

**PUTTING THE ENVIRONMENT  
IN  
GREEN INDUSTRY STRATEGIES:**

**THE ROLE OF ENVIRONMENTAL INDUSTRIES IN  
RESTRUCTURING FOR SUSTAINABILITY**



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**CANADIAN INSTITUTE FOR ENVIRONMENTAL LAW & POLICY**

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**THE ROLE OF ENVIRONMENTAL INDUSTRIES IN  
RESTRUCTURING FOR SUSTAINABILITY**

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## EXECUTIVE SUMMARY

This study has been prepared by the Canadian Institute for Environmental Law and Policy, to provide background and strategic focus for Canadian governments' environmental industry strategies. Particular attention is given to the situation of the Ontario government. However, the conclusions and recommendations are easily applicable to other jurisdictions.

Over the past four years the environmental, or "green" industry sector has received a great deal of government, media and public attention. The sector has been defined to include firms which provide technologies, goods and services which promote pollution prevention, waste reduction, reuse and recycling, water and energy efficiency, alternative energy sources, environmental remediation, and environmental protection. Significant economic opportunities for this sector have been identified as a result of increasing efforts by governments and industry to ensure that economic activities occur in an environmentally sustainable manner.

Within Canada, the development of the environmental industry sector has become a focus of public policy for the federal government and the governments of Alberta, Saskatchewan, Manitoba, Ontario, Quebec and Nova Scotia. The development of this sector has also been the subject of growing attention by the United States federal government, the governments of a number of U.S. states, and several other Organization for Economic Cooperation and Development (OECD) member nations, particularly Germany and Japan.

However, in general Canadian efforts to develop environmental industry strategies have failed to make strong linkages between the development of the environmental industry sector and the broader question of the restructuring of Canada's economy for environmental sustainability. The development and diffusion of skills and technologies related to waste reduction, reuse and recycling, energy and water efficiency, and pollution prevention throughout the wider economy will be especially important in this process. It is in the context of this potential linkage between environmental and industrial policy that a strategic role for the environmental industry sector emerges.

The environmental industry sector can play a significant role in overcoming the economic and technological barriers to the development and diffusion of pollution prevention and resource conserving technologies, particularly in relation to small and medium sized enterprises. In addition, the sector is emerging as a significant source of employment itself, especially in the areas of reuse and recycling of municipal solid waste, the retrofitting of buildings for energy and water efficiency, and environmental remediation.

Four factors have been identified as being essential to the development of a competitive environmental industry sector, capable of developing and diffusing the skills

and technologies essential to the process of restructuring for sustainability: (i) the establishment and expansion of demand for the sector's products and services, particularly through the establishment of *stringent and certain* regulatory requirements, accompanied by strong expectations of enforcement (ii) market access to ensure that firms which need environmental technologies and skills are able to make contact with the firms able to supply those goods and services (iii) access to capital for the development and commercialization of environmental technologies and skills by the environmental sector and (iv) the availability of capital to support adoption of these technologies and skills, by firms served by the environmental sector.

Ontario's current efforts in these areas were reviewed in comparison with the activities of the U.S. federal government and the states of California, Massachusetts, Michigan, Minnesota, New Jersey, New York, Pennsylvania, Oregon, and Washington. Ontario's environmental industry strategy is well advanced compared with the U.S. jurisdictions studied. Only the U.S. federal government and the states of California and Massachusetts have introduced comparable strategies. However, a number of other states have placed a strong emphasis on the development of their solid waste reuse and recycling industries.

The situation is more mixed with respect to the demand for environmental technologies and services created by government activities. While Ontario's environmental requirements compare favourably with the U.S. in the areas of water pollution prevention, solid waste 3Rs, the phase-out of ozone depleting substances, and acid causing gas emissions, the situation in the areas of toxic air pollution prevention, hazardous waste reduction and elimination, and contaminated sites remediation is less favourable.

However, the pace of environmental initiatives in the United States at both the federal and state levels is likely to slow over the next few years. Indeed, in light of the results of the November 1994 elections significant retrenchments appear to be a real possibility. Under such circumstances, continuing improvements in Canadian standards will provide domestic environmental firms with a "head-start" over their American counterparts in the Canadian domestic market, potential export markets and, ultimately, when support for environmental initiatives is re-established, in the United States as well.

In this context, a number of steps are proposed for the Ontario government. With respect to the establishment of demand for environmental technologies and services, it is recommended that the province proceed on performance-based regulatory standards in the areas of toxic air pollution prevention, and hazardous and liquid industrial waste reduction/elimination. Movement towards cross-media bans and phase-outs of persistent toxic substances, identified in the candidate substances process as per the recommendations of the International Joint Commission, also should be considered

In addition, it is recommended that the province resolve funding issues for residential recycling programs and articulate provincial waste diversion goals past the

year 2000. The current ban on new incineration and energy-from-waste facilities should be maintained. A plan to stabilize Ontario's CO<sub>2</sub> emissions and move to a 20% reduction and beyond as soon as possible should also be implemented as soon as possible. The outstanding policy issues with respect to contaminated site remediation should be resolved as well. Finally, it is proposed that the province explore the feasibility and implications of an environmental technology performance verification process for Ontario.

With respect to market access, it is recommended that the province's market development programs be focused on the strengthening of ties between Ontario, the environmental industry sector and its domestic market, rather than on export development. This reflects the very strong consensus in the literature on environmental industries that export markets for the sector flow from a strong domestic "home base" market. The development of a comprehensive environmental industry directory, and the establishment or support of an on-line brokerage system for the marketing of secondary materials also is proposed. Ontario's Green Industrial Analysis and Retrofits program is identified as a highly effective vehicle for linking improved economic performance, the development of environmental industries, and the adoption of pollution prevention and resource conserving technologies and skills.

It is recommended that the province's support for the development of new environmental technologies and skills should be provided in a more focused manner than is currently the case. Particular emphasis should be given to meeting the needs of small and medium sized enterprises in the areas of pollution prevention, municipal solid waste 3Rs and composting, alternative energy sources (non-nuclear or fossil fuel); and energy and water efficiency. Support also should be provided for the development of new skills and technologies in the area of environmental remediation and restoration. It is suggested that in the future, support for the development of new environmental technologies and skills be provided in the form of targeted loan or grant programs for research and development, and loan programs for commercialization. The use of tax expenditures should be avoided due to the difficulties inherent in effectively targeting these instruments.

It is proposed that this more focused approach also be employed in the provision of support to firms wishing to adopt pollution prevention and resource-conserving technologies. In particular, it is recommended that the Ontario Accelerated Capital Cost Allowance program for pollution control equipment be terminated. In its place it is suggested that support for the use of new environmental technologies be provided in the form of loans, and be targeted to assist small and medium-sized enterprises in the adoption of pollution prevention and resource-conserving technologies. The provision of support could be linked to participation in the Green Industrial Analysis and Retrofit Program.

Finally, it is proposed that programs to support the development and adoption of new environmental skills and technologies should be financed through a dedicated fund, supported through the imposition of a charge on landfilling and the use or discharge of substances identified in the Ministry of Environment and Energy's (MoEE) Candidate Substances for Bans or Phase-Outs list. This would follow the proposals of Ontario's Fair Tax Commission and the practices of many of the U.S. states reviewed for this study.

The transition to an environmentally sustainable economy will involve significant changes to the structure of industrial-consumption oriented economies, such as Ontario's. The environmental industry sector has a critical role to play in the process of restructuring for sustainability, through the development and diffusion of pollution prevention and resource-conserving skills and technologies. These skills and technologies will provide the means by which society can meet the imperative of environmentally sustainable development which ensures the environmental, social and economic well-being of its members.

## PUTTING THE ENVIRONMENT IN GREEN INDUSTRY STRATEGIES:

### THE ROLE OF ENVIRONMENTAL INDUSTRIES IN RESTRUCTURING FOR SUSTAINABILITY

#### I. INTRODUCTION

Over the past four years the environmental, or "green" industry sector, has received a great deal of government, media and public attention. The sector has been defined to include firms which provide technologies, goods and services which promote environmental protection, water and energy efficiency, waste reduction, reuse and recycling, environmental remediation, and pollution prevention.<sup>1</sup> Significant economic opportunities for this sector have been identified as a result of increasing efforts by governments and industry to ensure that economic activities occur in an environmentally sustainable manner.

Within Canada, the development of the environmental industry sector has become a focus of public policy for the federal government<sup>2</sup> and the governments of Alberta, Saskatchewan, Manitoba, Ontario, Quebec and Nova Scotia.<sup>3</sup> The development of this sector has also been the subject of growing attention by the United States federal government, the governments of a number of U.S. states,<sup>4</sup> and several other Organization for Economic Cooperation and Development (OECD) member nations, particularly Germany<sup>5</sup> and Japan.<sup>6</sup>

However, in general Canadian efforts to develop environmental industry strategies have failed to make strong linkages between the development of the environmental industry sector and the broader question of the restructuring of Canada's economy for environmental sustainability. The development and diffusion of skills and technologies related to waste reduction, reuse and recycling, energy and water efficiency, and pollution prevention throughout the wider economy will be especially important in this process. It is in the context of this potential linkage between environmental and industrial policy that a strategic role for the environmental industry sector emerges.

This paper will seek to identify strategic directions for the further advancement of the Canadian environmental industry sector within a framework of environmental sustainability. Particular attention is given to the situation of the province of Ontario. The key challenges facing the sector in this role, particularly with respect to the effects of regulatory initiatives and requirements on the sector, market development and access, and capital barriers to the development of the sector, will be analyzed.

In addition, recent initiatives in this area by the U.S. federal government and by the states of California, Massachusetts, Michigan, Minnesota, New Jersey, New York, Pennsylvania, Oregon and Washington, to address these issues will be reviewed and

assessed. On the basis of this review and analysis, potential responses by the Ontario government in the development of its environmental industry strategy are presented. Many of the conclusions and recommendations are applicable to other jurisdictions, particularly the Great Lakes region.

## II. A FRAMEWORK FOR ANALYSIS: ENVIRONMENTAL AND ECONOMIC SUSTAINABILITY

### 1) Defining Environmental Sustainability

In response to growing concerns around the world regarding environmental degradation, the United Nations established the World Commission on Environment and Development (the Brundtland Commission) in 1983. In its 1987 report Our Common Future the Commission proposed that the concept of "sustainable development" should provide the foundation for future environmental and economic policies around the world. This concept has two distinct dimensions. The first, *intergenerational justice*, defined as:<sup>7</sup>

"meeting the needs of present generations without endangering the capacity of future generations to meet their own needs."

The second dimension of sustainable development is related to *intragenerational justice*, the fair distribution of environmental resources in the present among the people of the world, particularly between the developed North and developing South.<sup>8</sup> The principle of sustainable development has been accepted and endorsed by governments around the world,<sup>9</sup> including the government of Canada and those of all of the provinces.<sup>10</sup>

### i) Intergenerational Justice

The Brundtland Commission identified the ensuring of environmental sustainability of economic activities as being the key to intergenerational justice. Underlying this position is a recognition of an interdependence between the environment and the economy. In particular, the economy is understood to be dependant on the environment for both material inputs and energy. The sustainable development concept stresses the importance of maintaining the productive capacity of the environment to provide these resources. Emphasis must be placed on protecting the integrity and functioning of essential biospheric systems, such as nutrient recycling, climate stabilization, and soil-building, the protection and enhancement of biological, ecological and genetic diversity, and the conservation of ecologically significant areas.

This stress on the protection and maintenance of the environmental foundation of the economy represents a radical departure from traditional economic thinking about the relationship between the environment and the economy. Conventional models of economic development have emphasized growth in production and consumption, measured as expansions in Gross National Production (GNP), as the overriding goals of economic policy. The focus has been on the maximization of economic returns from the intensive development and exploitation of natural resources.<sup>11</sup> Pollution and other negative environmental effects, such as species loss and habitat destruction have been seen as natural and inevitable products of the application of ingenuity and knowledge to

serve human wants.<sup>12</sup> It was assumed that any resources that might become scarce as a result of economic activities could be replaced through technological innovations.<sup>13</sup>

As a result of this approach, proper values have not been placed on aspects of the environment that are used in the production process. Many of the resource inputs have been seriously undervalued, while the air, water, and land have been regarded as "free" waste disposal facilities. Resources with a zero or low value are at serious risk of being overused. When something is provided at no cost, more of it will be demanded than if the good or service has a positive price. The results of this undervaluing of environmental resources have been evident in Canada and throughout the world in the over-harvesting of forests and the destruction of biodiversity,<sup>14</sup> agricultural practices that destroy soil-building processes,<sup>15</sup> the degradation of our air, water, and land by pollution,<sup>16</sup> and global phenomena such as the destruction of the ozone layer,<sup>17</sup> and climate change due to industrial carbon dioxide emissions.<sup>18</sup> In modern industrial societies, increases in material wealth, as measured by annual increases in gross national product, have been achieved through the consumption of the biological interest generated by the planet and, much more seriously, by drawing down on its natural "capital."<sup>19</sup>

In an environmentally sustainable economic system, the limited carrying capacity of the ecosystems within which the economy operates, is acknowledged. This implies that ecological resources can only be utilized at rates that do not exceed the regenerative ability of the resource base. Similarly, wastes cannot be discharged into ecosystems in quantities which exceed their assimilative capacities thereby undermining their integrity and functions. Rather, the possibility is explicitly recognized that activities which damage the productive capacity of the biosphere will ultimately undermine the basis of economic activity.<sup>20</sup> The application of the principle of environmental sustainability requires a shift in emphasis away from increasing consumption, and towards the maintenance of the planet's base of environmental systems as a central goal of economic policy.

## ii) Intragenerational Justice

In addition to this need to maintain the integrity of environmental systems for future generations, the Brundtland Commission also emphasized the need for social justice between the developed and developing world. The Commission recognized the serious imbalance in environmental resource consumption between the North and the South. It has been observed, for example, that industrial countries, with one fourth of the globe's people, account for over 80% of human beings' consumption of aluminum, chemicals, paper, iron and steel and 75% of the world's use of energy.<sup>21</sup> Not only does this consumption result in enormous environmental impacts on its own, it also uses the environmental carrying capacity needed to meet the basic requirements of people in the developing world.<sup>22</sup>

## 2) Establishing an Environmentally Sustainable Economy in Ontario

The maintenance of the carrying capacity of the environment, and protection of the integrity of essential ecological processes are central to the achievement of environmentally sustainable development. This has significant implications for the economic structure of industrial, consumption-oriented societies such as Ontario's. In particular, it requires that the level of environmental resources used by these societies in providing for the social and economic well-being of their citizens, be reduced. Services, such as shelter, packaging, and transportation will have to be provided through the use of much smaller quantities of energy and materials. Discharges of pollutants, such as persistent toxic substances, which undermine the integrity of ecological systems, must also be curtailed.

It has been suggested, for example, that a 50% reduction in worldwide materials consumption will be needed to arrest global environmental degradation, and that to achieve it, industrial countries need to aim for a 90% reduction.<sup>23</sup> The current rates of materials consumption are considered unsustainable, not so much due to shortages of materials themselves, but rather due to the extent of the environmental costs associated with their extraction and processing.<sup>24</sup> This is especially true with respect to metals, minerals, and fossil fuels and their derivative chemicals and materials. Similarly, it has been argued that industrial countries with high levels of energy consumption per unit of production, such as Canada, will need to achieve a net reduction of up to 50% in their carbon dioxide emissions merely to stabilize global emissions at their present level.<sup>25</sup> With respect to the release of pollutants into the environment, the Canada-United States International Joint Commission (IJC) and others have argued that the generation and release of persistent toxic substances into the environment must be eliminated completely,<sup>26</sup> as should releases of other toxic substances in toxic amounts.<sup>27</sup>

It is unlikely that the goals of placing the economy on an environmentally sustainable basis, while continuing to provide for the social and economic well being of its citizens, can be achieved through traditional approaches to environmental protection. These approaches have usually not questioned the structure of economic activities, particularly in the resource extraction and processing, and manufacturing sectors. Instead they have attempted to control their environmental effects through the addition of end-of-process, add-on measures, or through remediation of environmental damage after it has occurred. The more fundamental questions related to the environmental sustainability of the production system have been left unaddressed.

Experience with this reactive and remedial model indicates that the traditional approach to environmental protection is highly inefficient in economic terms, and of limited environmental effectiveness. In an economic sense, it has been observed that end-of-process, add-on measures often result in higher capital and operating costs to firms, while increasing their technological rigidity, reducing their capacity for technological



change and, as end-of-process technology is typically acquired outside of a firm, places them in a position of technological dependence.<sup>28</sup> From an environmental perspective, it is widely acknowledged that end-of-process solutions tend to transfer environmental problems between different media, rather than solving them.<sup>29</sup>

In light of these environmental and economic failings of conventional end-of-process approaches to environmental protection, it has become increasingly apparent that the goal of environmental sustainability must be integrated into the design of production processes. The development and diffusion of technologies which prevent pollution through the substitution of inputs, redesign of production processes, or reformulation of products (thereby reducing or eliminating the generation and use of pollutants at the outset rather than at the end of the production process), will be particularly important in this context. The development and use of technologies and skills which permit the reduction, reuse, recycling of wastes, and the use of energy and water resources more efficiently, also will be critically important. Skills and technologies in these areas will enable industrial/consumer societies, such as Ontario's, to meet the needs of their citizens while using environmental resources less intensively, thereby placing them on a more environmentally sustainable footing.

In addition to their much greater environmental effectiveness in comparison to traditional environmental protection technologies, the adoption of pollution prevention, waste reduction, or clean technology<sup>30</sup> strategies usually improves the economic performance of the affected firm through the more efficient use of energy and materials.<sup>31</sup> This potential for the *co-optimization*<sup>32</sup> of the goals of improved economic efficiency, while ensuring the availability of environmental resources to present and future generations, has been gaining increasing acceptance. Notice of the possibility was given in the federal government's 1990 Green Plan.<sup>33</sup> Similarly, in its 1991 budget, the Ontario government observed that:

"Technological innovation is also driven by challenges such as the need for improved environmental protection...

... An economic advantage will accrue to those who quickly recognize the universality of environmental concerns and who adapt to that new reality.

...stricter environmental standards can act as a spur to technological innovation, producing productivity gains from the systematic elimination of waste of production inputs."<sup>34</sup>

Notwithstanding this potential, the achievement of environmental sustainability will involve significant changes in the present structure of the Ontario economy. Activities in such areas as the production of chemicals, plastics, paper, glass and primary metals, which account for high proportions of hazardous emissions<sup>35</sup> and energy use,<sup>36</sup> will be particularly effected. Significant capital investments in the development of pollution

prevention and resource conserving technologies and skills will be necessary. Cities, where secondary resources, factories and labour are concentrated, may become more important sources of material resources than rural mines or forests.<sup>37</sup> This may have major implications for the current economic structure of resource-based communities in the North. However, these changes are necessary to ensure an environmentally and economically sustainable future for Ontario. The key challenge will be to facilitate a transition in a manner which ensures the continued social and economic well-being of all members of society and, in particular, where the transition costs are not borne by its weakest members.<sup>38</sup>

### 3) Barriers to the Development and Diffusion of Pollution Prevention and Resource Conserving Technologies

Despite the growing evidence of the possibility of simultaneously ensuring environmental sustainability and improving economic performance through the adoption of pollution prevention and resource-conserving technologies, a number of significant barriers exist to the development and diffusion of such technologies throughout the economy.

#### i) Economic Barriers

Significant economic barriers to the development and adoption of pollution prevention, waste reduction, reuse, and recycling and energy and water efficient technologies by individual firms have been identified. Among the most significant of these economic barriers is the limited availability of capital both to support the development of pollution prevention and resource conserving technologies, and to fund the actual adoption of such technologies. In some cases, firms may have already invested their available capital in the installation and operation of end-of-process technologies.<sup>39</sup>

Furthermore, the adoption of pollution prevention and resource conserving technologies often involves higher initial capital costs than the use of traditional end-of-pipe systems, as they sometimes entail significant changes to the firm's overall production processes. In addition, while it may be possible to purchase end-of-process systems "off the shelf," process-change based pollution prevention, waste reduction and energy efficiency measures usually have to be designed to fit the specific processes of the firm in question. The adoption of new technologies also may require staff retraining or the development of new technical skills.

These economic barriers tend to be particularly significant in the case of small and medium-sized firms, as their capital and in-house research and development resources are typically very limited to begin with.<sup>40</sup> In addition, among firms of all sizes, short-term profitability calculations may result in a low tolerance for the pay-back periods associated

with adoption of pollution prevention or waste reduction technologies.<sup>41</sup> This has been identified as a particularly serious problem in North America, where firms typically expect pay-back periods of between one and three years. It has been observed widely that European and Japanese firms tend to be prepared to tolerate much longer pay-back periods, up to a century in some cases.<sup>42</sup> The failure of traditional accounting frameworks to take environmental liabilities and other environmental costs fully into account has weakened the appeal of investments in pollution prevention and resource conserving systems.<sup>43</sup>

It also has been observed that certain tax expenditures provided by governments, such as accelerated capital cost allowances for pollution control equipment, provide positive incentives to adopt end-of-process pollution control systems, as opposed to pollution prevention systems.<sup>44</sup> Finally, the economic appeal of employing pollution prevention and resource conserving technologies may be reduced by the underpricing of natural resources due to government subsidies which support extraction, and weak environmental standards which permit a significant externalization of the environmental costs of development and processing.<sup>45</sup>

## ii) Managerial and Attitudinal Barriers

There are significant attitudinal barriers to the adoption of pollution prevention and resource conserving technologies as well. In particular, among the senior management of many Canadian firms the goals of enhanced environmental protection and increased competitiveness continue to be seen as mutually exclusive ends.<sup>46</sup> These attitudes arise from experience with traditional means of complying with pollution control requirements, such as the use of end-of-pipe or remedial technologies to deal with pollution after it has been created, which almost always add to manufacturing costs.<sup>47</sup>

The potential for pollution prevention or waste reduction, reuse or recycling approaches to pay for themselves through reduced material and energy use, particularly in comparison with the costs of achieving the same result through the use of end-of-pipe systems, has not been fully accepted.<sup>48</sup> Indeed, conventional economic analyses tend to assume that any cost-effective process-change opportunities already will have been taken by the firm in question.<sup>49</sup>

The internal organization of a firm also can present a significant obstacle to the adoption of pollution prevention or resource saving technologies. Environmental protection and occupational health and safety functions traditionally have been separated from production design and operations functions.<sup>50</sup> This reflects the conventional status of environmental protection measures as add-ons, or afterthoughts to the design of the firm's production process. In order to achieve the co-optimization of environmental protection and improved economic efficiency, these functions need to be closely integrated.

## iii) Technological Barriers

As noted earlier, the consideration that pollution prevention and resource efficient technologies must be tailored to the specific processes of each firm adopting them, presents a significant economic and technical barrier to their use. Unlike generic, end-of-process systems, the technology may need to be specifically modified for each application.<sup>51</sup> In some cases, appropriate technologies, or substitute inputs may not be immediately available, requiring investments in research and development.

Existing production processes also may prove to be highly inflexible, again requiring further investments in technology development. In addition, the use of pollution prevention or other resource efficient technologies may require a higher degree of technological sophistication than that to which the firm is accustomed. Firm managers also may be reluctant to invest in the adoption of a particular technology due to concerns that it may not perform as well as expected, leaving the firm both economically weakened, and unable to meet the environmental standards which the technology was intended to address.<sup>52</sup>

In general, older, established facilities, tend to face the greatest difficulties in the adoption of new technologies. Switches to new technologies are often easier when they occur during the expansion of existing plants, or the construction of new facilities which can incorporate state of the art systems from the outset.

## iv) The Need for Regulatory Incentives

Beyond these economic, attitudinal, and technological barriers, the structure of environmental regulations themselves can present barriers to the development and adoption of pollution prevention and resource-conserving technologies. Environmental protection requirements which remain static, which are not effectively enforced, or which actually are reduced, clearly provide no incentives for innovation and upgrading.<sup>53</sup> Indeed, there is a strong consensus that *Stringent and certain* regulatory demands,<sup>54</sup> supported by expectations of firm, predictable and targeted enforcement,<sup>55</sup> are essential to prompting the development and adoption of pollution prevention and resource conserving technologies.

In addition, it has been argued that environmental standards which are based on the performance of the "Best Available Control Technology (BACT)" at the time of their drafting provide weak incentives for technological innovation, as the technology to meet these standards already exists by definition. In the result, such standards are likely to strengthen the diffusion of the existing end-of-pipe technologies, rather than prompting technological innovation and process changes to prevent pollution or reduce waste.<sup>56</sup> In order to promote the development and adoption of new technologies, environmental

standards need to have a "technology-forcing" component, setting performance requirements beyond the capacity of existing end-of-process technologies, which will have to be met at some point in the near future.<sup>57</sup>

The existing regulatory system may discourage the use of new technologies in a number of other ways. It has been argued, for example, that regulatory authorities tend to favour the approval of known and proven technologies over the use of new technologies for which there may be a significant risk of failure. This can provide a significant incentive to firms to adopt well-known end-of-process technologies over new pollution prevention approaches.<sup>58</sup> In some cases, specific design standards may actually require the use of particular end-of-process technologies.<sup>59</sup> The need to permit "technological flexibility" in industry's responses to new standards has been emphasized as being important in facilitating the adoption of new process change-based technologies.<sup>60</sup> Furthermore, the continued use of media-specific standards also has been criticized as promoting end-of-process solutions which may result in the intermedia transfer of pollutants.<sup>61</sup>

#### 4) Conclusion

The process of restructuring for sustainability will require significant changes in Ontario's economy. The prevention of pollution and the reduction of consumption of material, energy, and water resources will be particularly important in this process. Environmental standards will have to be strengthened, and eventually, resource management policies significantly reformed in order to achieve these goals. Pollution prevention, waste reduction, reuse, recycling and composting, and energy and water efficient technologies will be critical enabling factors in the transition, from both an environmental and an economic perspective.

However, significant economic, attitudinal and technological barriers to the development and diffusion of the necessary skills and technologies to respond to these needs, exist. Effective and efficient means of overcoming these barriers, particularly from the perspective of small and medium-sized businesses must be identified and put in place. Such firms typically have limited capital and research and development resources. It is in this context that a strategic role for the environmental industry sector in the restructuring of the Canadian and Ontario economies for Environmental Sustainability, begins to emerge.

### III. THE ROLE OF THE ENVIRONMENTAL INDUSTRY SECTOR IN OVERCOMING BARRIERS TO RESTRUCTURING FOR SUSTAINABILITY

#### 1) Defining the "Green" or "Environmental" Industry Sector

The "environmental" or "green" industry sector has been broadly defined as "firms which produce pollution abatement equipment and a range of goods and services for environmental protection and management."<sup>62</sup> The Canadian sector captured by this definition is currently estimated to do \$11 billion of business annually, and to employ between 90,000 and 150,000 people.<sup>63</sup> However, the general definition can be refined into the identification of specific sub-sectors of the general "environmental" industry sector. These sub-sectors include:

- 1) *Pollution Prevention*. This sub-sector provides technologies and skills intended to reduce or eliminate wastes or pollutants, particularly toxics substances, at source, through changes in industrial processes, materials substitutions, and product reformulations. This may include improved manufacturing information, monitoring and control systems, the substitution of new catalysts and separation processes, precision fabrication, and innovations in materials design and processing.<sup>64</sup> These services are generally provided to the resource extraction and processing, and manufacturing sectors of the broader economy.
- 2) *Municipal Solid Waste Reduction, Reuse, Recycling and Composting*. This sub-sector provides technologies, services and products that help reduce the initial production of non-hazardous municipal solid wastes (MSW), or support the reuse, recycling or composting of post-consumer materials. The sub-sector also includes firms directly engaged in the collection, handling, processing or composting of post-consumer materials for reuse or recycling. These technologies and services may be provided to the industrial, commercial, and institutional (IC&I) and residential sectors.
- 3) *Hazardous Waste Reuse and Recycling*. This subsector provides technologies and services related to the off-site reuse or recycling of hazardous wastes.
- 4) *Water and Energy Efficiency*. This sub-sector provides technologies and skills which promote the efficient and economical use of energy and water resources in the IC&I and residential sectors. This sub sector includes firms which provide high efficiency motors and lighting, energy efficient appliances and windows, heat storage systems, low flow toilets, "smart" irrigation systems, and water recirculation systems.<sup>65</sup>

- 5) *Renewable and Alternative Energy*. This sub-sector is related to the energy efficiency sub-sector and is engaged in the development of renewable and alternative energy sources (non-nuclear or fossil fuel) including solar photovoltaics, solar thermal electricity, wind power, fuel cells, the use of hydrogen as a fuel, and the development of improved batteries with reduced, reusable or recyclable toxic metal components.<sup>66</sup>
- 6) *Environmental Remediation and Restoration*. This sub-sector includes firms engaged in such activities as the assessment and rehabilitation of contaminated sites, the clean-up of spills, and the restoration of ecosystems degraded as a result of mining operations and/or other resource extraction or industrial activities.
- 7) *Environmental Planning and Assessment Services*. This sector includes the provision of "soft," non-technological services, such as environmental planning, assessment, auditing and legal services to individuals, other firms, and municipal, provincial and federal government agencies.
- 8) *Monitoring and Analysis Equipment and Services*. This sub-sector includes the provision of equipment to measure, monitor, predict, and assess the nature and fate of pollutants and waste streams, and the provision of related laboratory services. Measurement technologies are considered key components of process control systems necessary for cleaner and more efficient industrial systems.<sup>67</sup>
- 9) *Environmental Protection*. This sub-sector includes most of the activities which have traditionally been associated with the "environmental" industry sector. It is focused on the provision of end-of-process waste treatment and the handling technologies and services. This includes:<sup>68</sup>
  - \* the provision of municipal waste collection, hauling and disposal technologies and services for the IC&I and residential sectors, and related consulting services;
  - \* the provision of hazardous waste hauling, treatment and disposal technologies and services to the IC&I sector, including incineration and landfilling, and related consulting services;
  - \* the provision of water or effluent treatment equipment to remove toxic or conventional contaminants from municipal or industrial water supplies and municipal or industrial waste waters prior to their discharge into the environment, associated materials and supplies, and related consulting fees.

- \* the provision of end-of-process air pollution control equipment to control the release of solid particulates, gases, liquids or liquid fumes; associated materials and supplies, and related consulting services.

The *Environmental Protection* sub-sector currently accounts for the overwhelming bulk of economic activity in the environmental industry sector within Ontario and Canada. Within Ontario, the sub-sector was estimated to provide \$2.5 billion worth of goods and services annually.<sup>69</sup> By comparison, firms engaged in the provision of technologies and services related to energy and water efficiency generated, are estimated to have had about \$150 million in sales in 1993.<sup>70</sup> Those engaged in solid waste reduction, reuse, recycling and composting activities generated between \$50 and \$100 million,<sup>71</sup> and those active in monitoring and laboratory services earned between \$25 and \$50 million.<sup>72</sup> The supply of pollution prevention services and technologies are generally thought to make up less than one per cent of the environment industry in revenue terms, or approximately \$25 million in Ontario.<sup>73</sup>

## 2) Key Roles of the "Environmental Industry" Sector in Restructuring for Sustainability

The potential economic opportunities for the environmental industry sector, created by rising public concern and resulting regulatory requirements, regarding environmental quality were first formally acknowledged in Canada in the 1987 report of the Canadian Council of Resource and Environment Ministers's National Task Force on the Environment and Economy.<sup>74</sup> Subsequently, environmental industry sector strategies have been initiated in the provinces of Alberta, Saskatchewan, Manitoba, Ontario, Quebec and Nova Scotia,<sup>75</sup> and by the federal government.

Notwithstanding these efforts, Canadian governments and industry have been comparatively late in their recognition of the economic potential of this sector. The market for environmental protection services has been pursued by Western European nations and Japan as a key component of industrial policy since the late 1970s. As a result, European and Japanese firms have been able to capture large portions of the environmental technology market in the United States and Canada.<sup>76</sup> German technology is used, for example, in Ontario Hydro's new sulphur dioxide scrubbers for coal fired generation plants. Similarly, many Canadian Pulp and Paper mills have adopted effluent treatment processes developed in Scandinavia.<sup>77</sup>

In addition, the Canadian government strategies which have been developed have tended to focus on the development of the sector as it is presently structured, with its strong emphasis on *environmental protection* services and technologies. This approach suffers from a number of major weaknesses. At best, it ignores the potential for the sector to play a more strategic role in the process of restructuring the Canadian economy for environmental sustainability. At worst, it may actually divert limited research and

development, and investment resources away from the development and diffusion skills and technologies essential to this process. In developing and implementing their environmental industry strategies, Canadian governments should place their emphasis on three key strategic roles for the sector in the broader economy.

**i) The Development and Diffusion of Technologies and Skills Essential to Environmental Sustainability**

The emphasis on the development and diffusion of traditional end-of-process waste management, and air and water pollution control and treatment technologies, downplays the potential role that might be carried by the environmental industry sector in overcoming the economic and technological barriers to the adoption of pollution prevention and resource-conserving technologies, throughout the wider economy. As noted earlier, many small and medium sized firms lack the in-house research and development capacity and capital resources to develop and adopt changes to their production processes to prevent pollution, reduce, reuse or recycle non-hazardous wastes, and use water and energy more efficiently. However, such changes are essential to both the economic viability and environmental sustainability of these companies.

In the context of these limitations, the "green" industry sector could play a significant role in enabling these firms to adopt pollution prevention and resource conserving technologies. This is especially true if "clusters" of firms exist in given manufacturing sectors. A "cluster" is a grouping of firms engaged in similar activities, usually in close geographic proximity to one another, linked together through customer, supplier or other relationships. Both manufacturing and service industries, such as environmental service firms, may be part of a cluster. Members of a cluster often choose to share common research and development and other capital intensive facilities.<sup>78</sup>

Environmental industry firms associated with particular "clusters" could, in effect, enable the manufacturing firms in the cluster to pool their capital, and research and development resources in the development of new technologies. This would enable them to develop and adopt pollution prevention and resource conserving technologies collectively in a way in which they could not individually.<sup>79</sup> Energy service companies (ESCO)'s already play a similar role in Ontario in relation to the residential market, by providing such items as energy efficient lighting, windows, and appliances and low-flow toilets to households.<sup>80</sup>

An emphasis on the strategic role of the environmental industry sector in linking environmental and industrial policy, through the development and diffusion of pollution prevention and resource-conserving technologies and skills throughout the economy, has significant implications for the design of sectoral strategies for the environmental industry in Canada. In particular, it suggests that public resources should be directed away from end-of-process pollution control, and waste treatment and disposal technologies and services,

and towards supporting the development and adoption of pollution prevention, waste 3Rs, and energy and water conserving technologies.

Such an approach is likely to prompt opposition from the *environmental protection* sub-sector.<sup>81</sup> This sub-sector is seen to associate its economic interests with the sale of highly standardized and easily recognizable products, and not to process changes which require long, specific studies and may be difficult to market. In addition, while end-of-pipe technologies often require maintenance and supplies, process changes are integrated into the production process, and therefore may provide limited opportunities in this regard.<sup>82</sup> However, the long-term goal of ensuring environmentally sustainable development requires this shift in structural emphasis.

**ii) The "Green" Firms as Major Employers**

A strategic role for environmental sector firms in facilitating the development and diffusion of skills and technologies related to pollution prevention, waste 3Rs, and water and energy efficiency throughout the broader economy implies that the sector will be a substantial employer of individuals with high levels of technical and planning skills.<sup>83</sup> In addition, some sub-sectors of the environmental sector are emerging as significant new industrial employers in their own right, particularly in urban areas. This outcome is especially noteworthy in the area of solid waste reuse and recycling.<sup>84</sup>

Efforts to promote solid waste diversion in Canada and the United States through regulatory initiatives, financial incentives and public education, have led to the establishment of material processing facilities (MRF's) which sort, process, and bale reusable or recyclable materials collected through IC&I and residential diversion programs. The materials handled can include glass, metal, cardboard, fine paper, newsprint and certain types of plastics. It has been estimated that, in addition, to reducing extractive pressure on natural resources, reuse and recycling programs generate on average one job for every 465 tonnes of materials handled.<sup>85</sup> Employment in the sub-sector in Ontario is currently estimated at approximately 1,000 persons.<sup>86</sup>

In addition, the emergence of supplies of secondary materials from recycling programs has often increased the economic viability of industrial employers in urban areas which use these materials. This trend appears to be particularly strong with respect to steel,<sup>87</sup> glass,<sup>88</sup> corrugated cardboard,<sup>89</sup> boxboard,<sup>90</sup> and fine paper.<sup>91</sup> Furthermore, there are examples of new plants that have been established in urban areas to take advantage of the supply of secondary materials provided by urban recycling programs. Such an outcome has been particularly evident in the United States with respect to paper over the past few years.<sup>92</sup> Unfortunately, it also may have a significant negative effect on the viability of the traditional virgin paper-based pulp and paper industry in Northern Ontario.<sup>93</sup> However, a number of paper mills in the North have developed operations to permit the use of old newsprint and old magazines in newsprint

production since 1991.<sup>94</sup>

Building-upgrading through the retrofitting of lights, appliances, windows, insulation and plumbing for water and energy efficiency in the commercial, institutional and residential sector may also emerge as a significant source of employment.<sup>95</sup> Indeed, the potential cumulative employment effects of such projects has lead to their being described as a "decentralized mega-project."<sup>96</sup>

### iii) Environmental Remediation and Restoration

The third strategic environmental role for the environmental industry sector relates to the restoration of degraded environmental systems. This includes the rehabilitation of sites contaminated with toxic pollutants. Such processes are especially important in facilitating the redevelopment of existing urban lands, and thereby directing growth away from prime agricultural lands and other environmental assets.<sup>97</sup> The restoration of degraded ecosystems, such as fish habitats, also is critical to re-establishing the quality, integrity and productive capacity of the environment.<sup>98</sup>

The process of environmental restoration is frequently labour intensive. Consequently, this form of long-term investment in environmental sustainability can have significant employment impacts as well.

### 3) Conclusion

The environmental industry sector has the potential to play a major role in overcoming the economic and technical barriers to the development and diffusion of technologies and skills, necessary to prevent pollution and reduce resource consumption in industrial consumer societies such as Ontario's. In addition, some elements of the environmental sector, particularly those related to municipal solid waste reuse and recycling, the retro-fitting of buildings in the residential and commercial sectors, and environmental remediation, are emerging as a significant industrial employers in their own right.

However, action by governments is required to ensure the continued development of these aspects of the sector in Ontario and Canada. Among other things, this will necessitate a reallocation of public resources towards the development of the environmental industry sector, and away from the *environmental protection* sub-sector. Instead, greater emphasis must be placed on the development of the *pollution prevention, waste 3Rs and composting, energy and water efficiency, renewable and alternative energy* and *environmental remediation* sub-sectors.

## IV. KEY FACTORS IN THE DEVELOPMENT OF THE ENVIRONMENTAL INDUSTRY SECTOR

Four factors have been identified as being essential to the development of a competitive environmental industry sector capable of facilitating restructuring for sustainability:

- 1) the establishment and expansion of demand for the sector's products and services;
- 2) market access to ensure that firms which need technologies and skills in the areas of pollution prevention, waste 3Rs or water and energy efficiency are able to make contact with the firms able to supply these goods and services;
- 3) access to capital for the development and commercialization of the necessary technologies and skills by the environmental sector; and
- 4) the availability of capital to support adoption of these technologies and skills by firms in the sectors which the environmental sector serves.

### 1) The Establishment and Expansion of Demand

"Well-designed, aggressive environmental policies to protect and promote environmental quality are the principal factor in forging the market for environmental technologies."<sup>99</sup>

It is widely acknowledged that demand for environmental services and technologies is almost entirely driven by *stringent and certain regulatory requirements*, accompanied by strong expectations of enforcement.<sup>100</sup> Numerous studies indicate that jurisdictions with the most stringent environmental requirements tend to have the strongest environmental industry sectors.<sup>101</sup> Environmental regulation and the anticipation of stricter environmental policies stimulates the innovation and diffusion of pollution prevention and resource conserving technologies and skills.<sup>102</sup> The importance of regulatory requirements in environmental innovation is reflected in **TABLE 1**.

In addition, it has been observed that domestic standards which anticipate international trends can be particularly beneficial, as they can assist in giving domestic environmental firms a lead in developing products and services which will be valued in other markets.<sup>103</sup> Conversely, it also has been noted that jurisdictions which lag behind competing jurisdictions, in environmental requirements, often lose their domestic environmental services' market to foreign suppliers.<sup>104</sup>

TABLE 1

PRINCIPAL MOTIVATING FACTORS IN THE ESTABLISHMENT OF PRIVATE SECTOR ENVIRONMENTAL MANAGEMENT SYSTEMS

MOTIVATING FACTORS	PERCENTAGE (%)
Compliance to regulations	95
Director/Officer liability	69
Employees	62
Cost savings	49
Customer Requirements	49
Insurers' requirements	46
Shareholders' concerns	42
Public pressure	40
Marketing advantages	32
Underwriters' requirements	29
Lenders requirements	26
International standards	25
Supplier requirements	22
Environmental interest groups	16
Voluntary government programs	16
Trade considerations	10

Source: Canadian Environmental Management Survey. KPMG. 1994.

The character of environmental regulatory design is an important factor in driving innovation in environmental technologies and services. It is argued widely that in order to facilitate the development and adoption of process change-based pollution prevention responses to environmental requirements, environmental standards must permit the affected firms "technological flexibility" in the formulation of their response. The use of performance standards, which establish a required result, but leave the firm free to choose the technology (as opposed to design standards, which prescribe the use of specific technologies), is often cited as a means of providing such flexibility.<sup>105</sup> However, sufficient regulatory oversight must continue to be provided to ensure that new technologies do not create additional risks to human health or the environment.<sup>106</sup>

As noted earlier, standards based on the best available end-of-pipe technologies provide incentives for the diffusion of that technology, rather than for the development and adoption of new and more effective pollution prevention approaches.<sup>107</sup> This implies a need for a "technology-forcing" element to environmental requirements to prompt process innovation and upgrading.<sup>108</sup> Such standards compel firms to look beyond end-of-pipe solutions and to examine their complete production processes in terms of the generation of pollutants and the use of energy and materials.<sup>109</sup> An approach of this nature is also more consistent with the principle of basing standards on what is required to maintain and enhance environmental integrity, rather than on existing control technologies.

Examples of the application of technology, forcing performance standards in Canada, are rare. Ontario's 1986-1994 Countdown Acid Rain program which, through regulations promulgated in 1986, required the largest emitters of acid-causing gas emissions in the province, to reduce their emissions by up to 25% of their 1980 levels by 1994, is the strongest and most successful illustration of this approach in action, in Canada.<sup>110</sup> More recent regulations implemented by the federal<sup>111</sup> and provincial governments<sup>112</sup> to phase-out of use of chlorofluorocarbons (CFCs), in accordance with the requirements of the *Montreal Protocol on Ozone Depleting Substances*, take a similar approach.<sup>113</sup>

**2) Market Access**

A second requirement for the development of a strong environmental industry sector is to ensure that firms which require specific environmental technologies and services, are able to make contact with environmental sector firms able to meet these needs. This critical point of connection between the environmental industry, which is essentially a service sector, and the broader economy, is often neglected in environmental industry strategies.<sup>114</sup> This is a major oversight, both from the perspective of the development of the sector itself and its most important strategic

environmental and economic functions, the development and transfer of new technologies and skills needed to facilitate environmentally sustainable development to other sectors of the economy.

**3) Access to Capital for the Research, Development and Commercialization of Technologies**

Limited access to capital, constrains the development of the environmental industry sector in a number of important ways. On the supply side, inadequate capital resources may limit research and development activities necessary to develop new technologies and skills.<sup>115</sup> Secondly, many firms encounter difficulties in finding the financial resources necessary to move new technologies from the prototype to commercial stage. The commercialization barrier is regarded as particularly problematic, as government research and development support programs rarely address this need.<sup>116</sup>

**4) Access to Capital for the Adoption of Pollution Prevention and Resource-Conserving Technologies**

As noted earlier, many small and medium-sized firms typically lack the financial resources necessary to adopt new technologies developed by environmental sector firms. This problem is compounded by the consideration that what capital they may have is often tied up in the purchase operation of end-of-pipe pollution control systems.<sup>117</sup> This barrier must be overcome if new pollution prevention and resource-conserving technologies are to be diffused throughout the wider economy.

**V. DEVELOPING THE ENVIRONMENTAL INDUSTRY SECTOR: RECENT TRENDS AND DEVELOPMENTS IN THE UNITED STATES**

Government activities have been widely identified as critical to the development of the environmental industry sector.<sup>118</sup> Actions in relation to the establishment and maintenance of demand, market access, and access to capital are particularly important in this regard. Canadian governments, including Ontario's, have begun to take steps in some of these areas over the past three years.<sup>119</sup> The economic and environmental potential of the environmental industry sector has also been the subject of growing government attention within the United States, at both the federal and state levels.

The activities of the U.S. federal government and the initiatives of the states of California, Massachusetts, Michigan, Minnesota, New York, New Jersey, Oregon, Pennsylvania, and Washington were reviewed in this context. Each of these states is considered to be among the leaders in specific areas of environmental policy. Most are also broadly comparable in economic structure to Ontario. Comparisons of Ontario's initiatives with the activities of these states will provide a means of measuring the potential effectiveness of Ontario's environmental industry strategy in relation to that of other jurisdictions, and may indicate potential paths forward, for the Ontario initiative.

**1) Comprehensive Environmental Industry Strategies**

**i) Federal**

During the 1960's and 1970's the United States developed a significant technological lead in a number of key environmental technology fields, especially in relation to energy. These included solar, wind, and geothermal energy sources, fuel cells, high efficiency appliances and equipment.<sup>120</sup> The U.S also established a lead in the area of air emission controls, particularly for automobiles, as a result of the requirements of the 1970 *Clean Air Act*.<sup>121</sup> The enactment of the *Clean Water Act* promoted corresponding innovations in the water pollution-control field.

However, with the arrival of the Reagan Administration, federal research and development support for alternative energy sources and energy efficiency improvements was eliminated,<sup>122</sup> and tax credits to support the adoption of alternative energy sources were removed.<sup>123</sup> In addition, the introduction of new environmental legislative initiatives was halted, and the administration pursued an explicit agenda of environmental deregulation.<sup>124</sup> In the result, the United States is generally held to have lost its technological lead in the areas of alternative energy and energy efficient technologies, automobile emission controls, and stationary source air pollution control equipment.<sup>125</sup>

The election of a Democratic President on an explicitly pro-environmental platform



in November 1992, appeared to be the opening of a new era in U.S. environmental policy and the development of the U.S. environmental industry sector. The development of the sector has been a major focus of the Clinton administration. Particular attention is being given to export development, and the conversion of defense industries to environmental activities. However, the future direction of all U.S. federal environmental programs is an open question in light of the results of the November 1994 Congressional elections, which resulted in Republican Majorities being instated in both the House of Representatives and the Senate.

An **Environmental Technology Initiative (ETI)** was announced by President Clinton in February 1993. It is a government-wide policy intended to coordinate federal government efforts in the development of new technologies in a variety of sectors that are concerned with environmental protection, including:

- \* semi-conductors;
- \* transportation;
- \* environmental management;
- \* information technology;
- \* clean industrial technologies;
- \* monitoring and instrumentation;
- \* advanced manufacturing and environmental technologies; and
- \* the conversion of defence technologies to civilian applications.

As a part of ETI, the EPA has designed a draft Technology Innovative Strategy which describes objectives and operating principles for the Initiative.<sup>126</sup> \$36 million has been allocated to the program for the 1994-95 fiscal year, and four theme areas identified. These are:

- \* **Environmental and Restoration Technologies**  
This includes technologies related to environmental monitoring, plastics recycling, pollution prevention in metal plating and finishing, clean car technology demonstrations, and environmental remediation.
- \* **Clean Technologies for Small Business**  
This includes the development of pollution prevention technologies for the dry cleaning, printing, metal plating and coating, printed wiring boards, and furniture coating sectors, and the provision of technical assistance to small business through the EPA's Control Technology Centre.
- \* **Improving Competitiveness of U.S. Environmental Technologies**  
This area is primarily concerned with the development of export markets for U.S. environmental technologies. It includes the packaging and dissemination of information on U.S. technologies, the assessment of international markets and needs, technology evaluation and testing, and in-country demonstrations of U.S.

environmental technologies, with particular emphasis on Asia, Central and Eastern Europe, and Mexico.

\* **Gaps, Barriers and Incentives**

This includes the identification of barriers to environmental technology diffusion, and is intended to ensure a national climate for environmental technology innovation, diffusion and commercialization.

A number of other federal programs provide support for the development of specific types of environmental technologies outside of the ETI. With respect to defense conversion **The Strategic Environmental Research and Development Program (SERDP)** was created through the *National Defence Authorization Act* to provide \$170 million to support research and development in environmental restoration, waste management and pollution prevention technologies which can be applied to Department of Defense and Department of Energy environmental problems.

The **National Industrial Competitiveness through Efficiency, Energy and Economics (NICE<sup>3</sup>) Program** is a cost sharing grant program sponsored jointly by the Department of Energy and EPA with state and industry partners for the development of technologies to save energy, prevent pollution and enhance industrial competitiveness. Grant awards average about \$250,000. Industry/state partnerships will cost-share at least 50% of the total cost of the project. A total of \$2.5M was appropriated under the program for 1993/94. Participating states include California, Colorado, Georgia, Indiana, Michigan, New York, Ohio, Oregon, Texas, and Washington.

The U.S. government has undertaken a number of initiatives intended to promote export markets for U.S. environmental technologies. The Department of Commerce leads the **National Environmental Technologies Trade Initiative (NETTI)** to promote US environmental technologies worldwide. There is also a Trade Promotion Coordinating Committee Working Group on Energy, Environment and Infrastructure. This is an interagency initiative to promote and coordinate US environmental exports to specific markets, particularly in Asia, Eastern Europe and Mexico.<sup>127</sup>

An *Environmental Technology Act* was passed by the United States Senate in June 1994.<sup>128</sup> A companion statute was introduced in the House of Representatives in the fall of 1994.<sup>129</sup> However, its fate is uncertain in light of the November 1994 Congressional elections. The Act would provide for the coordination of federal government efforts to promote the U.S. environmental industry sector.

## ii) State Environmental Industry Strategies

A small number of states have established comprehensive Green Industry Strategies over the past two years. California and Massachusetts have been the most active in this regard.

### California

A strategic plan for the California environmental industry was published by the California Environmental Technology Partnership (CETP) in January 1994.<sup>130</sup> CETP was established by the California Environmental Protection Agency (Cal/EPA), and the California Trade and Commerce Agency. It is a cooperative effort involving the state government, industry, academia, financial institutions, and public interest groups. The Strategic Plan includes the following elements:

- \* increasing the consistency of the process for the testing and demonstration of new environmental technologies to ensure their acceptance in wider markets;
- \* enhancing the performance, status and access to markets of environmental firms through the establishment of strategic partnerships;
- \* implementing a comprehensive, integrated communications strategy for regularly providing environmental firms with information that is integral to their business success;
- \* providing better focus for Cal/EPA and TCA programs for providing assistance, guidance and direction to developers of environmental technologies;
- \* supporting the research and development of new environmental technologies; and
- \* establishing the infrastructure necessary to train the professional workforce needed by the environmental industry.<sup>131</sup>

The reform of the *permitting* system to facilitate the development and implementation of new technologies, defense conversion initiatives (the "California Gold Strike" program), the use of closed defense facilities for the testing of new remediation technologies, the creation of a clearinghouse for California environmental goods and services, and the development of an overall marketing plan for the industry, are also major elements of the CETP project.<sup>132</sup>

### Massachusetts

The Massachusetts Strategic Envirotechnology Partnership (STEP) is a product of a July 1994 agreement between the Executive Office of Environmental Affairs, the Executive Office Economic Affairs and the University of Massachusetts System.<sup>133</sup> It defines State government interest in the development of innovative envirotechnologies. The objectives of this program are to provide easily accessible information for all interested developers, to effectively address the needs of the envirotech industry, to provide all required services, to facilitate access to public and private funding and business development services, and to assess the technical and environmental benefits of innovative environmental technology.

The Massachusetts Office of Business Development serves as a coordinator for all STEP ventures. It provides business plan review and assistance, and business evaluation for all STEP ventures that qualify for support. The Massachusetts Envirotechnology Commission, a subcommittee of the Governor's Council on Economic Growth and Technology serves as an oversight body for the STEP.

An Environmental Technology Review Panel, comprised of knowledgeable representatives in the fields of business, technology, management and policy is to be established. It is to be charged with reviewing and evaluating all technologies submitted to STEP, from technical and economic perspectives. Technologies recommended by the STEP panel may receive support through a proposed Public Venture Capital Fund, and in the processing of permits. An Energy Technology Review Panel, operated by the University of Massachusetts-Amherst's Energy Analysis and Diagnostic Centre, is to be established and charged with reviewing and evaluating energy-efficient technologies submitted to STEP. Guidance documents for the developers of such technologies are provided by the staff of the Department of Environmental Protection.

## ii) Sub-Sector Specific Environmental Industry Programs

While only a few states have introduced integrated environmental industry strategies, many have established programs targeted at the development of specific sub-sectors of the environmental industry sector. The municipal solid waste 3Rs and composting sector has been the subject of the most attention in this regard. This appears to be a function of the significant employment potential of the sub-sector. Among the nine states studied for this project, all but Massachusetts<sup>134</sup> had programs intended to assist in the development of this sector.

State programs typically include grants and loans for research and development activities, market directories, and "buy-recycled" public education campaigns, and *permitting* assistance. In addition, some states have established independent agencies specifically charged with the promotion of their recycling industries. Examples of such

bodies include the Clean Washington Centre, the Minnesota Office of Environmental Assistance, and New York Office of Recycling Market Development.

The recycling sector is also a major focus of federal environmental industry programs through the Recover America Program. Elements of this program include the Recycling Means Business initiative of the EPA to develop markets recycled goods. In addition, Recycling/Reuse Business Assistance Centers (RBAC) are to be established to offer direct cooperation of government and industry in order to encourage growth of recycling businesses. RBAC's will offer technical, business, financial and marketing expertise to private sector businesses. Successful models of business/government cooperation in progressive states will be used as examples to encourage replication. The EPA will also fund Recycling Economic Development Advocates, professionals employed by the state of tribal economic development agencies. Their function will be to encourage businesses to use recovered or recycled materials.<sup>135</sup>

## 2) Establishing and Maintaining Demand for Environmental Technologies and Skills

As noted earlier, the establishment and maintenance of demand for environmental services and technologies is essential to the development of the environmental industry sector. Governments can play a role in this process in two ways:

- \* the establishment of certain and stringent requirements for environmental protection; and
- \* the direct creation of demand for environmental technologies and services through purchasing and other activities.

### i) Environmental Protection Requirements: Current Trends in the United States

#### *Federal Statutes*

Demand for environmental technologies and services arises as a result of both federal and state initiatives, particularly regulatory requirements with "technology-forcing" components. Presently the most important measures in this regard at the federal level are the 1990 amendments to the *Clean Air Act*. The amendments include provisions requiring the federal government to reduce emissions from cars, trucks and buses, consumer products such as hair spray and window washing compounds, and from ships and barges during the loading and unloading of petroleum products in order to promote the attainment and maintenance of national ambient air quality standards. Areas in the U.S. which exceed carbon monoxide standards will be required to implement programs introducing oxygenated fuels and/or enhanced emission inspection programs.<sup>136</sup>

New standards for tailpipe emissions of hydrocarbons, carbon monoxide, and nitrogen oxides from trucks and cars are to be phased in beginning in 1994. Automobile manufactures also have been required to reduce vehicle emissions resulting from the evaporation of gasoline during refuelling. Fuel quality also is to be controlled to reduce emissions.<sup>137</sup> In addition, the amendments require the EPA to establish "Maximum Achievable Control Technology" based on emission standards for 189 toxic air pollutants.<sup>138</sup> A 50% reduction in sulphur dioxide emissions from major industrial sources by the year 2000 is also required. The phase out of CFC's, halons, carbon tetrachloride, methyl chloroform and HCFC's is mandated on a schedule similar to that specified in the *Montreal Protocol*.<sup>139</sup>

However, the impact of the *Clean Air Act* amendments on the demand for environmental technologies appears to be less than anticipated. This is especially true with respect to sulfur dioxide emissions, as the amendment's requirements can largely be met through the use of low-sulphur coal.<sup>140</sup> The administration has also recently retreated on some aspects of the auto emission standards required by the amendments.<sup>141</sup>

In addition to the *Clean Air Act* amendments, a *Pollution Prevention Act* was enacted in 1990. The Act was intended to focus the Environmental Protection Agency's multimedia waste management efforts on preventing or reducing pollution at source. The Act directed the EPA to facilitate the adoption of source reduction techniques by business and federal government agencies. However, the Act contains no requirements that businesses and government agencies develop or implement pollution prevention plans.<sup>142</sup>

A number of older U.S. environmental statutes continue to provide incentives for the development and adoption of pollution prevention technologies. Among the most important of these is Toxic Release Inventory (TRI) reporting requirement established through the 1986 *Superfund Amendment and Reauthorization Act*.<sup>143</sup> The TRI requires manufacturers to disclose information about the production, release and disposal of specific hazardous substances.<sup>144</sup> This has prompted companies to reduce releases, although usually through end-of-process control technologies.<sup>145</sup>

The EPA Office of Pollution Prevention has initiated a number of voluntary programs to promote pollution prevention. The most significant of these is the **33/50 Toxics Reduction Program**, which is linked to the TRI. This program aims for a 33% reduction in use and generation of 17 targeted chemicals by 1992 and a 50% reduction by 1995, using 1988 as a base year.<sup>146</sup> However, it is not clear how much of the committed reductions will go beyond what will be required by law.<sup>147</sup>

Several major federal statutes, including the *Clean Water Act*, the *Federal Insecticide, Rodenticide and Fungicide Act*, the *Safe Drinking Water Act*, the *Endangered*

*Species Act*, the *Resource Conservation and Recovery Act*, and the *Comprehensive Environmental Response, Compensation and Liability Act* (the 'Superfund' Law), are currently scheduled for reauthorization. Major revisions to the 1876 *Mining Act* also were proposed. Like the *Clean Air Act* amendments, the amendment and reauthorization of these statutes could significantly affect environmental standards.

However, in light of the outcome of the November 1994 Congressional elections, the direction of the reauthorization and amendment of these statutes is unclear.<sup>148</sup> In its "Contract with America," Republican leadership in the Congress has expressed its desire to weaken or even repeal federal environmental requirements which affect activities on private lands, impose strict risk/benefit tests in statutes dealing with toxic substances, and to eliminate federal mandates which require states to undertake and fund specific environmental activities and services.<sup>149</sup>

#### *State Initiatives*

Although the pace of federal environmental initiatives in the United States has slowed significantly, especially during the Reagan presidency, state governments continued to be active in the environmental field, particularly with respect to municipal waste management and pollution prevention. However, as is the case at the federal level, Republican victories in the 1994 gubernatorial and state legislative elections, may slow the pace of forward movement on environmental issues, and the reauthorization of some innovative state programs is now in serious doubt.<sup>150</sup>

#### *Air Pollution Prevention*

The state of California began to regulate air emissions from cars in the late 1960's. As a result, when the federal *Clean Air Act* was enacted in 1970, California was permitted to continue to set standards independently of the national program established through that Act. Subsequently, the state has lead the U.S. in the development of air pollution control regulations. Standards for automobile and truck emissions adopted in 1990 by the California Air Resources Board require the development of ultra-low emission vehicles by the mid 1990's, and by 1998, 2% of vehicles sold in California must have zero emissions. By 2003, 10% of new car sales must be zero emission vehicles (ZEV's).<sup>151</sup>

In addition, in conjunction with the Air Resources Board, over the past decade the South Coast Air Quality Management District has established stringent standards to control certain types of air pollution. This has included enactment bans on the use of aerosol containers and barbecue lighter fluids, mandated car pools, and the placement of limits on air pollution from dry cleaners, coffee roasters, print shops and even restaurants. The California Energy Commission also has imposed stringent emission

control requirements on electrical utilities.<sup>152</sup>

However, the pace of progress on air pollution control requirements in California has slowed significantly over the past two years. Several members of the South Coast Air Quality Management Board, associated with its strong air pollution rules, were removed in 1992 through recall elections and by the state legislature. In addition, Republican governor Pete Wilson has taken steps to strengthen executive control over the state's independent environmental agencies, particularly the Air Resources Board. This has included the creation of an overarching California Environmental Protection Agency (Cal/EPA), and the removal of key progressive Air Resources Board members.<sup>153</sup>

#### *Toxics Substances Use Reduction/Pollution Prevention Legislation*

In addition to the federal standards established through the *Clean Air Act*, and *Clean Water Act*, a large number of states, including California, Massachusetts, Minnesota, New Jersey, New York, Oregon and Washington, have enacted statutes intended to promote the reduction of the industrial use of toxic chemicals, and pollution prevention over the past five years. Most of these statutes require that the affected plants develop facility pollution prevention plans. Some states, such as New Jersey, require the achievement of specific toxics-use reduction goals, while others do not. The publication of reports on the progress of pollution prevention/toxics-use reduction measures, is usually mandated.<sup>154</sup>

These statutes also frequently provide for the establishment of technical assistance programs. The Minnesota Technical Assistance Program (MnTAP) is generally regarded as the most effective of these programs. Fees are often imposed on the use or manufacturing of hazardous substances, to fund these activities.<sup>155</sup> However, a number of these programs have reached or are approaching the end of their authorization periods.

#### *Sold Waste Management and Recycling*

In the waste management field, thirteen states, including California and Oregon have passed recycled-content legislation for newsprint, and a further twelve, including Massachusetts, Michigan, New York and Pennsylvania, have entered into voluntary recycled-content agreements (under the threat of legislation) with newspaper publishers. California also has established recycled-content requirements for plastic garbage bags, glass containers, and fiberglass. Oregon has set additional content requirements for telephone directories, glass and plastic containers.<sup>156</sup>

Recycled-content legislation is widely accepted as having had a major impact on

the development of markets for secondary newsprint in the North America. In 1988 there were only nine newsprint recycling plants on the continent. There are now twenty-nine.<sup>157</sup> The threat of further recycled-content legislation also appears to be driving the development of markets for plastics' recycling technologies, and in uses for secondary plastics.<sup>158</sup> Indeed, recycled content requirements and legislation have been described as "the most successful measures to date in creating new markets for recyclable materials."<sup>159</sup>

A large number of states including California, Massachusetts, and Michigan, have passed legislation which requires municipalities to prepare recycling plans. Minnesota, Oregon, and Washington have mandated municipal curbside or drop-off recycling services in a manner similar to Ontario's municipal 3Rs regulations. New Jersey and Pennsylvania require the source separation of recyclable materials. These provisions are comparable to Ontario's IC&I sector 3Rs regulations.<sup>160</sup>

A number of states, including Michigan, Massachusetts, Pennsylvania, and Oregon continue to actively promote incineration and energy from waste projects as waste management options.

#### *Permitting Assistance for New Technologies*

As noted earlier, the principle of permitting "technological flexibility" in industry's response to environmental protection requirements, has been widely identified as being essential to the development and adoption of new pollution prevention, and energy, water and materials-efficient technologies.<sup>161</sup> The concept of using "performance" standards to establish environmental objectives to be achieved within a set time-frame, as opposed to specifying the use of particular technologies towards this purpose, is also widely accepted.<sup>162</sup> However, considerable debate exists over how to operationalize this principle while ensuring environmental protection.

The key question which arises over the use of performance standards is "what happens if a new technology fails to meet the required environmental performance requirements?" Some authors suggest the use of "innovation waivers" which extend the deadlines by which industry must install equipment to meet emission standards, in order to permit time for innovation and testing. Such waivers have been employed under the U.S. federal *Clean Air, Clean Water and Resource Conservation and Recovery Acts*.<sup>163</sup> "Soft-fail" strategies, where a firm has made imperfect but good faith efforts to comply with regulatory requirements have also been suggested. Under these strategies, failure to comply with regulatory requirements in such circumstances would not result in a prosecution. This approach decreases the innovator's risk, inherent in the use of new technologies (as opposed to proven systems), of incurring severe enforcement actions in the event of failure.<sup>164</sup>

The weakness of these approaches is that they permit levels of discharge into the environment, which have been deemed unacceptable, to continue in the event of technological failure.<sup>165</sup> The possibility of establishing "certification" systems to address the effectiveness of new environmental technologies, has been proposed for this reason.<sup>166</sup> Certification would provide assurances regarding effectiveness, to both the environmental regulators responsible for authorizing their use, and to the firms wishing to adopt the technologies.

Environmental technology certification programs are currently under way at the federal level and in the states of California and Massachusetts. The federal program, the **Environmental Technology Improvement Commercialization and Enhancement Program (EnTICE)** was initiated in August 1994. It is intended to provide verification of the performance of new environmental technologies under carefully specified conditions. These conditions are intended to limit potential liabilities on the part of the EPA arising from the verification process.<sup>167</sup>

In September 1993, the California Department of Toxic Substances Control was authorized to establish a certification program for hazardous waste environmental technologies.<sup>168</sup> The program includes standardized testing requirements, independent third party certification test results, the publication of test results, and formal acknowledgements of technology demonstration for *permitting* purposes. The program was to be operational by the fall of 1994.<sup>169</sup> In addition, a pre-certification program for air pollution control equipment was authorized in September 1992,<sup>170</sup> and is now under development.<sup>171</sup>

In Massachusetts, a technology assessment process is to be established as part of the Strategic Envirotechnology Partnership (STEP). Assessments are to be conducted by a Technology Assessment Board, comprised of individuals from the state government, universities, and the private sector. The permit review process is to be expedited to facilitate the development and use of innovative environmental technologies identified as warranting state support by the Board. STEP support is also available to monitor technology performance and to provide objective evaluations of costs and benefits. While this information is to be disseminated to potential purchasers or investors, the Massachusetts government asserts that it is not a formal "state certification" program.<sup>172</sup> This qualification appears to reflect concerns over liability on the part of state officials.

#### *Permitting Assistance for Environmental Industry Facilities*

Numerous other states offer assistance to deal with *permitting* processes, particularly with respect to the establishment of recycling and composting facilities.<sup>173</sup> Some states, including California have worked with municipalities to create "recycling development zones." These are specially zoned areas within municipalities, where recycling manufacturers and other recycling businesses can locate.<sup>174</sup>

## ii) Direct Demand Creation

In addition to regulatory and *permitting* initiatives, U.S. federal and state governments have taken a number of direct steps to strengthen demand for environmental industry services and products, particularly with respect to the 3Rs and environmental remediation sub-sectors.

### *Waste Recycling*

The most important initiative by the U.S. federal government with respect to the development of demand for recycled content products is President Clinton's *Executive Order on Federal Acquisition, Recycling and Waste Prevention*. The order, released on October 20, 1993, directs every federal agency to purchase printing and writing paper containing 20% post-consumer material by the end of 1994, and 30% by the end of 1998. The order also requires federal agencies to use re-refined oil and to replace new tires with retreads, and to revise their procurement specifications and standards so that recovered materials can be used to make federally purchased products.<sup>175</sup>

At the state level, every state in the U.S. has legislation or a policy encouraging the procurement of products with secondary materials content, by state agencies and contractors. The majority of these laws are focused on paper products. However some states are extending the laws to cover products such as compost and motor oil. Thirty eight states including California, Massachusetts, Michigan, Minnesota, New York, New Jersey, Oregon, Pennsylvania, and Washington apply a price preference to their purchases of paper with secondary content. This is usually set at 5-10% above the price of new paper. Thirty-one states, including California, Michigan, New Jersey, Oregon and Washington "set aside" specific percentages of paper purchases for paper with secondary content. In addition to California, Oregon and Washington, nineteen other states have both set asides and price preferences for secondary content paper.<sup>176</sup>

### *Environmental Remediation*

#### *The Federal Superfund*

In general, programs in the United States related to the remediation of sites contaminated by hazardous substances are far more advanced than their Canadian counterparts<sup>177</sup> and have provided extensive opportunities for the development of skills and technologies in the field. The most important of these is the federal "superfund" program established through the *Comprehensive Environmental Response, Liability and Compensation Act* of 1980 (CERCLA) and the *Superfund Amendment and Reauthorization Act* of 1986 (SARA). These statutes provide for the identification,

evaluation, remediation and assignment of liability for hazardous waste sites in the United States. 1,200 sites are currently on the National Priorities List.

The "superfund" was intended to permit and finance the timely remediation of contaminated sites, rather than having to wait for the resolution of liability issues. Although the implementation of the "superfund" program has been highly controversial and its effectiveness subjected to serious question,<sup>178</sup> it has resulted in some significant expenditures in the area of environmental remediation technologies and services. Limited support for the development and testing of remediation technologies, is also provided through a **Superfund Innovative Technology Evaluation (SITE)** program. CERCLA was scheduled for reauthorization in 1994, but this was not achieved before the November 1994 congressional election. The future path of the reauthorization process is not clear.<sup>179</sup>

#### *State Superfunds*

In addition to the federal superfund, 49 states have enacted superfund legislation of their own to address aspects of contaminated site remediation efforts, including the remediation of sites not on the CERCLA National Priorities List, and not addressed through the federal Superfund program. Many of the state funds are considered to have been more successful than the federal program in bringing about the timely clean-up of contaminated sites.<sup>180</sup> The states with the largest state funds are those with the largest number of National Priorities List sites, notably, New Jersey (109 sites), Pennsylvania, (95), California (88), New York (83), and Michigan (78). New Jersey and Pennsylvania are noted for the strength of their environmental remediation industries. State superfund programs are funded through a variety of mechanisms. The most common means are the imposition of fees on the use or discharge of hazardous substances (23 states) and appropriations from general revenues (22 states).<sup>181</sup> However, as is the case with the federal superfund, many of the state funds are nearing the end of their authorization periods, and their future is unclear.<sup>182</sup>

## 3) Market Access

### *Export Development*

The U.S. federal government and many state governments have undertaken projects intended to improve contacts between U.S. environmental technologies and services' firms, and potential customers. As noted earlier, the federal government's efforts have placed particular emphasis on the development of export markets for U.S. firms, especially in Eastern Europe, Asia, and Mexico.

The states of California and Oregon<sup>183</sup> also have significant programs intended

to promote their environmental industries among Pacific Rim countries. In addition, California has a California-Mexico Border-Based Program which is intended to promote the export of California environmental technologies, products and services to Mexico.

#### *Directories*

A number of states have produced directories of environmental technologies and services. The most comprehensive of these is the California Environmental Technologies and Services Directory, produced by the California Environmental Protection Agency and the California Trade and Commerce Agency. The Directory includes lists of firms active in the sector, identifies their areas of specialization (air quality, water quality, non-hazardous solid waste, hazardous waste, site remediation, analytical services, agriculture related services and other) and is also cross-referenced to provide listings of firms providing specific services in these areas.

A number of other states have developed similar directories, although these tend to be focused on specific sub-sectors of the environmental industry sector, particularly the solid waste 3Rs and composting sub-sector. Michigan Departments of Commerce and Natural Resources for example, have published Michigan Recycled Materials Market Directory which provides information on county collection and recycling programs, and processors/brokers of paper, metal, plastic drums and barrels, pallets, wood and construction debris, glass, oils and solvents, and other miscellaneous recyclable products. The Washington State Clean Washington Center (CWC) offers a Recycled Products Directory and Recycled Content Building and Construction Products Directory. Similar directories have been produced in New Jersey.<sup>184</sup>

#### *Databases for Marketing Secondary Materials*

The New York Office of Recycling Development provides information to recycling businesses and clients through a computerized recycling markets database. The CWC operates a computerized Glass Markets Information System.

#### *Industrial Extension Programs*

Most state pollution prevention and 3Rs statutes include provisions for environmental auditing and technical assistance, to the affected firms. It has been noted that this is a potentially important means by which markets for pollution prevention and 3Rs technologies can be identified. There is, however, no evidence that U.S. states have linked these programs directly to the development of environmental industries, although this may be under consideration.<sup>185</sup>

#### 4) **Financial Assistance**

The U.S. federal and state governments provide a very wide range of financial assistance programs for the development and commercialization of environmental technologies and services.

##### i) **Support for Research Development and Commercialization of Environmental Services and Technologies**

#### *California*

In addition to the CETP initiative, financial support for the development and commercialization of 3Rs technologies and services is provided through the California Integrated Waste Management Board. The Board administers a **Used Tire Grant Program** which is intended to promote research, business opportunities and alternative methods of disposal for used tires. The program is financed through a \$1.25 charge on each new or used tire sold in the state. Approximately \$1 million in grants had been awarded by January 1994.<sup>186</sup>

The Board also administers a number of **Tax Credit Programs** which are applied to the use of recycled content feedstock or to the purchase of equipment to process recycled content materials. Banks and corporations may take a 40% tax credit for the cost of equipment used to manufacture recycled products with minimum 50% cent secondary content and 10% post-consumer content. Environmental technology firms are eligible for research and development tax credits. These firms are also entitled to an additional 6% tax credit on the purchase of environmental equipment.

#### *Massachusetts*

The creation of a **Public Venture Capital Fund**, to be managed by the Massachusetts Technology Development Corporation has been proposed. This \$5 million fund, if established, would be available to assist in the development of environmental technologies recommended for support by the STEP Panels.<sup>187</sup>

#### *Michigan*

The **Solid Waste Alternatives Program (SWAP)** was managed by the Department of Natural Resources. The program provided grants, loans and project funding to reduce the total amount of solid waste, as well as dependence on the state's landfills. Funding was targeted at the capital expense of waste diversion projects. Matching funds had to

be obtained and spent on items eligible for SWAP grants and loans. Eligible activities included the following:

- \* recycling-collection/processing (max. grant \$500,000 and max. loan \$1,000,000) composting (max. grant \$250,000 and max. loan \$500,000);
- \* resource recovery education (max. grant \$50,000 and max. loan \$100,000);
- \* market development (max. grant \$5,000,000 and max. loan \$5,000,000);
- \* market development research and demonstration (max. grant \$250,000 and max. loan \$500,000);
- \* waste reduction research and demonstration (max. grant \$250,000 and max. loan \$500,000); and
- \* household hazardous waste centers (max. grant 100,000 max. loan \$150,000);

Grants and loans of up to \$5 million or 25% of project costs also were made available for waste-to-energy projects.

Under the solid waste project category, funding was available to provide technical assistance on solid waste issues. Funds could be used to cover salaries, materials, supplies and operational costs. The maximum project amount was \$250,000. Priority was given to projects with matching funds from other sources.

**SWAP** loans were financed through \$159 million in Protecting Michigan's Future Bond funds, made available by the State Legislature in 1988. However these funds were exhausted as of December 1994, and there are currently no plans to establish a similar program in the near future.<sup>188</sup>

#### Minnesota

The Minnesota Office of Environmental Assistance (formerly the Office of Waste Management) provides financial assistance for research and development in the field of pollution prevention, and in the development of markets for recycled content products. With respect to pollution prevention, **Source Reduction Feasibility Study Grants** are available to provide resources to test new products and promote usable technologies. Commercial/industrial, wholesale, retail and manufacturing businesses, business and professional associations and non-governmental organizations may apply for such grants. Eligible cost is equal to 50% of the total or \$40,000, whichever is less. Public institutions are eligible for grants of up to 75% of the total project cost. Again the maximum grant is \$40,000.

The Office of Environmental Assistance also offers two matching grant programs. The **Community Partnership Grants** program focuses on community-based pollution prevention projects that prevent hazardous chemical pollution, and are carried out by partnerships of local government, business and citizen organizations. Maximum grant

amounts are \$25,000. The **Assistance Grants** program is focused on the needs and experiences of business associations. Matching grants of up to \$25,000 can be awarded to vendors and suppliers of pollution prevention training programs to Minnesota businesses.

These programs are financed through fees imposed on the release of toxic substances. Facilities must pay an annual fee of \$150 for each designated pollutant they release. Facilities which release more than 12.5 tones of a designated pollutant must pay an additional \$20 per ton released. These charges raise approximately \$1 million per year.

The Office of Waste Management's **Recycling Market Development Program** was established in 1987. The Office expanded its technical and financial assistance after the passage of the *Minnesota Waste Reduction and Recycling Act* in 1989. Recycling market development efforts are coordinated by the Market Development Coordinating Council (MDCC). Three financial assistance programs for market development have been established:

- \* the **County Grant and Loan Program** provides a maximum grant of \$50,000 for up to 75% of cost of non-capital project or up to 25% of cost of a capital project, or a maximum loan of \$150,000 for up to 50% of cost of a capital project. Eligible projects are those which improve the quality of recyclable materials supply, expand manufacturing capacity for recycled products or create demand for recycled products.
- \* the **Capital Loan Program** provides loans of up to \$500,000 or 50% of capital costs, and are available to private businesses and non-profit organizations. Eligible projects must create or expand manufacturing capacity using recyclable materials or create markets for recycling programs.
- \* the **Directed Research and Feasibility Study Grant Program** provides grants of up to \$100,000 for research institutions and private organizations for the cost of labour and supplies for project implementation. Eligible projects include feasibility studies, performance data development and directed research on products using recycled feedstock. A research institution can cover up to 100% of eligible costs from a grant, and private organizations can cover up to 50%.

More than \$4 million in loans and grants have been provided through these programs.<sup>189</sup> Finally, recycling equipment is exempted from the state sales tax. These programs are financed through a number of solid waste taxes, fees and charges, including tipping and landfilling fees.<sup>190</sup>



## New Jersey

The New Jersey Corporation for Advanced Technology (NJCAT) was created in 1993 to promote the development and commercialization of new environmental and energy technologies. It is to establish an international centre for the development environmental and energy technologies in conjunction with universities and the private sector. NJCAT will focus its efforts in the following areas:

- \* environmental restoration of air, land and water;
- \* ocean pollution prevention;
- \* emergency response clean-up;
- \* environmentally sound manufacturing processes;
- \* efficient generation, distribution and utilization of energy; and
- \* materials reuse and recycling;

The NJCAT program has been incorporated into state government economic development policy.

In addition to the work of NJCAT, two programs to support the development of recycling businesses have been established under the New Jersey *Mandatory Recycling Act* of 1987. **Recycling Loans** are made available through the New Jersey Economic Development Authority, subject to approval by the Department of Environmental Protection and Energy. Businesses which collect and process post-consumer waste into new or marketable products are eligible for the program. Loans are available in the range of \$50,000 to \$500,000. Up to \$1 million can be made available for projects involving difficult to recycle items such as tires, although no loans of this nature have been made. Financing is provided for up to 10 years at 3% below the prime rate. The loan program is financed through a \$1.50/ton charge imposed on landfill sites. Under the second initiative, businesses can deduct up to 50% of their state corporate business taxes for the purchase of recycling equipment.<sup>191</sup>

## New York

The New York Office of Recycling Market Development provides financial and technical assistance in developing industrial capacity to use recycled materials, the identification and development of markets for recycled materials and goods, and assists businesses in their waste reduction efforts. Financial assistance is offered through the Office to small and medium-sized businesses and non-profit organizations, with fewer than 500 employees and \$10 million in annual gross sales including:

- \* **Feasibility Study Grants** of up to \$50,000 or 80% of total costs are available for the evaluation of recycling technologies, processes, systems and products manufactured from recycled materials; and

- \* **Recycling technology financing loans** of up to \$500,000 or 50% of the total cost are available for the construction of recycling facilities and/or the acquisition of machinery and equipment.

In addition, targeted grants to address specific market development or waste reduction needs, are also available through the Office. This can include support for research and development of recycling technologies, and the provision of seed grants for the start-up and first year operations of secondary materials marketing cooperatives.

The state's grants and loans are funded through a combination of state appropriations and federal monies provided through the *Petroleum Overcharge Restitution Act* of 1987.

## Oregon

The Oregon Department of Environmental Quality is authorized to issue investment tax credits for the purchase of equipment used to manufacture reclaimed plastic products through the **Reclaimed Plastics Program** established in 1985. In 1989 the program was expanded to include credits for scrap plastic collection and intermediate processing. The credit is 50% of the equipment cost, applied over 5 years (10% per year).

## Pennsylvania

The Pennsylvania state government has developed a recycling market development strategy which combines the resources of the Departments of Agriculture, Commerce, Community Affairs, Education, Environmental Resources, General Services and Transportation, and the Pennsylvania Energy Office under the Governor's Market Development Task Force. Incentives offered to business include grants, low-interest loans, educational and technical assistance, and testing of new products made of recycled materials.

The majority of funding comes from the **Act 101 Recycling Fund**. This fund, created through the *Municipal Waste Planning, Recycling and Reduction Act (Act 101)* of 1988, is supported through a \$2/ton levy imposed on landfills which generates approximately \$20 million per year. These monies support programs conducted by the Department of Commerce and Pennsylvania Energy Office, and Department of Environmental Resources, which expand recyclable processing and manufacturing operations.

The following market development grant and loan programs are available:

- \* **Recycling Incentive Development Account (RIDA)** is administered by the

Department of Commerce providing a low-interest loans for machinery and equipment to recyclers and users of recycled materials (i.e. manufacturers). The goal of this program is intended to assist in the development and expansion of markets for recyclable goods. The maximum loan amount is \$300,000 or 50% of the cost of the project at an interest rate of 2% per year. Loans have to be repaid over a period of up to 7 years or the life of the asset, whichever is less. For each \$30,000 received, the recipient must create or preserve one full-time job within three years of the loan's disbursement.

- \* **Research and Development (R&D) Grants** are available from the Department of Commerce for recycling research and feasibility studies, commercializing of new products with recycled content, and the development of new technologies for processing recyclable materials and for replacement of non-recyclable materials with recyclable materials in commercial products.
- \* **Demonstration Projects Grants** are available through the Pennsylvania Energy Office's Recycling and Energy Technology Development Program. Projects demonstrating recycling processes that generate cost savings and/or energy savings and show a potential to stimulate recycling market development are eligible for support.
- \* **Act 101 Recycling Program Grants** provide funding for recycling market development projects. Recycling processing and manufacturing projects constructed and operated by private business are eligible for up to 90% coverage of their capital costs, by the state.<sup>192</sup>

## ii) Support for the Adoption of Environmental Technologies and Services

As noted earlier, capital access has also been identified as a barrier to adoption of pollution prevention, material, energy and water conserving technologies, especially by small and medium-sized firms with limited capital resources of their own. The federal government and a number of states offer programs intended to facilitate the adoption of new environmental technologies. These are generally targeted at small and medium sized enterprises.

### Federal

#### Small Business Administration Programs

The Small Business Administration (SBA) is authorized to provide financial assistance to businesses in the planning, design or installation of pollution control facilities. The **Pollution Control Loan Program** provided grants totalling \$3.7 million in

1991 and 1992. Resource recovery (energy-from-waste) projects are also eligible for loans.

#### Small Business Technical and Environmental Compliance Assistance Program Under 1990 Clean Air Act Amendments

Section 507 of the 1990 *Clean Air Act* amendments is focused on small businesses and requires all state governments and the EPA to establish small business technical and environmental compliance assistance programs to help those small businesses respond to the amendment requirements. It should be noted that this program is an example of an "unfunded mandate" of the type targeted for elimination by the Republican Congressional leadership in its 1994 election platform.

### Michigan

The **Small Business Stationary Source Technical and Environmental Compliance Assistance Program** was established through the *Small Business Clean Air Assistance Act* of April 1993. It is intended to meet the small business assistance requirements of the federal *Clean Air Act* Amendments of 1990 in the State of Michigan. It is one of the more advanced state programs in this regard. The program consists of three components:

- \* The **Small Business Clean Air Assistance Program (SBCAAP)** provides compliance information and technical assistance. It helps to identify requirements, prepare permits, provide information on pollution prevention methods, explain the legal rights of small businesses, and provides a list of qualified auditors.
- \* The **Small Business Clean Air Ombudsman (SBCAO)** represents the interests of small businesses to government agencies, and helps to resolve complaints against the state and local governments.
- \* The **Compliance Advisory Panel (CAP)** oversees implementation of the program, reviews information and assesses the effectiveness of the whole program.

Businesses with 100 or fewer employees are eligible for assistance. Funding for the program comes from the fee levied on air pollution sources, which is sufficient to cover all direct and indirect costs.<sup>193</sup>

### Pennsylvania

Pennsylvania has taken a different approach to meeting the 1990 *Clean Air Act* amendments' requirements for small business assistance. The **Air Quality Improvement**

**Fund (AQIF)** administered by the Department of Commerce provides low interest loans to small businesses for the purchase of machinery and equipment, or to make facility or process changes in order to comply with the 1990 *Clean Air Act* amendment emission standards. The maximum loan amount is \$100,000 or 75% of the total eligible project costs, whichever is less, at the interest rate 2% per year.

### Oregon

The Department of Environmental Resources' **Pollution Control Program** provides 50% investment tax credit for facilities constructed to prevent, control or reduce pollution, including solid waste recovery and recycling facilities. The credit is taken over 10 years (5% per year) and there is no maximum amount.

In addition, the Oregon Department of Energy offers a **Business Energy Tax Credit (BETC) Program** which provides tax credits in the amount of 35% of eligible energy and recycling project costs, and provides technical assistance. There is no minimum project cost. The maximum tax credit is \$2 million. An application for the BETC has to be made before the start of the recycling or energy project in question. BETC covers costs directly related to a project. The program is scheduled to sunset on December 31, 1995.

The Oregon Department of Energy **Small Scale Energy Loan Program (SELP)** provides low-interest loans for conservation and renewable energy projects to all Oregon businesses, homeowners, and public agencies. The costs of equipment, construction, design, and consultants fees are covered. The program is financed through the sale of state bonds, on which the interest is tax exempt from state taxes.

## 5. Conclusions

The U.S federal government and several state governments have taken a number of significant initiatives related to the development of the U.S. environmental industry sector over the past two years. At the federal level, the ETI is intended to coordinate the federal government's efforts to promote the development of the U.S. environmental industry. There is also a major emphasis on export development, particularly to Asia, Mexico and Eastern Europe. Among the states studied, only California and Massachusetts have established comprehensive environmental industry strategies. A number of other states have focused on the development of their municipal solid waste recycling industries.

The demand for pollution prevention services and technologies in the United States is driven by a number of federal and state initiatives. With respect to air pollution, the federal *Clean Air Act* amendments of 1990, and California air standards are important

sources of upward pressures, although the impact of the new federal standards has been less dramatic than anticipated. Demand for pollution prevention technologies and skills continues to be driven by the impact of the federal Toxic Release inventory and state pollution prevention/toxics use-reduction statutes. However, the future direction of the federal government on water pollution control and hazardous wastes management is now unclear, with many key statutes due for reauthorization by a hostile new Congress. Further movement forward on air standards in California also seems unlikely.

With respect to solid waste reduction, reuse, recycling and composting, on the supply side many states have established municipal recycling mandates, and sources separation requirements similar to Ontario's 3Rs regulations made under the *Waste Management Act*. Demand for secondary materials, and the development of technologies and skills in their processing, has been driven by recycled content legislation for newsprint, and more recently glass and plastics. Demand is also supported by federal and state procurement policies for secondary content paper. The federal government and some states are extending these requirements to include other materials, such as oil and tires.

"Soft-fail" and "innovation waiver" strategies have been employed under some federal environmental laws to promote the use of innovative environmental technologies. At the state level, certification or verification systems for environmental technologies are being established at the federal level in California and, in a less formal manner, in Massachusetts. Some states also provide *permitting* assistance for solid waste reuse, recycling and composting facilities.

The development of the environmental remediation sector has been strongly supported by the existence of the federal "Superfund" program and similar state level programs. Site remediation is also a major focus of federal and California defense conversion programs. However, the federal *Comprehensive Environmental Response, Liability and Compensation Act*, is now due for reauthorization, and several state superfund programs are also beginning to exhaust their original funding allocations. The future of these programs therefore, is uncertain, especially in light of the results of the November 1994 Congressional and state elections.

With respect to market access, as noted earlier, the federal government has focused its export development efforts on Mexico, Asia and Eastern Europe. California has also targeted Mexico as a potential market. Oregon has an export development program aimed at the Pacific Rim. California appears to be the only state which has developed a comprehensive directory of environmental service and technology firms in the state. Other states have developed directories specifically focused on the waste 3Rs and composting sector. Washington and New York have established on-line computerized brokerage systems to assist in the marketing of secondary materials.

Support for the development of environmental technologies is provided by both

the federal and state governments. Federal efforts are focused through ETI on pollution prevention and control, environmental monitoring and environmental remediation. Particular attention is given to the needs of small businesses.

Among the states, the Massachusetts STEP program is intended to target environmental technologies of various types for state support. Support for pollution prevention technology development is limited, and appears only to be a major focus in Minnesota. Among other states, major technology development support programs are targeted at waste recycling technologies. The federal and some state "Superfund" programs also include funding for technology development and demonstration.

Financial assistance to support the adoption of new environmental technologies is limited. The most significant current initiatives in this area are in response to the requirements of the 1990 *Clean Air Act* amendments that compliance assistance be provided to small businesses affected by the amendments. However, this program is considered an "unfunded mandate," and consequently may be targeted for elimination by the new Congress.

A number of states provide various forms of tax incentives, particularly with respect to 3Rs technologies. The effectiveness of these measures is however, uncertain. In addition, many states provide technical assistance in the areas of pollution prevention and waste reduction, reuse, recycling and composting, although explicit connections between these programs and the development of environmental industries do not appear to be being made in a systematic manner.

## VI. CONCLUSIONS AND RECOMMENDATIONS

The need for significant changes in the structure of the Ontario and Canadian economies to ensure their environmental sustainability, has been widely accepted. The Ontario Round Table on the Environment and Economy, for example, observed in its 1991 report Restructuring for Sustainability, that:

"if Ontario is to prosper, it will have to restructure for sustainability, reshaping its economy to reflect environmental costs and values."<sup>194</sup>

Implicit in this conclusion is a finding that the current patterns of resource use in Ontario are environmentally unsustainable, and threaten the capacity of future generations of Ontarians and others around the world, to meet their needs.

The transition to an environmentally sustainable economy in Ontario will require significant reductions in the consumption of energy, water and material resources, and the prevention of pollution which undermines the integrity and functioning of ecosystems. At the same time, the social well-being of Ontario residents must be provided for. The simultaneous achievement of these goals would be impossible employing traditional end-of-process approaches to environmental protection. Technologies of this nature have been associated with limited environmental effectiveness, and high economic costs.

Rather, the development and diffusion throughout the economy of technologies and skills which integrate environmentally sustainable development into production processes will be essential. Skills and technologies in the fields of pollution prevention, waste reduction, reuse, recycling, and composting, and energy and water efficiency will be particularly important in this regard. Skills and technologies in these areas will enable us to protect the integrity of the environment, and reduce extractive pressures on the environmental foundation of our economy, while improving the efficiency and quality of productive processes.

However, a number of significant economic, technological, and attitudinal barriers to the development and diffusion of technologies in these areas have been identified. These include the limited capital, and research and development resources available to many firms for the development of these technologies. In addition, the capacity of many firms, particularly small and medium-size enterprises, to finance their adoption, once developed, is limited.

It is in the context of these economic and technological barriers that a strategic role for the environmental, or "green" industry sector in the process of restructuring for sustainability, emerges. The sector has the potential to play a significant part in facilitating the development and diffusion of skills and technologies in the areas of pollution prevention and material, energy and water resources conservation. This is particularly

important in relation to small and medium sized enterprises with limited capital and research and development resources of their own. Environmental firms can have an important function as components of "clusters" of such firms in a given sector, enabling them to, in effect, pool their capital and research and development resources for the purposes of developing pollution prevention, and material, water and energy conserving technologies and skills.

Some environmental sector firms also are emerging as significant industrial employers in their own right. This is especially true in the area of the processing of secondary materials from residential, institutional, commercial and industrial sources. In addition, the availability of secondary paper, glass and metal resources appears to have enhanced the economic viability of many existing industrial operations in urban areas. The process-retrofitting of residences and institutional, commercial and industrial buildings for energy efficiency has significant potential for skilled employment as well. Environmental remediation activities also can play a role in both the restoration of the environmental systems essential to the functioning of an environmentally sustainable economy, and as sources of employment.

A number of key factors have been identified as crucial to the development of an environmental industry sector capable of fulfilling these strategic environmental and economic functions. These include the establishment of demand for the sector's technologies and services, effective market access mechanisms, and the removal of economic barriers to the development and diffusion of strategic environmental skills and technologies. Ontario is relatively advanced in comparison with most U.S. jurisdictions in many of these areas, and only the states of California and Massachusetts have taken the step of integrating their efforts into an environmental industry strategy.

#### 1) Demand Conditions

##### i) Key Regulatory Features

The first and most important key regulatory feature is the existence of *stringent and certain* environmental protection requirements, which establish demand for the sector's skills and technologies. The implementation of such requirements through performance-based standards, which permit "technological flexibility" in the response of the affected firm, has been identified as critical to promoting the development and adoption of innovative responses to environmental requirements.

Performance standards establish required outcomes without prescribing the technology to be used, to achieve the results. They may take the form of emission or effluent limits, requirements for the elimination of specific substances or processes, or the achievement of specified efficiency levels in the use of energy or water. However, sufficient regulatory oversight must be provided to ensure that new technologies do not

create additional risks to human health or the environment.

Performance standards which include "technology-forcing" aspects are particularly important in prompting innovation and upgrading, as opposed to the diffusion of existing end-of-process technologies. Standards which are established on a cross-media basis also are more likely to promote the development and adoption of pollution prevention, as opposed to pollution control, responses.

In addition, the use of technology-forcing performance standards is consistent with the overall goal of moving the economy towards an environmentally sustainable foundation. Standards should be based on what is required to protect the integrity of the environment, not the capacity of existing technologies. This will ensure that investments are made in technologies and skills which address the imperatives of environmental sustainability.

Predictable and consistent enforcement, versus the mere existence of environmental requirements, is critical to the creation of markets for innovative technologies. Strong enforcement policies are required to provide a "level playing field" among competing firms, and a degree of certainty regarding government policy direction in order to justify long-term investments in the development and adoption of pollution prevention and resource-conserving technologies. Finally, standards which anticipate and lead international trends also can have the effect of providing a strong "home base" market in which technologies and services, which will eventually be required in export markets, can be developed.

##### ii) Performance Standards, Forcing Technology and Facilitating Innovation

The use of performance standards in environmental policy is becoming increasingly common in the United States and Canada. Significant examples include the "Maximum Achievable Control Technology" emission standards for 189 toxic substances to be developed under the 1990 amendments to the U.S. *Clean Air Act*. The "Best Available Technology" based effluent limits, incorporated into the sectoral regulations developed through Ontario's Municipal Industrial Strategy for Abatement (MISA) program, also are explicitly stated to be performance, rather than design, requirements.

However, the application of standards which seek performance beyond the reach of existing technologies is much rarer in Canada and the United States. In the U.S. the strongest example has been the automobile emission requirements contained in the 1970 *Clean Air Act*. Some of California's air standards also have included significant technology forcing elements. In Canada, the strongest example of the use of technology-forcing regulations is the successful, recently completed Ontario Countdown Acid Rain Program.<sup>195</sup> Recently implemented federal and provincial regulations related to the phase-out of ozone depleting substances also include elements which may force the

development of new technologies.<sup>196</sup> The approach has been recommended by the International Joint Commission with respect to curtailing the discharge of persistent toxic substances into the Great Lakes, through the banning or phasing-out of the use, generation and release of persistent toxic substances.<sup>197</sup>

A number of additional proposals have been made to facilitate the development and adoption of new environmental technologies. It has been widely observed that the design of existing regulatory requirements often reinforces decisions to adopt traditional end-of-technologies, as does sometimes the desire of officials to support the use of technologies whose effectiveness is well demonstrated. "Soft-fail" approaches have been employed in the U.S. to facilitate the use of new technologies. However, this model raises the possibility of environmental protection being compromised in the promotion of new technologies.<sup>198</sup>

Consequently, the establishment of independent evaluation and verification processes for new technologies, providing both purchasers and regulators with assurances regarding their effectiveness, have been proposed as an alternative. Programs of this nature are currently under way at the federal level in the U.S. and in California and Massachusetts. A certification program has been suggested in Ontario.<sup>199</sup> However, it has yet to be empirically demonstrated that approvals are a significant barrier to the introduction of new environmental technologies in Canada. In this context, it should be noted that Canadian officials have much greater discretion in the drafting of environmental approvals than their American counterparts.

Furthermore, given the experience of the Canadian federal government's "Ecologo" program,<sup>200</sup> safeguards would have to be established to ensure the certification program's integrity. Serious concerns over government liability if a "certified" technology fails to perform also have been raised. This consideration appears to underlie the Massachusetts government's reluctance to describe its STEP testing and assessment process as a state "certification" program, as well as the limits which the EPA has placed on its EnTICE program. Liability issues should be examined carefully before such programs are introduced in Canada.<sup>201</sup>

### iii) Ensuring Environmental Law Enforcement

The importance of strong and consistent environmental law enforcement efforts in the development of new environmental systems has been demonstrated by Ontario's experience over the past decade. The strengthening of the province's approach to environmental law enforcement from 1986 onwards, through the passage of the *Environmental Statute Law Enforcement Amendment Act* and the creation of an Investigation and Enforcement Branch within the Ministry of the Environment, has been identified as a major catalyst for the development of environmental management systems within affected firms.<sup>202</sup> Indeed, in a 1994 survey of Canadian businesses, 95% of

respondents identified the need for compliance with regulations as their principal motivation for the establishment of environmental management systems.<sup>203</sup>

Unfortunately, there is evidence that Ontario's commitment to a strong regulatory approach to environmental protection may be weakening. Environment Canada and the Ontario Ministry of the Environment and Energy have recently entered into a series of pollution prevention voluntary agreements with key industry sectors, including automotive manufacturing, automotive parts manufacturing, metal finishing and chemical producers, over the past two years. Canadian government and industry participants in the agreements argue that they provide a faster and more cooperative means of achieving pollution prevention results than traditional regulatory approaches. The federal and Ontario governments indicated their intention to continue pursuing voluntary pollution prevention agreements with various industrial sectors, in the July 1994 *Canada-Ontario Agreement Respecting the Great Lakes Ecosystem*.

However, this approach seems unlikely to prompt significant technological innovation related to pollution prevention through the reduction and elimination of the use, generation and release of toxic substances, on the scale necessary to ensure environmental sustainability. The affected industry sectors are unlikely to volunteer to achieve goals significantly beyond the capacity of existing technologies. Were such commitments to be made, they are likely to be at the margins of the firm's operations.<sup>204</sup>

### iv) Recent Regulatory Developments in the U.S. and Canada: A Comparison

The status of current Canadian environmental regulatory action likely to promote environmental innovation, is mixed in relation to the situation in the U.S. At the federal level, regulatory initiatives likely to increase demand for pollution prevention technologies under the *Canadian Environmental Protection Act* (CEPA) of 1988 have been limited to the areas pulp and paper mill effluent,<sup>205</sup> and the phase-out of ozone depleting substances.<sup>206</sup> Furthermore, the federal initiatives in both areas are weaker than concurrent Ontario requirements<sup>207</sup> although the ozone depleting substances' regulations lead the equivalent provisions of the 1990 U.S. *Clean Air Act* amendments.

The likely impact of the *Chemical New Substances Notification Regulations* promulgated under CEPA in July 1994,<sup>208</sup> on the development of pollution prevention technologies in Canada is uncertain. The federal government established a National Pollutant Release Inventory in April 1993, based on the U.S. Toxics Release Inventory system. However, the Canadian program has been criticized for being less comprehensive than the U.S. program, and for having much weaker provisions related to public access to information.<sup>209</sup> In general, further regulatory action by the federal government, except in relation to substances which are considered "toxic" for the purposes of CEPA, highly persistent, extremely bioaccumulative and predominantly

anthropogenic, seems unlikely.<sup>210</sup>

In Ontario, with the exception of the control and phase-out of ozone depleting substances, and the now completed Countdown Acid Rain program, there are no significant regulatory initiatives under way, related to air pollution. A program to establish a comprehensive system of toxic air pollution control regulations, announced in 1987 as the Clean Air Program and similar to the requirements of the 1990 U.S. *Clean Air Act* amendments, has not been pursued.

There have been no significant regulatory initiatives related to the off-site disposal of liquid industrial and hazardous wastes in the province since 1985. The need for action in this area has recently been emphasized by the Ontario government's decision not to proceed with a hazardous waste treatment and disposal facility proposed by the Ontario Waste Management Corporation.<sup>211</sup> The province has indicated, among other initiatives, its intention to develop new pollution prevention legislation to deal with hazardous wastes.<sup>212</sup>

With respect to Greenhouse gas emissions, a draft climate change action plan released by the Canadian federal and provincial energy and environment ministers in February 1995 has been widely described as a major disappointment.<sup>213</sup> However, the Ontario Minister of the Environment and Energy has stated that the Ontario government is "working to take Ontario as quickly as feasible to stabilizing greenhouse emission levels and to a 20% reduction and beyond."<sup>214</sup> This statement places Ontario ahead of most other provinces and the United States,<sup>215</sup> although the province has yet to develop an action plan to implement its commitment.

The provincial Municipal Industrial Strategy for Abatement (MISA), initiated in 1986, was expected to have a major impact on the demand for water pollution monitoring, and control and prevention technologies. However, the program has progressed more slowly than anticipated.<sup>216</sup> Furthermore, the effluent standards adopted under the program have tended to reflect Best Available Control Technology similar to existing standards under the U.S. *Clean Water Act*. The pulp and paper sector regulation contains a weak, "technology-forcing" exception to the pattern with respect to organochlorine discharges.<sup>217</sup>

Ontario has been relatively active in mandating municipal residential recycling programs and requiring the source separation of wastes from IC&I sector waste generators. However, the issues of the long-term funding of residential recycling programs, the relative roles of recyclable and refillable beverage containers, and diversion goals beyond the next five years, remain unresolved. The province's efforts at market development have been limited to supporting voluntary initiatives along with some procurement initiatives. Much of the recent strength of markets for secondary materials in Ontario<sup>218</sup> appears to be a result of the impact of existing and anticipated recycled content requirements in the United States, particularly with respect to fibre and plastics.

Ontario's new ban on incineration and energy from waste facilities<sup>219</sup> appears to have played a significant role in securing supplies of secondary fibre for Ontario recycling mills. The shortages of materials which some of these mills are now facing would be even more serious if they had to compete with energy from waste facilities, for secondary fibre.

Canadian initiatives related to the remediation of contaminated sites have been weak, particularly in comparison to U.S. initiatives under the *Comprehensive Environmental Response, Liability and Compensation Act*, the *Superfund Reauthorization and Amendment Act*, federal and California defense conversion programs, and the various state superfund programs. Significant strength in the area of environmental remediation has emerged in some U.S. states as a result. In Canada, questions of the funding of remediation for orphaned sites, the establishment of the extent of the liability of potentially responsible parties, and the development of clear decision-making processes related to the approval and regulation of site remediation, are still to be resolved in many provinces, including Ontario.<sup>220</sup>

Notwithstanding these weaknesses in the current structure of Canadian environmental standards, significant opportunities to gain advantage in the environmental sector may emerge as a result of recent developments in the United States. It is clear that the pace of environmental initiatives in the United States at both the federal and state levels is likely to slow over the next few years. Indeed, in light of the results of the November 1994 elections, significant retrenchments appear to be a real possibility. Under such circumstances, continuing improvements in Canadian standards will provide environmental firms with a "head-start" over their American counterparts, in the Canadian domestic market, potential export markets and, ultimately, when support for environmental initiatives is re-established, in the United States as well.

**Recommendations: Demand Conditions**

- 1) **The province should proceed on performance-based regulatory initiatives in the areas of air pollution prevention and hazardous and liquid industrial waste reduction/elimination. The regulatory requirements should include technology-forcing elements.**
- 2) **The province should proceed on cross-media bans and phase-outs of persistent toxic substances identified in the candidate substances process as per the recommendations of the International Joint Commission. This might be achieved through the recently proposed pollution prevention legislation.**
- 3) **The province should resolve funding issues for residential recycling programs and articulate provincial waste diversion goals past the year 2000. The current ban on new incineration and energy-from-waste facilities should be maintained.**
- 4) **The province should develop and implement a plan to stabilize Ontario's CO2 emissions and move to a 20% reduction and beyond as soon as possible.**
- 5) **The province should resolve outstanding policy issues with respect to contaminated site remediation including:**
  - \* **the provision of a clear decision-making process;**
  - \* **the funding of "orphaned" site remediation; and**
  - \* **the assignment of liability.**
- 6) **The feasibility and implications of an environmental technology performance verification process for Ontario should be explored.**

**2) Market Access**

U.S. government efforts to develop export markets for the American environmental industry are extensive. In addition, segments of the Ontario domestic market continue to be dominated by foreign suppliers. In light of these considerations, Ontario's strategic focus should be on the strengthening of ties between the environmental industry sector and the domestic market, rather than on export development. This reflects the very strong consensus in the literature on environmental industries, that export markets for the sector, flow from a strong domestic "home base"

market.

An important component of the development of the environmental industry sector, and the diffusion of the skills and technologies it can provide to the wider economy, is establishment of effective mechanisms for linking environmental firms with institutions and enterprises in need of their services. The establishment of directories of firms in the sector is an essential basic component of establishing market access in this context. Directories, such as California's, which provide contacts with firms on the basis of their ability to provide specific skills and technologies, seem particularly useful for both domestic and export purposes.

Some states, most notably New York and Washington, have also begun to provide more active market access services particularly through the operation of computerized brokerage and clearinghouse functions, for the marketing of secondary materials collected through municipal and IC&I sector reuse and recycling programs. The recycling markets directory currently under development by the Recycling Council of Ontario may provide a means of meeting this need in Ontario.

Finally, there is a potential to link industrial pollution prevention, waste 3Rs, and energy and water efficiency technical assistance and extension programs, to the development of the environmental industry sector. Technical assistance and extension programs are typically targeted at the identification of potential process changes in industrial operations which will prevent pollution, reduce, reuse or recycle wastes, and use water and energy more efficiently. These programs might be refined to include reference to directories listing environmental sector firms which can provide the services and technologies necessary to exploit these opportunities. The Ontario MoEE's **Green Industrial Analysis and Retrofits** program may provide a good model for such linkages. No comparable programs are offered in the United States.



**Recommendations: Market Access**

- 7) **The province's Market development programs should be focused on the strengthening of the ties between its environmental industry sector and the domestic market, rather than on export development.**
- 8) **The province should facilitate the development of a comprehensive environmental industry directory similar to that produced by the state of California.**
- 9) **The province should explore the possibility of establishing or supporting an on-line brokerage system for the marketing of secondary materials similar to that in the states of New York and Washington**
- 10) **The province's Green Industrial Analysis and Retrofits program should be maintained and, if possible, expanded.**

**3) Removing Economic Barriers**

**i) Support for Environmental Technology Research and Development**

As noted earlier, the limited capital resources of some environmental sector firms has been identified as a barrier to the development and commercialization of new environmental skills and technologies. Substantial programs to support environmental technology research and development activities, already exist in Ontario and throughout Canada to address this need. However, most of these programs are poorly focused, and the bulk of their support appears to go the development of traditional, end-of-process, environmental technologies.<sup>221</sup>

This approach is inconsistent with the technology development and diffusion functions of the environmental sector which have been identified in this study. Public support for research and development activities within the environmental technology and services sector, should be directed towards the strategic technologies which have been identified as essential to the process of restructuring the Ontario and Canadian economies for environmental sustainability. These include:

- \* pollution prevention, defined to include input substitution, product reformulation, production process redesign and in-process recycling;
- \* non-hazardous solid waste reduction, reuse, recycling and composting in the residential and IC&I sectors;

- \* energy efficiency in the residential and IC&I sectors;
- \* alternative (non-nuclear or fossil fuel) energy sources;
- \* water efficiency in the residential and IC&I sectors; and
- \* environmental remediation and restoration.

Particular attention should be given to the pollution prevention, 3Rs, and energy and water efficiency needs of small and medium-sized enterprises, as such firms typically have a limited in-house capacity to develop technologies in these areas themselves. The Massachusetts STEP program review panel process may provide a useful model for the targeting of support for emerging environmental technologies. The use of tax credits for this purpose should be avoided, as they are difficult to target and monitor effectively.<sup>222</sup> Grants might be provided for basic research and development activities. Support for commercialization-stage activities should be limited to loans. A revolving fund, such as that employed in a number of states, would help to limit potential public liabilities.

**Recommendations: Support for Environmental Technology Research and Development**

- 11) **Support for the development of new environmental technologies and skills should be focused on meeting the needs of small and medium sized enterprises in the areas of:**
  - \* pollution prevention;
  - \* municipal solid waste 3Rs;
  - \* alternative energy sources (non-nuclear or fossil fuel); and
  - \* energy and water efficiency.
- 12) **Support should be provided for the development of new skills and technologies in the area of environmental remediation and restoration**
- 13) **Support for the development of new environmental technologies and skills should be provided in the form of targeted loan or grant programs for research and development, and loan programs for commercialization. The use of tax expenditures should be avoided.**

**ii) Facilitating the Adoption of Environmental Technologies**

The limited capital resources of many small and medium-sized enterprises also has been identified as a potential barrier to the adoption of pollution prevention, and resource conserving technologies by such firms. However, it is widely held that subsidies for

investments in environmental technologies are of limited effectiveness,<sup>223</sup> and clash with the polluter pays principle.<sup>224</sup> It also has been noted that the most important subsidies of this type in Canada, the **Accelerated Capital Cost Allowance (ACCA's)** permitted for pollution control equipment provide positive incentives to adopt end-of-process pollution control technologies, as opposed to pollution prevention systems.<sup>225</sup> Furthermore, the beneficiaries of such programs tend to be large enterprises, rather than small and medium sized firms which face more serious capital barriers to the adoption of pollution prevention and resource conserving technologies.

The termination of the federal ACCA program by 1998 was announced in the February 1994 budget.<sup>226</sup> The Ontario program should also be ended. In the future, support for the adoption of new technologies, where provided, should occur in the form of loans, and be targeted as is proposed, with research and development support toward the needs of small and medium-sized firms in the areas of pollution prevention, waste 3Rs, and energy and water efficiency. The provision of support could be linked to audits carried out under the **Green Industrial Analysis and Retrofit** program.

Loans to support to adoption of new environmental technologies, and loans and grants to support research and development activities could be provided through the creation of a dedicated fund for this purpose. A surcharge on landfill tipping fees, charges on the purchase or discharge of substances identified as posing environment or health hazards might be employed to finance such a fund. As noted earlier, financing mechanisms of this nature are widely employed in U.S. state pollution prevention<sup>227</sup> and 3Rs programs. Even a modest Ontario charge could generate significant revenues. A \$2/tonne landfilling charge, for example, could result in revenues of \$10-15 million per year. Charges on the use or discharge of certain chemicals, such as those proposed by the Ontario Fair Tax Commission Environment and Taxation Working Group, might generate similar results.<sup>228</sup>

**Recommendations: Facilitating the Adoption of New Environmental Technologies**

- 14) **The Ontario ACCA program for pollution control equipment should be terminated.**
- 15) **Support for the use of new environmental technologies should be provided in the form of loans and be targeted at assisting small and medium-sized enterprises to adopt pollution prevention and resource-conserving technologies. The provision of support could be linked to participation in the Green Industrial Analysis and Retrofit Program.**
- 16) **Programs to support the development and adoption of new environmental skills and technologies should be financed through a dedicated fund supported through the imposition of a charge on landfilling and the use or discharge of substances identified in the MoEE's candidate substances for bans or phase-outs list.**

**4) Towards an Environmentally Sustainable Economy**

The development and diffusion of technologies and skills in the strategic areas of pollution prevention and resource conservation will be critical elements of the process of restructuring the Ontario economy for an environmentally sustainable future. However, in order to complete this process, long-term reforms in current public policies related to natural resource extraction and processing, will also be required. A move towards the full-cost pricing of resource extraction and processing activities will be a central element of these reforms. The removal of direct and indirect federal and provincial subsidies for primary resource extraction will be an important first step in this regard.

In addition, the externalization of the environmental costs associated with these activities will have to continue to be curtailed. This can be achieved through the application and enforcement of stringent regulatory requirements regarding the use and release of potential pollutants to the public's air, water and land. The use of various forms of environmental taxes provide a further potential means of achieving the internalization of previously externalised environmental costs of production.

The transition to an environmentally sustainable economy will involve significant changes to the structure of industrial-consumption oriented economies such as Ontario's. The environmental industry sector has a critical role to play in the process of restructuring for sustainability, through the development and diffusion of pollution prevention and

resource-conserving skills and technologies. These skills and technologies will provide the means by which society can meet the imperative of environmentally sustainable development which ensures the environmental, social and economic well-being of its members.

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32.N.A. Ashford, "Understanding Technological Responses of Industrial Firms to Environmental Problems: Implications for Government Policy," in K. Fischer and J. Schot, eds., Environmental Strategies for Industry (Washington, D.C.: Island Press, 1992), p. 279.

33.Canada's Green Plan, p. 137.

34.Ontario Budget 1991, pp. 93-94.

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