

## Research Notes/Notes de recherche

### Economic Impact of Environmental Production\*

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The contribution of the environmental industry to the economy of Nova Scotia will be revealed here by an analysis of industry size distribution, productivity levels, and growth potential. Few precedents exist for this kind of analysis. The characteristics of environmental firms in the European Economic Community (EEC) were assessed in a report to the Organisation for Economic Co-operation and Development (OECD 1985). And in a report to Environment Canada, William Glenn (1987) analyzed employment opportunities provided by the Canadian environmental protection industry. Such studies, however, focused on specific components of the environmental industry (such as pollution control firms) rather than the whole industry. This study is therefore the first to assess the output of a broadly defined environmental industry for a discrete region.<sup>1</sup>

\*The authors wish to thank Alan V. Bell and two anonymous referees for their helpful comments. Thanks also are due to Environment Canada, the Department of Regional Industrial Expansion, the Atlantic Canada Opportunities Agency, and the Nova Scotia Department of Industry, Trade and Technology for their financial support of this study. Fazley Siddiq takes primary responsibility for this paper (and any errors remaining in it).

<sup>1</sup>Nova Scotia is ideally suited as a study area because of the economic importance of its agricultural, forestry, fishery, and tourism industries, all of which depend on sustainable resource utilization and maintenance of environmental quality. Furthermore, Nova Scotia, like other Atlantic provinces, faces critical decisions about the rehabilitation and upgrading of an aging sewer infrastructure. Thus, it currently is addressing the increasingly complex issues of solid and hazardous waste disposal, using its developing capabilities in new technology, environmental analysis, and information applications.

For the purposes of this study, the *environmental industry* is defined as the aggregate of all the environmental goods and services produced by firms—that is, (1) the ongoing assessment of existing environmental conditions; (2) the development of conservation and protection objectives, standards, and procedures; (3) the application of resource management practices, alternative process options, waste management, and restoration measures; (4) the monitoring of compliance; and (5) research and development on future environmental management requirements.

Within this broad definition “environmental firms” are defined as firms that provide as their principal function (50 per cent or more) environmental information management, research, measurement, monitoring, planning, design, construction, installation, maintenance, and management services pertaining to the environmental management cycle, including conservation, protection, and enhancement of the natural environment.

Thus, the environmental industry as a whole includes the environmental part of so-called environmental firms (that is, those firms whose output is at least 50 per cent environmental in nature), as well as the environmental part of the output of all other firms whose production of environmental goods or services constitutes less than 50 per cent of their output. The focus of this paper therefore is essentially two-tiered. On the one hand, it analyzes the size distribution of all environmental output produced by the industry for sale; on the other hand, it focuses more specifically on the economic characteristics of environmental firms.

A broad-based approach was used in defining the extent and characteristics of the environmental industry in Nova Scotia because of the increasing interest in the growth potential of environmental firms and the pressing need to develop a data base that would allow identification of policy initiatives for support of the industry. Information was collected on such key dimensions as output, size of fixed capital, employment, and growth potential to determine the current contribution of and prospects for environmental production in Nova Scotia.

Because there was no agreed-upon definition or data base for firms engaged in the production of environmental goods and services, the first step in this study was compilation of an industry list. A number of directories, including the *Nova Scotia Directory of Manufacturers*, the “Yellow Pages”, and *Scotts Industrial Directory*, as well as government files and listings, were used to compile a master list of firms potentially in the industry. These firms were then grouped according to eight categories of environmental activities: (1) waste recycling, (2) environmental consulting, (3) pollution control, (4) support services, (5) wastewater management, (6) solid-waste management,

(7) water and exploration drilling, and (8) environment monitoring services. Each firm was assigned to only one category. This process produced a list of 459 firms potentially in the environmental industry.

To determine the structure and composition of the industry, a relatively simple 17-item questionnaire was developed. The survey sought information on size, relevant economic and financial data, and each firm's outlook toward future growth.

As indicated in Table 1, an overall response rate of 28 per cent, or 128 of the 459 firms initially identified, was obtained. Twenty firms or 15.6 per cent of those who responded indicated that they were not involved in environmentally related activities. Since 108 of the 128 firms responding to the survey indicated that they derive a percentage of their revenues from environmental production, it follows that approximately 387 firms in Nova Scotia have an environmental component. It is believed that the responding firms constitute a random sample of the overall listing since there is no apparent correlation between environmental category (or output) and the probability of response.<sup>2</sup>

Of the 128 firms that responded, 75 indicated that more than 50 per cent of their revenues were derived from the provision of environmental goods and services. By definition, these firms are classified in this study as environmental firms. Based on this response, it is estimated that 269 environmental firms exist in Nova Scotia.

### Economic Characteristics of the Environmental Industry

The distribution of firms providing environmental goods and services indicates that environmental consultants, wastewater management firms, and waste recycling firms, in that order, constitute over 69 per cent of firms in the industry and almost 68 per cent of all environmental firms.

Our findings also indicate that environmental production in Nova Scotia is highly service-oriented. Nearly 73 per cent of environmental firms are engaged solely in the provision of environmental services. With respect to other activities, a greater proportion of environmental firms (13.3 per cent) indicated that they undertake both primary and

<sup>2</sup>The randomness of the sample is supported by the evidence in Table 1 which shows that the firms that responded to the survey are spread more or less evenly across the eight environmental categories identified. For example, the 28 per cent of all firms with an environmental component represented in the sample compares reasonably with the representation of the largest three categories in the sample: 21 per cent, waste recycling; 31 per cent, environmental consulting (not 33 per cent because two of the firms that responded declined to provide data and therefore had to be dropped from the sample); and 26 per cent for wastewater management.

Table 1  
SUMMARY OF SURVEY RESPONSES BY CATEGORY

Category	No. of Firms Surveyed	No. of Firms with Environmental Component	No. of Firms Not in Environmental Industry	Total No. of Responses <sup>a</sup>	Estimated No. of Firms in Environmental Industry <sup>b</sup>	Response Rate of Firms in Environmental Industry <sup>c</sup>
	(1)	(2)	(3)	(4)	(5)	(6)
Waste recycling	97	20	0	20	97	21%
Environmental consulting	112	32	5	37	97	32%
Pollution control	28	7	1	8	24	29%
Support services	65	11	7	18	40	28%
Wastewater management	99	23	3	26	88	26%
Solid-waste management	20	5	1	6	17	29%
Water and exploration drilling	35	8	3	11	25	32%
Environment monitoring services	3	2	0	2	3	67%
All	459	108	20	128	387	28%

<sup>a</sup>(4) = (2) + (3).

<sup>b</sup>Based on the assumption that the responses represent the surveyed population: (5) = (2)/(4) X (1).

<sup>c</sup>(6) = (2)/(5) X 100.

service activities than do firms in the industry as a whole (9.4 per cent).

Table 2 presents the distribution of firms in the industry by proportion of environmental output. Over half of the firms have an environmental output in excess of 90 per cent. The average productivity of labour in these firms is also high; at \$82,747, it is over 50 per cent more than for firms that have an environmental component of less than 50 per cent. As Table 2 indicates, the average value of fixed capital, employment, and the capital-labour ratio are also higher for the 90-100 per cent environmental component group than they are for other groups. Thus, on the whole, environmental firms appear to dominate the environmental industry since they not only constitute 70 per cent of all firms in the industry, but also have higher average employment and higher productivity levels than other firms in the industry.

The environmental industry by its very nature consists of a wide array of heterogeneous activities (ranging, for example, from environmental consulting to waste recycling), and the kinds of environmental capital employed across firms reflect this characteristic. Thus, some activities (such as drilling) use heavy, durable equipment, and other

Table 2  
ECONOMIC CHARACTERISTICS OF NOVA SCOTIA FIRMS  
IN THE ENVIRONMENTAL INDUSTRY ACCORDING TO  
THEIR PROPORTION OF ENVIRONMENTAL OUTPUT

Proportion of Environmental Output of Firms	Proportion of all Firms (%)	Average Value of Fixed Capital <sup>a</sup> (\$)	Average Annual Output <sup>a</sup> (\$)	Average No. of Employees <sup>a</sup>	Average Productivity of Labour <sup>a</sup> (\$)	Capital-Labour Ratio <sup>a</sup> (\$)
90-100%	51.5	645,401	1,067,438	12.9	82,747	50,031
50-89%	18.9	290,582	576,161	9.0	64,018	32,287
50% and Over	70.3	550,927	936,878	11.9	78,729	46,296
Less than 50%	30.7	296,073	488,097	8.9	54,842	33,267
All Firms	100.0	478,196	808,471	11.1	72,835	43,081

<sup>a</sup>All characteristics pertain only to the environmental component of firms.

activities (such as pollution control) use relatively less durable capital, leading to variations in the rate of investment required to sustain them. It therefore seems reasonable to confine the measurement of environmental capital to the financial value of a firm's capital stock. Any attempt to measure the relative durability of capital in such widely varying operations can be accomplished only by breaking the industry down into sectors. The differences in the kinds of capital employed also prevent any unambiguous conclusions about the impact of the capital stock employed by the industry on the environment relative to other kinds of capital.

The productivity of capital, moreover, does not represent a return to human investment in a particular type of skill. Indeed, the composition of the industry is such that the skilled workers required range from environmental engineers, some of whom work as consultants, to the various kinds of industrial workers and technicians engaged in the manufacture, installation, operation, and maintenance of environmental equipment. Given these variations in the characteristics of labour, it is not immediately clear what implications, if any, this would have on the regional labour force or on the development of the industry. Labour in the environmental industry is, however, generally highly skilled, which explains in large measure the relatively high average productivity of labour.

Tables 3 and 4 provide estimates of the output, employment, capital investment, average productivity of labour, and capital-labour ratios of Nova Scotia firms with an environmental component. Figures are given for both the environmental industry as a whole (Table 3) and so-called environmental firms (Table 4).<sup>3</sup> A notable

<sup>3</sup>Quintile shares of firm size and other variables were calculated after the firms were sorted in order of descending output per annum.

Table 3  
ECONOMIC CHARACTERISTICS BY QUINTILES ACCORDING  
TO ENVIRONMENTAL OUTPUT OF NOVA SCOTIA  
FIRMS IN THE ENVIRONMENTAL INDUSTRY

	Share of Total Output (%)	Average Annual Output (\$)	Average Value of Fixed Capital (\$)	Average No. of Employees	Average Product- ivity of Labour (\$)	Capital- Labour Ratio (\$)
Top Quintile	70.5	2,905,000	1,675,000	28.1	103,381	59,609
Fourth Quintile	17.2	710,000	460,300	9.7	73,196	47,454
Third Quintile	8.0	331,600	164,000	11.0	30,145	14,909
Second Quintile	3.4	139,900	69,000	5.2	26,904	13,269
First Quintile	0.9	36,700	64,091	2.7	13,593	23,737
Mean		808,471	478,196	11.1	72,835	43,081
Median		300,000				

Note: All characteristics pertain only to the environmental component of firms.

Table 4  
ECONOMIC CHARACTERISTICS BY QUINTILES ACCORDING  
TO ENVIRONMENTAL OUTPUT OF ENVIRONMENTAL  
FIRMS IN NOVA SCOTIA

	Share of Total Output (%)	Average Annual Output (\$)	Average Value of Fixed Capital (\$)	Average No. of Employees	Average Product- ivity of Labour (\$)	Capital- Labour Ratio (\$)
Top Quintile	69.9	3,356,250	2,068,750	33.8	99,297	61,206
Fourth Quintile	18.1	868,750	358,500	7.5	115,833	47,800
Third Quintile	7.8	373,875	233,125	12.0	31,156	19,427
Second Quintile	3.3	158,750	91,125	4.9	32,398	18,597
First Quintile	0.9	43,875	63,889	2.7	16,250	23,663
Mean		936,878	550,927	11.9	78,729	46,296
Median		340,000				

Note: All characteristics pertain only to the environmental component of firms.

feature that emerges from Tables 3 and 4 is the wide variation in output, employment, and capital-labour ratios within the environmental component of firm activity. The value of output of environmental goods and services for all firms averages \$0.81 million per annum; the top 20 per cent of firms, however, produce an average output of \$2.91 million per annum, while the bottom 20 per cent produce only \$0.04 million. This wide disparity in firm size is also reflected in the share of firms in total output: the top 20 per cent of firms control 70.5 per cent of the market and the bottom 60 per cent only 12.3 per cent. Similarly, firms overall have an average of 11.1 persons employed in their environmental component. The top 20 per cent of firms, however, averages 28.1 persons, and the lowest 20 per cent only 2.7 persons. As well, firms in the top quintile average almost \$1.68 million in their holdings of fixed capital; the corresponding figure for those in the lowest quintile is only \$64,091. Average productivity of labour shows a similar variation: \$72,835 overall but \$103,381 for the top 20 per cent of firms and \$13,593 for the bottom 20 per cent. Finally, the average capital-labour ratio for the environmental component of all firms is \$43,081, but the ratio once again ranges from \$59,609 for the top 20 per cent of firms down to only \$13,269 for the second quintile of firms.

The statistics for environmental firms only (Table 4) again show that the top quintile clearly dominates the market. In particular, this group of firms commands some 70 per cent of the market with each firm employing almost 34 persons on average or 60 per cent of the total. As well, the top quintile of environmental firms has a significantly higher level of fixed capital—\$2.07 million on average—which in turn translates into a high capital-labour ratio (\$61,206).

One of the criteria traditionally used to assess the importance of an industry to the economy is its contribution to the gross domestic product (GDP). At \$312.9 million, the value of the final output of firms in the environmental industry in Nova Scotia represents an estimated 2.5 per cent of the provincial GDP of \$12.6 billion for 1986. A number of caveats are in order, however. First, the concept of an environmental industry is so recent that data on it have not been collected. As a result, the contribution of this industry is not considered separately in calculations of GDP, and some portions of the contribution of environmental production to the economy are already captured in figures for other industry groupings. What can be said is that the effect of crediting other industries with the provision of environmental goods and services, as defined in this study, is a slight downward bias in the relative (not absolute) contribution of the environmental industry to the GDP. This problem of data collection and accounting with respect to the provision of environmental goods

and services is the subject of ongoing discussions between Statistics Canada, the Department of Industry, Science and Technology (DIST), and other interested departments in Ottawa. A second difficulty arises from the fact that the environmental industry uses some intermediate inputs. But because firms in this industry generally provide the kind of services that use very few intermediate inputs,<sup>4</sup> the resulting upward bias in the industry's contribution to GDP would not be great.<sup>5</sup> It must be acknowledged, nevertheless, that the above figure overstates, but not grossly, the industry's contribution to provincial GDP. By way of comparison, in 1985 OECD estimated that the contribution of the environmental industry to the GNP of the EEC countries ranged from 0.5 to 2.0 per cent. Thus, even if one used the value-added method to measure the actual contribution of the environmental industry (to remove the bias stemming from the presence of intermediate inputs), the contribution of the environmental industry to Nova Scotia's GDP would still compare favourably with that evident for the EEC countries.<sup>6</sup>

Environmental firms, on average, appear more vigorous than other firms in the environmental industry. Specifically, they account for over 80 per cent of total output, almost 75 per cent of total employment, and 80 per cent of fixed capital in the industry. Average productivity of labour increases from \$72,835 for the industry to \$78,729 for environmental firms and the capital-labour ratio from \$43,081 to \$46,296.

Our estimates indicate that some 4,300 persons are directly employed in the environmental industry in Nova Scotia. Nearly half of all firms expect the environment-related employment in their firms to grow by one to four jobs over the next five years. On the basis of the projected growth figures given by responding firms, it is estimated that employment will increase by over 1,600 over the next five years, or 37 per cent over the current level of employment. Environmental firms anticipate creating almost 1,300 new jobs, or 78 per cent of new employ-

<sup>4</sup>As mentioned earlier, this study shows that 73 per cent of firms provide only services, and an additional 18 per cent provide some combination of services and primary or secondary goods.

<sup>5</sup>Environmental consultants, support services, and environment monitoring services, for example, use only negligible amounts of intermediate inputs since they mainly create, process, and disseminate information—all of which are highly labour-intensive activities that largely contribute to the GDP in the final stages of production. Even activities that use more capital, such as waste recycling and water and exploration drilling, utilize relatively small amounts of intermediate inputs, such as fuel. This is not to imply that all service industries use very few intermediate inputs. Indeed, the airline industry probably uses a fairly large proportion of intermediate inputs, but their significance has not yet been studied.

<sup>6</sup>It is important to remember, however, that because the definition of *environmental output* is not applied uniformly, such comparisons must be made with some caution. It is possible that environmental output as it is defined in this study covers a much broader range of goods and services than it does in the European studies.

ment, in the industry over the next five years, assuming no major changes in existing environmental regulations. Should current environmental practices and regulations be made more stringent, the growth rate of this industry could be higher.<sup>7</sup>

Most firms in the industry expect the growth rate of environmental output to rise rapidly. Over 13 per cent of firms project their environmental output to go up by at least 50 per cent over the next five years. Of environmental firms, 78 per cent expect their output to grow by 5 per cent or more over the next five years, while only 59 per cent of other firms in the industry expect this amount of growth.

This projected increase in the production of environmental goods and services stems partly from the continuing environmental damage caused by our high-consumption modern life-style. This damage, if not controlled, could cause productivity in all sectors of the economy to erode.<sup>8</sup> When supplies of petroleum were reduced in the 1970s, for example, opportunities were created in the petroleum industry, and those who could take advantage of those opportunities benefited. Nevertheless, the economy as a whole was affected adversely. It is conceivable that a scarcity of environmental goods and services could contribute to the same type of macroeconomic problems caused by a scarcity of energy.

Although the relative performance of the environmental industry in Nova Scotia would be revealed by comparing it with those of other industries, estimates of output, employment, and capital are not available for other industries on a provincial basis. We thus had to rely on the less satisfactory national estimates (Table 5). The average productivity of labour and the capital-labour ratios are the most useful variables in Table 5. The data indicate that Nova Scotia firms in the environmental industry, and particularly environmental firms, have a significantly higher average labour productivity than Canadian firms

<sup>7</sup>In fact, Nova Scotia recently introduced new environmental legislation, imposing stiffer standards for environmental quality protection.

<sup>8</sup>The growing public concern about environmental problems was evident in the 1987 report of the World Commission on Environment and Development (Brundtland 1987), which focused global attention on the inextricable linkage between the environment and the economy. It recognized that sustainable development can be achieved only if natural resources are managed efficiently. As well, the National Task Force on Environment and Economy of the Canadian Council of Resource and Environmental Ministers expressed a similar sentiment when it said, "The economy and its participants exist within the environment, not outside it; we cannot expect to maintain economic prosperity unless we protect the environment and our natural resource base, the building block of development" (CCREM 1987: 3). Indeed, as McConnell (1981: 3-17) cautioned, Canada's natural resource base is not as extensive as is generally believed, and, since "environmental neglect creates serious damage to human health and the quality of the resource base" (Economic Council of Canada 1986: 56), this concern over productivity and economic growth does not seem to be overstated.

Table 5

ECONOMIC PERFORMANCE OF NOVA SCOTIA FIRMS IN THE ENVIRONMENTAL INDUSTRY AS OPPOSED TO CANADIAN FIRMS IN SELECTED INDUSTRIES, 1986

	Total Output (million \$)	Total Value of Fixed Capital (million \$)	Total Employment (thousands)	Average Productivity of Labour (\$)	Capital-Labour Ratio (\$)
Canadian firms in:					
Manufacturing	87,300.2	257,309.4	2,210.0	39,502	116,430
Agriculture	15,322.2	86,653.4	518.0	29,580	167,285
Forestry	3,132.6	2,366.0	91.0	34,424	26,000
Fishing	767.5	579.7	44.0	17,443	13,175
Mining	25,137.9	18,986.3	207.0	121,439	91,721
Nova Scotia firms in the environmental industry:					
All	312.9	185.1	4.3	72,835	43,081
Environmental firms	252.0	148.2	3.2	78,729	46,296

Sources for Canadian firms: Statistics Canada. *The Labour Force*, Cat. No. 17-001 (1984); *Fixed Capital Flows and Stocks*, Cat. No. 13-211 (1987); *Gross Domestic Product by Industry*, Cat. No. 15-001 (1988).

Note: All figures are expressed in constant 1986 dollars.

in all selected industries, with the exception of mining, and have a capital-labour ratio that is significantly higher than those in forestry and fishing but lower than those in manufacturing, agriculture, and mining.

## Conclusion

This study has shown that the environmental industry constitutes an important part of the Nova Scotia economy. Equally important is the impressive productivity level achieved by firms engaged in the production of environmental goods and services and that level's projected high growth rate. Within this general pattern of robust performance for the industry overall, environmental firms account for over four-fifths of output and three-quarters of employment. Current productivity levels and expected growth rates are also higher for environmental firms.

The performance of the environmental industry is all the more notable in that it has occurred at a very embryonic stage in our appreciation of the importance of the environment to the economy. But firms engaged in the production of environmental goods and services thus far have not fully appreciated their economic importance as an industry in these terms precisely because the environment-economy

concept is only just gaining recognition. If the pattern of other industries is followed, the next logical step for the environmental industry would be the development of mechanisms to enhance its self-awareness, cohesion, and ability to make known its contribution to the economy.

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