum and coal products	x	x	x	0.4	2.3	90.3
Chemicals	x	32.3	13.8	x	x	67.5
Non-metallic mineral products	9.1	1.9	1.3	0.5	0.3	13.2
Primary metals	23.8	9.6	25.6	1.1	3.5	63.6
Fabricated metal products	3.2	1.2	0.4	0.3	2.8	7.9
Transportation equipment	108.8	62.2	8.2	0.0	8.7	187.9
Pipeline transportation	7.5	7.9	x	x	x	17.4
Total	482.8	248.6	164.8	8.4	39.1	943.7

Notes:

Figures may not add up to totals due to rounding.

This table excludes capital expenditures on the 'Environmental monitoring' category.

Source:

Statistics Canada, Environment Accounts and Statistics Division.

Table C.6
Distribution of capital expenditures on pollution abatement and control (end-of-pipe), by medium and by industry, 2000

Industry	Air	Surface water	On-site contained solid and liquid waste	Noise, radiation and vibration	Total
	\$ million				
Logging	0.1	0.0	0.0	0.0	0.1
Oil and gas extraction	x	x	x	x	244.8
Mining	x	32.5	29.2	x	65.0
Electric power generation, transmission and distribution	15.9	18.2	x	x	56.0
Natural gas distribution	x	0.0	x	0.0	0.5
Food	7.0	32.9	5.0	0.6	45.5
Beverage and tobacco products	x	x	x	x	0.9
Wood products	43.7	0.5	6.8	0.3	51.2
Pulp, paper and paperboard mills	24.0	47.0	14.7	0.2	85.8
Petroleum and coal products	93.3	19.2	5.2	1.4	119.1
Chemicals	35.0	14.4	6.0	5.3	60.6
Non-metallic mineral products	72.6	4.7	0.2	8.0	85.5
Primary metals	22.0	9.8	4.9	0.3	37.1
Fabricated metal products	x	1.2	2.0	x	5.7
Transportation equipment	6.2	6.8	0.5	0.2	13.7
Pipeline transportation	x	x	0.6	x	9.9
Total	560.4	194.8	98.2	27.9	881.4

Notes:

Figures may not add up to totals due to rounding.

This table excludes capital expenditures on the 'Environmental monitoring' category.

Source:

Statistics Canada, Environment Accounts and Statistics Division.

Table C.7

Government expenditures on pollution abatement and control (PAC) and water purification and supply, 1990/91 to 2000/01

Level of government/Activity	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01
	\$ million										
All levels¹											
Sewage collection and disposal ²	2 001.1	1 953.3	2 051.3	2 186.1	2 297.4	2 742.2	2 547.5	2 692.8	2 433.2	2 438.6	2 678.2
Waste collection and disposal	1 220.3	1 324.7	1 427.2	1 346.2	1 578.1	1 366.4	1 343.5	1 395.8	1 462.7	1 622.2	1 476.6
Other pollution control activities	397.6	318.9	263.8	239.6	240.3	204.2	186.7	179.3	319.8	447.3	642.9
Other environmental services	1 096.3	1 289.0	1 272.6	1 329.2	1 317.1	1 338.7	1 274.5	1 353.8	1 231.9	1 110.0	1 404.2
Total PAC	4 715.3	4 885.9	5 014.8	5 101.1	5 432.9	5 651.5	5 352.2	5 621.8	5 447.6	5 618.0	6 201.9
Water purification and supply	2 470.5	2 377.3	2 426.0	2 747.5	2 965.6	3 014.0	3 029.4	3 082.0	3 118.7	3 053.9	3 030.5
PAC and water	7 185.8	7 263.2	7 440.8	7 848.6	8 398.4	8 665.5	8 381.6	8 703.8	8 566.3	8 671.9	9 232.3
Federal											
Sewage collection and disposal	0.0	0.0	0.0	229.4	320.7	313.7	300.7	371.5	341.5	309.3 ^f	319.4 ^f
Waste collection and disposal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 ^f	0.0 ^f
Other pollution control activities	117.9	20.2	4.3	11.2	14.7	13.9	5.7	4.7	4.0	155.5 ^{g3}	314.8 ^f
Other environmental services	620.2	720.9	747.0	728.7	745.3	703.2	635.6	761.8	785.4	579.6 ^f	683.9 ^f
Total PAC	738.1	741.1	751.4	969.4	1 080.8	1 030.7	942.0	1 138.0	1 130.9	1 044.3^f	1 318.1^f
Water purification and supply	7.1	7.8	9.6	235.1	344.7	360.0	328.9	392.0	360.7	318.1 ^f	324.7 ^f
PAC and water	745.2	748.9	761.0	1 204.5	1 425.5	1 390.8	1 270.9	1 529.9	1 491.7	1 362.5^f	1 642.8^f
Provincial/Territorial											
Sewage collection and disposal ²	75.3	100.9	97.8	90.6	132.8	256.3	186.8	181.4	131.2	91.3	69.7
Waste collection and disposal	132.4	164.1	176.7	121.5	295.8	71.3	30.5	27.8	65.6	69.9	45.5
Other pollution control activities	327.3	375.8	328.2	309.9	235.8	202.2	187.4	181.0	321.7	295.9	332.4
Other environmental services	443.4	535.0	467.0	516.7	531.3	564.0	531.0	494.9	327.5	439.1	434.5
Total PAC	978.4	1 175.7	1 069.7	1 038.7	1 195.5	1 093.8	935.8	885.0	846.0	896.2	882.1
Water purification and supply	1 130.6	1 012.5	991.5	872.3	948.6	985.8	987.1	822.5	666.7	784.5	508.2
PAC and water	2 109.0	2 188.3	2 061.3	1 911.0	2 144.1	2 079.6	1 922.9	1 707.5	1 512.7	1 680.7	1 390.2
Local											
Sewage collection and disposal	2 002.0	1 954.3	2 055.8	1 950.5	2 040.7	2 419.7	2 313.6	2 394.4	2 126.5	2 162.6 ^f	2 377.6 ^f
Waste collection and disposal	1 125.9	1 228.2	1 297.4	1 253.4	1 293.1	1 310.9	1 331.8	1 392.3	1 411.1	1 583.3 ^f	1 459.0 ^f
Other pollution control activities and other environmental services ⁴	82.3	80.9	102.6	126.8	144.2	133.0	129.4	129.8	138.1	114.8 ^f	335.3 ^f
Total PAC	3 210.2	3 263.4	3 455.7	3 330.7	3 478.0	3 863.6	3 774.8	3 916.5	3 675.8	3 860.6^f	4 171.9^f
Water purification and supply	2 078.2	2 039.6	2 105.0	2 296.8	2 479.4	2 555.7	2 524.9	2 525.9	2 575.0	2 527.4 ^f	2 551.4 ^f
PAC and water	5 288.5	5 303.0	5 560.8	5 627.5	5 957.4	6 419.3	6 299.7	6 442.3	6 250.8	6 388.1^f	6 723.3^f

Notes:

Fiscal year ending nearest to March 31, except for local government expenditures (calendar year).

Figures may not add up to totals due to rounding.

1. Expenditures presented for all levels of government do not equal the sum of federal, provincial/territorial and local expenditures. The data have been consolidated, excluding intergovernmental transactions between the three levels of government, which provides a more accurate account of total government expenditures.

2. May include some expenditures on water purification and supply.

3. The increase shown from 1998/99 is a result of a program restructure within the Department of Environment Canada, as described within the 1999 and 2000 Public Accounts (Vol. II, Part I).

4. Includes expenditures for other pollution control activities (such as clean-up and air pollution control) and other environmental services (such as environmental assessments).

Sources:

Statistics Canada, Public Institutions Division and Environment Accounts and Statistics Division.

Table C.8

Total government expenditures on forest management by activity, 1990 to 2001

Year	Silviculture	Protection (fire and pest control)	Resource access	Other management expenditures
	\$ millions			
1990	551	412	60	529
1991	571	409	46	635
1992	518	366	46	622
1993	484	308	64	634
1994	409	387	86	515
1995	392	468	107	583
1996	286	342	69	540
1997	276	302	14	357
1998	220	865	65	671
1999	236	573	66	646
2000	230	443	67	555
2001	193	459	68	582

Source:

Canadian Council of Forest Ministers, National Forestry Database Program, nfdp.ccfm.org (accessed May 27, 2004).

Environmental practices

Pollution prevention attempts to eliminate waste and pollution before it is created in manufacturing processes. It involves continuous improvement through changes in product design, technology, operations and behaviour. Table C.9 outlines pollution prevention methods adopted by industry. In 2002, the most widely used methods of pollution prevention by industry were 'good operating practices or pollution prevention training' (74%) and prevention of leaks and spills (70%).

Environmental management practices are used by businesses to facilitate the reduction or prevention of pollution or the conservation of resources. In 2002, 71% of reporting establishments indicated using at least one environmental management practice (Table C.10). The most widely reported practice was the use of an environmental management system (56%), followed by the preparation of environmental performance reports (41%).

In 2002, 1 001 kg of non-hazardous solid waste were generated per capita; an increase of 1% from 2000 (Table C.11). Nationally, 21% of the total non-hazardous waste generated was diverted from disposal. Nova Scotia had the highest diversion rate (30%) followed closely by British Columbia (29%) and Prince Edward Island (28%). The lowest per capita disposal rate was in Nova Scotia with 417 kg per capita. The highest disposal rate for 2002 was 928 kg per capita in Alberta. Almost half (47%) of waste was disposed by industrial, commercial and institutional sources, while residential sources accounted for 38% of waste disposed (Table C.12). The remaining 15% was disposed by construction and demolition sources.

Over 6.5 million tonnes of non-hazardous material were processed for recycling in 2002 in Canada (Table C.13). Mixed paper and organic material made up the bulk of the material recycled, accounting for 23% and 18% respectively of the total for 2002. Within material categories the largest increases from 2000 to 2002 were construction and demolition material (up 42%) and cardboard and box board material (up 27%).

Table C.9
Pollution prevention methods by industry, 1995 to 2002, selected years

Year/Industry	Product design or reformulation	Equipment or process modifications	Recirculation, recovery, reuse or recycling	Materials, feedstock or solvent substitution	Improved management or purchasing techniques	Prevention of leaks and spills	Good operating practices or pollution prevention training	Energy conservation	Other
	% ¹								
1995									
Logging	0	25	31	6	..	38	..	19	6
Crude petroleum and natural gas	7	39	48	42	..	71	..	77	10
Mining	5	25	50	36	..	59	..	39	7
Electric power systems	18	27	73	82	..	46	..	73	18
Pipeline transport and gas distribution systems	8	23	62	39	..	69	..	77	0
Food	4	26	69	13	..	51	..	33	1
Beverage	13	33	75	17	..	33	..	46	4
Pulp and paper	11	46	44	16	..	54	..	25	3
Refined petroleum and coal products	8	0	39	15	..	54	..	46	0
Chemicals	20	37	69	41	..	59	..	30	8
Non-metallic mineral products	19	23	68	34	..	49	..	38	9
Primary metals	9	51	65	42	..	42	..	37	7
Other manufacturing ²	7	28	69	43	..	42	..	36	3
Total	10	32	64	33	..	50	..	37	5
1996									
Logging	4	4	46	17	..	63	..	25	0
Crude petroleum and natural gas	3	41	66	41	..	79	..	76	0
Mining	5	23	58	27	..	49	..	42	21
Electric power systems	12	24	77	59	..	47	..	82	6
Pipeline transport and gas distribution systems	4	7	68	43	..	75	..	71	4
Food and tobacco products	12	25	60	29	..	52	..	43	7
Beverage	13	43	83	15	..	38	..	43	5
Pulp and paper	5	41	47	27	..	51	..	37	13
Refined petroleum and coal products	13	13	50	19	..	75	..	44	13
Chemicals	20	36	71	43	..	62	..	30	17
Non-metallic mineral products	9	30	73	39	..	42	..	39	9
Primary metals	5	37	70	39	..	49	..	38	6
Transportation equipment	18	43	80	57	..	51	..	57	6
Other manufacturing ²	13	29	72	40	..	39	..	38	4
Total	11	31	66	37	..	49	..	42	8

Table C.9
Pollution prevention methods by industry, 1995 to 2002, selected years (continued)

Year/Industry	Product design or reformulation	Equipment or process modifications	Recirculation, recovery, reuse or recycling	Materials, feedstock or solvent substitution	Improved management or purchasing techniques	Prevention of leaks and spills	Good operating practices or pollution prevention training	Energy conservation	Other
1997									
Logging	9	3	34	14	..	80	..	6	6
Crude petroleum and natural gas	34	40	74	49	..	94	..	66	6
Mining	4	23	59	24	..	50	..	54	3
Electric power systems	7	20	53	53	..	93	..	73	13
Pipeline transport and gas distribution systems	17	11	50	44	..	78	..	72	11
Food and tobacco products	14	30	67	30	..	63	..	59	6
Beverage	25	18	57	21	..	50	..	32	14
Wood products ³	16	21	58	35	..	61	..	35	9
Pulp and paper	8	27	72	31	..	58	..	41	12
Refined petroleum and coal products	39	44	72	50	..	78	..	61	0
Chemicals	27	23	61	36	..	69	..	39	5
Non-metallic mineral products	12	25	75	31	..	39	..	33	8
Primary metals	11	43	70	37	..	51	..	54	2
Transportation equipment	19	32	64	56	..	57	..	56	5
Other manufacturing ²	12	18	63	41	..	30	..	33	18
Total	15	24	64	37	..	51	..	42	10
1998⁴									
Logging	0	15	33	3	..	82	..	12	3
Oil and gas extraction	27	35	71	40	..	88	..	75	6
Mining	6	18	67	21	..	53	..	42	8
Electric power generation, transmission and distribution	13	22	65	52	..	87	..	74	4
Natural gas distribution	0	25	38	25	..	75	..	63	0
Food	13	26	72	34	..	55	..	61	3
Beverage and tobacco products	8	16	50	24	..	63	..	50	11
Wood products	23	25	62	22	..	58	..	40	12
Pulp, paper and paperboard mills	10	24	76	38	..	73	..	54	7
Petroleum and coal products	26	32	74	26	..	79	..	63	0
Chemicals	30	24	72	27	..	71	..	33	4
Non-metallic mineral products	18	20	67	27	..	49	..	51	9
Primary metals	14	28	82	31	..	55	..	54	6
Transportation equipment	21	25	69	51	..	69	..	56	9
Pipeline transportation ⁵	25	25	58	33	..	92	..	75	0
Other manufacturing ²	15	20	56	31	..	39	..	35	20
Total	17	23	66	31	..	59	..	45	10
2000⁶									
Logging	0	24	46	20	35	79	78	..	28
Oil and gas extraction	18	86	76	36	58	96	91	..	26
Mining	10	40	84	33	51	92	92	..	18
Electric power generation, transmission and distribution	21	40	62	39	55	79	84	..	19
Natural gas distribution	25	78	56	0	56	100	82	..	0
Food	22	46	61	26	36	65	72	..	12
Beverage and tobacco products	6	41	52	11	33	76	80	..	10
Wood products	24	47	70	27	42	67	75	..	17
Pulp, paper and paperboard mills	17	68	83	36	34	87	89	..	16
Petroleum and coal products	48	54	76	34	44	91	94	..	6
Chemicals	40	54	77	40	45	82	88	..	15
Non-metallic mineral products	22	48	73	31	40	66	76	..	22
Primary metals	16	57	76	34	33	78	80	..	10
Fabricated metal products ⁷	13	39	60	29	34	68	77	..	15
Transportation equipment	33	59	69	53	58	82	88	..	22
Pipeline transportation ⁵	40	49	49	35	55	98	95	..	11
Other manufacturing ²	26	40	56	37	41	55	67	..	11
Total	24	48	67	34	42	73	79	..	14
2002⁶									
Logging	5	25	61	9	34	84	85	..	19
Oil and gas extraction	30	77	71	42	48	92	91	..	16
Mining	9	35	77	32	39	82	79	..	34
Electric power generation, transmission and distribution	14	38	63	36	34	80	78	..	16
Natural gas distribution	11	44	82	22	82	100	100	..	33
Food	16	16	55	21	25	66	69	..	17
Beverage and tobacco products	8	31	40	15	17	46	50	..	9

Table C.9
Pollution prevention methods by industry, 1995 to 2002, selected years (continued)

Year/Industry	Product design or reformulation	Equipment or process modifications	Recirculation, recovery, reuse or recycling	Materials, feedstock or solvent substitution	Improved management or purchasing techniques	Prevention of leaks and spills	Good operating practices or pollution prevention training	Energy conservation	Other
Wood products	16	40	63	19	37	63	74	..	22
Pulp, paper and paperboard mills	10	70	81	30	30	85	90	..	21
Petroleum and coal products	39	63	72	47	43	85	84	..	0
Chemicals	16	40	63	25	35	78	79	..	13
Non-metallic mineral products	23	49	64	29	30	54	62	..	16
Primary metals	12	51	73	32	25	70	70	..	16
Fabricated metal products ⁷	14	49	64	33	41	66	73	..	10
Transportation equipment	32	52	61	48	51	71	69	..	24
Pipeline transportation ⁵	42	70	54	35	58	100	98	..	0
Other manufacturing ²	29	48	62	38	43	59	66	..	11
Total	22	49	65	31	37	70	74	..	16

Notes:

Figures may not add up to totals due to rounding.

This table includes reported data only.

The question on pollution prevention methods differed in reference years 1995 and 1996. Therefore, comparisons from 1995 to 1998 provide a general view but should be treated with caution.

1. Number of establishments indicating they used the pollution prevention method as a percentage of all establishments that provided a response.

2. Includes all other manufacturing industries not already specified.

3. Before 1997 the wood products industry was included with 'other manufacturing'.

4. Before the 1998 reference year, establishments were selected based on the 1980 Standard Industrial Classification System (SIC). However, beginning with reference year 1998, industry selection was based on the North American Industry Classification System (NAICS). For further information, see *Environmental Protection Expenditures in Business Sector*, (Catalogue No. 16F0006XIE).

5. Includes the two following industries: pipeline transportation and gas distribution systems.

6. As of reference year 1998, the Survey of Environmental Protection Expenditures is conducted every two years.

7. Before 2000 the fabricated metal products industry was included with 'other manufacturing'.

Source:

Statistics Canada, Environment Accounts and Statistics Division.

Table C.10
Distribution of environmental management practices by industry, 1998, 2000 and 2002

Year/Industry	Uses an environmental management system	Uses life cycle analysis	Has ISO 14000 certification	Participates in environmental voluntary agreements	Has a 'green' procurement policy	Participates in an 'eco-labelling' program	Prepares environmental performance reports	Other	Total ²
	% ¹								
1998									
Logging	59	10	17	16	3	5	50	10	72
Oil and gas extraction	88	47	3	77	24	6	40	20	93
Mining	72	22	5	51	18	..	55	39	91
Electric power generation, transmission and distribution	74	27	27	68	8	12	52	50	93
Natural gas distribution	92	25	8	91	42	..	67	..	100
Food	50	9	4	12	12	2	13	8	63
Beverage and tobacco products	55	14	3	25	23	19	14	7	78
Wood products	50	9	5	14	9	6	28	12	69
Pulp, paper and paperboard mills	70	11	17	65	11	16	63	21	95
Petroleum and coal products	74	52	7	58	11	11	49	50	88
Chemicals	69	28	17	46	17	9	34	28	89
Non-metallic mineral products	61	17	5	11	14	3	31	14	75
Primary metals	58	13	6	28	11	..	18	13	82
Transportation equipment	62	19	23	26	19	2	23	17	81
Pipeline transportation	91	43	5	86	14	..	52	33	100
Total	64	19	10	37	14	6	34	20	82
2000									
Logging	76	2	50	26	9	17	61	12	86
Oil and gas extraction	82	23	10	82	27	5	62	13	92
Mining	66	16	3	49	16	2	67	20	84
Electric power generation, transmission and distribution	53	14	17	47	18	8	44	14	73
Natural gas distribution	91	30	0	82	46	10	80	x	100
Food	48	10	4	10	14	3	25	10	64
Beverage and tobacco products	41	1	3	23	7	1	36	10	67
Wood products	42	5	11	23	13	11	38	7	63
Pulp, paper and paperboard mills	65	12	25	57	11	11	71	15	89
Petroleum and coal products	71	36	15	46	13	24	61	15	80

Table C.10
Distribution of environmental management practices by industry, 1998, 2000 and 2002 (continued)

Year/Industry	Uses an environmental management system	Uses life cycle analysis	Has ISO 14000 certification	Participates in environmental voluntary agreements	Has a 'green' procurement policy	Participates in an 'eco-labelling' program ¹	Prepares environmental performance reports	Other	Total ²
	% ¹								
Chemicals	60	15	5	36	14	7	46	14	78
Non-metallic mineral products	60	8	2	18	17	4	36	9	78
Primary metals	55	9	11	34	10	1	38	8	74
Fabricated metal products	41	8	7	13	8	6	15	5	57
Transportation equipment	65	16	30	20	19	0	33	11	76
Pipeline transportation	81	14	0	93	14	0	86	0	100
Total	58	12	11	34	14	6	45	11	75
Other manufacturing ³	32	7	10	10	12	3	17	8	60
Total including other manufacturing	52	11	11	29	13	5	38	10	72
2002									
Logging	82	11	66	23	20	24	48	4	88
Oil and gas extraction	90	34	5	81	23	4	81	16	97
Mining	75	19	9	53	19	0	72	23	88
Electric power generation, transmission and distribution	64	27	22	50	20	15	54	0	72
Natural gas distribution	92	36	18	92	27	0	92	25	100
Food	38	7	3	11	11	1	24	4	53
Beverage and tobacco products	36	5	3	20	5	0	29	9	55
Wood products	48	7	19	23	19	15	40	9	61
Pulp, paper and paperboard mills	75	10	38	43	8	6	76	18	93
Petroleum and coal products	73	38	19	50	9	22	67	0	88
Chemicals	61	19	11	37	12	3	45	11	76
Non-metallic mineral products	40	15	13	21	14	4	24	8	62
Primary metals	54	9	20	29	9	0	39	7	67
Fabricated metal products	55	6	23	13	13	0	23	0	68
Transportation equipment	66	22	46	23	18	4	34	13	75
Pipeline transportation	100	29	2	98	33	0	76	0	100
Total	61	15	23	35	15	5	47	9	74
Other manufacturing ³	38	9	19	10	12	3	23	7	63
Total including other manufacturing	56	14	19	29	14	5	41	9	71

Notes:

This table includes reported data only.

1. Number of establishments indicating they used the practice as a percentage of all establishments that provided a response.

2. Number of establishments indicating they used at least one environmental practice as a percentage of the total number of establishments that provided a response.

3. Includes all other manufacturing industries not already specified. Information on environmental management practices used by the 'other manufacturing' category was not collected in 1998.

Source:

Statistics Canada, Environment Accounts and Statistics Division.

Table C.11
Waste disposal, diversion and generation per capita, all sources, by province and territory, 2000 and 2002

Province/Territory	Disposal ¹		Diversion ²		Generation ³		Rate of diversion per capita	
	2000 ^f	2002	2000 ^f	2002	2000 ^f	2002	2000 ^f	2002
	kg per capita							
	%							
Newfoundland and Labrador	742	725	80	74	822	799	10	9
Prince Edward Island	x	x	x	x	x	x	20	28
Nova Scotia	416	417	150	182	566	598	26	30
New Brunswick	550	551	152	164	702	715	22	23
Quebec ⁴	936	872	209	234	1 145	1 106	18	21
Ontario	764	797	202	200	966	997	21	20
Manitoba	798	776	188	217	986	993	19	22
Saskatchewan	804	799	147	147	951	946	15	16
Alberta	914	928	140	189	1 054	1 117	13	17
British Columbia	636	667	278	269	914	936	30	29
Yukon Territory, Northwest Territories and Nunavut	x	x	x	x	x	x	3	10
Canada	789	790	199	211	988	1 001	20	21

Notes:

1. Total amount of non-hazardous waste disposed of in public and private waste disposal facilities. This includes waste that is exported out of the source province or out of the country for disposal. This does not include waste disposed of in hazardous waste disposal facilities nor waste managed by the waste generator on site.

2. Diversion represents the quantity of non-hazardous materials diverted from disposal facilities and represents the sum of all materials processed for recycling or reuse at an off-site recycling facility.

3. Total generation is the sum of total non-hazardous residential and non-residential solid waste disposed of in an off-site disposal facility and total materials processed for recycling at an off-site recycling facility. Note that these data only include those materials that are managed (disposed of or recycled) off-site by a municipality or waste management firm.

4. Figures are derived from the results of surveys conducted by the province.

Source:

Statistics Canada, Environment Accounts and Statistics Division.

Table C.12
Disposal of waste, by source and by province and territory, 2000 and 2002¹

Province/Territory	Residential sources ²		Industrial, commercial and institutional sources ³		Construction and demolition sources ⁴		Total waste disposed	
	2000 ^f	2002	2000 ^f	2002	2000 ^f	2002	2000 ^f	2002
	t							
Newfoundland and Labrador	x	216 218	146 843	140 377	x	19 999	398 818	376 593
Prince Edward Island	x	x	x	x	x	x	x	x
Nova Scotia	171 627	169 649	x	176 625	x	42 921	391 827	389 194
New Brunswick	198 603	203 506	x	154 812	x	55 288	415 058	413 606
Quebec ⁵	2 716 000	2 876 000	2 685 000	2 261 000	1 507 000	1 356 000	6 908 000	6 493 000
Ontario	3 318 478	3 438 408	4 606 409	5 193 240	1 006 714	1 013 985	8 931 600	9 645 633
Manitoba	451 505	412 612	x	405 954	x	77 990	914 511	896 556
Saskatchewan	272 104	278 692	x	441 109	x	75 323	821 946	795 124
Alberta	824 990	866 398	x	1 380 306	x	643 590	2 750 004	2 890 294
British Columbia	890 789	936 774	1 264 056	1 346 669	426 490	461 458	2 581 336	2 744 901
Yukon Territory, Northwest Territories and Nunavut	x	x	x	x	x	x	x	x
Canada	9 106 170	9 455 204	11 233 613	11 563 999	3 930 887	3 765 728	24 270 670	24 784 930

Notes:

Figures may not add up to totals due to rounding.

1. Total amount of non-hazardous waste disposed of in public and private waste disposal facilities. This includes waste that is exported out of the source province or out of the country for disposal. This does not include wastes disposed in hazardous waste disposal facilities or wastes managed by the waste generator on site.

2. Residential non-hazardous wastes generated (both those wastes destined for disposal or for recycling) includes solid waste produced by all residences and includes waste that is picked up by the municipality (either using its own staff or through contracting firms), and waste from residential sources that is self-hauled to depots, transfer stations and disposal facilities.

3. Industrial, Commercial, and Institutional (IC&I) non-hazardous solid wastes are those wastes generated by all IC&I sources in a municipality, and are excluded from the residential waste stream. These include: industrial recyclable materials, which are generated by manufacturing, and primary and secondary industries, and is managed off-site from the manufacturing operation; commercial materials, which are generated by commercial operations such as shopping centres, restaurants, offices, etc.; and institutional materials which are generated by institutional facilities such as schools, hospitals, government facilities, seniors homes, universities, etc.

4. Construction and demolition non-hazardous waste generated, also referred to as DLC (demolition, land clearing and construction waste), refers to waste generated (both those wastes destined for disposal or for recycling) by construction and demolition activities. It generally includes materials such as brick, painted wood, rubble, drywall, metal, cardboard, doors, windows, wiring, etc. It excludes materials from land clearing on areas not previously developed, asphalt and clean sand or gravel.

5. Figures are derived from the results of surveys conducted by the province.

Source:

Statistics Canada, Environment Accounts and Statistics Division.

Table C.13
Materials prepared for recycling, by type and by province and territory, 2002¹

Type of materials	N.L.	P.E.I.	N.S.	N.B.	Que. ²	Ont.	Man.	Sask.	Alta.	B.C.	Y.T., N.W.T. and Nvt.	Canada
Newsprint	x	x	22 131	6 764	..	544 752	45 165	15 564	57 201	104 065	x	800 043
Cardboard and boxboard	x	x	12 476	12 231	..	407 325	x	18 207	46 230	178 251	x	705 856
Mixed paper	x	x	2 627	4 265	946 000 ³	328 443	4 245	14 194	28 466	190 047	x	1 519 958
Glass	x	x	2 824	x	71 000	173 905	2 619	x	x	34 231	x	339 132
Ferrous metals	x	x	2 775	x	111 000	267 254	x	x	x	127 925	x	808 596
Copper and aluminum	x	x	x	x	11 000	19 927	x	x	x	1 965	x	44 070
Other metals	x	0	x	x	..	49 071	x	x	10 595	40 376	x	117 560
Plastics	x	x	1 560	1 038	52 000	42 770	2 548	910	8 280	34 100	x	152 266
Construction and demolition	0	x	53 359	30 153	213 000	225 282	581	x	x	162 168	0	702 202
Organics	0	x	62 341	62 725	246 000	293 328	16 261	x	261 069	198 996	x	1 170 790
Other materials	x	0	1 117	1 262	93 000	63 442	9 067	x	41 730	32 997	x	259 321
Total	38 386	x	169 724	122 957	1 743 000	2 415 498	250 880	146 607	589 642	1 105 121	x	6 619 794

Notes:

Figures may not add up to totals due to rounding.

1. This information covers only those companies and local waste management organizations that reported they prepared non-hazardous material for recycling.

2. Figures are derived from the results of surveys conducted by the province.

3. Includes all paper fibres.

Source:

Statistics Canada, Environment Accounts and Statistics Division.

Environment industry

Revenues derived from environment-related activities reached \$14.4 billion in 2000 (Table C.14). Environmental services accounted for 44% of total environmental revenues, while 43% of these revenues were derived from environmental goods. Environment-related construction services made up the remaining share (13%). The wholesale trade industry posted the highest share of business sector total environmental revenues at 30%, followed by the waste management and remediation services industry at 21% and engineering services at 14%.

As in previous years, businesses in Ontario and Quebec reported the highest environmental revenues in 2000, estimated at \$6.2 billion and \$3.2 billion respectively (Table C.15).

Table C.14
Environmental revenues by industry, 2000¹

Industry ²	Establishments ³ number	Environmental goods	Environmental services	Environment- related construction ⁴	Total environmental revenues
			\$ million		
Agriculture, forestry, fishing and hunting	18	x	x	0.0	8.4
Mining and oil and gas extraction	25	x	60.8	x	72.5
Utilities	16	9.7	x	x	30.0
Construction	125	73.9	190.3	1 322.6	1 586.8
Chemical manufacturing	55	154.3	68.4	0.0	222.9
Plastic and rubber products manufacturing	39	280.4	0.0	0.0	283.3
Non-metallic mineral product manufacturing	17	126.0	x	x	129.7
Primary metal manufacturing	10	70.8	x	x	77.9
Fabricated metal product manufacturing	47	197.4	0.0	0.0	197.9
Machinery manufacturing	149	574.4	19.2	9.0	602.7
Computer and electronic product manufacturing	55	112.9	0.0	0.0	114.9
Electrical equipment, appliance and component manufacturing	12	163.4	0.0	0.0	163.7
Rest of manufacturing sector	33	292.6	13.0	0.0	305.6
Wholesale trade	2 845	3 930.2	407.8	9.0	4 347.0
Retail trade	19	40.3	x	x	43.4
Finance and insurance services	16	x	x	x	27.2
Legal services	52	x	x	0.0	109.0
Architectural and landscape architectural services	27	0.0	8.8	0.0	8.8
Engineering services	666	61.3	1 446.8	469.9	1 977.9
Surveying and mapping (including geophysical) services	20	x	x	0.0	29.9
Testing laboratories	114	0.0	166.8	0.0	167.6
Computer systems design and related services	31	4.7	18.7	0.0	23.4
Management, scientific and technical consulting services	1 116	52.0	523.5	9.1	584.6
Scientific research and development services	31	x	13.6	x	54.6
All other professional, scientific and technical services	27	x	26.0	x	84.4
Management of companies and enterprises	22	x	41.1	x	65.4
Administrative and support services	47	x	80.0	x	98.5
Waste management and remediation services	1 796	x	2 945.2	x	3 020.5
Other services	63	x	83.4	x	136.9
Canada	7 493	6 352.5	6 299.1	1 923.8	14 575.4

Notes:

Figures may not add up to totals due to rounding.

1. The environment industry is composed of all establishments operating in Canada that are involved in whole or in part in the production of environmental goods, the provision of environmental services and the undertaking of environment-related construction activities. Environmental goods and services are used or can potentially be used to measure, prevent, limit or correct environmental damage to water, air, soil as well as problems to waste, noise and ecosystems. They also include clean or resource-efficient technologies that decrease material inputs, reduce energy consumption, recover valuable by-products, reduce emissions and/or minimise waste disposal problems.

2. Industry groups are based on the North American Industry Classification System (NAICS).

3. The total number of establishments does not include engineering construction establishments (NAICS 2313) due to the methodology used to derive the estimates.

4. Revenues from environment-related construction services were derived from demand-side estimates of environmental protection expenditures.

Source:

Statistics Canada, Environment Accounts and Statistics Division.

Table C.15
Environment revenues by province and territory, 2000¹

Province/Territory	Establishments ² number	Environmental	Environmental	Environment-	Total
		goods	services	related construction	environmental revenues
		\$ million			
Newfoundland and Labrador	150	18.5	62.7	21.1	102.3
Prince Edward Island	43	x	12.0	x	52.0
Nova Scotia	365	102.8	168.2	40.6	311.6
New Brunswick	293	89.2	107.6	50.2	247.0
Quebec	1 739	1 636.8	1 098.2	446.6	3 181.7
Ontario	2 383	3 270.9	2 526.6	477.9	6 275.5
Manitoba	228	373.4	117.4	28.2	519.0
Saskatchewan	289	96.5	84.7	34.2	215.4
Alberta	905	333.8	1 099.0	492.9	1 925.6
British Columbia	1 055	418.8	1 010.1	288.9	1 717.8
Yukon Territory, Northwest Territories and Nunavut	43	x	12.6	x	27.5
Canada	7 493	6 352.5	6 299.1	1 923.8	14 575.4

Notes:

Figures may not add up to totals due to rounding.

1. The environment industry is composed of all establishments operating in Canada that are involved in whole or in part in the production of environmental goods, the provision of environmental services and the undertaking of environment-related construction activities. Environmental goods and services are used or can potentially be used to measure, prevent, limit or correct environmental damage to water, air, soil as well as problems to waste, noise and ecosystems. They also include clean or resource-efficient technologies that decrease material inputs, reduce energy consumption, recover valuable by-products, reduce emissions and/or minimise waste disposal problems.

2. The total number of establishments does not include engineering construction establishments (NAICS 23711, 23712, 23731, 23799) due to the methodology used to derive the estimates.

Source:

Statistics Canada, Environment Accounts and Statistics Division.

Research and development

In 2001/02, expenditures on research and development in the higher education sector reached approximately \$6.5 billion, an increase of 12% from 2000/01 (Table C.16). Forty-three percent (\$2.8 billion) was spent in the natural sciences and engineering fields, 37% (\$2.4 billion) in the health sciences and the remaining 20% (\$1.3 billion) in the social sciences and humanities.

In 2001-02, federal spending on research and development aimed at pollution prevention and protection of the environment reached \$290 million (Table C.17). This accounted for 6% of total federal intramural research and development expenditures in 2001-02, and marks an increase of \$141 million over the amount spent in 1995/96 on this objective. Additional expenditures are allocated to environmental research and development as part of a higher level objective. Examples include: the study of energy conservation, and, the impact of agricultural forestry activities on the environment.

Table C.16
Research and development expenditures and source of funds in the higher education sector, 2001/02

Education sector	Total expenditures \$ million	Share of total	Source of funds				Foreign
			Federal government	Provincial governments	Business ¹	Higher education	
			%				
Social sciences and humanities ²	1 274.5	19.7	18.1	11.2	9.6	61.1	0.0
Health sciences ³	2 433.7	37.6	23.2	8.8	22.5	44.2	1.4
Other natural sciences and engineering ⁴	2 767.1	42.7	28.6	12.9	16.0	40.7	1.8
Total	6 475.3	100.0	24.5	11.0	17.2	46.0	1.3

Notes :

1. Includes private business and private not-for-profit organizations.

2. Social sciences embrace all disciplines involving the study of human actions and conditions and the social, economic and institutional mechanisms affecting humans. Included are such disciplines as anthropology, business administration and commerce, communications, criminology, demography, economics, geography, history, languages, literature and linguistics, law, library science, philosophy, political sciences, psychology, religious studies, social work, sociology, and urban and regional studies.

3. Health sciences consist of programmes directed towards the protection and improvement of human health.

4. Other natural sciences consist of disciplines, other than health sciences, concerned with understanding, developing or utilizing the natural world. Included are the engineering, mathematical and physical sciences.

Source:

Statistics Canada, 2004, *Science Statistics*, Catalogue no. 88-001-XIE, Vol. 28, No. 1, Ottawa.

Table C.17
Federal government research and development expenditures by socio-economic objective, 1995/96 to 2001/02

Socio-economic objective	1995/96		1996/97		1997/98		1998/99		1999/00		2000/01		2001/02	
	Intra-mural	Extra-mural	Intra-mural	Extra-mural	Intra-mural	Extra-mural	Intra-mural	Extra-mural	Intra-mural	Extra-mural	Intra-mural	Extra-mural	Intra-mural	Extra-mural
	\$ million													
Exploration and exploitation of the earth	161	42	186	39	178	25	179	29	186	99	207	46	125	69
Infrastructure and general planning of land use														
Transport	8	48	10	45	34	32	38	28	42	23	37	20	71	24
Telecommunications	64	4	34	9	33	21	32	35	24	34	28	15	44	23
Other	16	3	74	1	54	13	50	15	42	16	48	20	30	25
Pollution prevention and protection of the environment	99	50	96	45	97	73	98	83	122	88	143	112	142	148
Public health	37	305	76	306	80	282	87	318	103	390	116	519	152	709
Production, distribution and rational utilization of energy	201	63	273	64	209	57	170	65	171	68	187	64	248	117
Agricultural production and technology														
Agriculture	288	61	320	57	317	37	308	44	334	67	333	70	345	75
Fishing	51	4	37	4	30	8	42	10	43	13	51	14	47	15
Forestry	75	25	71	24	73	24	74	24	77	43	83	27	75	27
Industrial production and technology	64	295	104	326	119	429	123	406	137	398	165	518	164	741
Social structures and relationships	44	35	102	30	110	31	125	90	50	87	53	106	47	130
Exploration and exploitation of space	62	232	65	213	59	190	92	270	68	269	187	154	175	193
Non-oriented research	21	185	47	204	51	237	54	229	150	256	150	188	181	285
Other civil research	3	3	13	5	15	1	13	2	14	1	16	17	15	16
Defence	115	102	124	88	127	124	136	120	167	121	150	119	134	142
Other	289	232	4	97	3	74	4	68	4	57	3	62	5	67
Total	1 598	1 689	1 636	1 557	1 588	1 659	1 627	1 835	1 734	2 030	1 957	2 070	2 000	2 806

Note :

The research and development intramural expenditures are managed and carried out primarily by federal government employees. Non-program (indirect costs) are excluded. The management and conduct of the research and development extramural expenditures are entrusted to a non-federal organization.

Sources:

Statistics Canada, 1999, *Science Statistics*, Catalogue no. 88-001-XIB, Vol. 23, No. 5, Ottawa.
 Statistics Canada, 2000, *Science Statistics*, Catalogue no. 88-001-XIB, Vol. 24, No. 5, Ottawa.
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 Statistics Canada, 2003, *Science Statistics*, Catalogue no. 88-001-XIB, Vol. 27, No. 8, Ottawa.

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