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EnviroStats

Fall 2007 Vol. 1 no. 2

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Population 2005 to 2006 percentage change	1.0%
Gross domestic product April 2007 to May 2007 percentage change	0.3%
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Particulate matter ($PM_{2.5}$) 2000 to 2004	No significant trend
Ground-level ozone 1990 to 2004 median percent change per year	0.9%

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.	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

A demand perspective on greenhouse gas emissions

Joe St. Lawrence, Environment Accounts and Statistics Division

It is a well-reported fact that Canadian greenhouse gas emissions have risen substantially over the last fifteen years. To be specific, emissions increased 25% between 1990 and 2005 to 747 Mt,[1] a level 33% higher than the nation's Kyoto target.[2]

Typically, emissions are reported from this "supply" perspective, showing how much pollutant is produced and by whom. While this supply perspective is important, it is the demand for products and services that drives greenhouse gas emissions. The famous economist Adam Smith once wrote that "consumption is the sole end and purpose of all production," meaning that there would be no economic production or associated pollution, without a demand for products and services.

When demand for a good or service is sufficient, industry will meet the need. Greenhouse gas emissions are an unfortunate by-product of the associated production. This article considers the main drivers of greenhouse gas emissions during the period 1990 to 2002 from this demand perspective.

What is behind the increase in greenhouse gases from a demand perspective?

Canada is heavily integrated into the international economy and runs trade surpluses. As a result, we produce more greenhouse gases than we need to satisfy our demand for Canadian-made goods and services.

In fact, the greenhouse gas emissions created to satisfy internal demand for domestic goods and services accounted for 54% of the 574 Mt of greenhouse gases produced by industry in 2002 (Table 1). In other words, exports accounted for 46% of the industrial emissions of greenhouse gases, the

Background to the methodology and data sources

The results of this study are derived from a hybrid input-output model that combines physical data on greenhouse gas emissions by industry with economic data on production and consumption of goods and services. The model allows estimation of greenhouse gas emissions associated with the production of each good and service in the Canadian economy. It considers both the emissions associated directly with the industry producing the good or service as well emissions that are further up the supply chain. The latter emissions can be referred to as "indirect" or "embedded" emissions.

Canada is a signatory to the 1992 United Nations Framework Convention on Climate Change (UNFCCC) and is therefore required to submit annually on April 15th an inventory of its greenhouse gas emissions to the UNFCCC. Environment Canada is the department mandated to prepare the national inventory report for Canada. The inventory is prepared following UNFCCC guidelines. Upon ratification of the Kyoto Protocol to the UNFCCC in December of 2002, Canada committed to a 6% reduction in emissions by 2008-2012 (average) compared to the 1990 baseline. To support measurement of these reductions, new reporting guidelines and methodological guidance for national inventory reporting were developed by the Intergovernmental Panel on Climate Change (IPCC) and endorsed for use by the UNFCCC.

Statistics Canada's *Report on Energy Supply-Demand* and Environment Canada's *National Inventory Report* represent the most current information available on energy use and greenhouse gas emissions for Canada. To supplement the official international greenhouse gas reporting by Environment Canada, more detailed estimates of energy use and greenhouse gas emissions are produced by Statistics Canada according to the accounting framework of the Canadian System of National Accounts (CSNA). In addition to providing more industrial detail, these energy use and greenhouse gas emissions accounts can be linked with economic data in the CSNA to show how energy use and emissions are influenced by economic activity in the market.

Readers may notice that the emissions estimates in this document differ from the totals that appear in the official Environment Canada submission to the UNFCCC. This is due to adjustments that have to be made to IPCC sectoring and definitions in order to ensure consistency with the requirements of the CSNA. The accounts used for this analysis also include only the three main greenhouse gases, namely carbon dioxide, methane, and nitrous oxide, and do not include emissions from the decomposition or incineration of waste.

1. All emission figures in this report are expressed in carbon dioxide equivalent emissions. These are calculated by weighting emissions of individual greenhouse gases relative to the global warming potential of carbon dioxide (which is assigned a value of 1) and then aggregating over all gases.
2. Environment Canada, 2007, *National Inventory Report: Greenhouse Gas Sources and Sinks in Canada, 1990-2005,* Greenhouse Gas Division, Ottawa.

Table 1
Sources of industrial greenhouse gas emissions from the demand perspective, 1990 and 2002

Final demand category	1990	2002[p]	Percentage change 1990 to 2002	Share of total 1990	Share of total 2002[p]
	kilotonnes		percent		
Internal demand	308,276	309,485	0.4	63.6	53.9
Personal expenditure	196,193	209,787	6.9	40.5	36.6
Construction	43,853	42,490	-3.1	9.0	7.4
Machinery and equipment	11,005	10,505	-4.5	2.3	1.8
Government	42,710	41,641	-2.5	8.8	7.3
Inventories	14,515	5,062	-65.1	3.0	0.9
External demand					
Exports	176,363	264,358	49.9	36.4	46.1
Total domestic industrial emissions	**484,640**	**573,843**	**18.4**	**100.0**	**100.0**

Source: Statistics Canada, Environment Accounts and Statistics Division.

Final demand categories

In the final demand perspective, greenhouse gases emitted by industry are attributed to the end-user of goods and services rather than the producer and can be referred to as indirect emissions.

Final demand in the *Canadian System of National Accounts* is broken into the following categories:

Personal expenditure: represents the purchases of commodities, commodity taxes, wages and salaries and supplementary labour income of persons employed by the personal sector. Includes individuals, families and private non-profit organizations.

Construction and Machinery and Equipment: the value of a producer's acquisitions, less disposals, of fixed assets during the accounting period plus certain additions to the value of non-produced assets (such as subsoil assets or major improvements in the quantity, quality or productivity of land) realized by the productive activity of institutional units.

Government net current expenditure: economic activities of the federal government (including defence), the provincial and territorial governments, local (municipal) governments, universities, colleges, vocational and trade schools, publicly funded hospitals and residential care facilities, and publicly funded schools and school boards.

Inventories: consist of stocks of outputs that are still held by the units that produced them prior to their being further processed, sold or delivered to other units or used in other ways, and stocks of products acquired from other units that are intended to be used for intermediate consumption or for resale without further processing.

Exports: receipts from other provinces and territories or from abroad for sales of merchandise or services. The barter, grant and giving of goods and services as gifts would also constitute exports.

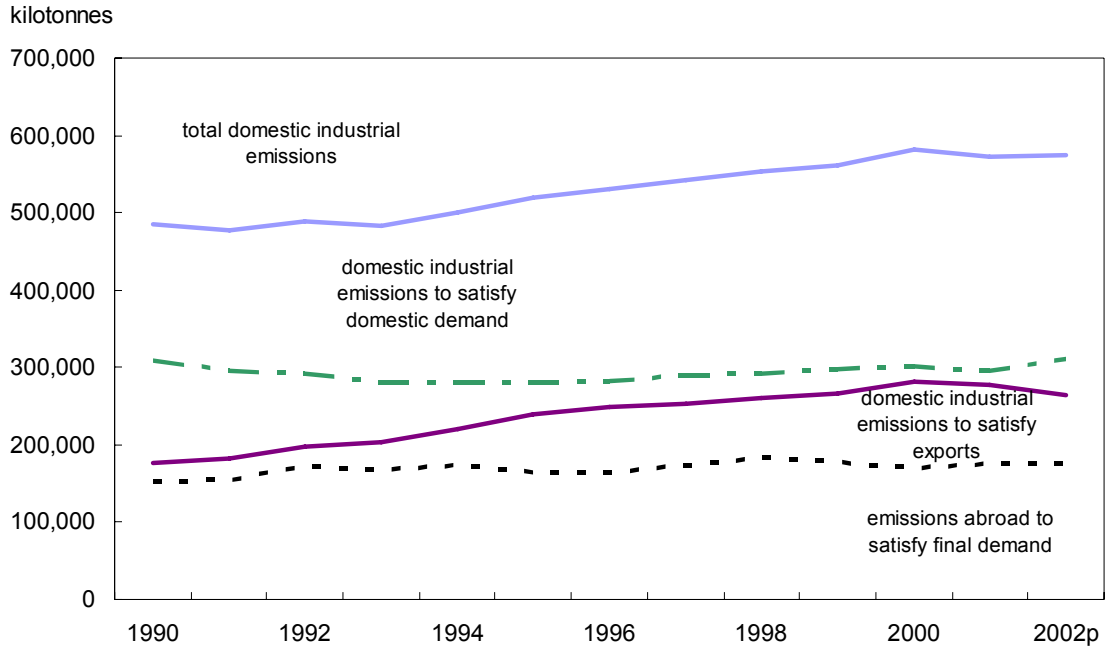
largest share of emissions from a demand perspective.

As globalization has led to better access to world markets, Canada has increased the degree to which it trades with the rest of the world. While this has benefited the Canadian economy, it has also caused greenhouse gas production to increase. In fact, much of the increase in total greenhouse gas emissions in Canada between 1990 and 2002 was due to emissions associated with exports (Chart 1).

Compared to 1990, the year 2002 showed a 50% increase in greenhouse gas emissions from the production of goods and services sent to external markets. In contrast, there was only a 0.4% increase in greenhouse gases from emissions caused by the production of goods and services to satisfy the demands of the domestic market. Combined, these two sources of demand led to an overall 18% increase in industrial emissions.

What is behind this increase in greenhouse gas emissions from the production of goods and services for export? The largest source of this growth was the export of mineral fuels, including coal, crude oil, and natural gas. In both 1990 and 2002, the production of these fuels for export emitted more greenhouse gases than the production of any other exported commodity (Table 2). Over the period, as worldwide demand for fuels surged, greenhouse gas emissions from the production of exported fuels jumped 135%.

Chart 1
Industrial emissions associated with the production of goods and services for domestic final demand[1] and exports, 1990 to 2002



1. Emissions produced abroad to satisfy demand for imported goods were estimated with the assumption that the technology used to produce imported goods yields the same emissions per unit of output as in Canada.

Source: Statistics Canada, Environment Accounts and Statistics Division.

Much of the strength in the Canadian economy right now can be tied to the remarkable boom in Alberta, which is due to the surge in demand for its valuable oil and gas.[3] While Ontario and Quebec remain much more populous than Alberta, greenhouse gas emissions from Alberta are the highest in the nation,[4] partly on account of the large amounts of greenhouse gases emitted to produce oil and gas for the export market.

The flip-side to this look at exports is that normal supply-side estimates of emissions do not include the greenhouse gases that the Canadian economy creates elsewhere through the importation of goods and services.

As exports have increased in quantity and value, so too have imports. Imports also have associated emissions of greenhouse gases, but these emissions do not occur in Canada and are not typically included in Canada's emissions estimates. Between 1990 and 2002, emissions outside the country associated with Canadian demand for imported goods and services increased an estimated 15% (Chart 1).

What about domestic emissions due to demands by Canadian households?

Next to exports, personal (or household) expenditures in Canada were the second largest source of greenhouse gas emissions when looked at from a demand perspective (Table 1). Production to meet household demand for goods and services was the cause of approximately 37% of domestic industrial emissions in 2002.

Because of the greater rate of growth in greenhouse gas emissions from exports, personal expenditure and exports switched positions between 1990 and 2002 in terms of their relative importance. Personal expenditure accounted for the largest share of domestic industrial emissions in 1990 at 41%, but dropped to 37% by 2002. For the same year,

3. Cross, P. and Bowlby, G., 2006, "The Alberta Economic Juggernaut: The Boom on the Rose," *Canadian Economic Observer*, Statistics Canada catalogue no. 11-010-XIB, vol. 19, no. 9, Ottawa.
4. Environment Canada, 2007, *National Inventory Report: Greenhouse Gas Sources and Sinks in Canada, 1990-2005,* Greenhouse Gas Division, Ottawa.

Table 2
Domestic industrial greenhouse gas emissions associated with the production of exports, 1990 and 2002

	1990	2002[p]	Share of total 1990	Share of total 2002[p]
	kilotonnes		percent	
Agricultural, forestry, fishing and trapping products	20,357	23,212	11.5	8.8
Mineral fuels	26,419	61,953	15.0	23.4
Non-metallic minerals, metal ores and concentrates	6,799	5,722	3.9	2.2
Services incidental to mining	0	98	0.0	0.0
Food products	7,289	16,038	4.1	6.1
Beverages and tobacco products	787	401	0.4	0.2
Leather, rubber and plastic products	1,382	2,534	0.8	1.0
Textile products, hosiery, clothing and accessories	2,072	2,045	1.2	0.8
Lumber, wood products, furniture and fixtures	4,234	8,253	2.4	3.1
Pulp and paper products	19,603	18,986	11.1	7.2
Printing and publishing	197	571	0.1	0.2
Primary metal and other metal products	16,737	20,992	9.5	7.9
Machinery and equipment	2,278	4,134	1.3	1.6
Motor vehicle, other transport equipment and parts	10,852	15,352	6.2	5.8
Electrical, electronic and communication products	1,665	2,994	0.9	1.1
Non-metallic mineral products	1,870	3,685	1.1	1.4
Petroleum and coal products	10,241	12,836	5.8	4.9
Chemicals, pharmaceuticals and chemical products	12,876	17,159	7.3	6.5
Other manufactured products	1,378	1,561	0.8	0.6
Transportation and storage	10,067	15,901	5.7	6.0
Communications services	303	411	0.2	0.2
Other utilities	2,577	7,150	1.5	2.7
Wholesaling, retailing margins and transportation margins	11,906	15,362	6.8	5.8
Other finance, insurance and real estate services	896	1,808	0.5	0.7
Business and computer services	737	3,549	0.4	1.3
Private education services	83	175	0.0	0.1
Health and social services	12	13	0.0	0.0
Accommodation services and meals	1,933	116	1.1	0.0
Other services	780	1,220	0.4	0.5
Sales of other government services	33	125	0.0	0.0
Total	**176,363**	**264,358**	**100.0**	**100.0**

Source: Statistics Canada, Environment Accounts and Statistics Division.

industrial emissions due to exports jumped to 46% while they were at 36% just 11 years earlier.

Motor fuels the largest source of direct household emissions

In the preceding section, the analysis looked at the industrial emissions associated with household consumption. These can be referred to as "indirect" household emissions. In 2002, the commodity leading to the highest indirect household emissions was electricity (13.5% of total household emissions), followed by "other" services (12.2%), food and non-alcoholic beverages (12.1%) and the combined fuel categories[5] (7.8%). Table 3 shows a full breakdown of the indirect and direct emissions that can be attributed to household purchases in 1990 and 2002. Now we turn to the emissions that come directly from households.

Household use of motor fuels was the main source of greenhouse gas emissions associated directly with households in both 1990 and 2002 (Table 3). Emissions associated with this fuel use are considered direct, since they are the result of household rather than industrial activity. The other

5. This includes natural gas, motor fuels and lubricants, and other fuels.

Table 3
Direct and indirect emissions from personal expenditure, 1990 and 2002

	1990	2002[p]	Share of total 1990	Share of total 2002[p]
	kilotonnes		percent	
Direct emissions	96,853	111,276	33.1	34.7
Motor fuels and lubricants	55,910	69,557	19.1	21.7
Heating, lighting and appliances	40,943	41,719	14.0	13.0
Indirect emissions	196,193	209,787	66.9	65.3
Electricity	35,839	43,343	12.2	13.5
Other services	31,177	39,011	10.6	12.2
Food and non-alcoholic beverage	46,228	38,874	15.8	12.1
Restaurants and hotels	12,777	15,972	4.4	5.0
Motor fuels and lubricants	13,933	15,554	4.8	4.8
Gross rent (imputed and paid)	11,004	14,555	3.8	4.5
Other non-durable goods	12,378	10,781	4.2	3.4
Natural gas	6,292	7,315	2.1	2.3
Other semi-durable goods	5,721	5,521	2.0	1.7
Motor vehicles, parts and repairs	4,083	5,023	1.4	1.6
Clothing and footwear	6,050	4,750	2.1	1.5
Other durable goods	3,310	3,741	1.1	1.2
Furniture and households appliances	3,238	3,066	1.1	1.0
Other fuels	4,163	2,281	1.4	0.7
Total	**293,046**	**321,064**	**100.0**	**100.0**

Source: Statistics Canada, Environment Accounts and Statistics Division.

principal direct emissions from households are those caused by burning fuel oil and natural gas to heat homes. [6]

Direct emissions from household use of heating and motor fuels accounted for approximately one-third of the total direct and indirect emissions associated with households in 2002. Households were directly or indirectly responsible for almost half of all domestic emissions in 2002 (321 Mt out of the total 685 Mt of greenhouse gases emitted in Canada). [7]

Household emissions intensity

In the case of households, greenhouse gas emissions intensity is a measure of the greenhouse gases that are produced per unit of personal expenditure.

Household direct greenhouse gas emissions grew 14% between 1990 and 2002, while indirect emissions grew 7% (Table 4). In addition to these domestic emissions are those that occur abroad from the production of imported goods that are used to satisfy household demand. Emissions associated with the production of these goods grew 17% over the period.

Taken together, these three types of emissions yielded an 11% increase in total emissions attributable to households, both at home and abroad.

Between 1990 and 2002, personal expenditure increased 35% from $444.5 billion to $600.5 billion in constant prices.[8] Since household greenhouse gas emissions grew much less than this, household emissions intensity fell by almost 18% over the period (Table 4).

Had it not been for this decline in emissions intensity, the greenhouse gas emissions associated with household spending would have been even higher by 2002.

The decrease in household emissions intensity was partially due to changes in personal expenditure patterns. Households spent relatively less on greenhouse gas-intensive goods and services in 2002 compared with 1990. It was also influenced by improvements in the energy efficiency of industrial output.

6. There are also direct household emissions associated with fuelwood combustion and outdoor cooking. These relatively small amounts are not considered in this analysis.
7. The emissions accounts used for this analysis are available on CANSIM Table 153-0034. For 2002, these accounts cover 685 Mt of the 720 Mt officially submitted to the IPCC by Environment Canada. The difference is due to the adjustments outlined in the *Background* text box.
8. Statistics Canada, n.d., CANSIM table 380-0017.

Table 4
Direct and indirect household greenhouse gas emissions, 1990 to 2002

	Direct	Domestic indirect	Foreign indirect	Total	Total emissions per unit of expenditure
	megatonnes				1990 = 100
1990	97	196	90	383	100.0
1991	94	194	91	380	100.9
1992	97	196	104	397	103.8
1993	101	187	102	390	100.2
1994	105	186	103	394	98.1
1995	103	189	98	391	95.4
1996	108	189	99	396	94.3
1997	106	199	101	406	92.4
1998	103	204	105	412	91.2
1999	106	205	102	413	88.1
2000	107	205	99	412	84.4
2001	106	200	104	410	82.2
2002[p]	111	210	105	426	82.5

Note: Foreign indirect emissions are those from foreign companies that are due to the production of goods and services purchased by Canadian households. Emissions produced abroad to satisfy demand for imported goods were estimated with the assumption that the technology used to produce imported goods yields the same emissions per unit of output as in Canada.
Source: Statistics Canada, Environment Accounts and Statistics Division.

Conclusion

While the traditional supply perspective provides essential information for understanding greenhouse gas emissions, a demand perspective also sheds light on this issue. The analysis in this paper has shown that growing exports of mineral fuels played an important part in the growth of greenhouse gas emissions between 1990 and 2002. At the same time, this export growth contributed significantly to Canada's healthy economic performance. Reconciling these two imperatives—the need to control greenhouse gas emissions on the one hand and the need to create jobs and economic well-being on the other—is complex, with both short-and long-term implications for the economy an the environment.

Canadian lawns and gardens: Where are they the "greenest"?

Mary Frances Lynch and Nancy Hofmann, Environment Accounts and Statistics Division

Varying local conditions such as climate, cultural influences, laws, and housing types result in a diversity of household lawn and garden practices across the country. Pesticide use in urban areas is a particularly divisive issue, with many Canadians calling for bans and restrictions on municipal and residential use. Pesticide and fertilizer use was highest in the Prairies and lowest in Quebec in 2005, where pesticide use has declined sharply since the mid-1990s.[1] Water conservation techniques are more common in areas that can experience dry summer weather. Households in British Columbia were most likely to reduce lawn and garden water use by using water sprinkler timers, while rain barrels or cisterns were most commonly used in the Prairies.

Lawn and garden care: a popular activity

Landscaping activities are a favourite pastime for many Canadians and much time and money is spent maintaining lawns and gardens. In fact, on a typical day in 2005 nearly 11% of Canadians aged 30 and over spent time working on their lawn or garden, with the average participant spending more than 2 hours doing yardwork.[2]

1. Statistics Canada, 2007, *Households and the Environment, 2006,* Statistics Canada Catalogue no. 11-526-XIE, Ottawa.
2. Statistics Canada, General Social Survey, 2005.

What you should know about this study

This study is based primarily on data from the 2006 *Households and the Environment Survey* (HES), conducted as part of the Canadian Environmental Sustainability Indicators project. Household pesticide use data was also derived from the 1994 *Households and the Environment Survey*.

Data for household pesticide and fertilizer use, outdoor water use and ownership of gas-powered lawn mowers are all based only on households who reported having a lawn or garden. All respondents were asked whether they had a rain barrel or cistern, with the exception of apartment dwellers. Apartment dwellers also did not respond to questions relating to water sprinkler timers or gas-powered mowers, but did respond to questions relating to their gardens (but not lawns).

Data on households with lawns or gardens, ownership of gas-powered lawn mowers and use of rain barrels or cisterns is for 2006. Data on lawn and garden practices such as pesticide and fertilizer application, lawn watering and the use of water sprinkler timers is for 2005.

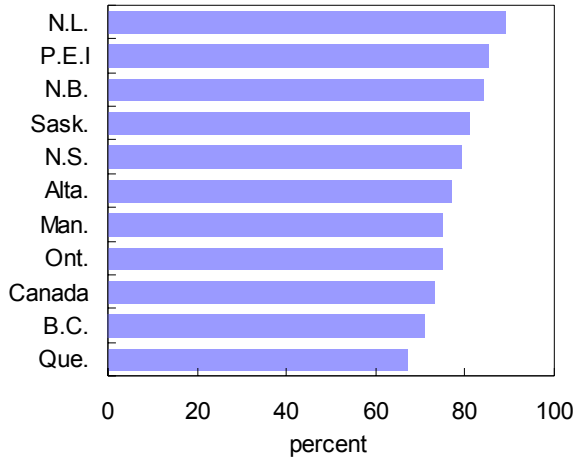
The popularity of landscaping activities has resulted in a booming lawn and garden industry. The sale of lawn and garden products, equipment and plants from large retailers rose by more than $600 million from 2002 to 2006, reaching over $2 billion.[3] A similar trend shows a boost in the area of agricultural land used to grow landscaping products. Between 2001 and 2006, there was a 24% increase in the area used to produce sod, as well as an expansion in the area used for nursery products such as trees, shrubs, and perennials.[4]

Where are the green thumbs?

In 2006, almost three quarters of Canadian households had a lawn or garden. Lawns and gardens were particularly common in the Atlantic provinces, with Newfoundland and Labrador, Prince Edward Island and New Brunswick comprising the top three provinces (Chart 1). The presence of lawns and gardens is influenced by housing type; these three provinces ranked above the national average for the proportion of single detached homes.[5]

3. Statistics Canada, n.d., CANSIM table 080-0009.
4. Statistics Canada, 2007, *2006 Census of Agriculture: Snapshot of Canadian agriculture,* www.statcan.ca/english/agcensus2006/articles/snapshot.htm (accessed June 4, 2007).
5. Statistics Canada, Households and the Environment Survey 2006.

Chart 1
Households with a lawn or garden, 2006



Note: As a percentage of all households.
Source: Statistics Canada, Households and the Environment Survey 2006

Quebec and British Columbia had the lowest proportion of households with lawns and gardens. Other types of housing, such as apartments, are relatively more popular in these provinces.

For certain provinces, there was some intra-provincial variation, including differences between large metropolitan regions. In Ontario, the presence of lawns and gardens ranged from 83% in the census metropolitan areas (CMA) of Oshawa, St. Catharines-Niagara and Thunder Bay to just 65% in Toronto. Similarly in Quebec, Saguenay had 75% of households with a lawn or garden, compared to 58% of households in lowest-ranked Montreal.

Bye-bye pests?

Pests, such as weeds and insects, can destroy lawns and gardens. Pesticides, including herbicides, insecticides and fungicides, can enhance the appearance of lawns and gardens by eliminating pests. Besides ensuring an aesthetically appealing lawn, herbicides can also be beneficial in reducing common allergy-causing plant species such as ragweed. Pesticides ensure that vegetable gardens are not devoured by various insects and diseases or dominated by invasive weeds.

However, pesticides can have negative effects on human and ecological health through the contamination of air, water, soil and food sources. In addition to killing target insects such as chinch bugs, insecticides can also kill other species that are beneficial to lawns and gardens. Insects may also be a source of food for birds, but this food source can be contaminated or reduced by pesticides.[6]

Pesticide use dipped slightly at the national level, Quebec pesticide use cut in half

In spite of increased efforts to build awareness of the potential health threats of pesticides, there has been little change in Canadian households' use of pesticides on their lawns and gardens. The proportion of households that used pesticides slipped only marginally from 31% in 1994 to 29% in 2005 (Table 1). In spite of this national trend, the proportion of households using pesticides was reduced by half in Quebec, with only 15% of households applying pesticides to their lawn or garden in 2005. The only other provinces to experience a decline in the proportion of households applying these substances were New Brunswick, Nova Scotia, and British Columbia. In contrast, the proportion of households using pesticides more than doubled in Newfoundland and Labrador and increased by almost half in Manitoba.

One possible reason for the large drop in pesticide use in Quebec dates back to the 1990s when the municipality of Hudson was the first in Canada to successfully implement a ban on cosmetic pesticides. By the spring of 2005, seventy other Canadian communities had banned non-essential household pesticides, a fact that was especially pronounced in Quebec.[7] As of April 30th 2006, the entire province of Quebec implemented a ban on the sale and use of the most toxic pesticides on public, private and commercial property, with the exception of golf courses and farmland.[8]

Prairies led country in pesticide use

In 2005, the Prairie provinces of Saskatchewan, Manitoba and Alberta led the country in pesticide use with about two out of every five households using them (Table 1). In contrast, pesticide use was approximately two-thirds lower in Prince Edward

6. Environment Canada, 2005, *12 Easy Steps to Get Your Lawn Off Drugs*, www.atl.ec.gc.ca/epb/factsheets/12_steps.html (accessed July 20, 2007).
7. Pralle, S., 2006, " 'The 'mouse that roared': Agenda setting in Canadian pesticides politics," *The Policy Studies Journal*, 34 (2): 171-194.
8. Government of Quebec, 2006, *The Pesticides Management Code*, www.menv.gouv.qc.ca/pesticides/permis-en/code-gestion-en/index.htm (accessed July 12, 2007).

Table 1
Households that used pesticides on their lawn or garden, by province, 1994 and 2005

Provinces	Used pesticides		Pesticide users,[1] 2005	
	1994	2005	Pesticides applied as part of a regular maintenance schedule[2]	Pesticides applied when a problem arose[2]
			percent	
Newfoundland and Labrador	9	21	48	51
Prince Edward Island	12	14	48	53
Nova Scotia	19	18	50	50
New Brunswick	20	17	45	48
Quebec	30	15	55	40
Ontario	34	34	58	42
Manitoba	30	44	41	59
Saskatchewan	37	43	42	57
Alberta	36	39	48	53
British Columbia	30	29	45	55
Canada	**31**	**29**	**52**	**47**

1. As a percentage of households with a lawn or garden.
2. Some respondents specified a frequency of application other than "part of a regular maintenance schedule" or "when problems arose." This proportion is not included here so some row totals may be less than 100 percent. In addition, some respondents specified both frequencies of application so some row totals may exceed 100 percent.

Source: Statistics Canada, Households and the Environment Survey, 1994 and 2006.

Island and Quebec, where about 1 in 7 households used them.

At the CMA level, some similar trends are found. Of the top three CMAs for pesticide use—Winnipeg, Saskatoon, and Regina—almost half of households used pesticides on their lawns and gardens. Meanwhile, cities in the province of Quebec had the lowest usage, including Saguenay (12%), Montreal (14%), Sherbrooke (15%) and Trois-Rivières (16%). In Ontario, the usage levels were more varied with about 45% of households in Hamilton, Oshawa and Kitchener applying pesticides while just under 30% of households in Kingston applied them.

Ontario households used pesticides as regular maintenance, Prairie provinces used pesticides when problems arose

There are two main treatment options for pesticide use: (i) using pesticides as part of regular lawn or garden care maintenance, or (ii) using pesticides when a problem or infestation arises.[9]

The second option can have fewer environmental impacts, since the frequency of use can be lower.

Of Canadian households using pesticides, just over half used them as part of a regular maintenance schedule. Ontario had the highest proportion in the country—almost 60% of households applied pesticides as part of a regular maintenance program in 2005 (Table 1).

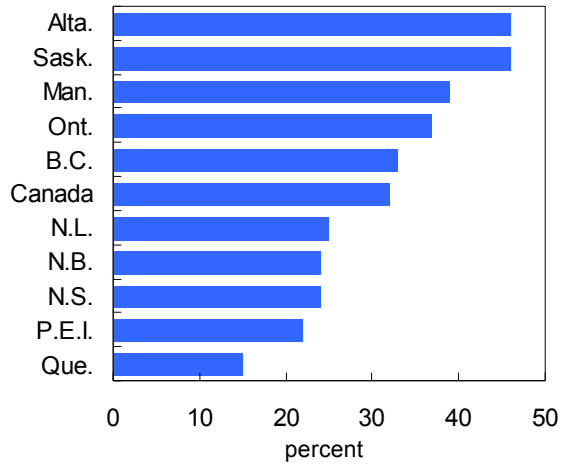
Manitoba (41%) and Saskatchewan (42%) had the lowest proportion of households using pesticides as part of a regular maintenance routine. Instead, households in Manitoba and Saskatchewan preferred to use pesticides in response to pest problems, potentially minimizing pesticide use. Almost 60% of pesticide users in these two provinces used pesticides when a problem arose—the highest rates in the country (Table 1).

Prairie lawns go green with fertilizers while Quebec lawns go "au naturel"

Fertilizers containing nitrogen, phosphorus and potassium add nutrients to lawns and gardens, making lawns greener and thicker. However, fertilizer use can be problematic if applied improperly or in excess. In such cases, these nutrients can run-off into storm water sewers and local streams reaching lakes and other surface water bodies. This nutrient enrichment, known as eutrophication, can lead to excessive growth of plants and algae in water bodies. When these plants die, their decomposition removes dissolved oxygen from the water, making

9. Environment Canada, 2002, *Integrated Pest Management in the Atlantic Region,* www.atl.ec.gc.ca/epb/envfacts/ipm.html (accessed June 20, 2007).

Chart 2
Households that used chemical fertilizers on their lawn or garden, by province, 2005



Note: As a percentage of households with a lawn or garden.
Source: Statistics Canada, Households and the Environment Survey 2006

the habitat unsuitable for many forms of aquatic life.[10]

Household chemical fertilizer use was highest in Alberta and Saskatchewan, where nearly half of households with lawns or gardens applied fertilizers in 2005 (Chart 2). Manitoba trailed closely with almost 40% of households using them. Fertilizer use was particularly high in Saskatoon (57%), Regina (54%), Calgary (49%) and Edmonton (48%).

Quebec had the lowest percentage of households applying fertilizers, with about 15% using them. Montreal (13%), Saguenay (15%), Sherbooke (16%) and Trois-Rivieres (17%) had the lowest proportion of households using chemical fertilizers in the country. Although there is no ban on chemical fertilizers, as of April 2004, Quebec instituted a ban on the sale of fertilizer-pesticide mixtures.[11]

There was also some variation amongst the CMAs in Ontario, including a 17 percentage point spread between those cities with the highest share and lowest share of fertilizer users. Oshawa (47%), Hamilton (46%), and London (44%) had the highest proportion of households using fertilizer in Ontario. Meanwhile households in Thunder Bay (30%) and Kingston (32%) had the lowest percentage of fertilizer use.

Water, water … not everywhere

Watering is another lawn and garden activity with possible environmental impacts. Different climates, laws, natural physical features and cultural influences may influence watering. Domestic water consumption can increase up to 50% during the summer months when many people water their lawns and gardens.[12]

In some parts of the country, grass will brown or die if it is not watered. Kentucky bluegrass, a common lawn grass used in North America, has low drought resistance and requires more water than other types of grass.[13] Many gardens also need watering; the need and frequency is dependant on the composition of its plants and local climatic conditions.

Three quarters of households watered their lawn or garden in 2005 (Table 2). New Brunswick and Prince Edward Island had the lowest proportion of households that watered their lawns and gardens. Ontario and British Columbia were the only two provinces above the national rate.

More garden watering than lawn watering

Over four out of every five Canadian households watered their gardens, while over half watered their lawns (Table 2).

There were pronounced differences between provinces in terms of lawn watering. In Prince Edward Island and New Brunswick, about two out of every ten households watered their lawn. In comparison, six out of every ten households watered their lawns in Alberta, British Columbia, Saskatchewan and Ontario. Provincial differences were less pronounced for garden watering.

10. Mason, C., 1991, *Biology of Freshwater Pollution,* John Wiley & Sons, Inc., New York.
11. Government of Quebec, 2006, *The Pesticides Management Code*, www.menv.gouv.qc.ca/pesticides/permis-en/code-gestion-en/index.htm (accessed July 12, 2007).
12. Environment Canada, 2003, *Down-to-Earth Choices: Tips for making where you live one of Canada's Healthy Neighbourhoods,* www.atl.ec.gc.ca/community/down_to_earth_choices/in_your_yard.html (accessed June 7th, 2007).
13. Kansas State University, 2000, *Horticulture Report: Kentucky Bluegrass Lawns,* www.hfrr.k-state.edu/DesktopModules/ViewDocument.aspx?DocumentID=1110 (accessed June 20, 2007).

Using less water…

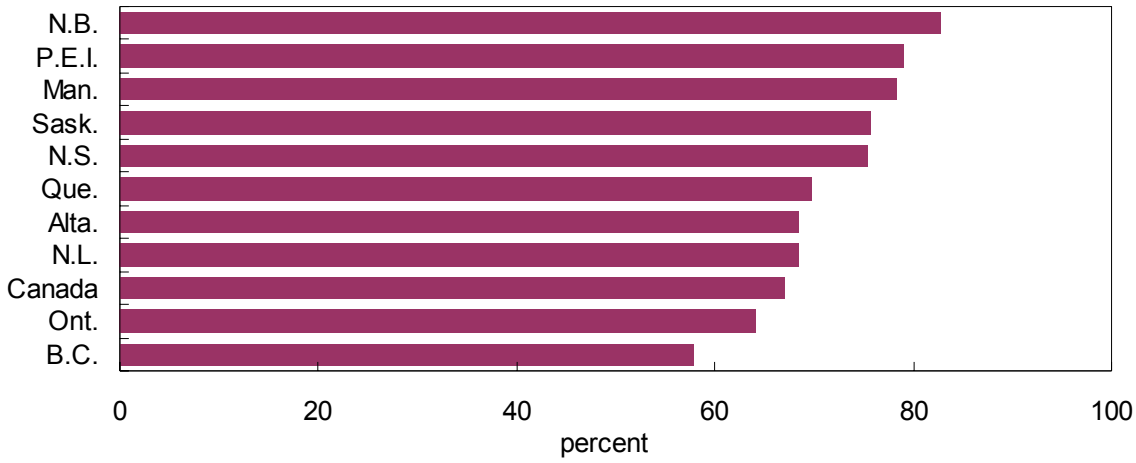
The use of sprinkler timers as well as rain barrels or cisterns are ways to potentially reduce water use. Using water sprinkler timers can help manage and conserve water and ensure that excessive amounts of water are not applied, such as when users forget to turn off sprinklers. They can promote watering at optimal times, including in the early morning when evaporation is less of a concern. Capturing water in rain barrels or cisterns reuses water that is naturally

Air quality and lawn mowing

Air quality problems are most often associated with emissions from cars and trucks. Although used less frequently overall, household gasoline-powered equipment can have a disproportionate effect on air quality. Studies show that depending on the age and model, gas-powered lawn mowers can emit the same amount of pollution in one hour, as a car driven 20 to 200 miles.[1] In one year, the average gas-powered lawn mower can emit the same amount of $PM_{2.5}$[2] as the average car traveling about 3300 km.[3] $PM_{2.5}$ is a key component of smog and can have negative health effects on humans and the environment.[4] In 2006, two thirds of Canadian households with lawns and gardens owned a gasoline-powered lawn mower (Chart 3). New Brunswick and Prince Edward Island had the highest proportion of households owning gas-powered mowers, whereas British Columbia had the lowest.

Although a third of Canadian households were aware of air quality advisories in 2005, 61% of these households did not change their activities or behaviour during these advisories. Changes in activities or behaviour might include using an asthma inhaler, curtailing outdoor physical activity (such as jogging or lawn mowing) or using public transit instead of their motor vehicle. Households in Ontario were most likely to change their activities under an air quality advisory. In 2004, Southern Ontario, home to approximately 30% of Canadians, had the highest concentrations of ground-level ozone, a key component of smog.[5]

Chart 3
Households that owned gasoline-powered lawn mowers, by province, 2006



Notes:
As a percentage of households with a lawn or garden.
Data do not include apartment building dwellers.
Source: Statistics Canada, Households and the Environment Survey, 2006.

1. Environment Canada, 2006, *Clean Air Online: Compiled List of Quick Facts,* www.ec.gc.ca/cleanair-airpur/default.asp?lang=En8n=2309FEF9-1 (accessed June 4, 2007).
2. Particulate matter under 2.5 microns in size.
3. Environment Canada, 2007, *Criteria Air Contaminant Inventory.*
4. Environment Canada, Statistics Canada and Health Canada, 2006, *Canadian Environmental Sustainability Indicators,* Statistics Canada Catalogue no. 16-251-XIE, Ottawa.
5. Environment Canada, Statistics Canada and Health Canada, 2006.

Table 2
Outdoor water use, by province, 2005

Provinces	Households that watered their lawn and/or garden[1]	Households that watered their lawn[2]	Households that watered their garden[3]	Used a sprinkler timer[4]
	percent			
Newfoundland and Labrador	69	54	72	F
Prince Edward Island	63	18	77	F
Nova Scotia	68	36	79	14
New Brunswick	56	20	72	F
Quebec	71	40	81	26
Ontario	80	61	84	21
Manitoba	67	44	70	13
Saskatchewan	75	61	74	16
Alberta	75	64	78	21
British Columbia	79	61	83	35
Canada	76	54	81	23

1. As a percentage of households with lawns or gardens.
2. As a percentage of households with lawns.
3. As a percentage of households with gardens.
4. Includes only households that reported having a lawn or garden that was watered in the summer of 2005. Percentages do not include apartment building dwellers.

Source: Statistics Canada, Households and the Environment Survey, 2006.

available, avoiding the use of municipally-treated water.[14]

Nearly a quarter of Canadian households with lawns or gardens used sprinkler timers to assist in watering in 2005. British Columbia had the highest percentage, with over one third of households using a water sprinkler timer (Table 2). The province promotes water conservation[15] and regulations on watering exist in several municipalities.[16] Quebec was the only other province where the use of sprinkler timers was higher than the national rate—26% of Quebec households[17] reported using a water sprinkler timer.

In 2006, about 14% of Canadian households[18] used rain barrels or cisterns. In the Prairie provinces, the use of rain barrels or cisterns was more common than anywhere else in Canada. Alberta (27%), Saskatchewan (27%) and Manitoba (20%) were the only provinces to exceed the national rate in the use of these water conservation devices.

Conclusion

This paper has looked at some of the activities Canadians undertake to maintain their lawns and gardens. While the picture that emerges is varied, it does show some marked differences as one travels from east to west. Households east of Ontario tended to make less use of pesticides and chemical fertilizers than those in the west. However, Easterners weren't as likely to use water sprinkler timers or capture rainwater for lawn and garden purposes. This mosaic of practices reflects the diversity of local growing conditions as well as economic and legal constraints and social values that exist in communities across Canada.

14. Environment Canada, 2002, *Water Conservation-Every Drop Counts,* www.ec.gc.ca/water/en/info/pubs/FS/e_FSA6.htm (accessed July 20, 2007).
15. Ministry of the Environment Water Stewardship Division, 2001, *Water Conservation,* www.env.gov.bc.ca/wsd/plan_protect_sustain/water_conservation/index.html (accessed June 15, 2007).
16. Greater Vancouver Regional District, 2004, *Lawn sprinkling regulations,* www.gvrd.bc.ca/water/sprinkling-regulations.htm (accessed June 21, 2007).
17. Only including those households that had a lawn or garden that was watered.
18. Not including those who live in apartments.

Heavy fuel oil consumption in Canada

Paul McPhie and Anthony Caouette, Manufacturing, Construction and Energy Division

Like other industrialized countries, Canada's thirst for energy continues unabated into the 21st Century. Despite our growing concern about climate change and air quality, petroleum products remain key to satisfying that demand.

Petroleum products include heavy fuel oil, a relatively low-grade fuel of tar-like consistency. Heavy fuel oil is generally higher in sulphur content than most petroleum products and is second only to coal as a carbon-intensive fuel.

In 1990, heavy fuel oil was used to produce 419.5 petajoules of energy; by 2005, this production had declined to 387.3 petajoules (Table 1). One petajoule contains energy equivalent to about 30 million litres of gasoline.

As a result, heavy fuel oil accounted for 4.1% of Canada's total energy needs in 2005, down from 5.5% in 1990.

This article examines trends in the use of heavy fuel oil in Canada at the industrial and provincial levels between 1990 and 2005, mostly using data from the *Report on Energy Supply-Demand in Canada* (Catalogue no. 57-003). A more detailed report on Heavy Fuel Oil Consumption is available through www.statcan.ca/english/research/11-621-MIE/11-621-MIE2007062.htm.

By far, the largest reduction in heavy fuel oil use has come from the pulp and paper industry. Between 1990 and 2005, this industry cut its consumption of heavy fuel oil by more than one-half. The decline was particularly strong in the Atlantic provinces and British Columbia, and to a lesser extent in Quebec.

The Atlantic provinces were the main consumers of heavy fuel oil in 2005, accounting for 44.4% of national demand (Table 2). In 2005, heavy fuel oil use by electric utility companies in Atlantic Canada dipped slightly compared to the amount used fifteen years earlier.

The sector most dependent on heavy fuel oil was marine transportation, where it accounted for more than 60% of energy consumed in 2005; the rest came

Table 1
Canada's energy demand, 1990 to 2005

	1990	1995	2000	2005	1990	1995	2000	2005
	petajoules				percent			
Total refined petroleum products	2,885.7	2,960.2	3,282.8	3,588.4	37.8	35.7	35.8	37.6
Heavy fuel oil[1]	419.5	302.4	351.0	387.3	5.5	3.7	3.8	4.1
Natural gas	2,370.9	2,715.1	3,055.3	3,007.0	31.1	32.8	33.4	31.5
Primary electricity (hydro, nuclear, wind and tidal)	1,682.1	1,824.2	1,980.6	2,089.0	22.0	22.0	21.6	21.9
Other[2]	694.0	781.3	839.2	855.9	9.1	9.4	9.2	9.0
Total	**7,632.7**	**8,280.8**	**9,157.9**	**9,540.2**	**100.0**	**100.0**	**100.0**	**100.0**

1. Heavy fuel oil is also counted as part of refined petroleum products.
2. Other includes spent pulping liquor and solid wood waste. This data is found in Catalogue no 57-003, but is not included in the CANSIM tables.

Sources: Statistics Canada, n.d., CANSIM tables 128-0002 and 128-0009.
Statistics Canada, 2007, *Report on Energy Supply-demand in Canada*, Statistics Canada Catalogue no. 57-003, Ottawa.

Table 2
Heavy fuel oil demand, by region, 1990 to 2005

Province/Territory	1990	1995	2000	2005	1990	1995	2000	2005
	petajoules				percent			
Atlantic provinces	189.5	152.7	178.2	172.1	45.2	50.5	50.8	44.4
Quebec	105.6	70.0	83.9	105.0	25.2	23.1	23.9	27.1
Ontario	70.9	46.9	50.0	58.0	16.9	15.5	14.2	15.0
Other provinces and territories	53.5	32.8	39.0	52.2	12.8	10.9	11.1	13.5
Canada	**419.5**	**302.4**	**351**	**387.3**	**100.0**	**100.0**	**100.0**	**100.0**

Sources: Statistics Canada, n.d., CANSIM tables 128-0002 and 128-0009.

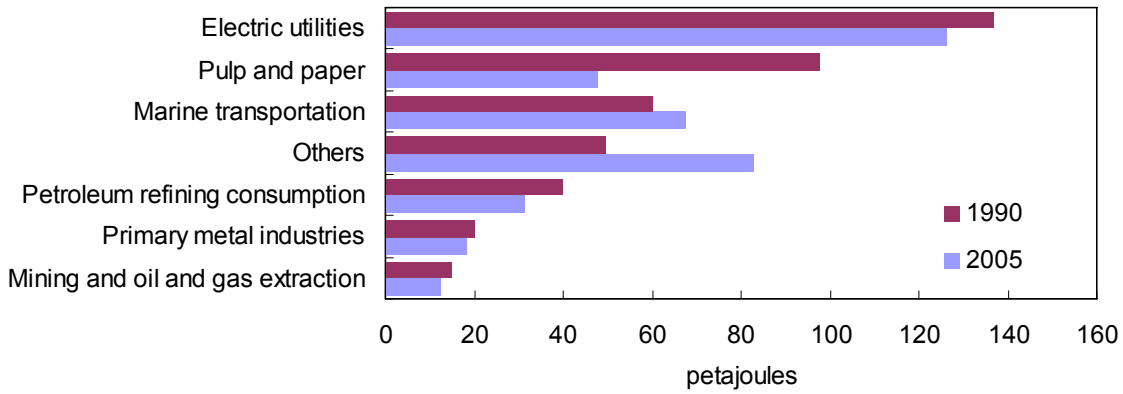
Table 3
Heavy fuel oil demand, by industry, 1990 to 2005

	1990	1995	2000	2005	1990	1995	2000	2005
	petajoules				percent			
Pulp and paper	97.6	58.7	56.7	47.8	23.3	19.4	16.1	12.3
Petroleum refining[1]	40.0	38.5	39.9	31.6	9.5	12.7	11.4	8.1
Primary metal manufacturing	20.0	15.2	14.8	18.5	4.8	5.0	4.2	4.8
Mining and oil and gas extraction	14.9	16.5	15.0	12.5	3.6	5.5	4.3	3.2
Other industrial	32.8	21.9	21.0	17.8	7.8	7.3	6.0	4.6
Utilities	137.1	80.6	110.1	126.5	32.7	26.7	31.3	32.7
Marine transportation	60.1	56.6	67.8	67.5	14.3	18.7	19.3	17.4
Other	16.9	14.5	25.9	65.2	4.0	4.8	7.4	16.8
Total	**419.5**	**302.4**	**351.2**	**387.3**	**100.0**	**100.0**	**100.0**	**100.0**

1. Producer consumption by the petroleum refining industry. The industry consumes some of the heavy fuel oil it produces to satisfy its own energy needs.

Sources: Statistics Canada, n.d., CANSIM tables 128-0002 and 128-0009.

Chart 1
Heavy fuel oil major users: pulp and paper down, utilities and marine still strong



Sources: Statistics Canada, n.d., CANSIM tables 128-0002 and 128-0009.

from diesel fuel. This sector was also the only major user that increased its consumption during this 15-year period. More than half of consumption occurred in British Columbia.

Energy demand on the rise

Even though Canadians, like people in many other industrialized countries, are concerned about increases in greenhouse gas emissions,[1] their demand for energy keeps rising.

Demands for all major energy sources such as petroleum products, natural gas and electricity have all increased in recent decades.

In 2005, Canada consumed 9,540 petajoules of energy, 25% more than in 1990 (Table 1). Meanwhile, greenhouse gas emissions also increased 25% from 1990 to 2005.[2]

The increase in demand between 1990 and 2005 was spread more or less equally across all major sources. During the period, there was no significant shift away from the combustion of hydrocarbons toward more benign and renewable energy sources such as hydro-electricity.

1. Brewer, Thomas L., 2007, *Public Opinion on Climate Change Issues in the G8+5 Countries,* www.usclimatechange.com (accessed July 26, 2007).

2. Environment Canada, 2007, *Canada's 2005 Greenhouse Gas Inventory: A Summary of Trends,* www.ec.gc.ca/pdb/ghg/inventory_report/2005/2005summary_e.cfm (site accessed July 25, 2007).

Table 4
Pulp and paper industry's energy demand, 1990 to 2005

	1990	1995	2000	2005	1990	1995	2000	2005
	petajoules				percent			
Spent pulping liquor	279.1	325.7	342.2	307.9	35.6	37.4	35.6	34.3
Solid wood waste	99.1	134.3	189.2	227.9	12.6	15.4	19.7	25.4
Electricity demand	175.8	201.2	221.7	221.2	22.4	23.1	23.1	24.7
Natural gas	114.9	136.0	125.8	69.6	14.6	15.6	13.1	7.8
Heavy fuel oil	97.6	58.7	56.7	47.8	12.4	6.7	5.9	5.3
Other	18.2	15.5	25.5	22.3	2.3	1.8	2.7	2.5
Total	**784.7**	**871.3**	**961.1**	**896.7**	**100.0**	**100.0**	**100.0**	**100.0**

Sources: Statistics Canada, n.d., CANSIM tables 128-0002 and 128-0009.
Statistics Canada, 2007, *Report on Energy Supply-demand in Canada,* Statistics Canada Catalogue no. 57-003, Ottawa.

Decline in use of heavy fuel oil

While Canadians generally remain dependent upon fossil fuels, they are becoming less dependent on heavy fuel oil. In fact, the consumption of heavy fuel oil as an energy source declined 7.7% between 1990 and 2005, from 419.5 petajoules to 387.3 petajoules. In 2005, it provided 4.1% of Canada's total energy needs, down from 5.5% in 1990 (Table 1).

A small portion of this drop (less than 15%) was attributable to a general reduction in energy use by consumers of heavy fuel oil. The other 85% of the decline was attributable to the substitution of heavy fuel oil by other energy sources.

While not one of the main energy sources nationally, heavy fuel oil is still an important fuel source for some industries. It is used for thermal-electric power generation and for heating boilers and furnaces in some manufacturing industries, notably the pulp and paper and petroleum refining industries. It is also used to power large marine vessels and to heat some large, usually older, commercial, institutional and multiple-unit residential buildings (Table 3).

The decline in heavy fuel oil use was not distributed evenly among its main users. Some industries reduced their dependence on this energy source, while others still depended heavily on it in 2005.

Pulp and paper industry led the reduction in use

By far, the pulp and paper industry most reduced its use of heavy fuel oil between 1990 and 2005 (Chart 1). The industry cut its consumption by more than half over the period, from 97.6 petajoules to 47.8 petajoules (Table 4).

The decline was strongest in the Atlantic provinces (-58.4%) and in British Columbia (-89.8%). In Quebec, the decline was 28.7%.

Spent pulping liquor, which contains the fiber removed from wood either chemically or mechanically, has been an increasing source of energy for this industry. It accounted for 34.3% of all energy needs in 2005.

Burning wood waste as a source of energy came second to spent pulping liquor, but doubled its share of the pulp and paper industry's energy needs from 12.6% in 1990 to 25.4% in 2005.

These two fuel sources combined provided almost 60% of total energy needs for the pulp and paper industry by 2005, displacing traditional energy sources such as fossil fuels. Electricity accounted for 24.7% of energy use.

Utility companies still dependent on heavy fuel oil

Heavy fuel oil use by electric utility companies in Atlantic Canada dipped slightly compared to the amount used fifteen years earlier.

In 2005, utility companies in Canada used 126.5 petajoules of heavy fuel oil, accounting for one-third of all demand for the fuel (Table 3). This was a reduction of 10.6 petajoules, or 7.7%, from the level in 1990. However, the contribution of this sector to the overall decline in heavy fuel oil from 1990 to 2005 was much less significant than the contribution of the pulp and paper industry.

Utilities in Atlantic Canada dominated when it came to using heavy fuel oil for thermal-electric generation. Almost 15% of the Atlantic region's

Table 5
Electricity generation, by utilities, by source, 2005

Province/Territory	Hydro[1]	Nuclear	Coal	Natural gas	Heavy fuel oil[2]	Other[3]
	percent					
Newfoundland and Labrador	96.6	0.0	0.0	0.0	3.4	0.0
Prince Edward Island and Nova Scotia	10.0	0.0	71.7	1.9	15.8	0.6
New Brunswick	18.8	21.6	18.0	5.2	36.1	0.2
Quebec	96.4	2.8	0.0	0.2	0.7	0.0
Ontario	22.3	50.2	19.7	7.3	0.6	0.0
Manitoba	98.8	0.0	1.2	0.0	0.0	0.0
Saskatchewan	24.0	0.0	55.8	20.1	0.0	0.1
Alberta	5.4	0.0	81.7	12.8	0.0	0.1
British Columbia	94.3	0.0	0.0	5.7	0.0	0.1
Yukon Territory, Northwest Territories and Nunavut	70.6	0.0	0.0	0.0	0.0	29.4
Canada	**59.0**	**15.6**	**18.2**	**4.9**	**2.3**	**0.1**

1. Includes small amounts of wind and tidal.
2. Includes petroleum coke.
3. Includes manufactured gases, other petroleum products, other fuels and station service.
Source: Statistics Canada, 2007, *Report on Energy Supply-demand in Canada*, Statistics Canada Catalogue no. 57-003, Ottawa.

electricity originated from this fuel source in 2005, down only slightly from 1990 (Table 5). Outside Atlantic Canada, only utilities in Quebec and Ontario burned heavy fuel oil to generate electricity, but it was responsible for less than 1% of production in each province in 2005.

Demand for heavy fuel oil in marine transportation still strong

The marine transportation industry, which has limited energy alternatives, relies solely on two fuel types: heavy fuel oil, which represented 60.7% of fuel consumption in 2005 and diesel which represented 39.3%.

This was the only sector to increase its consumption of heavy fuel oil between 1990 and 2005. Consumption rose 12.2% from 60.1 petajoules in 1990 to 67.5 petajoules in 2005 (Table 3). In contrast, diesel fuel consumption remained fairly constant over the period.

It is important to note that sales to ships of both Canadian and foreign registry are included in the estimates of heavy fuel oil use by the marine transportation industry.

In 2005, more than one half (55%) of heavy fuel oil sales to the marine transportation sector were made in British Columbia. An additional 23% of sales occurred in Quebec, while 12% were in Atlantic Canada and 10% in Ontario.

Heavy fuel oil use on decline in other industrial sectors

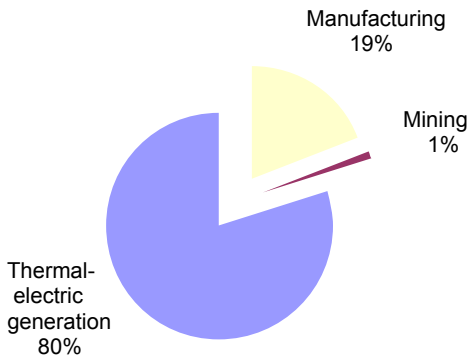
The petroleum refining industry consumes some of the heavy fuel oil it produces to satisfy its own energy needs. This industry along with the other two main industrial users—the primary metal industry and the mining, oil and gas extraction industry—reduced their use of heavy fuel oil between 1990 and 2005. They accounted for 62.6 petajoules, or 16.2%, of total heavy fuel oil use in 2005 (Table 3). It should be noted that heavy fuel oil meets only a small portion of the total energy needs of these industries, less than 3%.

The cost of water in the manufacturing sector

François Soulard and Andy Shinnan, Environment Accounts and Statistics Division

Almost every industrial process uses water, in some cases a great deal. In total, manufacturing, mining and thermal-electric generation withdrew 40,375 million cubic metres (MCM) of water in 2005,[1] enough water to fill half an Olympic-sized pool for every Canadian. These new data come from the 2005 Industrial Water Survey conducted by Statistics Canada. Complete survey results are available upon request.

Chart 1
Water intake, manufacturing, mining and thermal-electric power generation industries, 2005



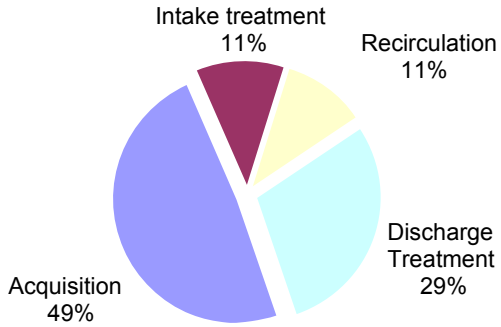
Source: Statistics Canada, Industrial Water Survey, 2005.

The manufacturing industries accounted for 19% (7,779 MCM) of water withdrawals (Chart 1). Water discharge by manufacturers was 6,728 MCM, resulting in water consumption of 1,051 MCM or a consumption rate of 13.5%. The three largest manufacturing users of water were the paper, primary metal and food industries, accounting for 70% of total manufacturing gross water use.

Water acquisition costs in the manufacturing industries—which include payments to public utilities for piped water; operation and maintenance costs for self-supplied water systems (excluding treatment); and licence fees—were about $1.24 billion in 2005, or half of total water-related costs.

Total costs for water, which include acquisition, water treatment and related operational expenses, stood at over $2.5 billion (Chart 2).

Chart 2
Water costs in manufacturing industries, by cost component, 2005

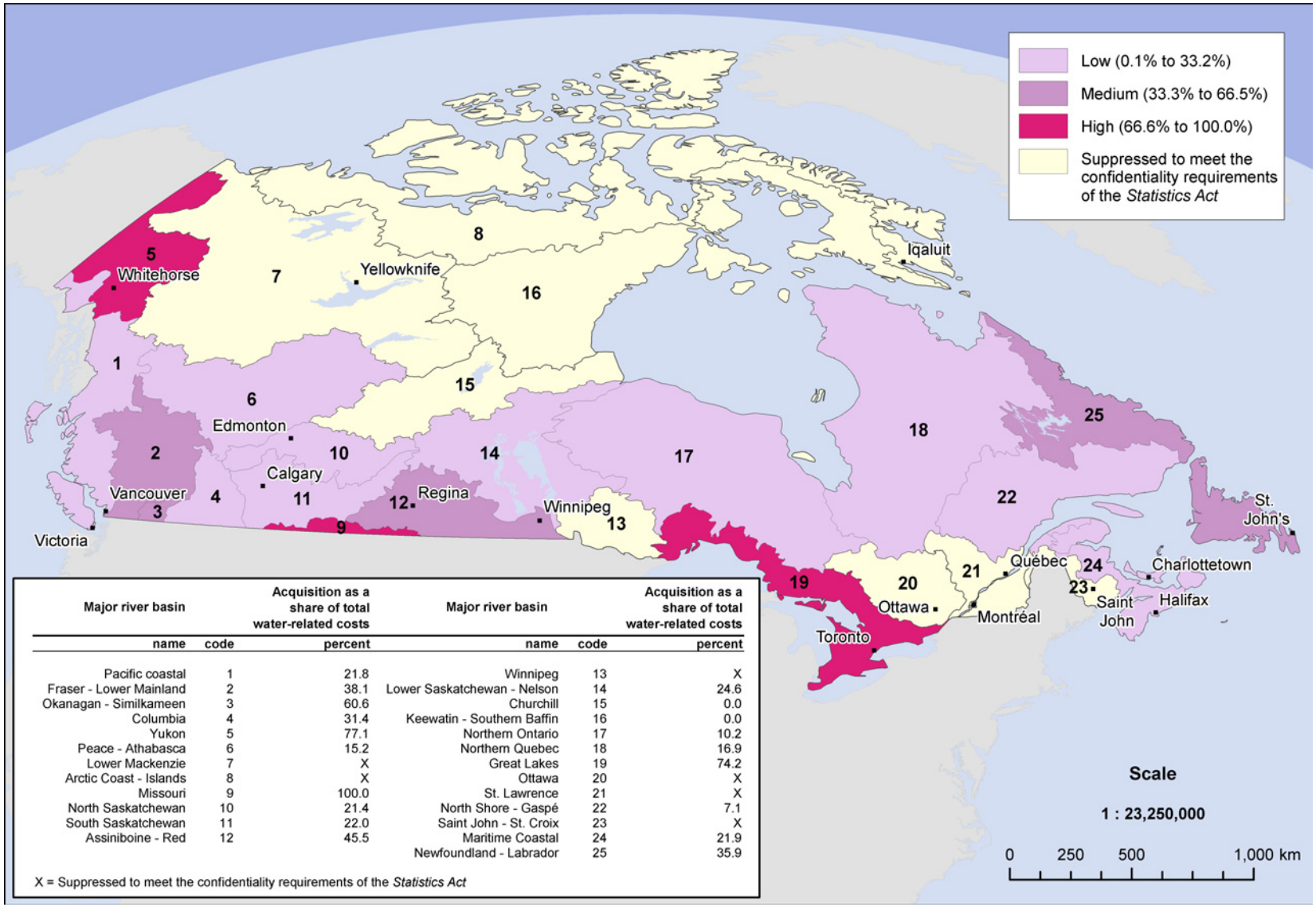


Source: Statistics Canada, Industrial Water Survey, 2005.

The cost of acquiring water, as a share of total water costs, varied across the country (Map 1). For example, the manufacturing industries in the Great Lakes River Basin devoted three-quarters of water-related costs to the acquisition of water, a proportion that was less than a quarter in the Pacific Coastal River Basin.

1. This amount excludes water withdrawn by the oil and gas extraction industry and the agricultural industry. Water used by these two industries will be measured by surveys that will be conducted in 2008.

Map 1
Acquisition as a share of total water-related costs in manufacturing industries, by major river drainage basin, 2005



Major river basin		Acquisition as a share of total water-related costs	Major river basin		Acquisition as a share of total water-related costs
name	code	percent	name	code	percent
Pacific coastal	1	21.8	Winnipeg	13	X
Fraser - Lower Mainland	2	38.1	Lower Saskatchewan - Nelson	14	24.6
Okanagan - Similkameen	3	60.6	Churchill	15	0.0
Columbia	4	31.4	Keewatin - Southern Baffin	16	0.0
Yukon	5	77.1	Northern Ontario	17	10.2
Peace - Athabasca	6	15.2	Northern Quebec	18	16.9
Lower Mackenzie	7	X	Great Lakes	19	74.2
Arctic Coast - Islands	8	X	Ottawa	20	X
Missouri	9	100.0	St. Lawrence	21	X
North Saskatchewan	10	21.4	North Shore - Gaspé	22	7.1
South Saskatchewan	11	22.0	Saint John - St. Croix	23	X
Assiniboine - Red	12	45.5	Maritime Coastal	24	21.9
			Newfoundland - Labrador	25	35.9

X = Suppressed to meet the confidentiality requirements of the *Statistics Act*

Source: Statistics Canada, Industrial Water Survey, 2005.

Environment and sustainable development indicators

Table 1
Selected environmental statistics

	2001	2002	2003	2004	2005	2006
Population						
Population (number)[1]	31,021,251	31,372,587	31,676,077	31,989,454	32,299,496	32,623,490
percentage change	1.1	1.1	1.0	1.0	1.0	1.0
aged 65 and over (percent of total)	12.6	12.7	12.8	13.0	13.1	13.2
urban (percent of total)	79.7	..	..	..	..	80.2
density (per square kilometre)	3.4	3.5	3.5	3.5	3.6	3.6
Economy						
Gross Domestic Product (million chained 2002 dollars)	1,120,146	1,152,905	1,174,592	1,210,656	1,247,780	1,282,204
percentage change	1.8	2.9	1.9	3.1	3.1	2.8
per capita (chained 2002 dollars)	36,109	36,749	37,081	37,845	38,632	39,303
Consumer Price Index (2002 = 100)	97.8	100.0	102.8	104.7	107.0	109.1
Unemployment rate (percent)	7.2	7.7	7.6	7.2	6.8	6.3
Social						
Average household spending (current dollars)						
water and sewage	195	190	209	209	217	..
electricity	973	1,019	1,056	1,065	1,099	..
food	6,415	6,692	6,787	6,910	7,135	..
gasoline and other motor fuels	1,539	1,729	1,713	1,893	2,075	..
Personal expenditure on consumer goods and services (million chained 2002 dollars)	632,781	655,722	675,443	698,138	724,942	755,204
Residential waste						
production per capita (kilograms)	..	390	..	418	..	..
disposal (tonnes)	..	9,447,531	..	9,792,787	..	..
disposal per capita (kilograms)	..	301	..	306	..	..
diversion (tonnes)	..	2,789,669	..	3,582,301	..	..
diversion per capita (kilograms)	..	89	..	112	..	..
diversion rate (percent of waste production)	..	23	..	27	..	..
Distance driven by light vehicles[2] (million kilometres)	238,380	290,320	286,803	285,164	289,717	296,871
Asthma (percent of population age 12 and over)	..	..	8.4	..	8.3	..
Energy						
Primary energy availability (terajoules)	10,950,393	11,163,501	11,478,526	11,527,500	11,310,201	..
Primary and secondary energy (terajoules)						
export	9,305,984	9,491,341	9,444,883	9,810,695	9,641,137	..
residential consumption	1,239,970	1,286,677	1,338,166	1,313,015	1,296,130	..
Established reserve, closing stock[3]						
crude bitumen (million cubic metres)	1,830	1,840	1,720	1,660	1,620	..
crude oil (million cubic metres)	644.7	606.1	590.0	603.8	752.3	..
natural gas (billion cubic metres)	1,590.8	1,569.7	1,504.1	1,532.2	1,621.2	..
Recoverable reserves, closing stock[3]						
coal (million tonnes)	4,555.4	4,485.3	4,423.1	4,357.2	..	..
uranium (tonnes)	452,000	439,000	429,000	444,000	..	..

Table 1 (continued)
Selected environmental statistics

	2001	2002	2003	2004	2005	2006
Total electricity generation (megawatt hours)	565,757,322	578,728,900	564,218,465	571,291,905	597,248,219	585,097,531
hydro (percent of total)	58.0	59.8	59.0	58.7	60.0	60.0
nuclear (percent of total)	12.8	12.3	12.5	14.9	14.5	15.8
thermal-electric (percent of total)	29.2	27.9	28.5	26.4	25.4	24.2
Research and development expenditures						
private sector R&D in alternative energy (million constant 1997 dollars)	228	196	204	..	..	..
Environment and natural resources						
GHG emissions (megatonnes of carbon dioxide equivalent)	714	720	745	747	747	..
GHG emissions by final demand (megatonnes of carbon dioxide equivalent)						
exports	278	264	..	..	..	..
personal consumption	200	210	..	..	..	..
Annual temperature departures,[4] Canada (degrees Celsius)	1.7	0.6	1.1	0.1	1.7	2.4
Value of selected natural resources (million current dollars)						
land	926,150	1,013,754	1,095,419	1,226,497	1,352,999	1,493,300
timber	300,445	303,278	297,474	302,358	281,125[p]	263,192[p]
subsoil resource stocks	396,760	375,276	465,083	558,023	817,416[p]	818,926[p]
Average farm pesticide expenditures (current dollars)	6,312	6,228	7,232	7,602	7,606 [p]	..
Air quality[5]						
ozone (population weighted, parts per billion)	40	41	40	35	..	..
$PM_{2.5}$ (population weighted, micrograms per cubic metre)	9	10	9	8	..	..

1. Population data is based on the Estimates of Population program, except for data on urban population, which is based on the Census of Population.
2. Distance driven for vehicles weighing less than 4.5 tonnes, excluding the territories.
3. The size of the reserve at year-end.
4. Annual departures from the 1951-1980 temperature normals.
5. Ground level ozone and fine particulate matter ($PM_{2.5}$) are two key components of smog that have been linked to health impacts ranging from minor respiratory problems to hospitalizations and premature death. There are no established thresholds below which these pollutants are safe and do not pose a risk to human health.

Sources: Statistics Canada, n.d., CANSIM tables 051-0001, 153-0037, 380-0017, 326-0021, 282-0002, 203-0003, 203-0002, 203-0007, 405-0063, 105-0400, 128-0002, 128-0009, 153-0012, 153-0013, 153-0014, 153-0017, 153-0018, 153-0019, 127-0001, 378-0005, and 002-0044.
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Updates

New releases

Canadian Vehicle Survey, 2006

The Canadian Vehicle Survey measures the activity of all on-road vehicles registered in Canada, except some vehicles such as buses, motorcycles, construction equipment and road maintenance equipment. Estimates of total vehicle-kilometres are available by province and territory. Estimates of passenger-kilometres are available by province only. Estimates of fuel consumed are available by vehicle type.

Released August 23, 2007

Households and the Environment Survey, 2006

The Household Environment Survey (HES) measures the environmental practices and behaviours of Canadian households that relate to the condition of our air, water and soils.

Released July 11, 2007

Industrial Water Use Survey, 2006

This survey is being conducted to fulfill the requirements for producing national environmental indicators of water quality as part of the Canadian Environmental Sustainability Indicators project.

Released, July 10, 2007

Report on Energy Supply-demand in Canada 2005:

This publication presents energy data in natural units and heat equivalents in primary and secondary forms, by province.

Released June 1, 2007

Upcoming releases

Environment Industry: Business Sector 2002 (revised) and 2004

Information on revenues earned from sales of environmental goods and services is reported in the upcoming Environment Industry publication. Environmental goods and services are used to measure, prevent, limit or correct environmental damage to water, air and soil as well as problems related 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 minimize waste disposal problems.

To be released shortly.

Canadian Environmental Sustainability Indicators: Highlights

This annual report provides a summary of the key findings from Canadian Environmental Sustainability Indicators. It presents a synopsis for each of the report's three environmental sustainability indicators: exposure to ground-level ozone and fine particulate matter, surface freshwater quality, and greenhouse gas emissions. The report provides answers to the following questions for each of the three indicators: What is the issue? What is happening? What does it mean? Why is it happening? The indicators are intended to assist those in government responsible for developing policy and measuring performance, while also helping Canadians who want to know more about the trends in their environment.

To be released, October 15, 2007

Survey of Environmental Protection Expenditures, 2004

This publication presents estimates from the *Survey of Environmental Protection Expenditures, 2004*. The survey covers capital and operating expenditures made in 2004 by businesses in order to anticipate or to respond to environmental regulations, conventions or voluntary agreements. In addition to statistics on environmental protection activities such as pollution prevention, end-of-pipe and environmental monitoring, statistics on the use of environmental technologies and their cost, as well as environmental management practices are also presented.

To be released shortly.

New developments

2008 Agricultural Water Use Survey

François Soulard

In Canada, as in other countries where crops are grown, the agricultural industry is a major water user and the principal water consumer. Amongst various agricultural activities, irrigation is, by far, the largest water using and consuming activity.

For the first time in Canada, a survey will be conducted to provide a coherent and comparable set of data on provincial water usage by the agriculture industry. In the past, national estimates of irrigation have been produced mainly though the assembly of data from various sources, including administrative data, surveys and modeling. The objectives of the survey are to collect information directly from agricultural producers on the type of irrigation systems used on Canadian farms, the amount of water applied to various crops by crop type, the frequency of application, and the source of the water and water treatment practices.

The reported information will help us develop a better understanding of the demand for water, and how water is used on Canadian farm operations. The data will also benefit provincial governments and agricultural producers themselves: the survey results will be used to estimate the current and future water needs of the agricultural industry; to develop programs and management practices to help operators use this resource more efficiently; and to develop water use indicators to assess how the agricultural industry uses water.

Funded by the Canadian Environmental Sustainability Indicators project, this new survey is being developed with the collaboration of Environment Canada and Agriculture and Agri-food Canada. The survey will be conducted by Statistics Canada on a voluntary basis in the winter of 2008. This computer-assisted telephone survey will have an appropriate sample designed to provide reliable national and provincial estimates. The results will be made available in the summer of 2008.