ECO CANADA

Canadian Environmental Sector Trends

SUPPLEMENTAL REPORT:

Future Growth Expectations for Worker Demand within each Environmental Subsector

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Labour Market Research Study 2010

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1.0 INTRODUCTION

1.1 ABOUT ECO CANADA

Environmental Careers Organization Canada (ECO Canada) is a not-for-profit corporation that assists the Canadian environment sector in implementing sound human resource development policies. Since its founding in 1992 (as the Canadian Council for Human Resources in the Environment Industry or CCHREI), ECO Canada has taken great strides toward developing a national human resource strategy that is focused towards the needs of environmental practitioners, employers and educators.

1.2 RESEARCH OBJECTIVES

ECO Canada has been collecting labour market information relevant to the environmental sector for over 15 years. Due to the dispersed and diversified nature of the sector itself, the majority of information has had limited applicability as regional and other modalities are often so substantive that it is hard to identify common denominators and monitor common indicators.

ECO Canada therefore commissioned the Canadian Environmental Sector Trends study to obtain baseline data from a macro and micro level analysis of factors & drivers of change and growth within the environmental sector with a special focus on how those changes impact employment, occupations and labour issues.

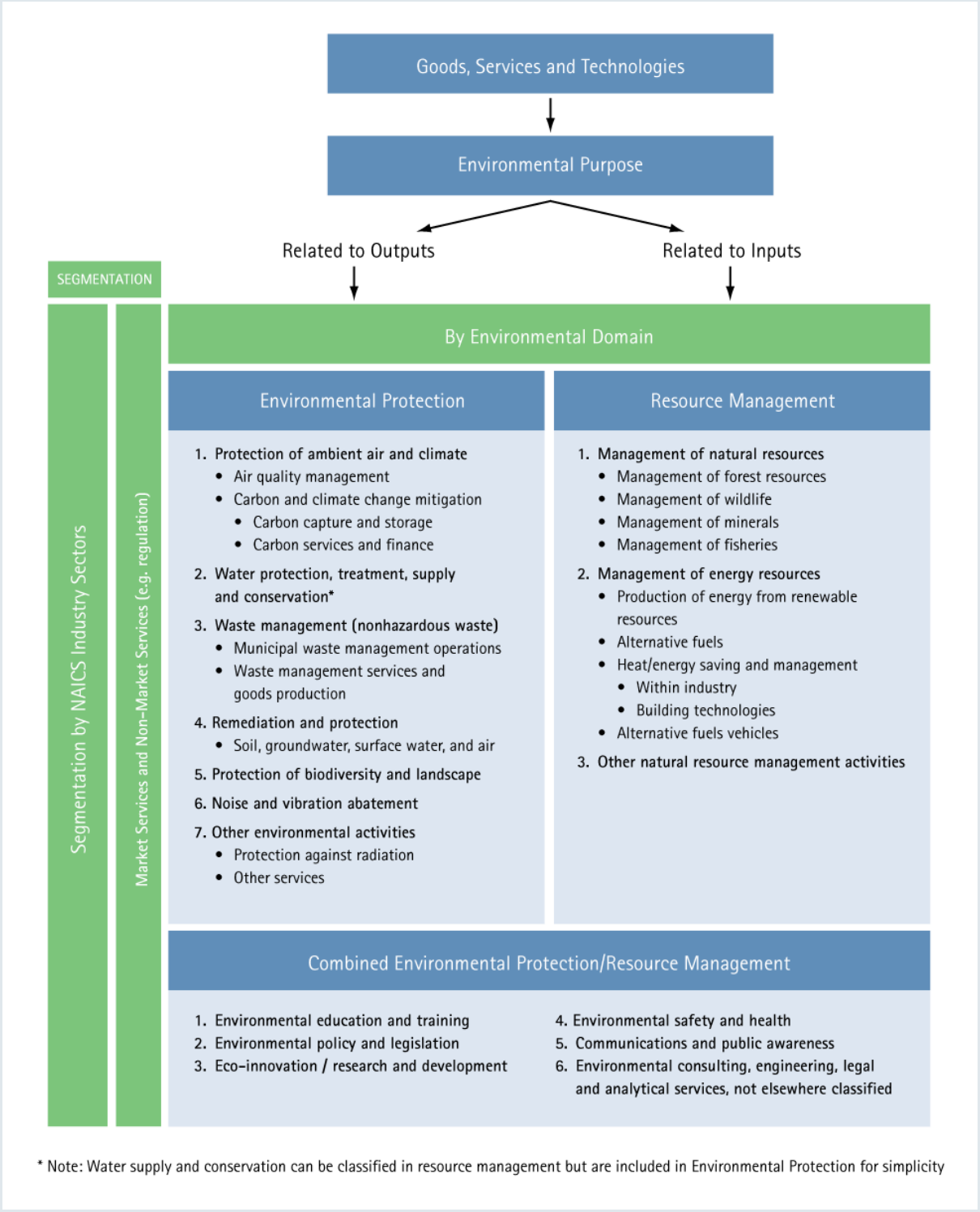
As part of this project, the research team spoke with several key informants who are experts on the Canadian environmental industry and its sub-divisions. These informants identified key trends that they view as major factors that are currently driving changes in environmental employment in Canada as well as factors that they see as major drivers in the future. In the report, these trends were explored using secondary data to describe how these trends are likely to shape demand for environmental employment in the future. The key micro trends in each sub-sector of the environmental sector and their potential impact on the environmental labour market were also investigated and are outlined in this report.

The primary report can be found in a separate ECO Canada report entitled *2010 Canadian Environmental Sector Trends Final Report*. This report provides employers, government, environmental practitioners and ECO Canada with a broad and detailed overview of the trends affecting growth in Canada's environmental sector. The report contains extensive background on the sector's history, the drivers and barriers of growth in the sector. The research in the report is organized according to a new model for categorization of employment in the environmental sector that is based on the definitional structure of the Environmental Goods and Services Sector recently adopted by the United Nations and the European Commission. Use of this definitional framework allows for comparisons between Canada and other nations.

The report contains statistics and commentary which are useful for policy development to support growth of the sector. The report findings have implications for developing a proactive policy for human resource development in the sector and addresses current and future potential labour supply and demand gaps. It may also be used to inform government policy decisions on the direction of future environmental employment, particularly the impacts of social, economic and other drivers on environmental employment. The project provides direction to government regarding what areas of environmental employment are of primary importance to support and, therefore, what policies may be implemented to ensure the healthy future development of environmental employment in Canada.

The following discussion of the divisions of the environmental sector is organized according to the domains of the Canadian Environmental Goods and Services Sector (Figure 1), beginning with the Resource Management (inputs) followed by the Environmental Protection domain (outputs). A discussion of activities that span both domains follows.

Figure 1
Canadian Environmental Goods and Services Sector Model



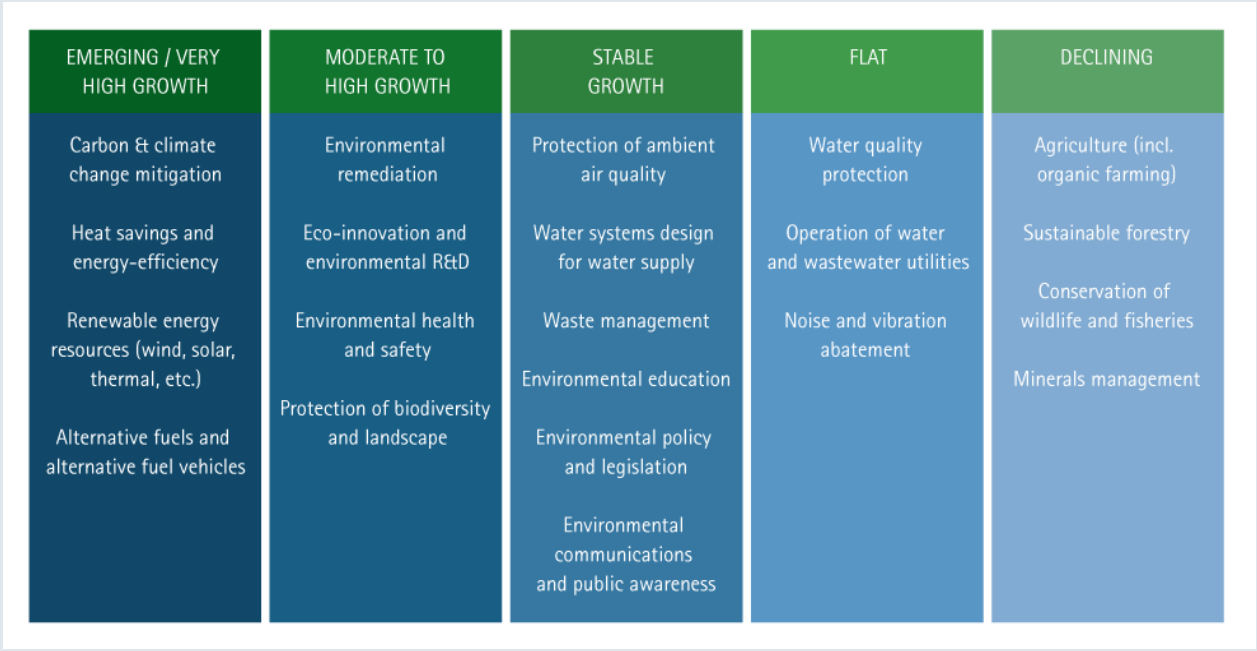
* Note: Water supply and conservation can be classified in resource management but are included in Environmental Protection for simplicity

2.0 EXECUTIVE SUMMARY

In this section, we review trends in each division of the Environmental Goods and Services Sector and focus primarily on identifying the size and growth of employment in each sector.

The greatest growth will occur in the energy-related divisions (energy efficiency, renewable energy generation, alternative fuels, and alternative fuel vehicles). Several of the energy-related sectors have seen double-digit growth over the past decade and will continue to grow. Climate change mitigation has been growing with provinces implementing provincial emissions reduction and trading schemes (Figure 2). Further compliance mechanisms could stimulate future growth in both new jobs and new skills in this area.

Figure 2
Future Growth Expectations for Worker Demand in each Environmental Sub-sector



High to moderate growth is expected eco-innovation, protection of biodiversity, environmental health and safety, and environmental remediation. Spending on eco-innovation for energy efficiency is related to energy prices with demand for more efficient processes and products going up when energy prices spike. Protection of bio-diversity is a small but growing area with most provinces developing a bio-diversity protection division within the last few years. Accelerated spending on federal contaminated sites will drive high growth in site assessments and site remediation in the next few years. Environmental health and safety employment has grown by 8% per year between the last two census periods (2001 and 2006) driven by regulation and efforts by firms to mitigate exposure to injury litigation.

Several of the more traditional environmental industry areas continue to grow in the 3% to 5% employment growth range. These stable growth industries are growing in line with or slightly faster than overall national employment growth. They include protection of ambient air, water systems design (for water supply), waste management, environmental education, environmental policy and legislation, and environmental employment and communications.

Growth in some sectors has been flat for some time. These include water quality protection, water and wastewater utilities. Industry capital expenditures for water quality protection have been flat for the past decade and employment in water utilities has been flat for several decades, with essentially the same number of workers employed in the sector today as were employed 20 years ago. Retirements of these workers, however, will drive replacement demand.

Employment in the natural resources industries (agriculture, forestry, fishing, and minerals (except oil and gas) have been in long-term structural decline. Most growth in these areas is in changes in the skills required of workers. There is significant growth in the number of farms using organic farming practices, however the total number of workers employed has declined. There is growth in demand for forestry professionals in the government sector where efforts are made to manage sustainable forests. However, overall the demand for professionals and workers in all parts of the forestry sector are in decline. Employment in the minerals sector is highly cyclical, with employment driven by commodity prices while the industry experiences long-term structural declines in employment as technology and innovation make mines more efficient.

3.0 DRIVERS OF EMPLOYMENT IN ENVIRONMENTAL SUB-SECTORS

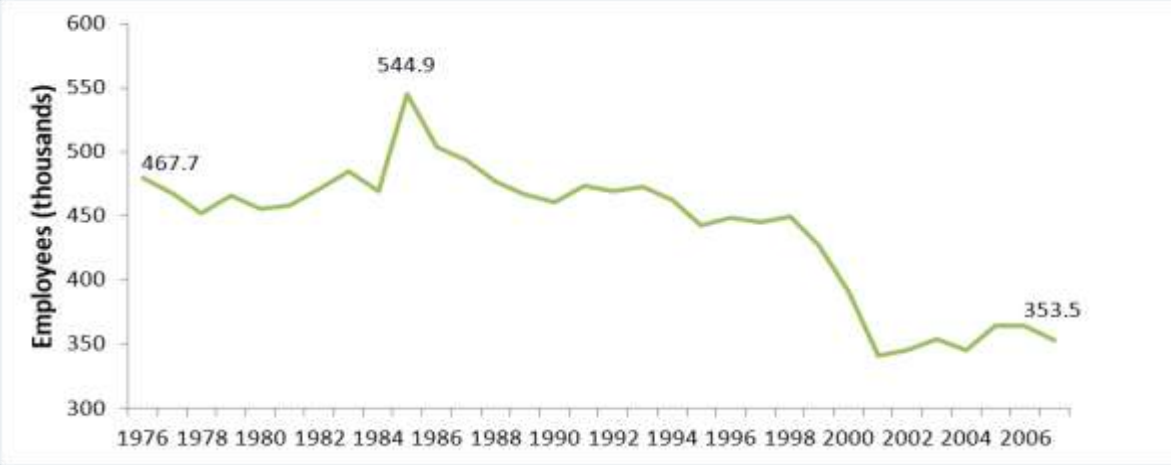
3.1 ENVIRONMENTAL INPUTS: RESOURCE MANAGEMENT

3.1.1 MANAGEMENT OF NATURAL RESOURCES

Resource management of natural resources includes management of agricultural resources, forest resources, wildlife and fisheries resources, and minerals resources. The focus in agricultural resource management is on sustainable agricultural practices and development of organic or other farming techniques which protect land and agricultural resources. The focus in forest management is on forest resources that are non-cultivated and forests that aren't available for wood supply. All of the activities that are carried out for the maintenance and management of these resources are included in forest management. This includes restoration activities (reforestation and afforestation) as well as the prevention and control of forest fires. Management of wildlife and fisheries activities are aimed at the minimization of the intake or disturbance of wild flora and fauna through in-process modifications as well as withdrawals reduction and regulation measures. Restoration activities are included (replenishment of wild flora and fauna stocks). The focus is on 'wild' flora and fauna and all the activities carried out for their maintenance and management. Often the management of game reserves, e.g. in the case of birds, has the purpose of maintaining the stock of 'wild' fauna, even if for hunting purposes. Management of minerals comprises activities aimed at the minimization of the intake of minerals through in-process modifications as well as the reduction of scraps and the production and consumption of recycled materials and products.

Management of Agricultural Resources

Figure 3
Total Employment in Agriculture 1976 – Present



Source: Labour Force Survey

Employment in agriculture in general has been in decline for over twenty years in Canada (Figure 3). The same trend may be observed in most developed nations, as technology advances have reduced labour demand for agricultural activities. Between the 1996 and 2006 Censuses, there was an increase in demand for landscapers and horticulture supervisors, rising from about 6,500 workers in 1996 to about 9,400 workers in 2006 with an annual average growth rate of 3.8%.

In the years between the most recent census, demand for farmers and farm managers in Canada declined by 13% and demand for agricultural service contractors and managers declined by 62% (Table 1).

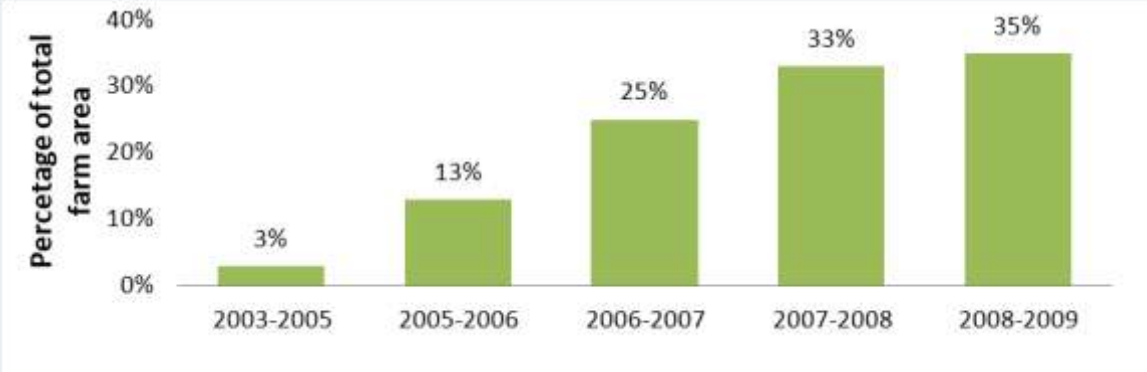
Table 1
Employment in Key Agricultural Occupations

Canada Selected Occupations	1996	2001	2006	Growth 1996-2001	Growth 2001-2006
I011 Farmers and farm managers	229,590	229,440	199,435	-0.1%	-13.1%
I012 Agricultural and related service contractors and managers	3,905	3,920	1,470	0.4%	-62.5%
I013 Farm supervisors and specialized livestock workers	9,165	9,080	9,380	-0.9%	3.3%
I016 Supervisors, landscape and horticulture	6,535	8,370	9,435	28.1%	12.7%
I021 General farm workers	132,355	112,850	104,555	-14.7%	-7.4%
Total	381,550	363,660	324,275	-4.7%	-10.8%

Source: Census of Canada 1996, 2001, 2006

While overall employment in the sector is declining, there has been strong growth in sustainable farming practices. The percentage of farm land in Canada with Environmental Farm Plans has grown from about 4% of farm land in 2003 to about 35% of farm land in 2008/2009 (Figure 4). These sustainable practices encourage protection of biodiversity.

Figure 4
Sustainable Development on Agricultural Land



Source: Agriculture and Agrifood Canada, 2009

In addition, there has been a growing trend toward organic farming practices. The number of farms in Canada declined by 7.1% between 2001 and 2006, but the number of farms reporting certified organic farm products grew by 59% (Table 2). Still, less than one percent of Canadian farms produce certified organic products.

Table 2
Certified Organic Products

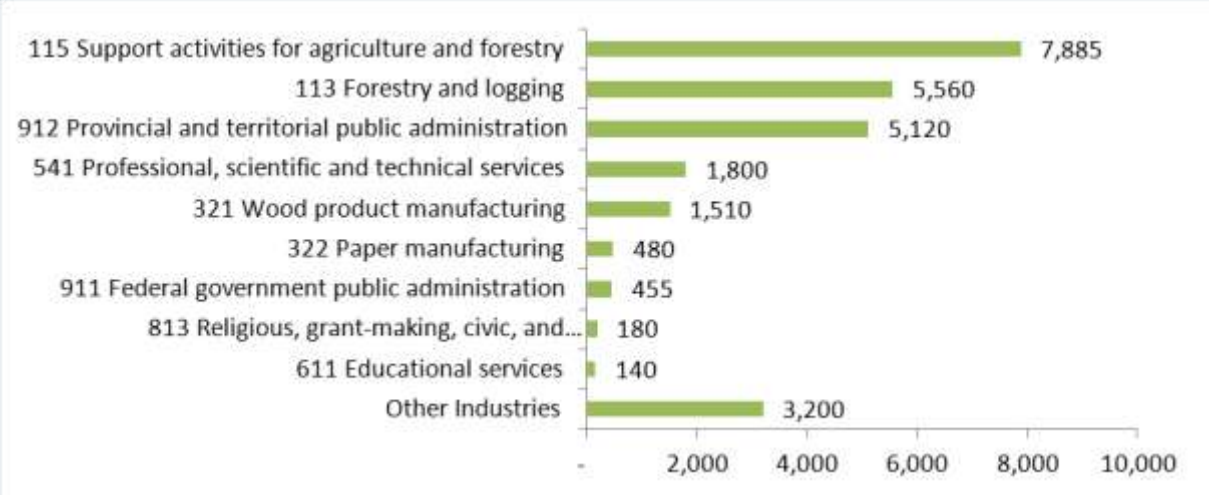
	2001	2006	Growth
All farms	246,923	229,373	-7.1
Farms reporting certified organic products	2,230	3,555	59.4
Type of certified organic product:			
Hay or field crops	1,442	2,462	70.7
Fruits, vegetables or greenhouse products	614	916	49.2
Animals or animal products	381	673	76.6
Maple products	129	299	131.8
Other (herbs, etc.)	211	190	-10

Source: Statistics Canada, Census of Agriculture.

Management of Forest Resources

While most forestry professionals and technicians workers are employed in support services for forestry, there are a significant number of these professionals employed in other industry segments. Notably, about one in five forestry professionals was employed by provincial and territorial governments in 2006. These forestry professionals are likely employed in the management of forestry resources, including management of public lands (Figure 5).

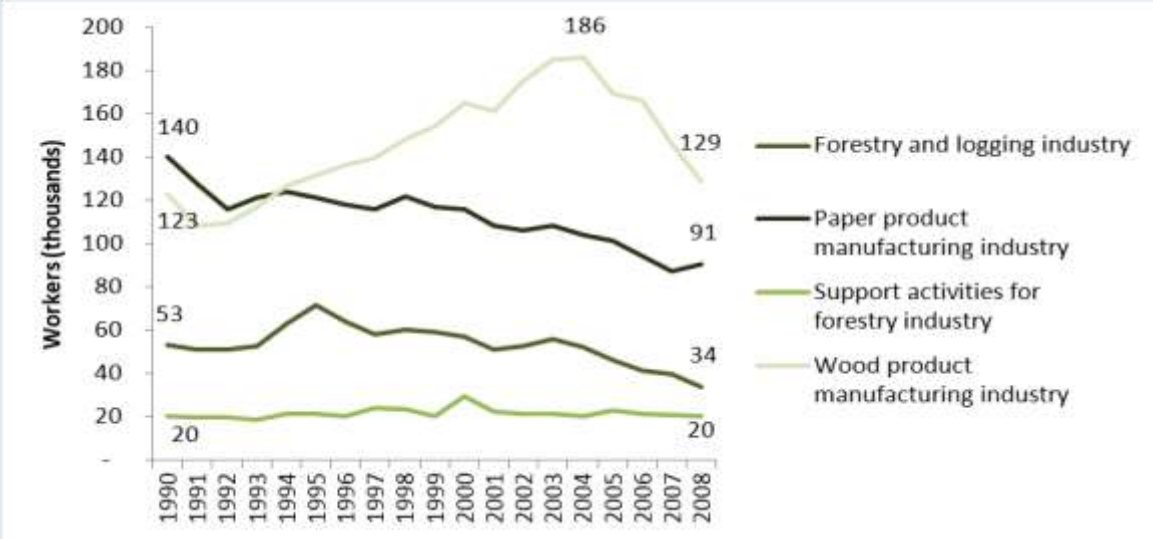
Figure 5
Industries Employing Forestry Professionals, Forestry Technicians and Silviculture & Forestry Workers 2006



Source: Statistics Canada 2006 Census

The forestry sector has been experiencing long-term secular decline in Canada driven by competition from foreign markets and declining demand for paper and other forest products. Wood product manufacturing in Canada experienced growth in employment through the 1990s and early 2000s, reaching peak employment of about 186,000 workers in 2004 and since declining to about 129,000 workers in 2008. All other components of the sector have experienced long-term employment decline. (Figure 6)

Figure 6
Employment in the Forestry Sector 1990-2008



Source: Labour Force Survey

Between 1996 and 2001, there was growth in demand for forestry professionals (42% growth), forestry technicians (4.8% growth) and silviculture and forestry workers (22% growth). The growth in these professions did not carry through the next census gap, when negative growth rates were experienced for essentially all forestry occupations. (Table 3)

Table 3
Employment in Forestry Occupations 1996-2006

Employment in Selected Occupations	1996	2001	2006	Growth 1996-2001	Growth 2001-2006
C022 Forestry professionals	4,750	6,780	6,505	42.7%	-4.1%
C123 Forestry technologists and technicians	10,455	10,960	9,805	4.8%	-10.5%
I11 Supervisors, logging and forestry	6,530	5,335	4,620	-18.3%	-13.4%
I16 Logging and forestry workers	34,375	29,370	22,335	-14.6%	-24.0%
I161 Chain saw and skidder operators	24,610	17,430	12,315	-29.2%	-29.3%
I162 Silviculture and forestry workers	9,770	11,935	10,020	22.2%	-16.0%
I216 Logging and forestry labourers	19,180	15,485	12,745	-19.3%	-17.7%
J015 Supervisors, forest products processing	11,825	11,020	10,150	-6.8%	-7.9%
Total	121,495	108,315	88,495	-10.8%	-18.3%

Source: Census of Canada 1996, 2001, 2002

Industries that have experienced significant growth in demand for these workers include support activities for agriculture and forestry (12% growth) and provincial administration (10% growth). (Table 4)

Table 4
Growth in industry demand for Forestry Professionals

Industry	2001	2006	Growth 2001-2006
All industries	6,780	6,505	-4.1%
115 Support activities for agriculture and forestry	1,395	1,565	12.2%
541 Professional, scientific and technical services	1,310	975	-25.6%
912 Provincial public administration	1,165	1,285	10.3%
113 Forestry and logging	1,125	1,110	-1.3%
321 Wood product manufacturing	735	645	-12.2%
322 Paper manufacturing	160	160	0.0%
911 Federal government public administration	105	95	-9.5%
611 Educational services	60	70	16.7%
813 Religious, grant-making, civic, and professional and similar organizations	75	60	-20.0%
Other Industries	650	540	-16.9%

Source: Statistics Canada Census 2001, 2006

3.1.2 WILDLIFE AND FISHERIES

There has been modest long-term decline in the demand for wildlife and fisheries workers in Canada. Conservation and fisheries officers have declined from 6,800 workers in 1996 to about 5,765 workers in 2006. The decline in demand has accelerated in the 2001-2006 period, during which time total worker demand declined by about 11% (Table 5).

Table 5
Employment in Conservation of Wildlife and Fisheries

Selected Occupations	1996	2001	2006	Growth 1996-2001	Growth 2001-2006
C124 Conservation and fishery officers	6800	6470	5765	-4.9%	-10.9%

Source: Statistics Canada Census 1996, 2001, 2006

Management of Minerals

The mining industry in Canada has experienced long term secular decline in worker demand since the 1950s. It is likely that vast majorities of workers in mining-related occupations are employed in minerals mining or oil and gas mining and related industries, and are not primarily involved in the management of mineral resources. Official statistics do not contain segmentation adequate to comment on demand for workers specifically engaged in management of minerals.

There has been dramatic decline in most mining occupations in the 2001 to 2006 period. There has been growth in demand for geological and mineral technologists and technicians, but much of this growth has likely been in support of development of oil and gas mining. (Table 6)

Table 6
Employment in Mining Occupations

Selected Occupations	1996	2001	2006	Growth 1996-2001	Growth 2001-2006
C112 Geological and mineral technologists and technicians	8,670	8,405	10,075	-3.1%	19.9%
J111 Central control and process operators, mineral and metal processing	5,605	6,550	3,780	16.9%	-42.3%
J121 Machine operators, mineral and metal processing	10,155	13,985	8,585	37.7%	-38.6%
J125 Inspectors and testers, mineral and metal processing	4,335	4,575	4,070	5.5%	-11.0%

Source: Statistics Canada Census 1996, 2001, 2006

3.1.3 MANAGEMENT OF ENERGY RESOURCES

Management of energy resources comprises activities aimed at the minimization of the intake of fossil resources through the production of energy from renewable sources, heat/energy saving and management and the minimization of the intake of fossil resources for raw materials for uses other than energy production.

Heat Savings and Energy Efficiency

Workers engaged in energy efficiency and heat savings may be employed in:

- The construction sector — Workers employed in the installation of energy-efficient building technology, especially in energy efficiency upgrades to homes or to industry as well as new building construction.
- The manufacturing sector — Workers employed in the design of energy-efficient processes and products.
- Government — Includes a variety of program administrators, energy auditors, city planners, civil engineers, and similar workers engaged in government programs to reduce energy demand and increase efficiency.
- Service Sectors — Workers employed in facilities management and related activities.

There is no comprehensive source of information on the number of workers engaged in energy-efficiency activities. The number of workers in the segment has likely increased in step with growth in spending on energy related environmental processes and technologies. From 2002 to 2006, there was a 78% increase in such expenditures in the manufacturing and natural resource sectors. This equates to an annual average growth rate of 16%. It is important to note, however, that the actual growth in the sector is not gradual. Most of this growth occurred more recently in 2004-2006. Total expenditures declined from 2002 to 2004. The more labour-intensive operating expenditures increased only marginally from the 2002-2004 period. (Table 7)

Table 7
Industry Expenditures on Energy-Related Environmental Processes and Technologies

Years	2002	2004	2006	Annual Growth 2002-2006
Operating Expenditures	$ 523.0	$ 575.8	$ 1,009.0	18%
Capital Expenditures	$ 583.3	$ 379.3	$ 964.0	13%
Total Expenditures	$ 1,106.3	$ 955.1	$ 1,973.0	16%

Source: Statistics Canada Survey of Environmental Protection Expenditures in the Business Sector

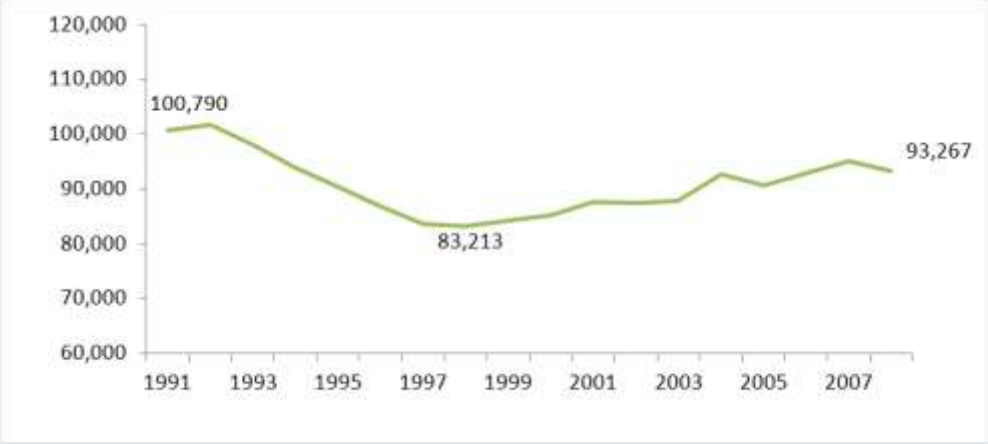
In the construction sector, growth in demand for energy auditors is perhaps the best indicator of growth. Growth in demand for energy auditors certified by Canada's ecoENERGY program has surged since the program was formed. In 2008, the first year of the program, there were 1,004 energy auditors who were certified by the ecoENERGY program. This number grew by 76% in the 2008 to 2009 period to 1,770 workers. The Atlantic Provinces have higher concentrations of these workers on a per-capita basis. More than half of these workers are employed in Ontario, where demand for these workers effectively doubled between 2008 and 2009.

This high growth trend is expected to continue in the next few years while the ecoENERGY federal program is in place. In addition, some provinces have introduced similar programs or matching programs which further incentivize homeowners and businesses to invest in energy efficiency for their homes and facilities.

Renewable Energy Resources

The total number of workers employed in electric resources has varied in the last two decades. In the period from 1990 through 1998, the industry underwent gradual decline in employment, decreasing from about 100,800 workers in 1990 to 83,200 workers in 1998. Since 1998, the number of workers in the industry has increased. There were 93,000 workers employed in the industry in 2008. (Figure 7) The return to growth in the industry is likely tied to the increase in employment related to renewable energy.

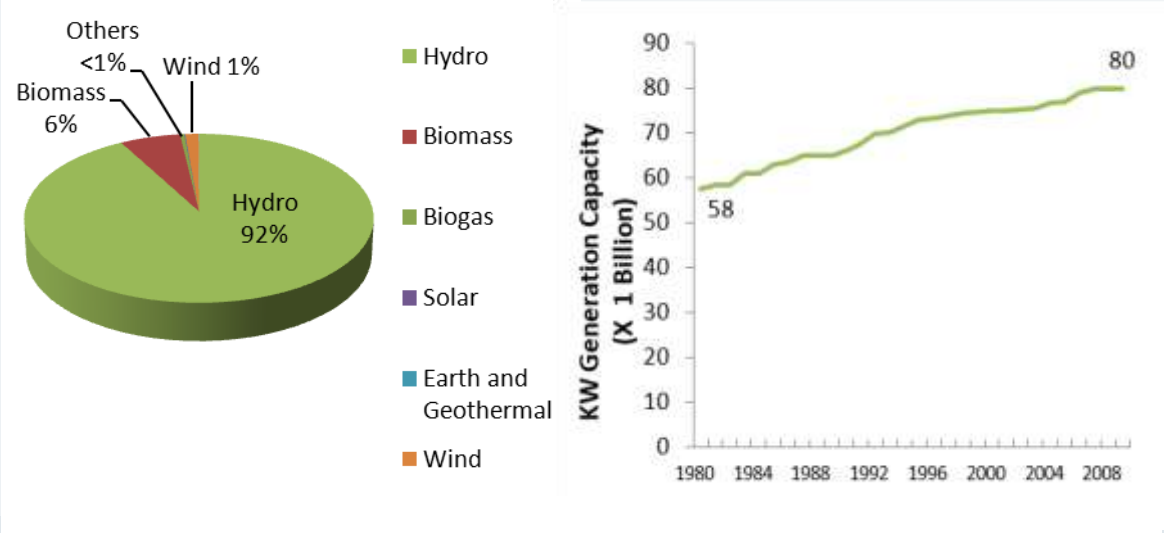
Figure 7
Workers Employed in Electric Power Generation, Transmission & Distribution 1991-2008



Source: Statistics Canada Survey of Employment Payroll and Hours (SEPH)

The vast majority (92%) of Canada's renewable energy generation capacity is hydro power generation. Biomass is the second largest component, representing 6% of capacity. Total renewable energy generation capacity (including hydro, wind, solar, thermal, and other forms of energy generation), has grown gradually in Canada since the 1980s at an average annual growth of about 1.1%. (Figure 8)

Figure 8
Generation Capacity of Renewable Energy Sources in Canada



Source: CIEEDAC Renewables Database

While the total generation has grown gradually, there has been tremendous growth in the segments outside of hydro and biomass, namely in wind, solar, and thermal power generations. (Table 8)

Table 8
KW Capacity by Renewable Energy Source

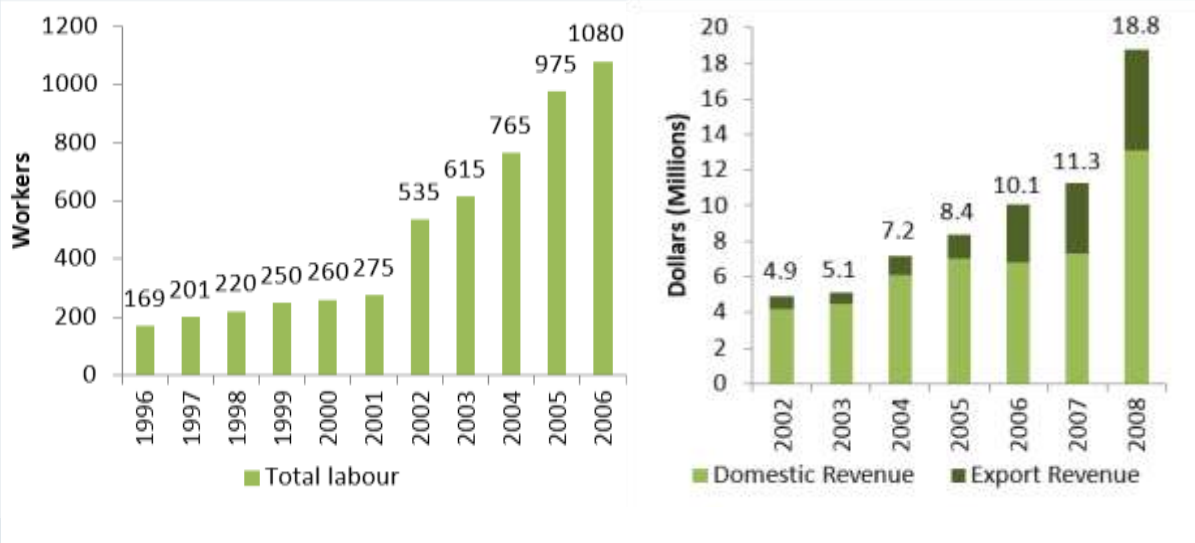
KW Capacity (X 1,000)	1980	1990	2000	2009	1990-2000 Avg. Annual Growth	2000-2009 Avg. Annual Growth
High Growth						
Solar (on-grid)	405	417	2,121	43,150	20%	40%
Wind	-	20	124,107	1,045,567	164%	27%
Geothermal	387	492	9,754	30,266	39%	13%
Low Growth						
Hydro	55,498,324	62,326,768	69,683,968	73,286,368	1.2%	0.6%
Biomass	1,988,041	3,759,097	4,681,993	4,828,093	2.5%	0.3%
Municipal Solid Waste	21,100	22,300	22,300	22,300	0.0%	0.0%
Tidal	-	20,000	20,000	20,000	0.0%	0.0%
Total	57,507,465	66,128,165	74,408,261	78,156,761	1.3%	0.5%

Source: CIEEDAC Renewables Database

PV Solar Power Generation

Employment in the solar power sector spans manufacturing of solar panels, sales and distribution, installation, and maintenance of on-site solar power. The industry is comprised of grid-connected solar power and off-grid generation at the site of consumption.

Figure 9
Revenues and Workers Employed in Manufacturing of Solar Power Panels



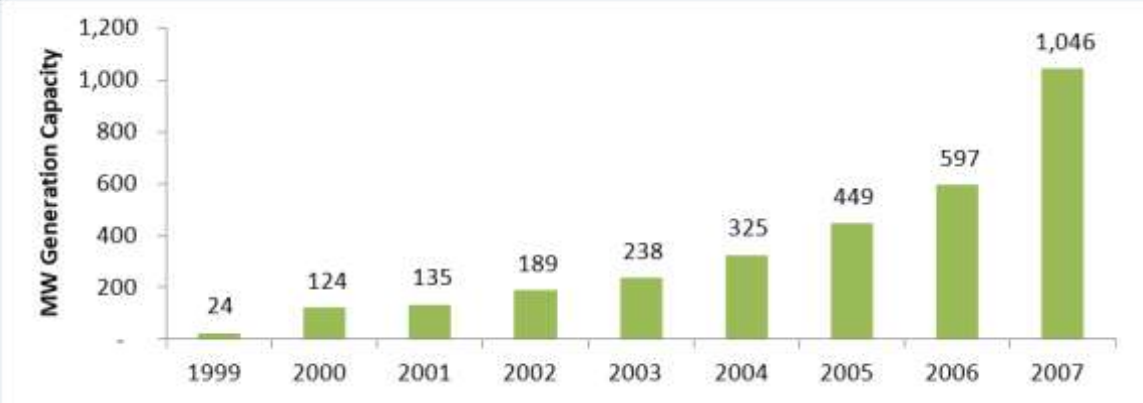
Source: Natural Resources Canada, Canmet Energy Survey of Active Solar Thermal Collectors

Total revenues for PV solar power generation in Canada have grown from $4.9 million in 2002 to $18.8 million in 2008. (Figure 9) Much of this growth has been driven by exports of solar panels. Employment figures for manufacturing of panels indicate that employment has grown from a mere 169 workers in 1996 to over 1,000 workers in 2006. Since 2002, employment in the industry has growth at an annual average growth rate of 19% per year, which is roughly the same average growth of revenue in the sector.

There is little information available on the labour requirements for installation and maintenance of solar panels. However, it is expected that growth in demand for installation of PV solar power will roughly match domestic demand for sales of solar panels.

Wind Power

Figure 10
Growth in Wind Generation Capacity in Canada



Source: CIEEDAC Renewables Database

Wind power generation capacity in Canada has been growing at an annual average growth rate of 35% per year from 2000 to 2007 (Figure 10). Direct employment in wind power generation in 2005 was estimated at 722 workers. This figure nearly doubled between 2005 and 2006 growing to about 1,200 workers. The Canadian Wind Energy Association (CANWEA) estimates that total direct employment in the wind industry will grow at an annual average growth rate of 35% from 2006 to 2011, growing to 5,300 workers. Demand for workers in this industry is expected to be very strong for all occupations. Notably, CANWEA expects demand for trades workers to grow from 190 in 2006 to about 1,300 full time equivalent workers in 2011, an annual growth rate of 47% per year. Demand for engineers and scientists is expect to grow at 20% per year and demand for managers is expected to grow at 25% per year. (Table 9)

CANWEA has proposed a goal of 55,000 MW of generation capacity in Canada by 2025. The organization estimates that if this goal is attained, it will result in creation of at least 52,000 new jobs for Canada by 2025. Approximately half of these would be high quality manufacturing jobs and a third would relate to operation and servicing. CANWEA estimates that about $132 billion of investment will be required to achieve the 2025 goal.

Table 9
Direct Employment Estimates for the Canadian Wind Industry

	2005	2006	2011	Average Annual Growth 2006-2011
Total employment	722	1,200	5,300	35%
Non-support staff	not reported	850	3,200	30%
Management and Supervisors		230	700	25%
Engineers and Scientists		240	600	20%
Trades		190	1,300	47%
Other occupations		190	600	26%
Support Staff	not reported	360	2,100	42%
Labourers (assembly etc.)		270	1,800	46%
Other support staff		90	300	27%

Note: Employment expressed in terms of Full-Time Equivalents, or FTE
Source: Canadian Wind Energy Association (CANWEA), 2007

Alternative Fuels & Alternative Fuel Vehicles

Canada will require five percent renewable-fuel content in gasoline by 2010 and two percent renewable content in diesel and heating oil by 2011. The provinces of Manitoba, Alberta and British Columbia have all drafted biofuel legislation that takes effect by 2010.

The industry is supported by federal spending as part of Canada's strategy to reduce greenhouse gas emissions. The federal government has awarded operating subsidies to 23 biofuel plants under its assistance program, distributing $1.5 billion over nine years beginning in 2008. Canadian plants make ethanol, for use in gasoline, from corn and wheat, and biodiesel from animal fat, soybeans and canola.

The Canadian Renewable Fuels Association estimates that Canadian biofuel production will rise 76% in 2010 to 2012, as government subsidies for production plants and renewable-fuel requirements take effect. Canada currently produces 1.3 billion litres of ethanol annually and 120 million litres of biodiesel.

Alternative fuel vehicles represent a small but growing share of total vehicles in use in Canada. According to the Canadian Vehicle Survey, the number of alternative fuels vehicles in use in Canada grew from 68,645 in 2001 to 82,231 in 2008, an average annual increase of 3.1%. (Table 10) Production of alternative fuel vehicles in the US has grown at an annual growth rate of 12% per year from 2003 to 2007.

Table 10
All Vehicles in Scope for Canada by Fuel Type

Total, all vehicles	2001	2008
Total, all fuel types	17,444,421	20,166,421
Gasoline	16,470,569	18,923,790
Diesel	905,207	1,160,400
Other fuel type	68,645	82,231

Source: Canadian Vehicle Survey

3.2 ENVIRONMENTAL OUTPUTS: ENVIRONMENTAL PROTECTION

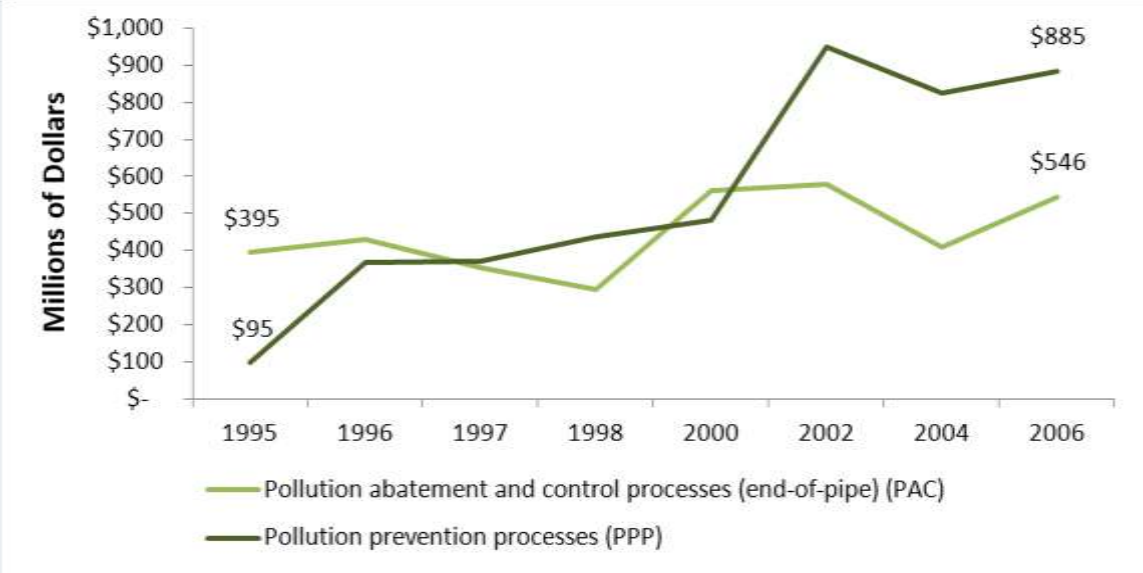
3.2.1 PROTECTION OF AMBIENT AIR AND CLIMATE

Protection of ambient air and climate comprises measures and activities aimed at the reduction of emissions into the ambient air or ambient concentrations of air pollutants in addition to measures and activities aimed at the control of emissions of greenhouse gases and gases that adversely affect the stratospheric ozone layer.

Employment in protection of ambient air and climate is difficult to quantify and is not well tracked in Canada. The sector is comprised of activities related to pollution control and prevention as well as activities related to reduction of greenhouse gas emissions.

Employment in air pollution control has declined in the EU, due to maturity of the industry. Over the past decade, there has been an ongoing trend toward spending on air pollution prevention processes and less growth in spending on air pollution abatement and control (end-of-pipe) processes. From 1995 to 2006, capital spending on air pollution prevention processes (PPPs) has growth from $95 million in 1995 to $885 million in 2006. Growth in spending has risen in intervals with strong growth in spending on PPPs in 2006 and in the 2000-2002 periods. Capital spending on end-of-pipe processes has grown at a more modest rate, increasing from $395 million in 1995 to $546 million in 2006. (Figure 11)

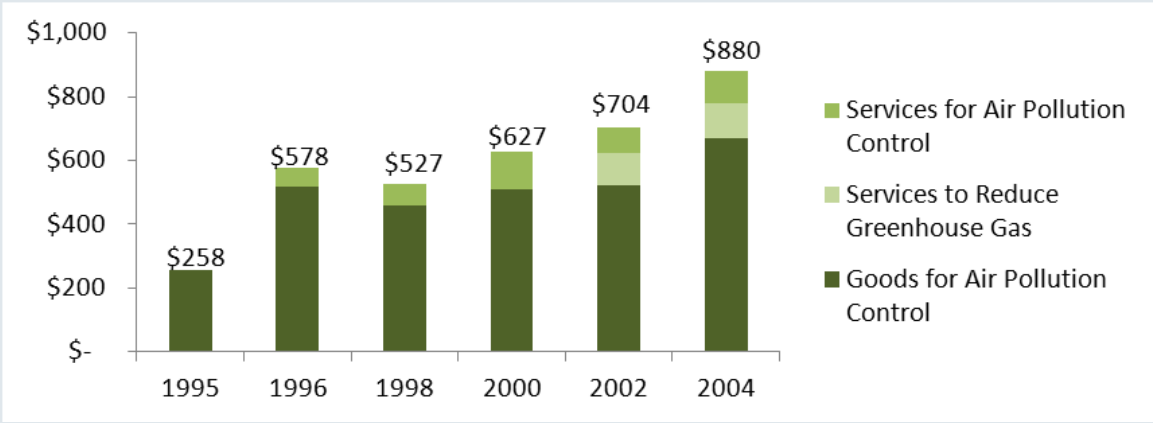
Figure 11
Capital Expenditures on Air Pollution 1995-2006



Source: Statistics Canada Survey of Environmental Expenditures

Industry revenues from air quality protection rose in Canada from $258 million in 1995 to $880 million in 2004 (Figure 12). It is interesting to note that spending on air quality goods, rather than services, represents the majority of total industry spending on air quality protection. Revenues of Canadian firms for air quality protection goods amounted to $671 million in 2004.[1] Revenues for air quality protection services amounted to $100 million. Services to reduce greenhouse gas emissions exceeded spending on air quality protection services in 2004, with total industry revenues of $109 million.

Figure 12
Revenues of Canadian Firms for Air Pollution Control Goods and Services



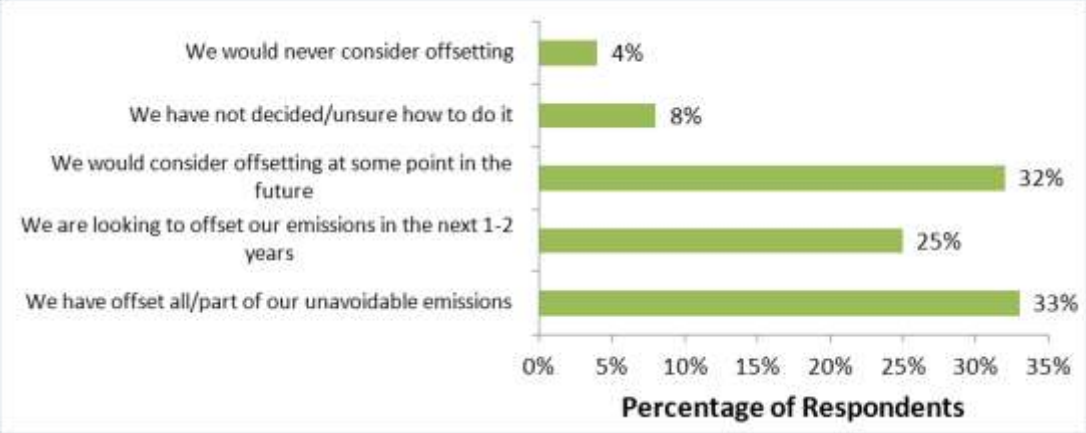
Source: Environmental Industry Survey

Revenues for services to reduce greenhouse gas emissions has likely grown since 2004, although at the writing of this report, no data to describe the growth rate of employment in the sector could be identified. All indications suggest that the sector is growing, and future legislation is likely to accelerate

[1] See Statistics Canada Environment Industry Survey. Data from 2004 is the most recent data available.

this growth. For example, a survey of large global firms by EcoSecurities highlights that as of 2007; most large firms have offset all or part of their carbon emissions or are planning to do so in the next 1 to 2 years (Figure 13).

Figure 13
What Do You Believe Your Company's Policy is Towards Carbon Offsetting?



Source: EcoSecurities 2007

In the UK, it is expected that the carbon finance market will grow from £5.19 billion in 2007 to £8.42 in 2014, an annual growth rate of 7.2% per year. As Canada's carbon emission reduction policy develops and is implemented, it is likely that the market could exceed this growth rate in Canada.

Carbon capture is an area of specialization for Canada. The Province of Alberta has committed to $2 billion in investments in carbon capture and storage through four large-scale projects. (Table 11)

Table 11
Alberta investments in Carbon Capture and Storage

Grant Recipient	Project Description	Grant (in Millions)
Enhance Energy	A 240 km pipeline will transport CO2 from the Agrium Redwater Complex and the North West Upgrader	$495
Shell	Quest will capture and store 1.2 million tonnes of carbon dioxide annually beginning in 2015 from Shell's Scotford upgrader and expansion, near Fort Saskatchewan	$745
TransAlta	The project will utilize leading-edge technology to capture CO2 which will be used for enhanced oil recovery (EOR) in nearby conventional oil fields, or stored almost three kilometres underground. The project is expected to capture one million tonnes of carbon dioxide annually beginning in 2015.	$436
Swan Hills Synfuels	This is an in-situ coal gasification (ISCG) project which will access deep coal seams. These seams, which are about 1,400 metres below surface, have traditionally been considered too deep to mine. Wells will access the seams and be used to convert the coal underground into a clean synthetic gas known as syngas. The syngas will be used to fuel new high-efficiency power generation and the CO2 created during this process will be captured and used for enhanced oil recovery	$284
Total		$1,960

3.2.2 WATER PROTECTION, TREATMENT, SUPPLY, AND CONSERVATION

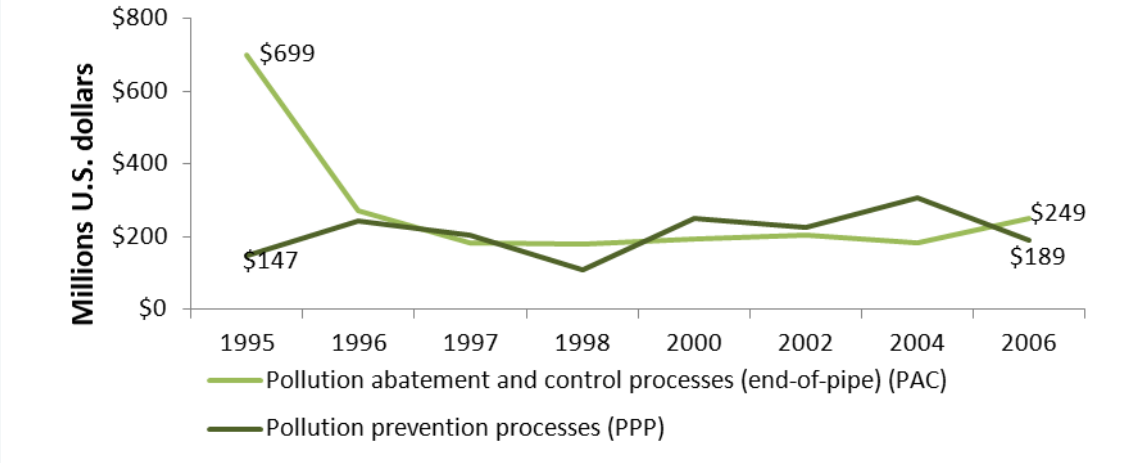
This segment includes conservation and management of water supply as a resource, protection of water from pollution, and treatment of wastewater.

Management of water as a resource includes activities aimed at the minimization of inland waters intake through in-process modifications as well the reduction of water losses and leaks or reduction of the intake by substituting the resource with alternative resources, the installation and construction of facilities for water reuse and savings, shower heads and taps, etc. Restoration activities are included.

Wastewater is defined as water that is of no further immediate value for the purpose for which it was used or in the pursuit of which it was produced because of the quality, quantity or time of its occurrence. Wastewater management comprises activities and measures aimed at preventing the pollution of surface water by reducing the release of wastewater into inland surface water and seawater. It includes the collection and treatment of wastewater including monitoring and regulation activities. Septic tanks and cooling water systems are also included.

Industry expenditures on water pollution abatement control and pollution prevention have been relatively flat from 1996 to 2006, following a decline in pollution abatement spending in 1995. Spending is about evenly split between end-of-pipe processes and pollution prevention processes. (Figure 14) It is likely that the employment associated with water pollution abatement and prevention processes has been flat as well, although employment data on workers engaged in these activities is not collected.

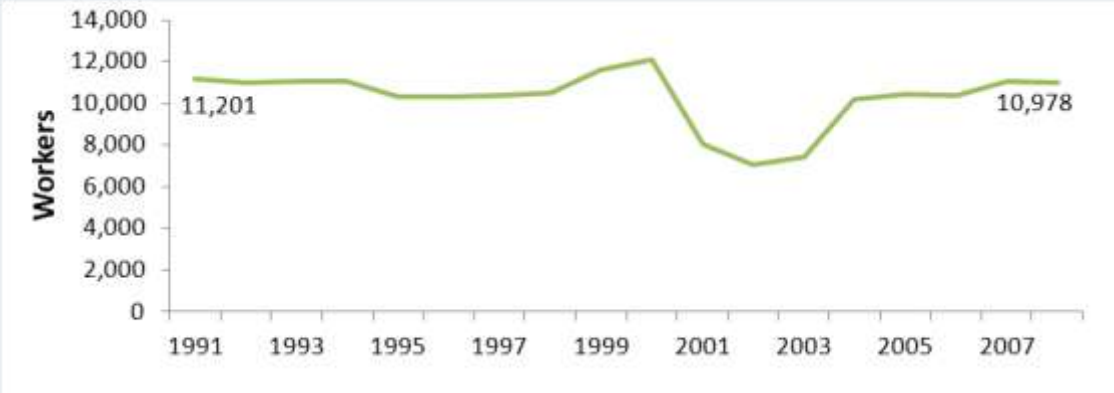
Figure 14
Industry Capital Expenditures on Water Pollution 1995-2006



Source: Statistics Canada Survey of Environmental Protection Expenditures

Operation of water treatment and sewage plants in 2008 is at roughly the same level as it was in 1991. In the 2000 to 2004 period, there was a dip in demand for these workers. (Figure 15) The reason for the decline is somewhat unclear. It is possible that concerns over public safety following the Walkerton water contamination in 2000 prompted a change in employment practices and different training standards for these workers, to avoid a similar tragedy in the future. Outside of this event, it appears that employment among workers operating wastewater plants has been flat.

Figure 15
Employees in Water, Sewage, and similar systems



Source: Statistics Canada, SEPH, CANSIM table 281-0024

Most growth in water treatment has been on capital expenditures on water, sewage, and water utility systems. The growth in capital expenditures has likely benefited manufacturers of water and sewage systems and construction firms that install these water and sewage systems. Growth in capital expenditures was relatively flat from 1991 through 2002, increasing at an annual average rate of 1.7%. Since 2002, there has been more significant growth in these expenditures; annual average growth from 2002 to 2009 was 15.8% per year. (Figure 16) The growth in capital expenditures has likely spurred growth in labour demand in construction sector. It is more difficult to determine if it has spurred growth in the manufacturing sector. Revenues and output of the manufacturing sector as a whole has been growing for the last several decades while employment in the sector has declined. This reflects changes in global supply chains for manufacturers and labour efficiencies achieved through process improvements.

Spending on repairs to water and sewage systems also drives employment demand; however it is difficult to discern a trend in the spending patterns of utility operators. Spikes in spending in some years may reflect large repairs, availability of budgets for repairs, or regulatory measures triggering surges in spending. (Figure 17)

Figure 16
Capital Expenditures on Water, Sewage and Other Water Utility Systems

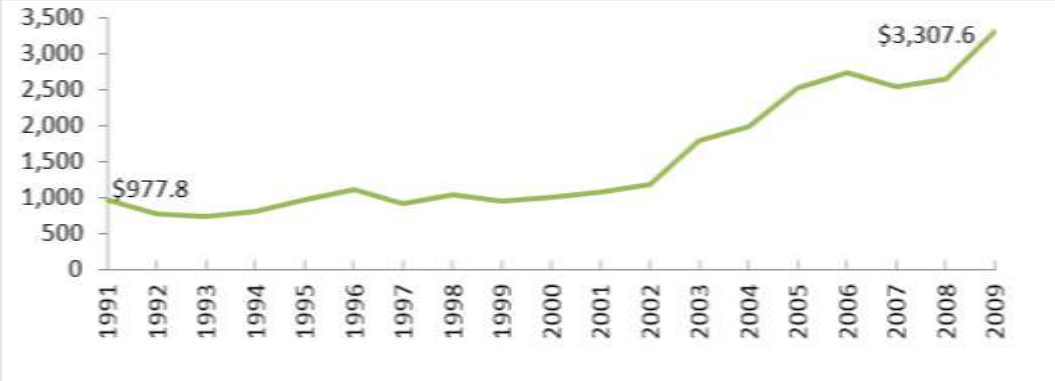
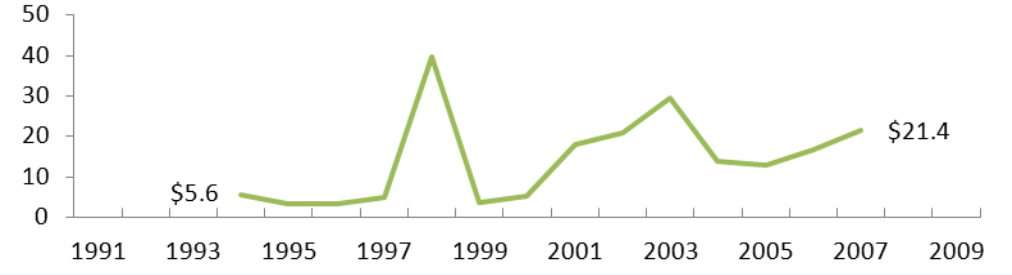


Figure 17
Expenditures on Repairs to Water, Sewage and Other Water Utility Systems



Source: Statistics Canada

Management and conservation of water as a resource has become an increasing strong public concern, especially in the western provinces where freshwater is scarce. A study by Schindler and Donahue[2] in 2006 highlights how drought cycles, climate changes, and human modifications to water catchments are reducing water supply flows to population centers such as Winnipeg. The authors anticipate that in the near future climate change impacts to glaciers, snowpacks, and evaporation will cause a crisis in water quantity and quality with far-reaching implications. These observations have prompted the Manitoba Water Stewardship and Manitoba Agriculture, Food and Rural Initiatives to implement a community-based watershed management process. The process assists stakeholders to develop appropriate agricultural water management and conservation decisions that are sustainable and appropriate for local conditions.

It is likely that there will be significant growth in climate change adaptation activities related to implementation of sustainable water practices in Canada, however, the number of workers required for these activities is somewhat uncertain.

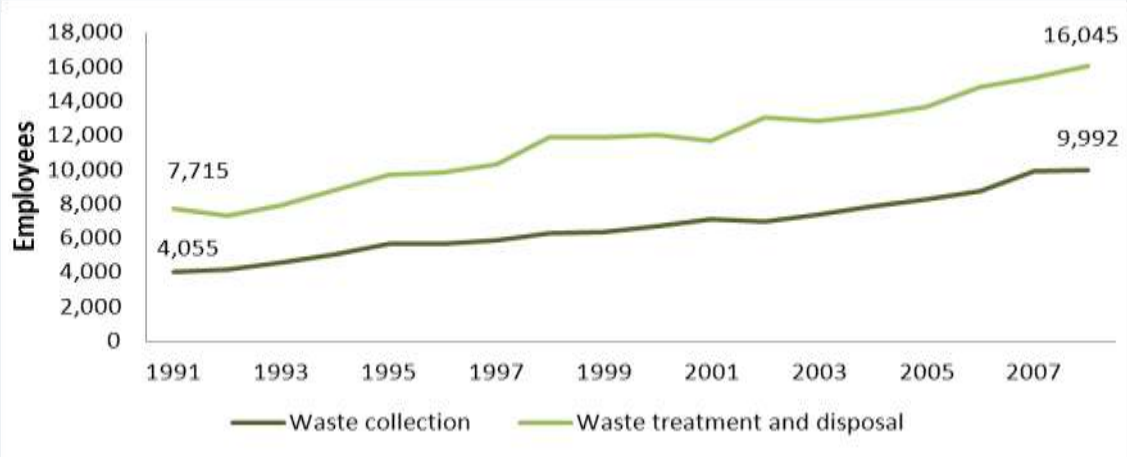
3.2.3 WASTE MANAGEMENT (NONHAZARDOUS WASTE)

Waste management refers to activities and measures aimed at the prevention of the generation of waste and the reduction of its harmful effect on the environment. It includes the collection and treatment of waste, including monitoring and regulation activities. It also includes recycling and composting, the collection and treatment of low-level radioactive waste, street cleaning and the collection of public litter.

Treatment of waste refers to any process designed to change the physical, chemical, or biological character or composition of any waste to neutralize it, render it non-hazardous, safer for transport, amenable for recovery or storage, or to reduce it in volume. A particular type of waste may undergo more than one treatment process. Treatment of waste comprises the processes of physical/chemical treatment, thermal treatment, biological treatment, conditioning of wastes and any other relevant treatment method. Disposal of waste is the final deposition of waste above ground or underground in controlled or uncontrolled fashion, in accordance with the sanitary, environmental or security requirements. Disposal of waste comprises landfill, containment, underground disposal, and any other relevant disposal method.

[2] See An impending water crisis in Canada's western prairie provinces, (Schindler and Donahue, 2006)

Figure 18
Growth in Waste Management Employment



Source: Statistics Canada SEPH

According to the Survey of Employment, Payroll and Hours (SEPH), direct employment in waste management services has seen relatively stable growth since 1991, growing from about 11,770 workers in 1991 to about 26,037 in 2008. (Figure 18) Employment in waste collection and employment in waste treatment/ disposal have grown in step with one another although growth in waste collection employment slightly outpaces growth in employment for disposal. Recently, in the 2005-2008 period, waste collection employment has grown at 6.5% per year and waste treatment and disposal employment has grown at 5.4% per year. (Table 12)

Table 12
Growth in Waste Management Employment

Employment							Average Annual Growth		
	1991	2000	2005	2006	2007	2008	1991-2000	2000-2005	2005-2008
Waste collection	4,055	6,711	8,278	8,745	9,942	9,992	5.8%	4.3%	6.5%
Waste treatment and disposal	7,715	12,052	13,713	14,832	15,380	16,045	5.1%	2.6%	5.4%
Total	11,770	18,763	21,991	23,577	25,322	26,037	5.3%	3.2%	5.8%

Source: Statistics Canada SEPH

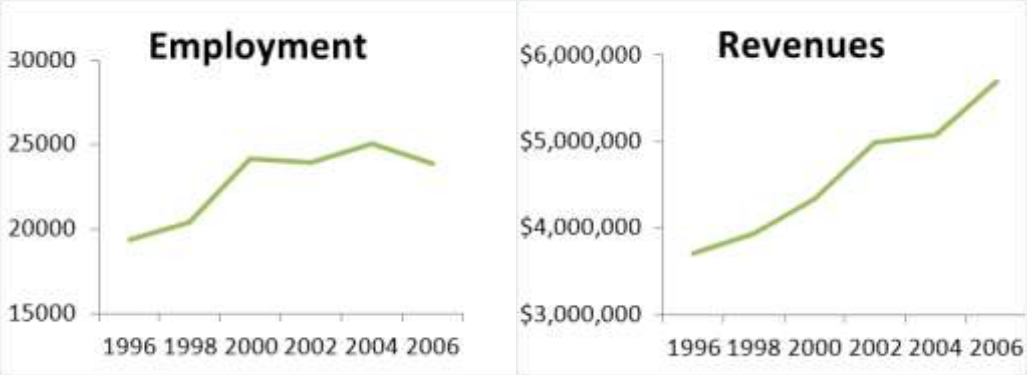
Demand for waste management, at a basic level, is driven by growth in waste generation as a result of population growth, growth in waste per capita, and growth in commercial and industrial waste generation.

Drawing conclusions on the impact of these drivers on waste management employment is difficult, in part because of the lack of time-series data and in part because multiple forces shape demand for employment in the sector. In addition, employment estimates from the SEPH do not align perfectly with the estimates obtained through the in-depth Waste Management Industry Survey (WMIS) conducted every two years in Canada. Employment figures from the WMIS indicate that there has been more

variation in employment growth in the sector over time. The survey explores several related measures such as waste generation per capita, revenues from waste management services, and other measures connected to performance of the industry.

Review of this data suggests that demand for waste management labour is not strongly tied to spending in the sector. Revenues for the waste management industry have seen steady growth from 1996 to 2006 with essentially flat growth in 2002-2004. Employment in the sector has been less steady with employment declines in the 2000-2002 period and 2004-2006 period. Notably, employment in the sector grew in 2002-2004 period while revenues were flat. Likewise, stronger growth in employment between 1998 and 2000 was paired with relatively low growth in revenues. The disconnection between employment growth and revenue growth is likely a function of government role in price-setting for the industry. (Figure 19)

Figure 19
Employment and Revenues in Waste Management



Source: Waste Management Industry Survey: Business and Government Sectors, 1996-2006.

Growth in worker demand may be somewhat tied to growth in generation of waste per capita. The level of waste generation per capita in Canada has growth significantly from 1996 to 2006, while the rate of waste diversion for recycling and other use has been essentially flat. (Table 13)

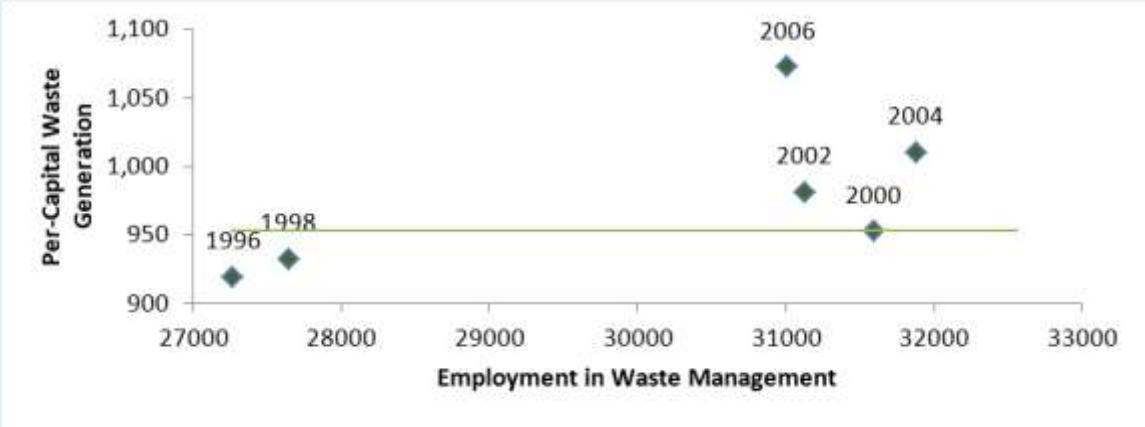
Table 13
Trend in Per-Capita Waste Management in Canada

	1996	1998	2000	2002	2004	2006
Disposal of Waste Per Capita	697	688	753	769	788	835
Diversion of Waste Per Capita	222	244	199	212	222	237
Generation of Waste Per Capita	919	932	952	981	1,010	1,072

Source: Waste Management Industry Survey: Business and Government Sectors, 1996-2006.

Employment in the sector was in the 27,000 workers range in the 1990s and then jumped into the 31,000 workers range in 2000 as per-capita waste generation increased (Figure 20). This suggests that employment demand in the industry will respond in "lumpy" growth to increases in waste generation; employment levels are able to meet demand for waste management services up to a point, at which, demand for workers will grow quickly. Because the number of data observations is low (only six observations), it is difficult to make definitive conclusions on the drivers of growth. It is possible that other factors may have driven the growth in employment in this period, which cannot be fully explained by the data we have available.

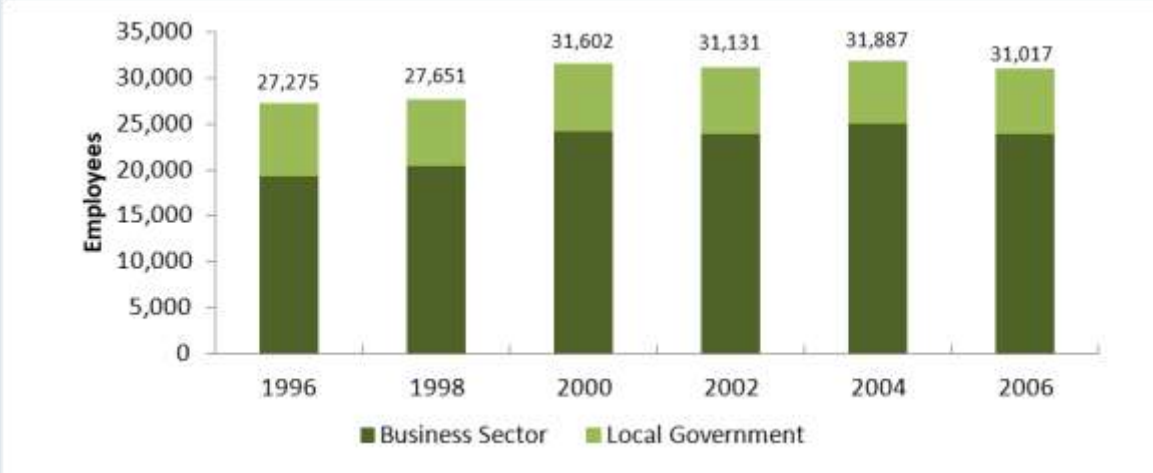
Figure 20
Employment and Per-Capita Waste Generation



Source: Waste Management Industry Survey: Business and Government Sectors, 1996-2006.

Most employment in waste management is in the business-sector, which is comprised of a mix of large and small waste management businesses. Only about a quarter of workers are employed directly by local governments in municipal-operated waste management services. There has been a gradual trend toward privatization of the waste management sector, although this trend varies somewhat. In the most recent period for which data is available (2004 to 2006), employment in the waste management industry declined by 3% in total. Employment in the business sector of the industry was down by 5%, while employment in the government sector in waste management rose by 5%. (Figure 21)

Figure 21
Employment in Waste Management 1996-2006



Source: Waste Management Industry Survey: Business and Government Sectors, 1996-2006.

Recycling

Canada's Recycling industry is broad and complex with recycling supply chains in existence for a vast array of materials. Natural Resources Canada divides the industry into the following materials groups: Construction, renovation and demolition

- Glass
- Metals
- Minerals
- Liquids, chemicals and gases
- Oils and petrochemicals
- Organic matter
- Paint, pigment and ink
- Paper
- Plastics
- Rubber and tires
- Textiles
- Wood

Supply chains exist for each materials group, that are comprised of waste collectors, wholesalers, dealers, processors, brokers/traders, generators, and other supply chain participants that provide specific or unique services required for recycling of the particular material.

Employment in the recycling sector is not well tracked because of the integrated nature of the industry. The Natural Resource Canada's Canadian Metals and Minerals Recycling Database lists 4,845 recycling firms which are in operation in Canada, ranging from large recycling employers such as Waste Management™ to specialty recycling service providers. As mentioned earlier, per-capita waste generation in Canada has grown significantly from 1996 to 2006, providing ample materials for recycling services. However, policy on recycling requirements in Canada lags behind that of the EU.

Aggressive policy in the EU, in particular the use of "take-back" legislation, has driven very strong growth in EU recycling employment. According to the EU Directorate General for the Environment, employment in the recycled materials sector in Europe grew at nearly 11% per year from 2000 to 2008, making it the second fastest growing environmental employment sector. It was also the second largest employment segment in the EU environmental sector with over 512,000 workers in 2008. The segment generated an impressive 283,000 new jobs in the between 2000 and 2008, making it the second largest sub-sector contributing to new environmental jobs (behind waste management).

"Take-back" legislation requires manufacturers to take responsibility for the disposal of waste from products they produce once those products have reached their useful life. Several provinces have recently introduced and passed targeted "take-back" legislation for electronic products, batteries, and other products. In the absence of a federal program, it is difficult for recycling businesses to grow to scale in Canada as provincial mandates differ from one another.

3.2.4 REMEDIATION AND PROTECTION

The remediation and protection sub-sector includes protection and remediation of soil, groundwater and surface water. It includes activities aimed at the prevention of pollutant infiltration, cleaning up of soils and water bodies and the protection of soil from erosion, and other physical degradation and also from salinisation. Monitoring and control of soil and groundwater pollution are examples.

Figure 22
Growth in Employment for Remediation Services

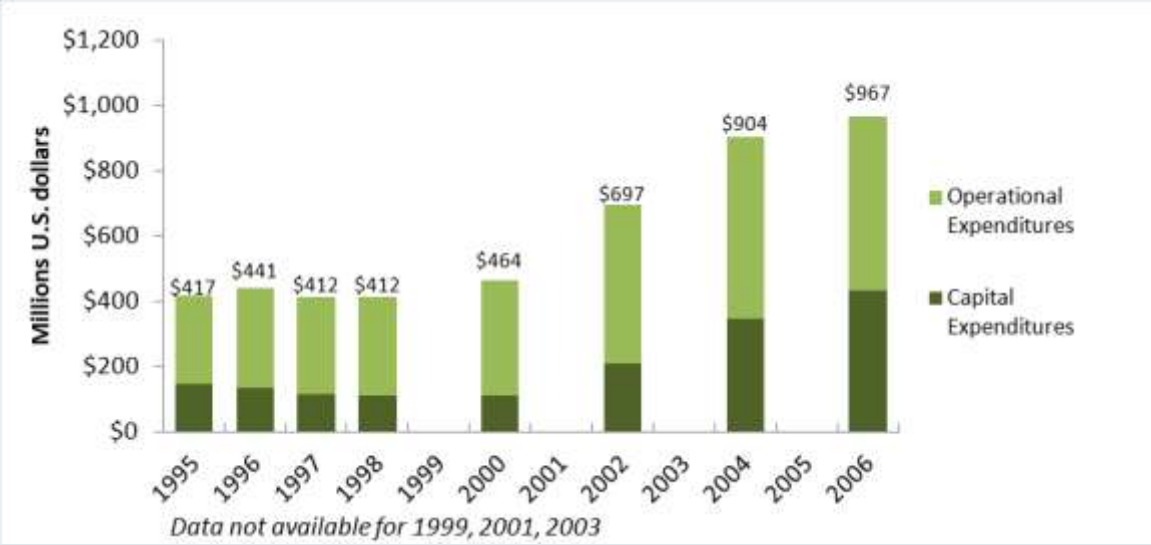
Employment							Average Annual Growth		
	1991	2000	2005	2006	2007	2008	1991-2000	2000-2005	2005-2008
Remediation services	4,347	6,512	9,091	9,695	10,212	10,577	4.6%	6.9%	5.2%

Source: Statistics Canada SEPH

Waste remediation of non-hazardous waste has grown at slightly faster rates than waste management in Canada. From 2005 to 2008, waste remediation employment grew from 9,091 workers to 10,577 workers, an annual average growth rate of 5.2%. (Figure 22)

Spending by businesses on remediation has grown significantly from 2000 to 2006, growing from $464 million in 2000 to $967 million in 2006. Growth in remediation has occurred in both capital expenditures on goods for remediation and in more labour-intensive operational expenditures on remediation goods and services. (Figure 23)

Figure 23
Environmental Remediation Spending 1995-2006



Source: Statistics Canada, Survey of Environmental Protection Expenditures in the Business Sector
Note: Surveys were conducted every second year beginning in 2000-2006

Government spending on federal contaminated sites has increased significantly over the past five years, driving demand for workers. The federal government has allocated $792 million dollars for the Federal Contaminated Sites Action Plan[3] (FCSAP) program between 2009 and 2011, including work on close to 590 FCSAP remediation projects.

Site assessment work is an important part of the FCSAP program and overall remediation process. Assessment projects involve detailed scientific and engineering analysis to identify the nature and extent of the contamination. A full-scale assessment of the severity of contamination for a specific site is a lengthy and complex process, with significant human resource demands for scientists, engineers, chemical analysis professionals, sampling and laboratory testing technicians, environmental consultants, contractors, and trades people. The program has the complementary objectives of supporting other socio-economic outcomes, such as training and employment of Canadians and promotion of innovative technologies.

Table 14
Government Spending for Federal Contaminated Sites

	2003-2004	2004-2005	2005-2006	2006-2007
Spending on Federal Contaminated Sites ($MM)	$75	$100	$155	$182
Site Assessments Funded			660	1,252

Source: Annual Report of Spending on Federal Contaminated Sites

Annual spending by the FCSAP has grown from $75 million in 2004 to $182 million in 2007. The number of assessments funded under the program doubled from 660 assessments in 2006 to 1,252 assessments in 2007. (Table 14)

Through Canada's Economic Action Plan (Budget 2009), the federal government intends to accelerate activities under the FCSAP over the next two years. Additional funding will enable accelerated action with a goal of funding over 3,500 site assessments. This new funding is also expected to accelerate an estimated $165 million in environmental remediation activity on approximately 225 priority federal contaminated projects across Canada.

According to the program website, the initiative will provide employment opportunities for a wide variety of companies and workers throughout the country including professional science and engineering services firms, construction and contractor firms, drilling and environmental service companies, analytical laboratories, transport companies, tradesmen and labourers, Aboriginal labourers and students, and hospitality-related businesses.

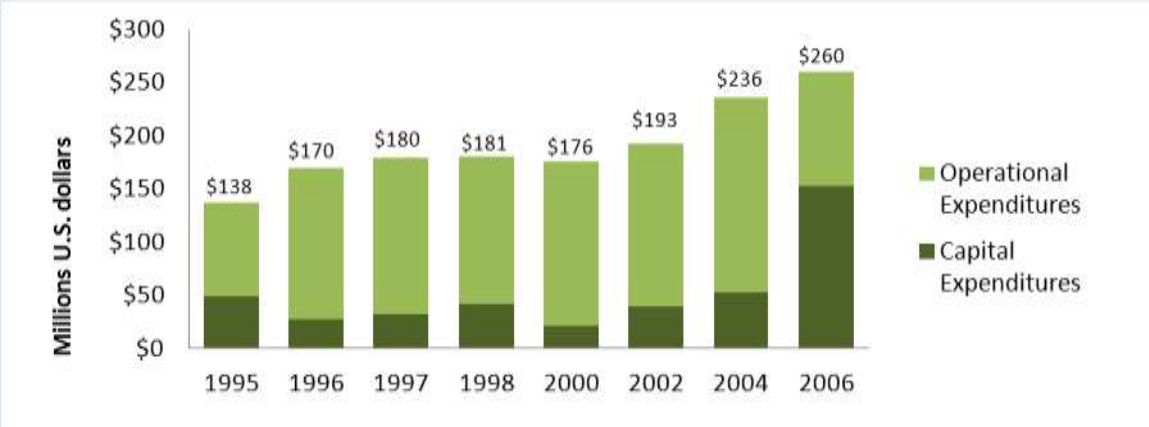
3.2.5 PROTECTION OF BIODIVERSITY AND LANDSCAPE

Protection of biodiversity and landscape refers to measures and activities aimed at the protection and rehabilitation of wildlife species, ecosystems, and habitats in addition to the protection and rehabilitation of natural and semi-natural landscapes. Maintaining or establishing certain landscape types, biotopes, eco-zones, and related issues (hedgerows, lines of trees to re-establish 'natural corridors') have a clear link to biodiversity preservation.

Industry spending on biodiversity protection has grown modestly over the 1996 to 2006 period growing from $138 million in 1995 to $260 million in 2006 an average annual growth rate of 6.0% per year. (Figure 24)

[3] Information for this section was provided by the FCSAP website. Source: http://www.federalcontaminatedsites.gc.ca

Figure 24
Spending on Wildlife and Habitat Protection



Source: Statistics Canada Survey of Environmental Protection Expenditures

Spending on protection of biodiversity is likely to accelerate as greater governmental attention is given to the topic. Several provinces have developed a biodiversity protection division within the provincial government, beginning with Quebec in 1996.

Direct government employment for protection of landscape and biodiversity is small, with approximately 100 workers employed directly in the sector at provincial ministries. Actions to protect biodiversity and landscape are also largely embedded in other environmental protection activities, making employment related to the sector difficult to discern.

Province	Biodiversity Protection Actions
Quebec	Quebec was the first province to develop a provincial biodiversity strategy and action plan in 1996; currently, the Province is developing its third strategy. Developed through public consultation and inter-ministerial collaborations and commitments, its priorities include biodiversity in wildlife, forests, urban areas, biotechnology, and education. The province employs 88 workers directly in its biodiversity and parks/environment department
Saskatchewan	Saskatchewan released its Biodiversity Action Plan in 2002 as a supporting document to the province's wider-reaching Green Strategy. Its plan emphasizes shared responsibility, effective public participation, ecosystem-based management, balanced values, knowledge-based decisions and a government leading the conservation of biodiversity. The province employs fewer than 20 workers directly in biodiversity protection.
Ontario	Ontario's Biodiversity Strategy was released in 2005, following cross-sectoral discussion among municipal, environmental and conservation, industry and Aboriginal leaders, with public consultation available through an informative, web-based Biodiversity Workbook. The Strategy outlines action to protect the diversity of Ontario, use and develop the biological assets of Ontario sustainably, and capture the benefits from such use. Biodiversity and landscape protection activities are embedded within several of branches of the provincial ministry.
Northwest Territories	Northwest Territories developed its Biodiversity Action Plan in 2005 through a Biodiversity Team consisting of territorial and federal government, First Nations, ENGOs, and citizens. The Action Plan displays the guiding principles of ecosystem based management, sustainable development, and shared responsibility for stewardship and collaboration.

Province	Biodiversity Protection Actions
New Brunswick	New Brunswick launched a Provincial Biodiversity Strategy on June 18, 2009. The Strategy provides a framework for advancing a coordinated and collaborative approach to the conservation and sustainable use of biological resources, representing a significant evolutionary step forward. Influenced by the Biodiversity Outcomes Framework for Canada, the strategy will be followed up with the development of biodiversity action plans over the next 12 to 16 months. These plans will involve stakeholders and will identify specific actions assigned to Departments that will move us incrementally closer to achieving the strategy's management outcomes. A New Brunswick Biodiversity Secretariat will be established to provide coordination and support to the Strategy. The province directly employs about 20 workers in biodiversity protection.
Manitoba	Manitoba has developed Sustainable Development Strategies for natural lands and special places, forestry, energy and mines, soil and water, and wildlife and fish, as well as initiatives such as the Prairie Conservation Action Plan and long-term forest management plans. There are about 45 workers employed in the province's Wildlife and Ecosystem Protection branch.
Alberta	Alberta adopted a Land Use Framework in 2008 to better manage public and private lands and natural resources in the achievement of their long-term economic, environmental and social goals. The framework provides a blueprint for land-use management and decision-making that addresses Alberta's growth pressures by adopting an ecosystem approach and considering the cumulative impact of development on biodiversity. The province employs about 20 people working directly on biodiversity and about 40 workers employed in the public land division.
British Columbia	British Columbia developed a Conservation Framework in 2008 to provide a set of science-based tools and actions for conserving species and ecosystems in the Province.

Future growth in the sector will be determined by policy created by these organizations and by the Canadian Council of Ministers of the Environment (CCME). At a national level, the Canadian Biodiversity Strategy[4] was developed under the auspices of the CCME. In 2006, the organization adopted the Biodiversity Outcomes Framework which guides policy-making, monitoring, and reporting of biodiversity protection activities in Canada.

3.2.6 NOISE AND VIBRATION ABATEMENT

Noise and vibration abatement refers to measures and activities aimed at the control, reduction, and abatement of industrial and transport noise and vibration. Activities for the abatement of neighbourhood noise (e.g. soundproofing of dancing halls, etc.) in addition to activities for the abatement of noise in places frequented by the public (e.g. swimming pools, schools, etc.) are included.

[4] See http://www.eman-rese.ca/eman/reports/publications/rt_biostrat/intro.html

Table 15
Revenues from Sales of Noise and Vibration Abatement

	2002		2004	
	Noise and Vibration	Percent of Total	Noise and Vibration	Percent of Total
	Sales Revenue from Goods ($ millions)			
Total	5,453.50	100%	4,138.60	100%
	Sales Revenue from Services ($ millions)			
Engineering services	27.3	25.8%	70.3	24.1%
Environmental consulting services	9.5	9.0%	63.7	21.9%
Waste management and remediation services	1.6	1.5%	77.8	26.7%
Total	105.9	100%	291.4	100%

Source: Environment Industry: Business Sector, 2002 (revised) and 2004.

There is no direct employment data or information available on employment in the noise and vibration abatement sector in Canada. The majority of industry revenues for this sector were for goods to reduce vibration and noise. Total industry revenues for these products declined from $5.4 billion in 2002 to $4.1 billion in 2004 (Table 15). Industry revenues on noise and vibration reduction services tripled between 2002 and 2004 from $106 million in 2002 to $291 million in 2004. With such limited information available, it is difficult to draw conclusions on the growth of the industry in Canada.

Noise and vibration abatement is one of the smallest employment sectors in the EU environmental sector, employing about 4,100 workers in 2000 and growing to about 7,600 workers in 2008, an annual average growth rate of 7.1%.

3.3 OTHER ENVIRONMENTAL SUB-SECTORS

3.3.1 ENVIRONMENTAL EDUCATION AND TRAINING

Environmental Education and Training (EET) includes technical and scientific education as well as values-based education that promotes attitudes and value systems that influence environmentally ethical behavior by developing understanding, skills and values that will enable people to participate as active and informed citizens in the development of an ecologically sustainable and socially just society. EET occurs in primary and secondary schools, within higher education, and among environmental advocacy organizations. Environmental education also involves education for technical skills and knowledge that may be applied in any sort of activities related to protection of the environment or the minimization of use of environmental resources.

The number of workers employed in environmental education in Canada is difficult to estimate. Statistics on the topic are not collected discretely because of the diversity of types of workers employed in environmental education and because environmental education is embedded in a diverse set of educational activities. The main players engaged in environmental employment in Canada are:

1. Provincial and territorial governments, and to a lesser extent, federal government
2. The formal education system (kindergarten - grade 12 system & higher learning)
3. The NGO environmental education community

Provincial and territorial governments have the jurisdiction over setting the educational curriculum. Environment Canada is the main federal player in environmental education, but educational programs are also offered by Natural Resources Canada and other organizations. These organizations facilitate provincial and territorial working groups to integrate sustainable development education into curriculum and also operate direct education programs and other forms of support.

Local school boards are responsible for implementing the provincial curriculum, and each board makes budget allocation decisions and chooses and/or develops their own curriculum materials for environmental education curriculum. School principals and teachers also play a key role in implementing the curriculum. Thus, the type and amount of environmental education taught in the classroom varies by school and even from class to class.

A number of post-secondary institutions in Canada are involved in environmental education. The Université du Québec à Montréal (UQAM) holds the only Canadian Research Chair in Environmental Education. Post-secondary operate a wide variety of training and education programs that prepare environmental practitioners for careers in the diverse environmental sector.

In addition to these groups, there are several non-governmental environmental organizations that promote environmental awareness and environmental educational programs. The Canadian Network for Environmental Education and Communication (EECOM), Learning for a Sustainable Future (LSF), and Green Street are examples of these organizations.

While it is difficult to estimate employment in environmental education, enrollment in environmental-related university programs gives some indication in growth in demand for these workers. Enrollment in environmental programs of study has grown from 69,700 enrollments in 1998 to 83,000 enrollments in 2007 (the latest year for which data is available) a growth rate 19% and an annual average growth rate of 2.0% per year. (Table 16)

Table 16
Enrolment in University Environmental Education in Canada 1998-2007

Program Title	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	CHANGE (1998-2007)	RATE OF CHANGE
Agriculture, General	4446	4704	3138	2706	2193	2106	1959	1785	1755	1773	-2673	-60%
Biology Teacher Education	0	114	255	252	222	195	270	234	285	306	192	168%
Biology/Biological Sciences, General	25116	24297	23076	22569	23889	25896	27951	28536	29424	29811	4695	19%
Chemical Engineering	4284	4428	4497	4377	4674	5124	5370	5631	5808	6123	1839	43%
Chemistry Teacher Education	0	39	87	87	90	84	111	111	117	87	48	123%
Chemistry, General	6249	6156	5706	5697	6240	7089	7674	7890	8259	8505	2256	36%
City/Urban, Community and Regional Planning	2013	1986	1833	1863	2076	2376	2583	2775	2934	2946	933	46%
Civil Engineering, General	6738	6723	5820	6084	6963	7908	8559	9165	9654	10254	3516	52%
Conservation Biology	0	0	0	0	0	18	174	171	168	159	141	783%
Ecology	0	0	102	90	114	141	243	294	321	312	210	206%
Environmental Science	0	207	858	1023	1269	1425	1710	1830	2085	2211	2004	968%
Environmental Studies	6336	5514	4851	4857	4560	4641	4152	4281	4524	4845	-1491	-24%
Environmental/ Environmental Health Engineering	0	69	231	204	240	324	438	321	420	507	438	635%
Forestry, General	3021	2358	1584	1188	1107	972	843	855	792	819	-2202	-73%
Geography	8220	8100	7983	7899	8448	8724	9123	9003	8931	8799	579	7%
Geography Teacher Education	0	54	108	81	153	174	183	159	195	174	120	222%
Geological/Geophysical Engineering	0	141	315	303	282	249	255	255	306	324	183	130%
Geology/Earth Science, General	3135	3012	2739	2682	2715	2685	2718	2988	3072	3297	162	5%
Natural Resources Management and Policy, General	0	78	141	183	231	342	528	552	657	717	639	819%
Physics Teacher Education	0	21	63	48	63	51	75	60	63	51	30	143%
Science Teacher Education	0	78	345	354	459	537	750	780	798	816	738	946%
Soil Science and Agronomy, General	183	177	186	171	147	150	180	180	186	180	-3	-2%
Water, Wetlands, Marine Resources	0	18	63	63	48	48	51	48	48	42	24	133%
TOTAL ENROLLMENT	69738	68271	63975	62775	66177	71256	75900	77901	80802	83052	13314	19%

Source: Statistics Canada PSIS Database

3.3.2 ENVIRONMENTAL POLICY AND LEGISLATION

Environmental policy and legislation refers to any activities involved in the development of regulations on activities that may be undertaken by organizations or individuals which have an impact on the environment. Environmental policy researchers, policy consultants, and policy program officers conduct research, prepare reports, provide consultation and advice, and administer programs in a variety of environmental areas related to the natural and applied sciences. They are employed by federal, provincial and municipal governments. They are also employed by private sector employers to evaluate the impact of environmental policy changes on a firm's operations and develop analysis to influence public policy development.

There is no direct statistical tracking of environmental policy workers. The occupation that is most closely related is natural and applied sciences policy researchers, consultants, and program officers (NOC E031). Employment in this occupation has grown from 9,870 workers in 1996 to 17,550 workers in 2006. Growth in employment of these workers increased at an annual average growth rate of 4.9% from 2001 to 2006. (Table 17)

Table 17
Occupations in Environmental Policy and Legislation

Workers	1996	2001	2006	Growth 1996-2001	Growth 2001-2006
E031 Natural and applied science policy researchers, consultants and program officers	9,870	13,785	17,550	6.9%	4.9%

Source: Census of Canada 1996, 2001, 2006

There were about 3,185 of these workers employed in federal government and about 2,500 employed in provincial government in 2006. Annual growth in demand for these workers was high in government sectors between 2001 and 2006 with employment growth in federal and provincial government growing at 8% and 9% per year respectively.

It was mentioned in interviews that energy firms tend to hire these workers to conduct environmental policy analysis. Growth in demand for these workers was very strong in the oil and gas extraction industry, where employment of natural science policy analysts and consultants grew at 15% per year between 2001 and 2006. The professional, scientific, and technical services industry is the largest employer of these workers with 6,365 such workers employed in 2006. Growth in demand for these workers was slower in this industry where employment of these workers grew at about 3% per year between 2001 and 2006. (Table 18)

Table 18
Industries Employing Natural and Applied Science Policy Researchers, Consultants and Program Officers

Workers	2001	2006	Annual Average Growth 2001-2006
Total Employment	13790	17550	5.9%
Selected Environmental Industries			
115 Support activities for agriculture and forestry	20	40	15%
211 Oil and gas extraction	85	170	15%
212 Mining (except oil and gas)	80	105	6%
213 Support activities for mining and oil and gas extraction	80	70	-3%
219 Mining – unspecified	0	10	
221 Utilities	385	565	8%
418 Miscellaneous wholesaler-distributors (incl. Recycling)	165	200	4%
541 Professional, scientific and technical services	5465	6365	3%
562 Waste management and remediation services	200	320	10%
911 Federal government public administration	2195	3185	8%
912 Provincial and territorial public administration	1595	2500	9%
913 Local, municipal and regional public administration	410	610	8%
Other Industries	3110	3410	2%

Source: Census of Canada 2001, 2006

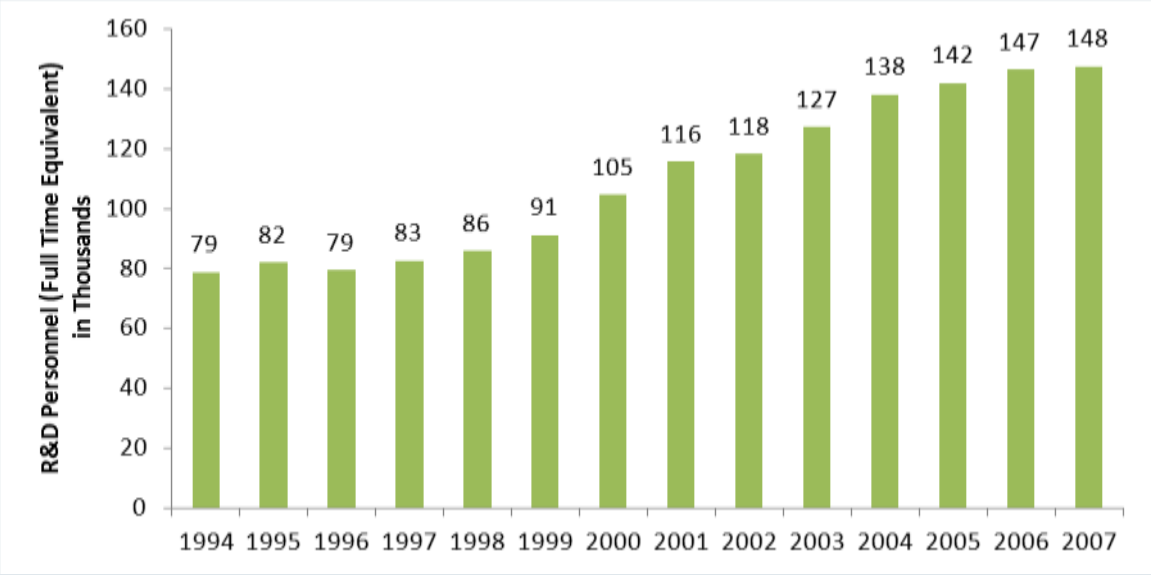
3.3.3 ECO-INNOVATION / RESEARCH AND DEVELOPMENT

Research and development (R&D) includes activities undertaken on a systematic basis in order to increase the stock of knowledge and the use of this knowledge to devise new applications in the fields of environmental protection and resource conservation. This includes research activities involved in the identification and analysis of sources of pollution, mechanisms for the dispersion of pollutants in the environment in addition to their effects on human beings, species and the biosphere. It covers R&D for the prevention and elimination of all forms of pollution, and also R&D oriented towards equipment and instruments of pollution measurement and analysis.

Eco-innovation is the production, assimilation, or exploitation of a product, production process, service or management or business method that is novel to the organization (developing or adopting it) and which results, throughout its life cycle, in a reduction of environmental risk, pollution and other negative impacts of resources use (including energy use) compared to relevant alternatives.

As of 2007, there were about 148,000 full-time equivalent workers employed in research and development in Canada (across all fields of R&D). Between 1994 and 2007, employment in R&D grew at an annual average growth rate of 4.9% per year. (Figure 25)

Figure 25
Total Research and Development Employment in Canada



Source: Statistics Canada CANSIM table 358-0024

The portion of this R&D employment that is related to environmental research and development and eco-innovation is somewhat uncertain. Eco-innovation is difficult to measure in employment terms.

Growth in eco-innovation is an important trend occurring in the environmental sector. Manufacturers initially introduced environmental innovations to add value to their products and these innovations are becoming increasingly common. The eco-innovation performed on product design is typically one component of overall product design, making it difficult to distinguish eco-innovation from other forms of product innovation.

Energy-related R&D investment declined in Canada between 2000 and 2004, but grew again from 2004 to 2007. Oil prices and other related energy prices generally began rising dramatically in 2003 and 2004, which likely contributed to the growth in demand for energy R&D. Growth has been particularly strong in research and development for energy conservation which grew from $71 million in 2004 to $188 million in 2007. (Figure 26)

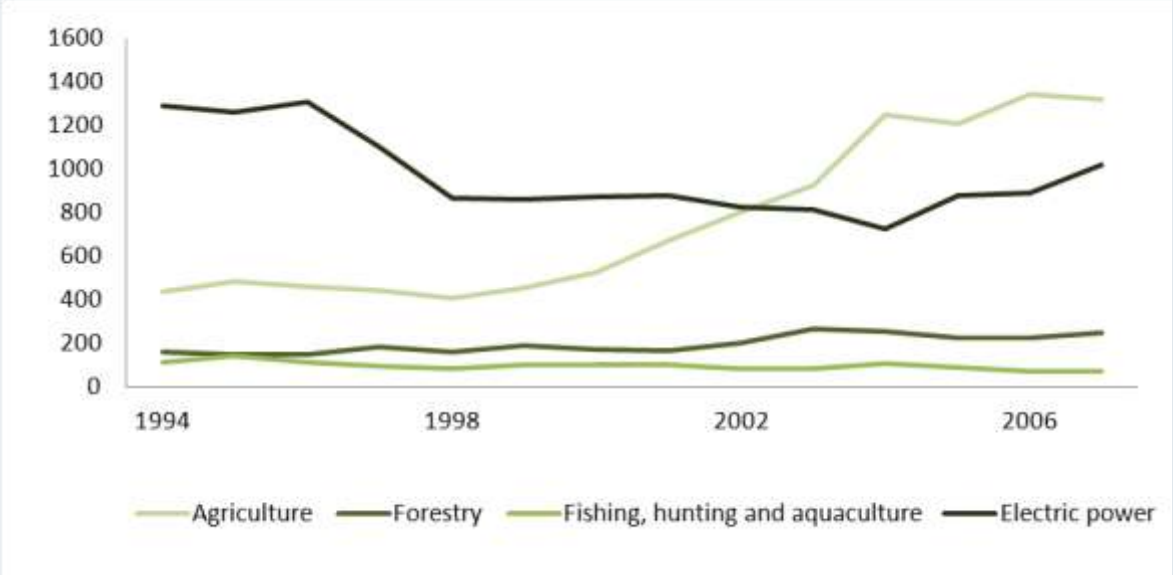
Figure 26
Expenditures on Energy R&D by Type of Expenditure

	2000	2001	2002	2003	2004	2005	2006	2007
Renewable resources	$78	$91	$95	$69	$83	$64	$59	$72
Transportation and transmission	$158	$101	$89	$86	$80	$79	$82	$122
Conservation	$209	$134	$121	$118	$71	$143	$173	$188
Total	$445	$326	$305	$273	$234	$286	$314	$382

Source: Statistics Canada

Employment of R&D personnel in electric power also began to grow again in 2004 after a long term slow decline through the 1990s and early 2000s. There has been significant growth in R&D employment, especially since 2000 in the agricultural sector. Between 2000 and 2007, the number of agricultural R&D personnel in Canada grew from 527 to 1,320 full-time equivalent workers. Research and development in forestry and fishing sectors has been essentially flat with about 249 R&D workers in forestry and 79 in fishing in 2007. (Figure 27)

Figure 27
Employment of R&D Personnel in Resource Industries



Source: Statistics Canada

3.3.4 ENVIRONMENTAL SAFETY AND HEALTH

Environmental health and safety is a cross-disciplinary area concerned with protecting the safety, health and welfare of people engaged in work or employment. The goal of all environmental safety and health programs is to foster a safe work environment. As a secondary effect, it may also protect co-workers, family members, employers, customers, suppliers, nearby communities, and other members of the public who are impacted by the workplace environment. It may involve interactions among many subject areas, including occupational medicine, occupational (or industrial) hygiene, public health, safety engineering, chemistry, health physics, ergonomics, toxicology, epidemiology, environmental health, industrial relations, public policy, sociology, and occupational health psychology.

Demand for workers in this field doubled from 10,590 employees in 1996 to 20,080 in 2006. Between 2001 and 2006, demand for these workers grew at an annual average growth rate of 8% per year. (Figure 28)

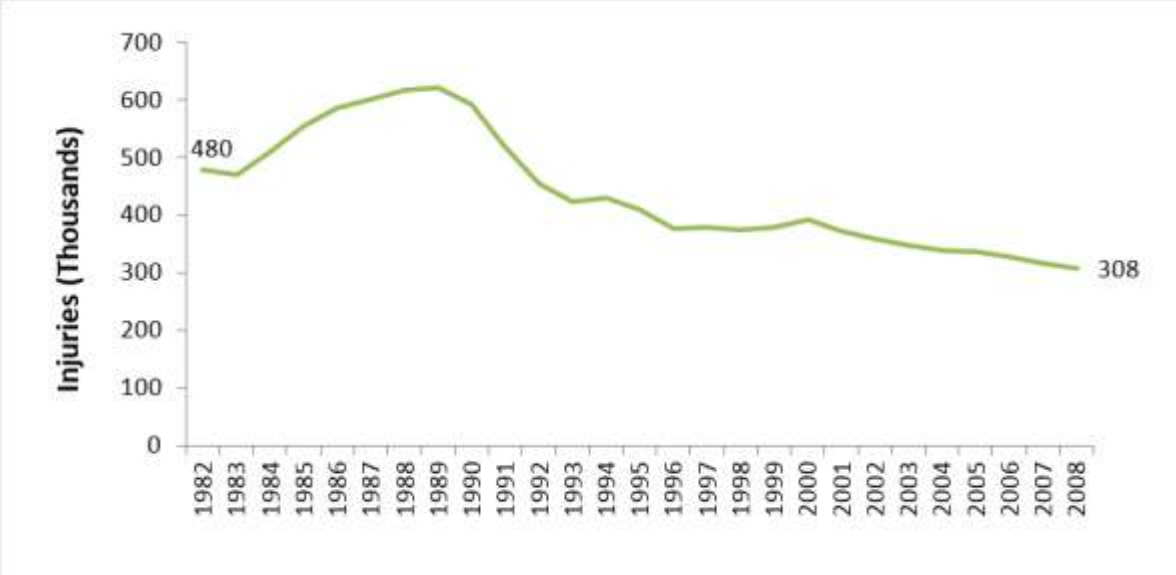
Figure 28
Occupations in Public and Environmental Health and Safety

Census Year	1996	2001	2006	Avg. Annual Growth 1996-2001	Avg. Annual Growth 2001-2006
NOC Occupation					
C163 Inspectors in public and environmental health and occupational health and safety	10,590	13,640	20,080	5.2%	8.0%

Source: Census of Canada 1996, 2001, 2006

Demand for workers in this field is likely related to efforts of firms to improve the safety and well being of workers, to comply with safety regulation, and to avoid negative consequences that may result from litigation for work-related injuries. Time-loss injuries occurring at work grew in Canada in the 1980s reaching a peak of 621,000 such injuries in 1989. Since that time, actions by firms to improve safety and environmental health have brought about declines in the number of injuries. Still, there were about 308,000 time-loss injuries at workplaces in Canada in 2008 suggesting that there are improvements yet to be made in workplace and environmental safety (Figure 29).

Figure 29
Number of Accepted Work-Related Time-Loss Injuries in Canada



Source: Statistics Canada

3.3.5 ENVIRONMENTAL COMMUNICATIONS AND PUBLIC AWARENESS

Environmental public relations and communications include activities that have an environmental component to the communication. This includes the development and implementation of communication and promotion strategies and information programs for media relations on behalf of businesses, governments and other organizations. Workers in this field are employed by consulting firms, corporations, associations, government, social agencies, museums, galleries, public interest groups, and cultural and other organizations, or they may be self-employed.

There is no official statistical tracking of workers in environmental communications. Similar to environmental education, the level of environmental content in public communications can vary significantly by organization, making measurements of employment in the sector difficult.

The occupation most closely related to these activities is NOC F024: professional occupations in public relations and communications. Demand for workers in this occupation was essentially flat between 1996 and 2001. In the 2001 to 2006 period, employment of these professionals increased at an annual average growth rate of 6.1% per year. There were about 36,905 public relations and communications professionals in Canada in 2006. (Table 19)

Table 19
Total Public Relations and Communications Occupations

Occupation	1996	2001	2006	Avg. Annual Growth 1996-2001	Avg. Annual Growth 2001-2006
F024 Professional occupations in public relations and communications	27,065	27,460	36,905	0.3%	6.1%

Source: Census of Canada 1996, 2001, 2006