

AN ASSESSMENT OF BRITISH COLUMBIA'S

ENVIRONMENTAL BUSINESS SECTOR

Prepared by



November 15, 2003

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Table of Contents

1. **Introduction**
 - Study Objectives
 - Methodology
 - Contributors
2. **Executive Summary**
 - The BC environmental business sector in brief
 - Strengths and weakness of BC's environmental business sector
 - Emerging market opportunities for BC's environmental business sector
 - Impediments to be overcome
 - Recommended strategies
3. **Existing and Future Markets for BC's Environmental Sectors**
 - Global Market Outlook
 - National Market Outlook
 - British Columbia Market Outlook
4. **Factors Affecting Environmental Business Sectors in BC**
 - Changing industrial demand
 - Compliance and liability
 - Climate Change
 - Environmental infrastructure
 - Urban sustainability
5. **Emerging Opportunities for Environmental Business Sectors in BC**
 - Alternative energy systems
 - Fuel Cells and the Hydrogen Economy
 - Contaminated sites and brownfield reclamation
 - Green building design, technologies and products
 - Sustainable communities and integrated environmental solutions
 - Water/wastewater technologies, services and solutions
6. **Enabling and Impeding Factors Affecting BC's Environmental Sectors**
 - Supportive business clusters
 - Government Assistance programs
 - Small and medium sized enterprises
 - Venture Capital financing
 - Resistance to change
 - A British Columbia Brand
7. **Strategic Initiatives for BC's Environmental Business Sectors**
 - Marketing British Columbia's Excellence
 - Establishing Centres of Excellence
 - Creating Demonstration Projects
 - Providing Innovation incentives
 - Promoting Investment financing and venture capital
 - Mentoring environmental enterprises
8. **Conclusions and Recommendations**
9. **Contributors**
10. **Information Sources**

1. INTRODUCTION

STUDY OBJECTIVES

This review of British Columbia's environmental sector was commissioned by Western Economic Diversification Canada in part as a contribution to a Western Canadian Forum on Environmental Technologies scheduled for December 2003 in Vancouver.

The intended purpose of the Forum is to build greater understanding between industry, communities, and government as to opportunities and strategies necessary to promote the development and adoption of Western Canadian environmental technologies both in Canada and abroad.

The Forum seeks to develop a shared vision for the future of environmental technology development in Western Canada. This review of environment related business sectors in British Columbia – and similar reports for the other three western provinces - will be used to facilitate discussions at the Forum and will serve as background resources for possible program development activities after the event. While the driving force for these reviews has been primarily focussed on technology development, this assessment of environment-related business sectors in British Columbia has taken a much broader perspective incorporating areas of expertise and business activity that are not normally encompassed in the somewhat limited definition of the “environment industry”. This is in keeping with opinions and advice received from key leaders in the environment sector in the province who were consulted throughout the preparation of this report.

METHODOLOGY

Information gathered for this report was drawn from many sources including government departments and agencies at all levels; joint government-industry partnerships established to promote technology and human resource development in the environmental sector; universities and applied technology research organizations; international financial developmental agencies; professional and key business associations; private companies; and other organizations with links to key environmental markets around the world.

As requested by Western Economic Diversification, this review is not based on any new business surveys. Rather, it builds on the conclusions of work already completed in order to articulate a number of action-

oriented strategic recommendations to be discussed at the Environmental Technologies Forum. As a consequence, some of the statistics used herein are based on the last Statistics Canada survey of the industry, which was published in 2000. More up to date information on the various environmental business sectors is not routinely maintained by the provincial government.

The most recent comprehensive assessment of BC's environment sector was a report entitled Positioning for Growth in the 21st Century prepared by the GLOBE Foundation for the Government of British Columbia. A number of the conclusions and strategies contained in that report were reviewed in the context of today's changing needs in this sector the preparation of this report.

Selected excerpts from a more recent assessment of a water-related environmentally sustainable technologies cluster prepared by the Centre for Sustainable Communities Canada also was reviewed in the preparation of this report.

CONTRIBUTORS

Also aiding the review process was support provided by a highly knowledgeable cadre of 'stakeholders' drawn from, business, government and academia, that provided information, insights and suggestions on how best to proceed. A much larger group of business, government and academic stakeholders assembled to review an early draft of this report provided invaluable assistance by focusing attention on the most critical issues affecting the business of the environment. Their comments are also referenced throughout this report.

The report that follows provides:

- ❖ A summary assessment of the strengths and weaknesses of key components of environment-related business sectors in the province;
- ❖ An overview of emerging market opportunities for the technologies and/or service competencies related to our main areas of strength;
- ❖ A description of key enablers facilitating (or barriers impeding) realization of these market opportunities; and
- ❖ Recommendations for strategic measures that will help accelerate the development of technologies, services or products needed to realize these environmental market opportunities.

1

Introduction

At the Environmental Technologies Forum it is hoped that one or more strategic initiatives recommended herein will be adopted to help enterprises in British Columbia and across Western Canada to pursue the business of the environment.

2. EXECUTIVE SUMMARY

THE BRITISH COLUMBIA ENVIRONMENTAL BUSINESS SECTOR - IN BRIEF

In 2000 it was estimated that over 800 firms in British Columbia were active in providing goods and services to measure, prevent, limit or correct environmental damage to soil, air, water or to deal with problems of waste, noise reduction or eco-system protection. Employing over 22,000 people and generating annual revenues in excess of \$1.8 billion, these firms represented roughly 12-15% of the Canada's environment industry in 2000.

As traditionally defined, the environment industry is essentially an enabling industry, providing expertise, technologies and services to other sectors (mining, forestry, energy, manufacturing, etc.). Environmental business firms vary in size and revenues, from lone operators with revenues of less than \$100,000 to large firms employing over 500 people and operating income in excess of \$200 million. Most are small enterprises employing fewer than 25 people and in British Columbia they are clustered in two main regions of the province - the Lower Mainland and the Vancouver Island/Coast area.

Most firms surveyed in 2000 had been in business for 5 or more years (the median age in 2000 was 11 years), though a new entrants were noted, which was regarded as an encouraging sign in that new players were entering the sector, but also an indication of the volatility of the environmental marketplace.

The United States was and remains the largest export market for BC-based environment companies, though many are now venturing out to markets in the Asia Pacific, Central and South American and Western and Central Europe. Despite this, British Columbia remains a net importer of goods and products related to environmental business activity.

Over 75% of the environmental companies surveyed in 2000 reported some form of basic, applied or developmental research with respect to processes, services or technologies. These ranged from environmental instrumentation and monitoring systems to incineration, water and wastewater technologies, fuel cells, and complex industrial close loop manufacturing processes to minimize the impact of solid waste, wastewater and emissions on the environment.

The 2000 survey did not deal with the broader notion of environmental business that characterizes the current perspective. We anticipate that some of the firms that were active in 2000 will have disappeared and others reconstituted themselves along a new business line that focuses on the broader concept of sustainability. In addition there are a number of new areas such as green building technologies that would not have been considered in the earlier survey.

STRENGTHS AND WEAKNESSES OF BC'S ENVIRONMENTAL BUSINESS SECTOR

The major areas of strengths most often cited with respect to the environmental technologies and services sector in British Columbia relate to: Water and wastewater services and technologies; Alternative energy systems, including fuel cells, clean fuels technologies and biomass/co-generation systems; Sustainable resource management, specifically related to forestry and mining reclamation; and Environmental instrumentation technologies.

Another emerging source of strength is the growing presence of supportive clusters enabling smaller firms in the sector to work jointly with select government agencies, academic and other research institutions. Such clusters are present in the fuel cell technologies sector, the water/wastewater sector, and increasingly in the green building sector. They in turn are supported by a growing milieu of innovation related to the business of the environment in this province, fostered in part by excellent university programs, skilled patent and trademark law firms, a growing number of research laboratories and technology testing facilities, as well as readily available expertise in market intelligence and environmental marketing.

The main weaknesses in the sector stem from the fact that the environmental sector is not a homogenous whole. It consists of a series of market segments each with very significant differences in market conditions and each with different challenges with respect to technology development and commercialization. Each market segment involves many different players, including corporations, universities, applied research organizations, government departments and specialized agencies and financing bodies.

As noted, in some areas these various players have come together to form mutually supportive clusters. In other areas (notably related to soil remediation, air quality management, and solid waste management), the market continues to be served by small and medium sized enterprises working in an uncoordinated milieu, without the benefit of

strong industry associations or alliances. Indeed, the absence of a strong industry-based environmental business association is a contributing factor behind the lack of influence this sector has with respect to shaping new regulatory regimes and government practices regarding the early adoption of environmental technologies developed in the province.

Other factors contributing to weaknesses in parts of the sector include scarcity of investment funding; inconsistent support from government agencies and programs; poor market intelligence; resistance to change by key players in the local and regional markets; and the lack of unified or coherent marketing of technologies and problem-solving expertise in the international marketplace.

EMERGING MARKET OPPORTUNITIES FOR BC'S ENVIRONMENTAL BUSINESS SECTOR

Gauging emerging market opportunities for environmental technologies and services is an imperfect science at the best of times. Not only is there considerable variability in global estimates of market potential and growth rates, this variability increases when specific sectors and geographic markets are discussed.

In part the problem stems from how the environment sector has been defined, namely as consisting only of businesses producing goods and services that measure, prevent, limit or correct environmental damage (both natural or by human activity), to water, air and soil, or which deal with problems of waste, noise reduction and ecosystems protection. Technologies that reduce material inputs and energy consumption or recover useful by-products are also considered environmental sector offerings, though this is not consistently applied because of the lack of consistent information across jurisdictions.

The problem with this definition is that it does not encompass all the business and industry sectors involved in sustainable development or climate change adaptation activities. In fact, the environmental business has evolved into a complex and rapidly changing network of sectors no longer focused on "end-of-pipe" solutions to treat pollutants released into the air, water or soil. The 'business of the environment' now includes an extensive variety of engineering, analytical and design services designed to help businesses incorporate environmental considerations into their production processes and their dealings with client communities and their customers.

The environmental business sector in today's terminology includes a variety of activities involved in sustainable community development; green building design and construction; energy efficiency and eco-industrial networking; sustainable urban infrastructure; and sustainable resource management. When these activities are taken into account, the environmental marketplace becomes very large indeed.

It is almost impossible to estimate either the size or the potential revenue base of this more broadly defined environmental technology and services market. The problem is not the lack of opportunity. Rather, the problem is choosing the most viable opportunities and removing any impediments to the development of technologies and competencies needed to realize these opportunities.

There are a number of other factors affecting the environmental technology and service marketplace. These include:

- ❖ The changing nature of business perspectives with respect to environmental stewardship and sustainability;
- ❖ Concerns of both industry and governments over compliance with respect to environmental regulation and associated liability issues;
- ❖ The ongoing demand for energy domestically and in a North American context to underpin the continuing economic development in the region.
- ❖ The pervasive impact of all aspects of climate change and the need to adapt to a new set of global realities;
- ❖ Changing public attitudes with respect to health and the environment;
- ❖ The environmental impacts associated with the need to expand and/or replace our aging infrastructure; and
- ❖ The growing demand for urban sustainability and improved quality of life.

On the basis of our demonstrated strengths, and taking into account these other related factors, the most promising opportunity areas for British Columbia's environmental technology and related sectors appear to be:

- ❖ ***Alternative energy systems and associated technologies***, including fuel cells, clean fuel technologies, small scale hydro and biomass co-generation systems;

- ❖ **Urban Environmental management systems** including:
 - Contaminated site remediation and brownfield reclamation;
 - Green building design, technologies and products;
 - Planning for Sustainable communities and integrated environmental solutions; and
 - Urban environmental management systems.
- ❖ **Water/wastewater technologies, services and solutions.**

These opportunity areas are both local and international. Other emerging areas of opportunity relate to air quality management, sustainable infrastructure, and sustainable resource management, though these sectors have not been discussed in detail in this report.

IMPEDIMENTS TO BE OVERCOME

However, there are impediments that must be dealt with before these potential opportunities areas can be fully realized. These include in particular:

- ❖ Promoting international recognition of British Columbia's environmental excellence.
- ❖ Establishing supportive centres of excellence or government-business clusters in key environmental business sectors;
- ❖ Providing consistent technology development and commercialization support, particularly for small and medium sized enterprises;
- ❖ Encouraging venture capital financing and investment for innovative environment-related technologies being developed in British Columbia; and
- ❖ Overcoming resistance to change factors in key domestic markets that are impeding the adoption of innovative technologies and solutions developed locally.

RECOMMENDED STRATEGIES

The strategies recommended to overcome these impediments and to realize the market opportunities identified include:

1. **Promoting British Columbia's environmental excellence** – through collaborative programs involving technology demonstration, testing and certification; market development and networking; and national and international promotion in order to attract new customers and new investment to the sector.
2. **Creating Centres of Excellence** – by providing the vehicles where experts in environmental technology development and verification can work in mutually supportive clusters with those having the academic, marketing, business and financial management expertise needed to develop and deliver the technologies, services and integrated environmental solutions required in the national and international marketplace.
3. **Encouraging demonstration projects** – particularly involving large scale, real-world urban demonstration sites where Western Canadian environmental technologies, products and services can be tested and showcased in order to attract new international customers and to foster their adoption by local industries and municipal governments.
4. **Encouraging venture capital and investment financing** - by removing or reducing the risk factors associated with technology verification and commercialization; by providing fiscal incentives to stimulate capital investment in the environmental business sector; and by supporting specialized technical conferences and venture capital venues where investors and potential customers can interact with government agencies, technology research and development organizations, industry and professional associations to see what British Columbia's environment sectors have to offer.
5. **Providing incentives for innovation** – by undertaking the research needed to identify and remove barriers to the adoption of innovative technologies and integrated environmental solutions by municipalities, other government agencies and by major industry players in British Columbia.
6. **Mentoring environmental enterprises** – by working with individual firms and industry associations to improve environmental technology development and commercialization; to provide the

2

Executive Summary

tools needed to penetrate new markets; and to establish mutually supportive and dynamic networks that enable the delivery of flexible solutions and technologies for local, regional and international customers.

These strategies and the rationale supporting them are discussed in more detail in the balance of this report.

3. EXISTING AND FUTURE MARKETS FOR BC'S ENVIRONMENTAL SECTORS

THE GLOBAL MARKET OUTLOOK

Market Size: Current estimates of the global market for environmental goods and services vary from US\$500 billion to over US\$800 billion per annum and are expected to reach \$1 trillion U.S. by 2010. These estimates are based on a variety of surveys most of which use the OECD definition of the environment industry, which is, consistent with that used by Statistics Canada and Industry Canada in their reports. By any measure, the global environmental business market is large and growing at 4-5 percent per annum in developed country markets, and at over 10 percent in selected developing economies. The United States is the largest, single environmental technology market in the world but it exports only about 11% of its output compared to Japan, Germany and Great Britain each of which export over 20%. Canada's exports of environmental goods and services, valued by Statistics Canada at \$1.6 billion in 2000, represent less than 1% of the overall global market.

Demand Growth: The demand for environmental technologies and solutions is rising the fastest in Asia, Eastern Europe, Africa and Latin America particularly for water and waste water treatment technologies and services, solid waste management, air pollution abatement, industrial efficiency, environmentally related construction, and environmental management and advisory services.¹ The most significant projected annual growth rates are for solid waste management (21.2%), water utilities (15.6%), and water treatment works (14.6%).

The largest component of the global environmental market relates to water supply and wastewater treatment. The current worldwide requirement for this market component is estimated by the World Bank at between \$US 600 and \$US 800 billion.² As noted by Industry Canada, virtually every major international agency with an interest in

¹ The Canadian Environment Industry at a Glance, Industry Canada, Strategis, 2000 Available at <http://strategis.ic.gc.ca/environment>

² Market Intelligence Report of Environmental Technology Opportunities in Canada, Calibre Strategic Services (SK) Inc., May, 2002. Quoted in Cities of Tomorrow: National Centre for Sustainable Urban Environmental Management, Sustainable Communities Institute. Available at www.jump.ca/emis

environmental issues -- whether from the development, financial or political perspective -- has determined that clean water, or lack thereof, is a priority for the foreseeable future in developing countries. The problem has reached crisis proportions in many places where millions of people around the world die every year from water-borne diseases.³

Climate Change: Climate change is another driving force affecting the global environment industry. Described as the ultimate sustainable development issue, climate change represents both an environmental challenge and an economic opportunity. Reducing greenhouse gas emissions and introducing sustainable development principles into all aspects of society without causing major disruption to our economic and social well-being is the challenge. Achieving the benefits of sustainable development technological innovation and energy efficiency in our transportation, agriculture, manufacturing and primary resource sectors, as well as creating more sustainable cities represents the opportunity.

Energy: Fossil fuel consumption – particularly for transportation purposes and the depletion of global forest reserves are cited as two of the more obvious sources of greenhouse gas emissions. Poor agricultural practices, improper management of waste sites and inadequate construction methods are also major factors. The demand for greenhouse gas emission reduction technologies is expected to grow significantly in most developed countries. While Canada is not seen as a world leader in climate change technologies, we do have technologies that are expected to make a positive contribution in this regard, including fuel cell technology, energy conservation, alternative energy systems, waste management, bio-mass and low-cost filtration systems.⁴

The climate change issue and the rising costs of energy have sparked renewed in energy alternatives and energy efficiency measures. While alternatives to fossil fuels are many, on a global scale no one source has the capacity to replace our dependency on oil and gas in the near term. Fossil fuel reserves according to most long range forecasts appear adequate to meet anticipated energy demands for at least the next three decades. But continued dependency on hydrocarbons

³ Canada's Environment Industry: An Overview, Environmental Affairs Branch, Industry Canada, January 2002, p. 8. Available at <http://strategis.ic.gc.ca/>

⁴ Ibid.

raises concerns about future investment in energy infrastructure; the potential environmental damage caused by fossil fuel energy production and use; and perpetuation of unequal access of most of the world's population to adequate energy supplies.

In its latest review, the International Energy Agency states that world energy demand will increase steadily through to 2030, reaching an annual level of 15.3 billion tonnes of oil equivalent. Key points from the review are:

- ❖ Fossil fuels will remain the primary source of energy, meeting more than 90% of the anticipated increase in demand. Global oil demand will rise by about 1.6% per year.
- ❖ Demand for natural gas will rise more strongly than for any other fossil fuel. Primary consumption will double between now and 2030. Consumption of coal will also grow, but more slowly than that of oil and gas.
- ❖ The role of nuclear power will decline markedly, because few reactors will be built and some will be retired.
- ❖ Renewable energy will play a growing role in the world's primary energy mix. But non-hydrocarbon renewable energy sources will make only a small dent in global energy demand in 2030, because they start from a very low base
- ❖ New sources of energy and advanced technologies will emerge during the Outlook period. Non-conventional sources of oil, such as oil sands and gas-to-liquids, are set to expand, as their production costs decline.
- ❖ Global energy-related emissions of carbon dioxide will grow slightly more quickly than primary energy demand.
- ❖ Carbon sequestration and storage technologies hold out the long-term prospect of enabling fossil fuels to be burned without emitting carbon into the atmosphere. These technologies, however, are unlikely to be deployed on a large scale before 2030. They are at a very early stage of development and are very costly.⁵
- ❖ Hydroelectric power will remain as the principal source of renewable energy to 2020, but its share of electricity generation will

⁵ Cleaner Hydrocarbons: Technology Challenges and Opportunities For The Western Canadian Hydrocarbon Energy Sector, The Cleaner Hydrocarbon Technology Futures Group, 2003, p.5.

fall. Non-hydro renewable energy sources, taken as a group, will grow faster than any other primary energy source.⁶

Continued reliance on hydroelectric power as the principal source of renewable energy is very much a part of British Columbia's energy strategy.⁷ The province's energy policy as outlined in *Energy for our Future: A Plan for BC* includes among other things a commitment for the promotion of cleaner energy sources and measures to increase conservation and energy efficiency.⁸

Fuel Cells: Another energy-related dimension of the global environmental market that has particular relevance for Canada in general and British Columbia in particular relates to fuel cells and the hydrogen economy. Fuel Cells represent a very significant alternate energy market for which British Columbia has distinct market advantages. Long viewed as the "power to change the world," the use of hydrogen as a source of relatively inexpensive and clean energy is approaching technical and economic feasibility. By 2020, the worldwide market will exceed \$145 billion with the potential of 15,000 jobs for every billion dollars in demand.

Global demand for fuel cell products and services could reach \$46 billion per year by 2011, and has the potential to exceed \$2.6 trillion per year world wide by 2021. Stationary power is projected to be the largest of the top three market components (\$17.9 billion by 2011), followed by the portable market (\$17.6 billion) and the transportation market (\$10.3 billion).⁹ Much of the current emphasis on technology development is focused on the potentially huge transportation market. However, commercialization in the portable and stationary markets is expected to precede commercialization in the transportation market. Canadian companies can participate in the fuel cell export market in a number of ways.

⁶ World Energy Outlook: 2002 Executive Summary, International Energy Agency, September 2002, p. 26. Available at <http://www.worldenergyoutlook.org/weo/pubs/weo2002/weo2002.asp>

⁷ Electricity accounts for about 11% of all energy produced in B.C., most of which (85%) is generated from hydro sources.

⁸ Energy for Our Future; A Plan for BC, Government of British Columbia, 2002, Solutions and Conclusions, p. 14. Available at www.gov.bc.ca/em/popt/energyplan.htm

⁹ Canadian Fuel Cell Commercialization Roadmap: Executive Summary Industry Canada, 2003. Available at <http://strategis.ic.gc.ca/> See also The Canadian Fuel Cell and Hydrogen Industry: A Capabilities Guide September 2003, Fuel Cells Canada. Available at www.fuelcellscanada.ca

Urbanization: Another factor contributing to the rapid growth in the global environmental technology market is continuing growth of the world's urban population, which placing tremendous pressure on the infrastructure of cities and towns and surrounding areas in both developed and developing countries. The need to replace deteriorating infrastructure and to provide new capacity for urban and industrial growth is sparking the demand in particular for environmental technologies and services related to water and wastewater services.

Water/Wastewater: Global market opportunities for water-related technologies are huge - estimated by the World Bank to be in excess of \$600 Billion.¹⁰ The Canadian water and wastewater technologies market is relatively small in comparison to the world-market demand. In North America, the United States is undergoing major infrastructure renewal programs related to water. Industry Canada and others have suggested that in order for smaller Canadian companies to be successful in the global or US marketplace, they must develop partnerships and collaborations with larger players in this sector.

THE NATIONAL ENVIRONMENTAL MARKET

Canada's market for environmental goods and services involves many end-users operating under an array of provincial and federal regulatory frameworks and guidelines that differ by jurisdiction. The market is driven in large part by resource sector industries (i.e. forestry, pulp and paper, mining, and energy), local governments. Firms in the environment sector provide expertise, technologies and services to larger companies in resource sectors and typically are located in close proximity to the clients they serve.¹¹ The largest end-user groups consist of local and provincial government clients (approximately 20%); mining and energy sector users (approximately 11%); and the forest products sector (approximately 10%). Local and other government spending relates largely to waste management and water treatment facilities

¹⁰ For a general overview of global issues pertaining to water/wastewater see World Development Report 2003: Overview - Sustainable Development in a Dynamic World. Chapters 1 and 5, The International Bank for Reconstruction and Development/ World Bank, 2002. Available at <http://econ.worldbank.org/wdr/wdr2003/text-17926/>

¹¹ Environment Industry Survey: Business Sector 2000, Statistics Canada, Environment Accounts and Statistics Division, Cat. No.16F0008XIE, 2002, p.3 Available at <http://www.statcan.ca/cgi-bin/downpub/freepub.cgi>

and services, air pollution control, monitoring and assessment, livestock pollution, health and hygiene issues, and hazardous waste remediation. Industrial buyers are concerned more with environmental goods and services that improve production, prevent pollution (thereby avoiding costly remediation), and add to the bottom line by reducing energy consumption and wastes.

Market Size: The most recent assessment of the national market for environmental goods and services published by Statistics Canada notes the following:

- ❖ Revenues from environment-related activities reached \$14.4 billion in 2000, representing 55% of the total revenues reported by firms in Canada's environmental business sector.
- ❖ Environmental services accounted for 44% of total environmental revenues; environmental goods accounted for 43% and environment-related construction services the remaining 13%.
- ❖ Almost two-thirds of the environmental services revenues related waste services activities (\$3.9 billion).
- ❖ Four industry groups account for three-quarters of business sector environmental revenues: Wholesale Trade (30%); Waste Management and Remediation Services (21%); Engineering Services (14%); and Construction Services (11%).
- ❖ Ontario and Quebec are the biggest earners of revenues from environment-related activities, \$6.2 billion and \$3.2 billion respectively in 2000. Other top performers were firms in Alberta (\$1.9 billion) and British Columbia (\$1.7 billion).
- ❖ Small and medium-sized establishments dominate the sector, accounting for 96% of all establishments. These firms are variously organized on a regional basis. There is no truly effective national industrial structure.
- ❖ Environmental goods and services are supplied mainly by small establishments, while environment-related construction services are provided mainly by larger medium-sized establishments.
- ❖ Export market revenues (only 9% of Canada's environmental revenues), reached \$1.3 billion in 2000, mostly for environmental goods (\$0.9 billion).

- ❖ The United States is by far the biggest export market for Canada's environment sector, followed by Europe and Asia and the largest supplier of environmental goods and technology to Canada.
- ❖ Total employment in businesses reporting environment-related activities in 2000 reached 159,269, which includes all workers performing environmental and non-environmental activities.

Demand Growth: Market growth in the national environmental marketplace will be driven mainly by: environment-related health concerns; the need to upgrade municipal water treatment infrastructure in all provinces; growing public concern about air pollution and air quality in urban areas; hazardous and solid waste treatment needs; livestock pollution; and changing corporate perspectives and practices with respect to environmental protection and sustainability.¹²

- ❖ **Health and the Environment** - There is a growing level of public concern across the country about the impact of working and living environments on the health of Canadians, especially for children. Quality of life issues and the demand for healthier and more sustainable urban environments are prompting new spending initiatives and increased political commitment to environmental matters. Canadians are demanding that governments commit to improving living and working environments and increasingly are holding governments accountable for meeting those commitments.
- ❖ **Water Treatment Infrastructure** - Many municipalities across Canada still discharge raw sewage into adjacent waterways. While some of these practices are being addressed (particularly in the wake of the Walkerton disaster) others remain unresolved pending the availability of financing to replace or upgrade aging water related infrastructure.
- ❖ **Air Quality Management** - Building on the theme of prevention versus reliance on end-of-pipe remediation, the market for system-oriented solutions to various environmental issues is growing across the country, particularly with respect to air quality management.

¹² *Canada's Environment Industry: An Overview*, Environmental Affairs Branch, Industry Canada, January 2002. Available at www.strategis.ic.gc.ca/

Combined with the government mandated need for companies to upgrade their air quality monitoring and analysis capabilities, this component of the environmental market in Canada could become very significant in the years ahead.

- ❖ **Hazardous and Toxic Waste Treatment** - New funding is being directed toward the remediation of contaminated sites across the country and for the recovery of brownfield sites in or adjacent to major urban areas. The clean up of toxic waste sites across Canada (estimated at over 10,000), suggests the hazardous wastes component of the national environmental marketplace also will become increasingly important.
- ❖ **Solid Waste Management** – Efforts to reduce total solid wastes continue to be a challenge everywhere. Creative solutions and initiatives are being developed and tested across the country, but most municipal governments have yet to implement programs that have a significant impact in this area. Solid waste reduction will require innovative waste management systems and related support technologies and services to make them work effectively, particularly in larger cities and towns.
- ❖ **Livestock Pollution** - Alberta, Manitoba, Ontario and Quebec have significant environmental problems related to wastes associated with livestock, most notably hogs. A market exists for practical and economical technologies and solutions to deal with problems of odour and water runoff, not only for large factory farms but also for smaller operations, particularly those close to major urban areas.
- ❖ **Changing corporate perspectives** – Many corporations now routinely report on their economic, environmental and social policies and achievements. ISO 14000, the internationally recognized standard for corporate environmental management systems, is being adopted throughout the Canadian business community, in turn prompting many companies to change production systems and practices to reduce environmental pollution; to improve bottom line performance; to increase shareholder value; and to build better relationships with customers and local communities.
- ❖ **Energy:** Climate change and rising energy costs have renewed interest in energy alternatives and energy efficiency. Environment-related industries identified with strong growth opportunities include:

- Improved urban transit and higher occupancy vehicles: intelligent highways and road construction services potential investment of \$2.3 billion by 2010;
 - Large and small hydro electricity potential investment of \$15 billion by 2010;
 - Sustainable forestry investment of \$1 billion by 2010;
 - Environmental engineering and consulting worth \$9 billion through 2010.
 - Biomass, which is a significant source of process heat and electricity in the forestry and pulp and paper industry and Canada's second most important source of renewable energy after hydroelectricity.
 - Fuel cell technology applications in the transportation sector to power vehicles or for stationary power generation.
 - Environmental building products and "smart building" techniques, which are making inroads due to renewed interest in energy conservation and efficiencies.
- ❖ **Clean production/processes** - The next generation of environmental technologies will serve both environmental and economic objectives. Clean production/processes decrease input, resource and energy requirements, and reduce the dispersion of toxic substances into the environment. Because significant cost savings are involved, investments in clean production processes essentially pay for themselves over time, with demonstrable commensurate impacts on domestic and international competitiveness. This area of environmental technology development is expected to eventually dominate the growing international market for environmental goods and services.

BRITISH COLUMBIA MARKET OUTLOOK

The overall outlook for the business of the environment in BC can best be understood in the context of what constitutes a sustainable British Columbia. Such a vision was outlined by the BC Climate Change Economic Impacts Panel in its March, 2003 report to the BC government. That vision illustrates the interconnected nature of sustainable technologies and practices in the various environment-related business sectors in the province.

A SUSTAINABILITY VISION FOR BRITISH COLUMBIA

As part of its work to develop a "made-in-BC" approach for a climate change action plan, the British Columbia Climate Change Economic Impacts Panel outlined a vision for a sustainable BC economy to 2030. Achieving this sustainable future not only requires substantial reductions in GHG emissions from today's levels, but also other significant environmental, social, and economic changes and benefits, including:

- ❖ More cost-competitive BC businesses through improved resource and energy efficiency and the easier movement of goods;
- ❖ Major improvements in local air quality from the reduction of smog precursors and particulates;
- ❖ Healthier and more liveable communities for existing citizens and skilled workers from outside the province seeking a place to live;
- ❖ Greater preservation of BC's unique wilderness and natural areas as a result of more sustainable resource extraction and land use practices;
- ❖ Increased tourism and business location successes due to a high quality of life;
- ❖ Enhanced attractiveness for international investment;
- ❖ Development of the fuel cell industry, with a workforce estimated at more than 50,000 employees by 2030;
- ❖ Sustained growth in the oil and gas industry, which currently provides \$3.1 billion in capital spending and \$2 billion in provincial revenues;
- ❖ Long-term sustainability of the BC forest products industry, through narrowing of the competitive gap with Scandinavian countries;
- ❖ Further expansion of the provincial green building economy, from architects to manufacturers of building products; and
- ❖ Job creation from energy efficiency and renewable energy projects throughout BC.

Report of the BC Climate Change Economic Impacts Panel,
Prepared for the Minister of Water, Land and Air Protection, March 25, 2003

As was noted earlier, British Columbia's environmental sector has traditionally been defined to include business activities related to goods and services to measure, prevent, limit or correct environmental damage (both natural or by human activity) to water, air and soil, or to deal with problems of waste, noise reduction and ecosystems protection. Previous estimates of the size of the sector did not include environment-related activities of other sectors associated with sustainable community development; green building design and construction; energy efficiency and eco-industrial networking; sustainable urban infrastructure; and sustainable resource management.

Principal Drivers: The principal drivers affecting the global and national environmental markets for environmental goods and services are also shaping the growth and direction of the environmental business sector in British Columbia. The business of the environment in BC is being influenced by the tightening of pollution prevention requirements; a shift towards community-based environmental management strategies; the development of integrated and eco-efficient solutions to environmental management problems; various green initiatives (i.e., green electricity, green buildings, etc.), and government incentives for technology development related to the energy and natural resource sectors.

Climate Change: With respect to climate change and efforts to reduce greenhouse gas emissions, British Columbia's Energy Plan commits the province to the development of alternative energy technologies having net environmental improvements relative to existing production methods. Technology areas to be explored include fuel cells; small/micro hydro-electricity generation; wind energy; solar and photovoltaic energy; geothermal heat sources; tidal and wave power generation; biomass and cogeneration of heat and power from landfill gases, wood residue and municipal solid wastes; and efficiency improvements at existing facilities.

The business potential of this commitment will be significant for environmental technology and service companies in the province. BC Hydro estimates roughly of 10 percent of current electricity demand could be economically saved by 2015 through greater conservation and efficient energy use, and through alternative energy sources. The utility commissioned a series of studies of the economic potential of these various "green" energy alternatives. The overall conclusion was that while there is promising potential for developing green energy in

B.C., only biomass, geothermal, small hydro and tidal current had viable potential to contribute to the utility's resource mix. Compared to the 54 000 gigawatt hours of electricity generated annually by BC Hydro, the projects assessed had the capacity for an annual energy production potential of about 18 000 gigawatt hours. Many of these resources were seen as near-commercial as production costs were expected to decrease as the technologies were developed further.¹³

BC Hydro has already made important strides in this area. The utility's recent announcement of agreements in principle to purchase 1,800 gigawatt hours per year of green energy could result in \$800 million of new private-sector investment in 16 small scale power projects. Guaranteed grid access and long-term purchase agreements will enable independent power producers to launch new ventures and to develop new generation technologies.¹⁴

Oil and Gas: British Columbia new Energy Policy, while reaffirming the continued importance of hydro-generated electricity as the cornerstone of our economic future, also pointed out the importance of developing emission control technologies to permit greater use of our hydrocarbon resources, including coal. The BC Oil and Gas Commission has allocated a portion of its industry-supported Environmental Fund to finance projects related to emissions from the oil and gas industry, and CO₂ sequestration in coal. Support has been given to universities in B.C. to research clean energy options for hydrocarbons, and carbon dioxide sequestration.

British Columbia's oil and gas sector is part of a transformation now underway across Western Canada shifting from traditional hydrocarbon operations to more sustainable conventional oil and gas production; developing unconventional natural gas resources (including off shore); exploiting methane from deep, coal reserves; utilising carbon dioxide as a commodity for hydrocarbon energy

¹³ Background reports on these studies are available from the BC Hydro web site (www.bchydro.com/environment/greenpower). See also Green Energy Study for British Columbia- Phase 2: Mainland, BC Hydro Green & Alternative Energy Division Engineering Report No. E44, October 2002. Available at www.bchydro.com/environment/greenpower

¹⁴ News Release: "Record Power Purchase Yields \$800 Million in Investment", Office of the Premier, Ministry of Energy and Mines and BC Hydro, Sept. 26, 2003. Available at www.bchydro.com. The Independent Power Producers Association of B.C. has grown to 170 members from only 22 two years earlier, a clear indication of the optimism associated with the small scale energy generation market

extraction; integrating hydrocarbon resource development with the petrochemical industry to produce saleable petrochemicals, oil, gas, electricity and hydrogen as by-products, and addressing a wide range of environmental issues affecting the air, land and water ecosystems.¹⁵

The development of British Columbia's offshore oil and gas reserves will create a wide range of business opportunity for energy-related environmental technology and service companies in the province. While much of the resource extraction technology likely to be deployed has been proven in other world locations (i.e. the North Sea or Canada's East Coast), the environmental protection imperatives in BC undoubtedly will lead to further technology development activities related to geotechnical surveys and assessments, navigation and positioning systems for surface and sub-sea marine applications, materials engineering, and environmental services.¹⁶

Clean Energy: The Government of British Columbia announced in its Budget 2000 initiatives designed to promote clean energy development in the province. One proposal was an examination of the concept of an environmental tax shift, a market-based tool to encourage environmentally desirable behaviour and discourage behaviour which is harmful to the environment.¹⁷ Burning wood residue in beehive burners or unmodified silo burners was singled out as a major contributor to air quality and human health problems and wasteful of a potentially valuable resource.

While the tax shift initiative has not developed significantly since Budget 2000, measures have since been introduced to phase out beehive burners in favour of such facilities as the Burnaby Incinerator a 'waste-to-energy' facility owned by the GVRD. Since its opening, a

¹⁵ Cleaner Hydrocarbons: Technology Challenges and Opportunities For The Western Canadian Hydrocarbon Energy Sector, p. 4. See also BC's Offshore Oil and Gas information site: <http://www.offshoreoilandgas.gov.bc.ca/>

¹⁶ See Opening Up British Columbia: Serving the Offshore Industry, Ministry of Competition, Science and Enterprise and Ministry of Energy and Mines, Available at: www.offshoreoilandgas.gov.bc.ca

¹⁷ See Environmental Initiatives Part 1 Tax Shift – Update and Status Report, Budget 2000 Papers. Available at http://www.legis.gov.bc.ca/2000/bgt2000/reports/bgt2000_topicbox_c01.htm. The discussion paper released at the time was Environmental Tax Shift: A Discussion Paper for British Columbians, Amy Taylor and Mark Jaccard, School of Resource and Environmental Management and Nancy Olewiler, Department of Economics, Simon Fraser University, Vancouver, October, 1999. Available at <http://www.emrg.sfu.ca/articles/EnvTaxShift5.pdf>

series of innovative strategies have reduced operating costs, averaged out tipping fees and significantly reduced impact on the area's air quality. The steam generated from garbage incineration is sold to a nearby paper recycling mill. A new turbo-generator will use the facility's excess steam to generate electricity that will be sold to the BC Hydro grid. Using steam in place of fossil fuels as an energy source will also reduce greenhouse gases by around 59,000 tonnes per year.¹⁸

Sustainable Communities: Sustainable communities and quality of life issues will also be major factors influencing technology development in the environment sectors of British Columbia. With respect to green building, British Columbia is one of the foremost centres of excellence in green building design and construction in North America. There is a readily available pool of expertise, as well as the resources to support the expansion of green building in the region and to export this business expertise to other markets. British Columbia expertise already is being employed by other jurisdictions to develop their own green building portfolios and proactively pursue economic development opportunities associated with green building.¹⁹

Another area of emerging importance relates to Eco-Industrial Networking involving relationships, or networks, to better manage resources, especially in industrial areas. These networks can exist between any combination of businesses, local governments, and the community and can involve not only materials, energy and water, but also land, infrastructure, and business services such as logistics, marketing, or research. Such projects help to build relationships, lever funds, provide access and share the technical expertise needed to put innovative solutions into place. There are several projects and studies ongoing or completed in British Columbia related to Eco-Industrial Networking.²⁰

¹⁸ For more details on the Burnaby facility see http://www.gvrd.bc.ca/recycling-and-garbage/pdfs/BurnabyIncinerator_brochure.pdf.

¹⁹ A Strategic Framework for Green Building in Greater Vancouver Report of the Green Buildings Task Group, Sustainable Region Initiative, Phase 2, Greater Vancouver Regional District, 2003. Available at www.gvrd.bc.ca. See also Industry Profile on Vancouver's Environmental Sector: Study conducted by the Vancouver Economic Development Commission November 2003. Available at www.vancouvereconomic.com

²⁰ Information provided by Tracy Casavant, Eco-Industrial Solutions Ltd., www.ecoindustrial.ca

4. FACTORS AFFECTING THE ENVIRONMENTAL BUSINESS SECTORS IN BC

CHANGING INDUSTRIAL DEMAND

Corporate environmental management and the integration of environmental and economic considerations into the internal governance processes and structures of leading companies is becoming increasingly evident. A number of leading corporations in this regard are based or have substantial operations in British Columbia, including ALCAN INC, Weyerhaeuser, Placer Dome (PDG), Westcoast Energy (now called Duke Energy Gas Transmission Canada (DEGTC), VanCity Savings, Terasen (formerly BC Gas), Ballard Power Systems, and Telus Corporation. When companies such as these look for environmental technology or service providers, they are seeking:

- ❖ Environmental solutions that carry quantifiable benefits to improve the bottom line (cost savings, labour efficiencies etc.); minimize potential liabilities (employee health risks, community perceptions, etc.); and which enhance/maintain corporate image (community relations).
- ❖ Integrated solutions that reduce emissions at source; optimize processes and resource use; and increase efficiencies.
- ❖ Suppliers that have a detailed knowledge of the client's need the specific facility as well as the company's domestic and international standards and principles.
- ❖ Suppliers that can address increasingly complex problems with multidisciplinary teams that have the financial resources to shoulder some of the risk involved in implementing new solutions.

Environment service and technology providers have come to realize that their success depends upon being able to accurately respond to client needs that are constantly changing. Many smaller companies in the environmental business sector are not well equipped to keep up with these changing demands due to limited financial resources or lack of technology development depth. Thus they rely on technologies and solutions often imported from elsewhere, or to adapt existing technologies to meet changing circumstances and conditions. Helping larger corporate players to be aware of the locally developed technologies and environmental management expertise would greatly assist smaller environmental companies in the sector to grow.

BC companies are particularly well equipped to help such corporations incorporate energy-saving technologies and practices into their operations, thereby increasing the use of clean carbon fuels/processes; reducing greenhouse gas emissions; and ultimately reaching acceptable emission generation levels. Areas of corporate needs having particular significance for environment-related technology development in British Columbia include:

- ❖ Technologies and services that increase energy efficiency, particularly in industrial processes;
- ❖ Cost-effective alternative energy sources such as applications for biomass or industry-specific small hydro, wind and solar applications;
- ❖ Eco-efficiency technologies that enhance production and reduce transportation and other costs, (particularly for energy-intensive industries such as forestry and mining);
- ❖ Alternative fuel technologies for the transportation sector.

COMPLIANCE AND LIABILITY

Related to changing corporate attitudes with respect to environmental stewardship and management, are growing concerns associated potential liability for non-compliance with various regulatory requirements. Corporations are increasingly aware of the risks of direct prosecution of owners and board members of companies convicted of environmental negligence. The need to ensure environmental compliance, as well as to reduce costs and enhance shareholder value, is also fuelling the demand for new environmental technologies and services.

Despite the growing movement toward responsible corporate environmental management, there will always be a need for regulatory regimes to guide industry environmental behavior and practice. Such regimes also contribute to the development and adoption of innovative environmental technologies that not only deal with environmental concerns, but also have the potential to strengthen export competitiveness. A case in point is the British Columbia pulp and paper industry. It has become a world leader in technology designed for environmental compliance, largely as the result of very high standards for effluent treatment imposed in the late 1980s. The industry invested heavily in new environmental technologies and now is

recognized globally as having achieved some of the highest standards in environmental management and control systems.

Planned changes to the regulatory regime regarding the remediation of contaminated sites will greatly assist this component of the BC environment sector. An improved, risk-based system for the clean up of contaminated lands will soon become law in the province. It will replace a regulatory system widely criticized for being slow, cumbersome and complicated. This new regulatory regime will increase the scope of opportunities for private sector environmental companies to develop technologies and expertise needed to clean up contaminated sites throughout the province.²¹

CLIMATE CHANGE

Climate Change is a real and pressing driver for the development of clean energy alternatives and technologies to mitigate the disruptive impacts of adaptation. Many impacts of climate change are already evident: altered weather patterns, severe weather events and more fires, floods and droughts. These will continue to impact significantly on economic sectors of importance to British Columbia, our agricultural industries and on human health.²² Important regional concerns include the forestry sector in Northern B.C.; the impact on water resources and agriculture in the Okanagan; flood risks in the Georgia Basin watershed; and impact on coastal fisheries resulting from erosion in marine coastal communities.²³

ENVIRONMENTAL INFRASTRUCTURE

Canada has developed a vast network of roads, bridges and airports that allow us a quality of life unequalled anywhere on earth. This infrastructure – a \$1.6 trillion asset value - has deteriorated. Systems that

²¹ Final Report of the Minister's Advisory Panel on Contaminated Sites, British Columbia Ministry of Water, Land & Air Protection, January 2003. See also Ministry of Water, Land and Air Protection web site (www.gov.bc.ca/bvprd)

²² A sobering assessment of the impact of climate change on Canada is contained in Chapter 6 Vulnerability Assessment, Climate Change Impacts, and Adaptation Measures, Canada's Third National Report on Climate Change, Minister of Public Works and Government Services, 2001

²³ Climate Change Impacts and Adaptation in British Columbia: Briefing Prepared for the Senate Standing Committee on Forestry and Agriculture, Dr. Stewart J. Cohen, Science Advisor to the British Columbia Office of the Canadian Climate Impacts and Adaptation Research Network (C-CIARN), December 10, 2002

at one time made our other industries competitive – transportation, energy, communications etc., have suffered for want of sufficient funds to preserve them. The Association of Consulting Engineers of Canada estimates the shortfall at \$44 billion, of which \$17 billion is attributable to under-investment in roads and highways.²⁴ A 2002 TD Bank Financial Group special report on cities estimates that the total infrastructure shortfall is growing by about \$2 billion per year.²⁵

The Government of Canada launched a physical infrastructure program in 2000 in partnership with provincial, territorial and local governments, First Nations communities and the private sector to renew and build infrastructure in rural and urban municipalities across Canada. The Infrastructure Canada-British Columbia Program specifies a minimum 75% of the total value of all approved projects must be invested in green municipal infrastructure. The 2003 federal budget provided an additional \$3 billion for municipal infrastructure for safe and reliable drinking water systems or systems for the sustainable treatment of wastewater.²⁶ Renewing Canada's infrastructure provides a number of opportunities to showcase new sustainable construction technologies and design philosophies that involve environmentally sound materials, products and methods.²⁷

The EcoSmart™ Concrete Project is a local example of a highly successful government-industry partnership focused on reducing greenhouse gas (GHG) emissions by encouraging the use of high-volume supplementary cementing materials in concrete. The guiding principle of this Vancouver-based project is that the environmental impacts of products, services or projects can be reduced in such a way that performance and profitability are maintained or enhanced. EcoSmart concrete is being used in a range of construction projects across Greater Vancouver, from residential developments to rapid

²⁴ Tackling the National Infrastructure Deficit: Pre-Budget Submission to the House of Commons Standing Committee on Finance, Association of Consulting Engineers of Canada, September 2002

²⁵ A Choice Between Investing in Canada's Cities or Disinvesting in Canada's Future, TD Bank Financial Group Special Report, April, 2002. Available at: www.td.com/economics/

²⁶ See "An Introduction to Infrastructure Canada" at www.infrastructurecanada.gc.ca for more details.

²⁷ Innovative Technologies for Canada's Civil Infrastructure Systems, Town Hall Meetings - Forum - Phase II Background Material, Canadian Society for Civil Engineering, December, 2002. Available at www.csce.ca

transit stations. Promising new EcoSmart techniques are being explored involving blended cement and pre-cast concrete.²⁸

URBAN SUSTAINABILITY

Almost half the world's population now resides in urban settings and this migration trend is expected to continue. For many the economic benefits of urban living are far outweighed by environmental and related social ills such as lack of safe drinking water, air pollution, poor sanitation, sickness and disease, and social unrest. Achieving even modest levels of urban sustainability will require a drastic alignment of resource consumption and pollution generation in cities large and small.

As noted earlier the global demand for urban environmental solutions is expected to increase exponentially and the market demand for the Canadian expertise in this area will also increase, particularly with respect to water, wastewater and waste treatment; air quality management; transportation and sustainable infrastructure; urban environmental management expertise; landfill and solid waste practices; green building technologies; eco-industrial networking and energy conservation; and environmental management accounting systems.

In terms of the physical aspects of urban settings, British Columbia boasts an ever-increasing network of business, academic, governmental and other non-governmental interests that have the knowledge, technological capability and the networks needed to design and implement integrated environmental solutions at the community and regional level. Translating this market potential into confirmed sales will require strategies and programs to integrate the technologies and expertise of these players into internationally recognized products and services, preferably with a "Made in British Columbia Brand." The newly established Canada Green Building Council, which has a very active presence in British Columbia, also is striving to make Canada's buildings and construction processes more sustainable through a variety of educational and promotional activities, and the sharing of design practices and green building information.²⁹

²⁸ See www.ecosmart.ca for more details on this partnership.

²⁹ See the Canada Green Building Council web site for more information. (www.cagbc.ca/).

5. EMERGING OPPORTUNITIES FOR ENVIRONMENTAL BUSINESS SECTORS IN BC

On the basis of our demonstrated strengths, and taking into account these other related factors, the most promising opportunity areas for British Columbia's environmental technology and related sectors appear to be:

- ❖ Alternative energy systems;
- ❖ Fuel Cells and the hydrogen economy
- ❖ Contaminated site remediation and brownfield reclamation;
- ❖ Green building design, technologies and products;
- ❖ Sustainable communities and integrated environmental solutions; and
- ❖ Water/wastewater technologies, services and solutions.

Each of these market areas are discussed more fully in the pages that follow, with particular attention given to potential technology development opportunities and needs.

ALTERNATIVE ENERGY SYSTEMS

The BC Climate Change Panel has recommended the development of clean, zero and low-emitting technologies as the cornerstone of the provincial sustainability plan. Panel members identified the need for R&D support in such areas as fuel cells, ethanol from biomass, bio-fuels, and biomass gasification. The Province was urged to consider setting aggressive R&D targets and launching government-enabled (but industry-led) R&D programs carried out as cooperative efforts involving government, industry, academia, and service organizations.³⁰

The most promising areas for environmental technology development in the short term with respect to electricity generation are those associated with BC Hydro's commitment to small generation facilities. BC Hydro has already announced agreements in principle to purchase green energy which result in \$800 million of new private-sector investment in 16 small scale power projects. While these projects are grid connected (i.e. local in scope) they can lead to the development

³⁰ Report of the BC Climate Change Economic Impacts Panel, p. 23.

of new small scale power generation technologies that could have enormous export potential in the developing world, particularly in energy starved regions of Africa and Southeast Asia.

This does not rule out the export potential either of the technologies or expertise being developed with respect to large scale hydro-electricity generation technologies, particularly by BC Hydro's research and development subsidiary PowerTech Labs. These too could become important export commodities for British Columbia and a continuing source of innovative environmental technology.³¹

FUEL CELLS AND THE HYDROGEN ECONOMY

Fuel cells are becoming commercially available power sources for a wide range of consumer products and the enabling technology for environmentally clean transportation and power generation systems. The economic spin-off benefits of fuel cell technology, including the supply of parts and subsystems and engineering, design, testing, training and research services, could make it one of the most important, high-growth, knowledge-based industries in the province.

British Columbia has the largest concentration of fuel cell expertise in Canada, with more than 40 companies and other organizations involved in various aspects of the sector, including companies developing hydrogen fuelling infrastructure. British Columbia is also home to Fuel Cells Canada, a non-profit organization created to foster industry growth and to establish a fuel cells technology cluster in Western Canada.³² Ballard Power Systems, Methanex Corp and XCELLESIS are leading companies in this rapidly expanding BC-based industry cluster.

International competition in fuel cell technology has grown enormously. The rush to commercialize fuel cell products in the

³¹ The United Nations Environment Programme encourages electricity companies in advanced economies to share expertise and technologies to help expand access to electricity for all people. See Electricity: Industry as a Partner for Sustainable Development Series, A report prepared by E7 Network Expertise for the Global Environment, Montreal, 2002, p. 31, Available at <http://www.unep.org/outreach/wssd/docs/sectors/final/electricity.pdf>

³² Information on companies and institutions active in the fuel cell industry and the hydrogen economy in general is available at the Fuel Cells Canada web site <http://www.fuelcellscanada.ca/memberlist.html>

transportation sector has led to consortiums in Germany, Japan and the United States to create the hydrogen infrastructure needed to make economically viable the advanced technology vehicles that employ fuel cell technologies. The California Fuel Cell Partnership is developing various models to market fuel cells and a hydrogen fuel distribution system. Though the large automakers agree fuel cells are a cleaner and cheaper alternative to gasoline-powered combustion engines, the hydrogen infrastructure needed to support them has not yet been perfected. Vancouver-based General Hydrogen Inc., headed by Geoffrey Ballard and Paul Howard, the original founders of Ballard Power Systems, is working with various financing and technology partners (including General Motors) to develop fuelling systems for the next generation of advanced technology vehicles.

Powertech Labs is another local player involved in developing the hydrogen economy. It is the only company in Canada capable of testing and certifying the small, high-pressure cylinders suitable for the mass public consumption of the future. With BC Hydro, Stuart Energy Systems and Dynetek Industries, Powertech has initiated a Compressed Hydrogen Infrastructure Program to make the vision of hydrogen-fuelled vehicle travel a reality. The Program is testing the technical feasibility of high-pressure gaseous hydrogen fuelling stations. This will provide the basis for the commercialization of hydrogen fuelling station infrastructure.³³ Greenlight Power Technologies is another BC-based supplier of testing and diagnostic equipment to the fuel cell sector. The company's product line includes test stations for fuel cell stacks, components, fuel reformers, electrolyzers and fuel cell systems. This focus on fuel cell testing and diagnostic equipment is an important factor in helping companies to commercialize their products and deliver the benefits of fuel cell technology.³⁴

Many fuel cell companies in British Columbia are focusing on the knowledge development and support technologies market areas as opposed to trying to become major manufacturers of fuel cell stacks. In part this is in recognition of the enormous market power of competing jurisdictions. Despite optimistic growth rate predictions of 60% over the next decade, Canada's many fuel cell related successes do not guarantee continued prosperity in this sector. The main

³³ See the Powertech Labs web site for more details (www.powertechlabs.com).

³⁴ More information on Greenlight Power Technologies is available on the company's web site: <http://www.greenlightpower.com/>

challenges will be technological innovations from competing jurisdictions (Japan, the European Community and the United States).

The recently announced \$1.2 billion US FreedomCAR and Fuel Initiative is a case in point. Intended to reverse America's growing dependence on foreign oil by developing the technology needed for commercially viable hydrogen-powered fuel cells, the Initiative will invest \$720 million in new funding over the next five years to develop the technologies and infrastructure needed to produce, store, and distribute hydrogen for use in fuel cell vehicles and electricity generation. The Canadian auto industry in general and fuel cell technology development companies in British Columbia in particular will need to establish clear links to this and other similar initiatives if we are to retain our lead in this sector.³⁵

The Fuel Cells Commercialization Roadmap notes a number of significant interrelated challenges (all of which have implications for British Columbia) that the fuel cell sector must deal with and which will require the collaborative efforts of many stakeholders.³⁶ These include:

- ❖ **Stimulating Early Market Demand:** The high price of new fuel cell products (due in part to small production volumes) poses a prohibitive barrier to potential purchasers. Production costs and prices must come down to stimulate demand and increase production volumes.
- ❖ **Improving Product Quality While Reducing Cost:** The sector must enhance product quality and reduce production costs. The development of an effective supply chain requires fuel cell developers and systems integrators to standardize their component specifications.
- ❖ **Financing:** Securing the capital needed to move products toward commercialization is a problem facing almost every industry participant, not just in Canada, but throughout North America.³⁷

³⁵ See "The President's FreedomCAR and Fuel Initiative: A Clean and Secure Energy Future" US Department of Energy, Hydrogen, Fuels Cells and Infrastructure and Technologies Program, Available at <http://www.eere.energy.gov/hydrogenfuel/>

³⁶ Canadian Fuel Cell Commercialization Roadmap, "The Opportunity"

³⁷ Also noted in 2003 Fuel Cell Industry Survey, Survey of 2002 Financial Results of North American Public Fuel Cell Companies, Price Waterhouse Coopers, 2003. Available at www.pwc.com/ca

- ❖ **Creating Supporting Infrastructures:** Securing sufficient skilled personnel and implementing industry codes and standards will be critical to the safe introduction of fuel cell applications, particularly for the mobile sector that requires a fuelling infrastructure.

CONTAMINATED SITES AND BROWNFIELD RECLAMATION

In Canada there are an estimated 30,000 abandoned, idle or underutilized commercial or industrial properties where past actions have caused known or suspected environmental contamination, but where there is an active potential for redevelopment. In western Canada these represent an untapped opportunity to revitalize older neighbourhoods and generate wealth for communities. With the right kind of incentives and partnerships, brownfield clean ups could create thousands of jobs, millions of dollars in additional property taxes and thousands of new housing units. There is increasing recognition in British Columbia of the risks to human health, the environment, property values and economic opportunities from high concentrations of soil and water pollution. A wide range of commercial, industrial, mining and waste disposal practices going back decades have been carried out on public and private lands throughout the province.

As at October 2003 the number of known or potential contaminated sites in British Columbia totalled more than 7,000, two-thirds of which are located in the Lower mainland, the Peace River District and Vancouver Island. New sites are being added at the rate of 44 per month, and cleanups reported on average of 16 per month.³⁸ Not all of these sites pose significant environmental, health or other public safety risks. However, they do represent a growing area of business opportunities for the environment business sector in this province.

However, the entire governance structure under which contaminated sites in this province were classified, assessed and occasionally cleaned up have been judged as ineffective, cumbersome or totally lacking according to the 2002/2003 Report of the BC Auditor General.³⁹ The report noted that in the absence of long-term contaminated site management plans by most of government departments and other public agencies in the province, there has been littler incentive for the

³⁸ Statistics provided by the BC Ministry of Water, Land and Air Protection, Environmental Management Branch.

³⁹ Report of the Auditor General of British Columbia, 2002/03 Report 5, Managing Contaminated Sites on Provincial Lands. Available at www.gov.bc.ca

development of new technologies and risk assessment techniques either by agencies or the private sector. This is a contributing factor to the lack of a strong site remediation industry cluster in this province.⁴⁰

Planned changes to the regulatory regime regarding the remediation of contaminated sites will greatly assist this component of the BC environment industry. An improved system for the clean up of contaminated lands will be introduced consistent with a risk-based approach. It will replace a regulatory system widely criticized for being slow, cumbersome and complicated. These measures will increase the scope of opportunities for private sector environmental companies to develop technologies and expertise needed to clean up contaminated sites throughout the province. This sector represents an emerging opportunity area for technology development and capacity building within the industry.

GREEN BUILDING DESIGN, TECHNOLOGIES AND PRODUCTS

British Columbia is home to a world class pool of expertise related to making cities liveable. This component of the industry includes professional, academic and research expertise concerned with the design and construction of green buildings and the management of sustainable urban environments, a host of private sector and joint private-public initiatives relating to sustainable building products and construction systems, energy conservation, air and water quality management, soil and water remediation, eco-industrial networking and technology development related to alternate energy systems.

As noted by the Green Building Task Force in its draft report to the Greater Vancouver Regional District, the wave of green building construction in the U.S. is spilling over into BC and elsewhere in Canada, where the number of institutional and commercial new building and major retrofit projects registered for LEED™ certification is growing rapidly. A total of 21 LEED projects are now underway in the province (most in Greater Vancouver) and many more green building projects are in the planning stages. Some of the best examples of green buildings in North America can be found in the province.

⁴⁰ An uncompleted study of the Soil Remediation Cluster in British Columbia has confirmed this point. Contaminated Soil Remediation Technologies Cluster Analysis A Study of British Columbia Based Companies, British Columbia Environment Industry Association (BCEIA), December, 2003.

The economic benefits of green building practices have been the subject of extensive review and commentary. A very recent study completed in California notes that integrating “sustainable” or “green” building practices into the construction of buildings is a solid financial investment in that a minimal upfront investment of about two percent of construction costs typically yields life cycle savings of over ten times the initial investment. The example cited suggests that an initial upfront investment of up to \$100,000 to incorporate green building features into a \$5 million project would result in a savings of at least \$1 million over the life of the building, assumed conservatively to be 20 years. These benefits flow as a consequence of lower energy, waste disposal, and water costs, lower environmental and emissions costs, lower operations and maintenance costs, and savings from increased productivity and health.⁴¹

On a global scale, the potential environmental impacts of building cities better by employing green building technologies and products and sustainable construction methods are staggering when seen in the context of the following facts:

- ❖ The construction industry is the principal user of concrete and related building products. It is estimated that building construction, renovation and operation consume more of the earth’s resources than any other human activity. In the process, millions of tonnes of greenhouse gases, toxic air emissions, water pollutants, and solid wastes are produced.
- ❖ The built environment constitutes more than half of total national capital investment in most countries. In Europe, the built environment accounts for about 40% of energy use, rising 50% in some countries if construction activities including materials production and transport are taken into account.
- ❖ Almost half of all materials extracted from the earth’s crust are transformed into construction materials and products. When installed in a building they account for as much as 40% of all energy

⁴¹ The Costs and Financial Benefits of Green Buildings: A Report to California’s Sustainable Building Task Force, Greg Kats, Capital E Inc., Principal Author, October 2003, p. 7. Figures quoted are in US dollars. Available at http://eetd.lbl.gov/EMills/PUBS/PDF/Green_Buildings.pdf

use. When these materials enter the waste stream, they account for 50% of all waste generated prior to recycling, recovery or final disposal.

- ❖ In developed economies, the construction, operation and subsequent demolition of built facilities account for about 40% of all energy end-use and a similar percentage of greenhouse gas emissions. Overall, the built environment is the largest single contributor to greenhouse gas emissions.

Changing the way buildings are designed, built and maintained constitutes the construction industry's most significant potential contribution to sustainable development. Indeed, the potential for reducing greenhouse gas emissions in existing and new buildings is greater than that of any other sector, and represents one of the more readily applicable ways to reach the targets laid down in the Kyoto Protocol. British Columbia stands on the threshold of an important area of sustainability-related business opportunity with respect to green building practices and construction.⁴²

SUSTAINABLE COMMUNITIES AND INTEGRATED ENVIRONMENTAL SOLUTIONS

Many experts now recognize the value of an ecological approach in dealing with pressing environmental problems. In urban settings this approach involves policies and activities that emphasize environmentally sound waste management and disposal practices; air and water quality management; the promotion of energy efficiency; the incorporation of eco-logical principles and techniques in city planning and development activities; and facilitating the active participation of the private sector and local communities in the process of governance. Urban environmental solutions typically involve numerous players and a combination of tactics ranging from public education programs, private-public partnerships, regulation, market-based incentives, government funded programs and community-based voluntary initiatives.⁴³

⁴² British Columbia's strength with respect to 'Building Cities Better' will be showcased at GLOBE 2004, along with the EcoSmart Partnership project. See <http://www.globe2004.com/> for details.

⁴³ See *Strategies and tools for urban environmental improvement*, Human Settlements Programme, International Institute for Environment and Development, London. Available at www.iied.org

British Columbia has many examples of initiatives involving broadly-based public-private partnerships focused on the development of integrated solutions to pressing environmental problems. These include:

- ❖ **The Sustainable Region Initiative (SRI)** of the Greater Vancouver Regional District (GVRD) is an extension of reviews of the region's Liveable Region Strategic Plan and Air Quality Management Plan focusing on sustainability – social, economic and environmental as a fundamental objective. SRI involves a major community engagement process and a policy framework for management of social, economic and environmental affairs of the region.
- ❖ **The cities^{plus} Initiative** was the Canadian submission to an international sustainable urban systems design competition sponsored by the International Gas Union (IGU) representing more than 62 countries. First prize was awarded to the winning Canadian entry, based on Greater Vancouver Regional District plan.⁴⁴
- ❖ **The Georgia Basin Ecosystem Initiative** is a set of action plans to improve air quality, reduce and prevent water pollution, conserve and protect habitat and species, and support community-based environmental and sustainability initiatives in four priority areas: clean air and climate change; clean water; natural habitat and species conservation; and planning for sustainable growth.⁴⁵
- ❖ **The Georgia Basin Futures Project (GBFP)** is a project exploring ways to achieve long-term sustainability by reconciling limits to the ecological carrying capacity of the Georgia Basin to human well being over the next 40 years. The project seeks to increase public understanding of how ecological, social and economic systems interact and how to achieve a sustainable future through a powerful, user-friendly game (QUEST) that allows people to explore their own visions of the future of the region.⁴⁶
- ❖ **The Fraser Basin Council** is a not-for-profit, charitable organization established to facilitate problem solving and decision making that balance social, economic and environmental values. The Council publishes sustainability indicators and works to strengthen rural and

⁴⁴ A Sustainable Urban System: The Long-term Plan for Greater Vancouver, cities^{plus} The Sheltair Group Inc., Vancouver, 2003

⁴⁵ More information on the Georgia Basin Ecosystem Initiative is available at www.pyr.ec.gc.ca/georgiabasin/reports/5_year_perspective/report_c1_e.htm

⁴⁶ More information on the Georgia Basin Futures Project is available at <http://www.basinfutures.net/>

aboriginal communities through sustainable development principles.

- ❖ **The International Centre for Sustainable Cities (ICSD)** is a Vancouver-based organization that promotes sustainable urban development around the world through demonstration projects using Canadian experience and technologies to help deal with problems of rapid urbanization. Its efforts focus on shelter and land use planning, infrastructure development, clean air and potable water, waste management, institution building, training programs, public participation and transfer of relevant Canadian technologies.
- ❖ **The City of Vancouver** has launched an ambitious Sustainable City endeavour involving a wide array of urban design, green space development and urban environmental management initiatives preparatory to the 2010 Winter Olympics and the development of the Southeast False Creek area of the city.
- ❖ Both **Simon Fraser University** and the **University of British Columbia** have specialized institutes/centres dealing with sustainable development and urban environmental management education.

Other community-wide sustainability initiatives include UBC Sustainable Campus Policy, and Whistler's goal of becoming the world's first sustainable resort destination. The expertise and knowledge associated with these and other BC-based urban environmental management initiatives will be showcased at the World Urban Forum and United Nations Conference on Human Habitation (Habitat+30) taking place in Vancouver in 2006. They will also be very much a part of the 2010 Olympics, which organizers of the 2010 Vancouver Bid have labelled as the first truly "sustainable Olympics".

These various initiatives are part of an environment-related "innovative milieu" that has developed in British Columbia – particularly in the Lower Mainland - built on quality of place strategies that combine the cultural attributes of tolerance and openness with lifestyle amenities associated with attractive built environments and sustainable natural ones. Inherently social and interactive, such milieus nurture the development of talent pools "disposed to cooperate for mutually beneficial ends as well as to compete for individual advantage."⁴⁷

⁴⁷ Why Cities Matter: Policy Research Perspectives for Canada, Neil Bradford, Canadian Policy Research Networks Inc., Ottawa, 2002, p.32. Available at <http://www.cprn.org>

While on the surface these initiatives may not appear particularly focused on environmental technology, they have the potential to be the most important enabling factor in the development of “packaged solutions” to environmental and sustainable development problems, particularly in the developing world. British Columbia’s strengths with respect to environmental innovation and the business of the environment are not well coordinated across the broad spectrum of integrated sustainable development and environmental solutions.

Many BC firms do well at winning contracts for environmental planning, institution building, regulatory infrastructure and monitoring and evaluation. They are less successful in developing and financing large-scale build-operate-transfer (BOT) or build-own-operate-transfer (BOOT) projects because of limited human and financial resources. The solution is to build a critical mass through partnering arrangements with larger Canadian companies (Terasen, BC Hydro, Alcan, etc.), and to be able to offer foreign partners or clients contacts, intellectual resources, specialized environmental expertise and proven integrated environmental solutions for communities and regions large and small that complement the technology strengths that firms throughout the industry can offer.

As noted by the OECD, such public- private partnerships are key to developing environmental technologies that can contribute both to sustainable development and industrial competitiveness. Partnerships help overcome the fact that most governments are constrained with respect to their research and technology budgets, and can stimulate innovation in developing integrated processes and clean technologies that might not otherwise be pursued by industry on its own. Partnerships help overcome information gaps, facilitate the involvement of smaller firms, and help to demonstrate the cost-effectiveness of new technologies.⁴⁸

WATER/WASTEWATER TECHNOLOGIES, SERVICES AND SOLUTIONS

As was noted earlier, a recent assessment of the water/wastewater industry concludes that British Columbia has the potential to become a world leader in this area attracting capital, manufacturing and

⁴⁸ *Technology and Environment: Towards Policy Integration*, OECD, Directorate for Science, Technology and Industry, Committee for Scientific and Technological Policy, 1999, p. 5. Available at www.oecd.org/dataoecd/58/2/1898311.pdf

increased domestic and international revenue to the BC economy.⁴⁹ This cluster includes over 330 companies involved in the manufacture of small to medium-sized water and wastewater treatment systems; stormwater management; and groundwater remediation and water reuse technologies. It has a healthy balance between technology developers and manufacturers, systems integrators and consulting services, including policy and demand-side management expertise. A recent overview of opportunities for Canadian companies in IFI-financed water and sanitation projects notes that Canadian firms tend to win consulting contracts, as opposed to those for goods procurement. This is a reflection of the relative size of Canadian firms compared to larger corporations from OECD countries and their subsidiaries, particularly in locations where control of large-scale water supply projects have been privatized. Canadian firms win contracts in "micro" areas of unique engineering or systems consulting expertise.⁵⁰

Interestingly, the United States supplies close to 90% of water/wastewater technologies and related goods used in Canada. There are healthy prospects for demand growth in the domestic market simply through strategies focused on import substitution. In the long term, however, it is the global marketplace where British Columbia water-related companies could prosper. Demand in these markets will be fuelled by emerging water shortages, the deterioration of water quality due to population growth, industrialization, lack of adequate sewage systems and excessive use of agricultural pesticides and fertilizers.⁵¹ British Columbia companies are well positioned to provide improved sewage handling and water recycling systems for the international marketplace.

To successfully penetrate these markets our companies must form trade consortiums that are market or technology solution specific. For example, the Netherlands has since the 1950s developed a water

⁴⁹ SWOT Analysis of the Water -Related Environmentally Sustainable Technologies in British Columbia: An Executive Summary, Prepared by the Centre for Sustainable Communities Canada for the BC Environment Industry Review, Sept. 11, 2003., p.2

⁵⁰ Market Brief Opportunities for Canadian Companies in IFI-Financed Water and Sanitation Projects, Department of Foreign Affairs and International Trade, Report prepared by Ranjani Sankaran, Office of Liaison with International Financial Institutions (OLIFI), Canadian Embassy, Washington, Available at <http://www.infoexport.gc.ca>.

⁵¹ See Global Water Outlook to 2025: Averting an Impending Crisis, Mark W. Rosegrant et al, International Food Policy Research Institute, Washington, D.C., 2002.. Available at www.ifpri.org/media/water2025.htm

engineering consortium of some 22 companies that has now established over 144 offices worldwide. This has allowed these relatively smaller firms that operate in a small domestic market, to compete against French, German, British and even American multinationals.⁵² This approach is reinforced in a recent, but as of yet unpublished Industry Canada competitiveness survey update of the Canadian environment industry. It confirms that Canadian companies must focus on innovation and increasing their domestic strength by replacing environmental goods and services imports. Winning major projects in developing countries will require gaining critical mass through integrated environmental solutions and the fostering of partnerships and collaborations.

There is also a significant niche market available at home yet to be developed. Only 63.3% of the population of British Columbia is served by secondary or better level of waste water treatment facilities (1999). Compared to other provinces, BC only ranks ahead of New Brunswick (62%), Quebec (54%), PEI (20%), and Newfoundland (12%).⁵³

⁵² Extract from the Summary of the Water-related Environmentally Sustainable Technology Report, "The State of the Export Market", prepared by Reibling and Finnegan, p. 9.

⁵³ Environmental Indicator: Mitigating Environmental Impacts in British Columbia, "Wastewater Treatment across Canada in 1999", BC Ministry of Water, Land and Air Protection, 2002. Table 2, p. 4. Available at http://wlapwww.gov.bc.ca/soerpt/pdf/9mitigation/Mitigation_2002.pdf

6. ENABLING AND IMPEDING FACTORS AFFECTING BC'S ENVIRONMENTAL SECTORS

ENABLING: SUPPORTIVE INDUSTRY CLUSTERS

One of the most compelling enabling factors supporting environmental technology development in British Columbia is the presence of supportive industry clusters consisting of small-scale firms cooperating with one another and with public sector institutions in the pursuit of what one expert calls "knowledge-intensive production to achieve global competitiveness."⁵⁴

Such clusters enable private companies, government agencies and local educational institutions to collaborate openly without compromising individual identities or sacrificing independence. These clusters exhibit:

- ❖ A shared understanding of the importance of co-operation in providing competitive advantage.
- ❖ A bias toward action and a focus on removing obstacles and easing constraints.
- ❖ An integrative structure that encourages wide involvement of participants and associated institutions.
- ❖ Shared leadership with active government participation, rather than government control.
- ❖ The creation of formal organizational structures and ongoing programs.

Fuel Cells Canada is BC-based cluster that combines corporate research and development and government programming with respect to fuel cell technology. Its mandate includes promoting the Canadian fuel cell industry in the global market and encouraging a national strategic approach for the development of the industry.⁵⁵

⁵⁴ Why Cities Matter: p. 30.

⁵⁵ See also An Integrated Strategy for British Columbia's Technology Clusters: A White Paper, British Columbia Technologies Industry Association, October, 2003. Available at www.bctia.org/files/White_Paper/

As Adam Holbrook notes in his assessment of the biotechnology cluster in Vancouver, technology-based clusters “are anchored by strong research universities, industrial laboratories and entrepreneurial companies, with human capital and infrastructure to match. Collectively these clusters form regional and national systems of innovation.”⁵⁶

ENABLING: GOVERNMENT ASSISTANCE PROGRAMS

Government departments such as Industry Canada, Environment Canada, NRCan and the Department of Foreign Affairs and International Trade (DFAIT) support enterprises in the environment sector. Industry Canada promotes companies through such tools as the Canadian Environmental Solutions information database and its Website; the Environment Industry Virtual Office; and the Business Environmental Performance Office. DFAIT provides international market intelligence, while Environment Canada’s many laboratories and funding programs play a vital role in advancing environmental technology development.⁵⁷ Similarly a number of provincial programs are available that provide assistance or information support for various aspects of the industry.

However, many small and medium sized firms in the sector believe that most government assistance programs are cumbersome to work with and are generally unavailable at the most critical stages of technology development and commercialization. BC firms interviewed as part of the water/wastewater cluster analysis were not familiar with most federal government programs and most had not heard of the CETAC program. This is consistent with the earlier review of the BC environment industry where it was found that over 90% of exporting firms reported they had not received any financial assistance despite the existence of several export promotion programs.⁵⁸ Those who had used such programs reported the assistance received was hard to obtain; often late; and administered by processes that were cumbersome, bureaucratic, and time-consuming.

⁵⁶ *The Biotechnology Cluster in Vancouver*, J. Adam Holbrook, Simon Fraser University, Centre for Policy Research and Technology, 2003, p.2

⁵⁷ *Environment Industry*, Sector Competitiveness Frameworks Series, Business and the Environment, Industry Canada. Available at strategis.ic.gc.ca/

⁵⁸ *Positioning for Growth in the 21st Century*, p. 16

The issue is broader than simply improving access to the existing array of government programs. The most effective nexus between technology development and environmental policy according to the OECD, involve:

- ❖ **Giving effective incentives** – Environmental regulations and other well-designed policy instruments are generally more effective as incentives for the adoption of new technologies, though direct and indirect financial incentives can also prove useful.
- ❖ **Promoting clean technologies** – Government programs should focus on disseminating clean technologies which entail changed production processes rather than add-ons or end-of-pipe solutions.
- ❖ **Targeting sectors and problems** – The most effective support programs are those that target specific industrial sectors or environmental problems.
- ❖ **Orienting programmes locally** – Programs should reach and interact with enterprises as close to home as possible. The best programs incorporate both local and national elements.
- ❖ **Providing integrated services** – The integration of information sources and technology diffusion into broad co-operating networks greatly facilitates ease of access for clients and users.⁵⁹

The success parameters outlined by the OECD should be an essential part of the agenda of the planned Environmental Technologies Forum.

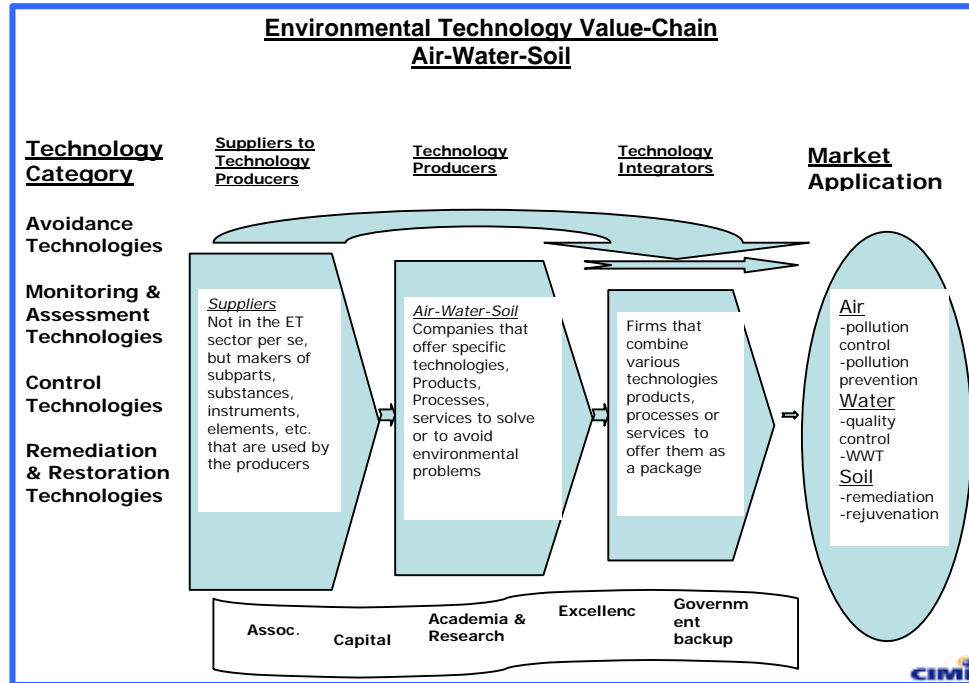
IMPEDING: SMALL AND MEDIUM SIZED ENTERPRISES

As noted earlier, most firms active in this sector are small to medium-sized enterprises. While many are noted for the high quality of their technologies and services, most lack the money or managerial capacity to engage in extensive technology development or market expansion activities. Small and medium sized enterprises such as these need reinforcement along the lines of the value-chain shown in the diagram below.⁶⁰ Such enterprises need to know each other and to understand their suppliers and their markets so they can better define complementarities and form partnerships. They need to be aware of

⁵⁹ *Technology and Environment: Towards Policy Integration: "Government Programmes for Diffusing Environmental Technologies"*, p. 51

⁶⁰ Source: Ben Assen, Senior Business Analyst, Canadian Institute for Market Intelligence.

available supports from various government programs and what research facilities and capacities are available to them.



They need to be able to attract investment community interest in their products and services. In short, they need a business environment that:

- ❖ Reinforces research and development for innovative technologies;
- ❖ Provides accurate market intelligence on the global marketplace (and the Asia Pacific market in particular); and
- ❖ Provides local demonstration sites to showcase new technologies, processes and products to foreign buyers seeking solutions to environmental problems.

The Canadian Institute for Market Intelligence suggests that one end result of the planned Environmental Technologies Forum could be an initiative to address these and related SME issues across Western Canada. Another positive effort that could help in this regard is to provide higher profile to awards that celebrate the excellence of small enterprises. The Canadian Institute of Energy (B.C.) Energy Awards is one example of an awards program that recognizes achievements in the British Columbia energy and environment sector. The GLOBE

Foundation Awards for Environmental Excellence are another example of recognition that is actively sought and highly valued.⁶¹

IMPEDING: LACK OF VENTURE CAPITAL FINANCING

A persistent theme in all recent surveys of the environment industry has been the concern expressed by many managers over the lack of available financing for the development and commercialization of their technologies. Some hold that more government funding should be made available for research and development, demonstration projects and market penetration efforts. Others decry the lack of available venture capital.

There are many factors limiting access to such funding for environmental technology development, including: unpredictable commercialization pathways; lack of management experience; the risk of liabilities; and lack of adequate data on technical performance. Another key reason is that many promising technologies simply go unnoticed by the financial community for want of showcase venues. Many potential investors turn away from deals involving start-up companies with little or no prior business experience. Technical expertise does not necessarily translate into management skills and many companies have found it necessary to include partners with solid business backgrounds in order to attract investors. Similarly, companies with new, untried environmental technologies are often at a disadvantage in terms of developing performance data for their products. Few investors are willing to risk financing an untried technology.⁶²

However, growing investor interest in green technology is reported by the Cleantech Venture Network. Cleantech organizes venture forums, provides deal flow, publishes its venture monitors and offers related services to investors and entrepreneurs. In 2002, just under \$1.1 billion was invested in 179 emerging clean technology companies. Nearly 100 Cleantech companies were venture funded in the first half of 2003, doubling its venture capital market share to 8% during the first two

⁶¹ Jointly sponsored by the GLOBE Foundation and The Globe and Mail, this national awards series recognizes the contributions of Canadian enterprises to environmental excellence within Canada and around the world through creativity, initiative and leadership. See www.globe.ca for more details.

⁶² Green Technologies: Markets, Competition and Barriers: New Paradigms for Natural Resources, Dan Yurman, 1994 dyurman@igc.apc.org

quarters of 2003 from 4% in 2002. While energy technology is a key investment segment of interest, clean technology investors are diversifying into other clean technology segments including more efficient materials, air quality and water purification.⁶³

For most small start up companies, however, the reality of investment financing is that very few are successful in attracting venture capital. Investors invariably look for: senior executives on the management team who have experience in building successful companies; a proprietary technology in a sector viewed by the venture capital industry as having terrific market potential; a top-notch technical team; a substantial target market; and experience in selling to solid customers. Cash flow is everything. Without it, potential investors will be wary, regardless of how attractive the technology in question might otherwise appear.

IMPEDING: RESISTANCE TO CHANGE

One of the disturbing findings of the water/wastewater cluster analysis was that when foreign delegations visited British Columbia to see new technologies in action, too often they were told that the technology in question was not used in a Canadian urban setting due to regulatory constraints. At the core of the problem are risk aversion tendencies of municipal regulators prompting continued use of traditional solutions (i.e. old technologies) for urban environmental applications. While provincial legislation may exist that permits the use of innovative technologies for water reuse, all too often these technologies are met with apprehension at the municipal level. As one stakeholder observed risk is a sensitive issue for operators of municipal infra-structure facilities, and the adoption of innovative solutions for water and wastewater treatment (which have a direct impact on human health) is often avoided. All too often such facilities use technologies that have been developed over 20 to 30 years ago. While the secure and risk avoidance track record of such technologies is commendable, other inefficiencies are embedded which can be eliminated if newer solutions are adopted.⁶⁴

One measure that could help overcome municipal reluctance to adopt innovative environmental technologies is to reduce the associated risks, particularly with respect to water/wastewater and

⁶³ See www.cleantechventure.com for more information.

⁶⁴ Source: Anton Kuipers, Director, Leading Edge British Columbia

solid waste services. Developers often are not willing to pay Development Service Charges for stormwater systems because they plan to install alternative systems. Municipalities, on the other hand, are concerned about funding stormwater systems retroactively if the developer's alternative system fails. Another way to reduce risks is to do more evaluations of pilot projects involving such technologies, including post-occupancy assessments of green buildings to see if the benefits promised are delivered in actuality.⁶⁵

IMPEDING: LACK OF A BRITISH COLUMBIA BRAND

Providing a 'single window on the world' to present British Columbia as a premier source of innovative technology and expertise and the place for practical solutions to environmental problems will help establish international recognition of the 'BC brand' for environmental excellence. This hinges on creating a supportive environment where private companies, business service providers, research institutions, government agencies and educational institutions can come together in a non-competitive collaboration without compromising their individual identities or sacrificing their independence.

The GLOBE Foundation, through its biennial GLOBE Series events, has done a great deal to place British Columbia in general and Vancouver in particular on the international map with respect to the business of the environment. However, there has never been a comprehensive, sustained or focussed marketing effort mounted by the either industry or government to 'brand' British Columbia for its excellence in these matters. Such an effort, skilfully managed by public relations and/or marketing specialists could prove highly advantageous. Its dimensions could include print and on-line media, trade fair and conference presence, common promotional themes and materials for private companies and government agencies, and targeted site visits, in-bound buyer missions and outbound trade delegations (à la Team Canada).

⁶⁵ Source: Nancy Knight, Director, Demand Side Management, Greater Vancouver Regional District. She notes this problem is not restricted to the water/wastewater sector. Until recently there was a general lack of interest in sustainability from the construction sector, its clients and other related stakeholders. The construction industry remains resistant to changes in construction methods, building material uses, or technologies that involved risks or extra costs.

7. STRATEGIC INITIATIVES FOR BC'S ENVIRONMENTAL BUSINESS SECTORS

Based on the foregoing analysis, a number of strategic initiatives have been proposed by many of the stakeholders consulted. These are:

- ❖ Marketing British Columbia's environmental excellence
- ❖ Establishing Centers of Excellence
- ❖ Creating demonstration projects
- ❖ Providing Innovation incentives
- ❖ Attracting investment financing and venture capital
- ❖ Mentoring SME environmental enterprises

MARKETING BRITISH COLUMBIA'S ENVIRONMENTAL EXCELLENCE

The authors of the water/wastewater cluster report noted as 'Strength' in their analysis that globally there is a water crisis, thereby creating a market for Canadian-branded environmentally sustainable technology. On the opposite side of the ledger was recorded as a 'Weakness' the fact that there was an obvious lack efforts to consolidate industry producers under the context of a "Certified Canadian Brand for Export".

As noted earlier, providing a 'single window on the world' to present British Columbia as a premier source of innovative technology and expertise and the place for practical solutions to environmental problems will help build international recognition of British Columbia's environmental excellence. The biennial GLOBE Series events - one of the most widely recognized international gatherings on the business of the environment has helped considerably to build international recognition of British Columbia as a centre of excellence on environmental matters.

There is, however, a need to go beyond periodic trade shows and conferences. There needs to be a deliberate and coordinated campaign involving all of the many companies, academic and research institutions, government agencies and business associations focused on delivering a consistent and positive message that British Columbia is home to a vast array of expertise, technologies and

practical solutions designed to deal with environmental problems and sustainable development priorities anywhere in the world.

This is basically a marketing initiative and like any market penetration strategy, it must be backed up with solid, up-to-date market intelligence. The various surveys cited in this report have all called for better ways to identify market opportunities, both by sector and by world regional area. The high demand for comparatively advantageous environmental technology solutions that we have or are currently developing means we will have serious competition, particularly from European Union and American concerns. For this reason, the branding initiative has to be carefully choreographed so as to reach the right market audiences in languages that they understand. It has to be supplemented by site visits, focused trade fair/conference presentations, sponsored buyer missions, demonstration projects and on-line and printed information.

The branding should also emphasize that British Columbia is the place to come to for integrated solutions to complex environmental and sustainability problems. Of necessity, through the various government-industry clusters that are being proposed herein, and though government assistance initiatives that may flow from the Environmental Technologies Forum, substance must be given to this assertion. In other words, British Columbia must "walk the walk" as well as "talk the talk."

ESTABLISHING CENTRES OF EXCELLENCE

The various national and international examples cited in this report demonstrate the importance of focusing the varied talents, expertise and resources available through the medium of centers of excellence or clusters of players pursuing common objectives and markets as providers of integrated environmental solutions. The enabling power of government-industry clusters and associated centers of excellence are readily apparent in British Columbia with respect to fuel cell technology, bio-technology, healthcare/life sciences, and new media. Such centers build on the innovation milieu present in British Columbia and provide practical vehicles for risk reduction associated with technology development, commercialization and investment attraction. Two sectors that should be considered at the outset include: Green Buildings and Sustainable Construction, and Water/Wastewater.

Green Buildings and Sustainable Construction: Such a Centre could undertake a number of strategic initiatives, such as those recommended by the GVRD Green Building Task Force to advance the spread of green buildings and sustainable construction practices far beyond the Greater Vancouver region.

- ❖ **Linking Green Buildings to Infrastructure Requirements:** A green building information strategy would establish the link between green buildings and infrastructure, and identify potential savings with respect to infrastructure and utilities needs.
- ❖ **Linking Green Buildings to the Kyoto Protocol:** Linking lower energy consumption for space heating, lighting, air conditioning and equipment would reduce the environmental impacts associated with energy generation and building operation, contributing to our Kyoto targets.
- ❖ **Improving the Regulatory Context for Green Buildings:** Developing models and best practices for local codes, by-laws and building standards would help foster green building innovation.
- ❖ **Linking Green Buildings to Financial and Economic Considerations:** Developing accessible business-case scenarios for green buildings would demonstrate the short and long-term economic benefits for developers and building owners.
- ❖ **Creating Consumer Demand for Green Buildings:** A program to educate residential consumers and commercial tenants of the benefits of green buildings will increase market demand and promote a wider buy-in by construction and property development companies.
- ❖ **Developing Local Expertise and Products:** Programs to develop green building expertise and to make available proven technologies and products will stimulate the demand for green building products.
- ❖ **Developing Demonstration Projects:** Demonstration projects to show the benefits of green buildings and sustainable construction practices will lower perceptions of associated risks to developers, building owners and the public at large.
- ❖ **Establishing Partnerships for Funding and Implementation:** Creating partnerships between governments, building industry organizations, local utilities and non-governmental groups for the funding and implementation of green building programs would greatly assist in transforming the building industry.

- ❖ **Linking Green Buildings to Servicing Plans:** In the longer term, the development of integrated community and infrastructure/utility servicing plans will foster a willingness to innovate in terms of green building design and shared infrastructure services.⁶⁶

Water/Waste Water: Similarly there is need to help the water/waste water sector in British Columbia to develop into a world-class cluster capable of attracting scientific expertise, financial capital and buyers to this province. A centre of excellence in this area could support technology development and commercialization by providing technology certification and verification services; testing, demonstration and laboratory services; support to secure patents, trade-marks and intellectual property rights; international marketing and market intelligence support; and university-based educational support. Other activities that could help to commercialize water/wastewater technologies could involve the development of programs designed to:

- ❖ Incubate innovative technologies and assist with technology design and development;
- ❖ Link technology innovators with national and international funding agencies and investors;
- ❖ Provide technology and market intelligence to reduce investor risk;
- ❖ Advise government on technology change implementation;
- ❖ Establish protocols for and manage pilot studies and demonstration projects;
- ❖ Establish design standards & regulations in the sector;
- ❖ Provide scientific review, testing, and certification for water/wastewater solutions; and
- ❖ Provide networking for academia and government.

Another major service that could be provided by such a centre would be to expand the local market base for British Columbia companies by encouraging the adoption of innovative technologies and solutions developed in the province by municipalities, resource industries and other users. An import substitution strategy could have considerable impact in this regard.

⁶⁶ A Strategic Framework for Green Building in Greater Vancouver, p 3

Other Sectors: It is too early to determine whether there is need for similar cluster initiatives or centres of excellence in other components of the environmental business sector. Contaminated site remediation and air quality management are two areas of growing importance for a variety of reasons. However, there does not yet appear to be sufficient critical mass in either of these areas to warrant such action at the moment. In any event, the first step in such a process would be the strengthening of an industry association encompassing either or both areas to set the stage for further review in the future.

CREATING PRACTICAL DEMONSTRATION PROJECTS

Throughout this report reference has been made to the need for Demonstration Projects to showcase technologies and related expertise developed in British Columbia. There was mixed opinion among the stakeholders consulted during the preparation of this report on the merits of such projects. While some argued they were essential to showcase our excellence, others noted that funding demonstration projects on an ad hoc basis was not advisable. In effect, there was concern that isolated demonstration sites, facilities or program initiatives would only be 'half measures' that would fail to change industry practices or to attract new customers. Several respondents noted that strategies and demonstration initiatives launched in the wake of the Positioning for Growth Report failed for these very reasons.

Several respondents noted that governments should consider demonstration project strategies that reduced the financial risks associated with technology development; that built on proven strengths; which created an environment for collaboration; and which provided real-world incentives for governments and industry practitioners to change their ways of doing business. One example cited is the eco-industrial networking project at Maplewood in North Vancouver. This project involves a partnership where all participants were expected to contribute to the development of technologies that eventually could be exported.

Other examples cited involved firms in the construction sector that could be encouraged to build green buildings if governments (at all levels) inserted green specifications into bid documents and helped in the marketing and promotion of success stories. In this way, such firms would become more involved in the process of technology

development and verification and would see themselves as part of the solution rather than as the problem.

Another demonstration project concept suggested was a large scale integrated demonstration program with a "Buy BC" or "Buy Canada" integrated multilevel risk reduction component that was supported by senior and local governments. This would be linked to a "smart energy, water, environmental village" – a living/working showcase of world class technologies and integrated environmental solutions developed in British Columbia. Such a showcase could demonstrate the real world advantages of a variety of green technologies in a large urban setting (i.e. solar, gray water, black water, fuel cell, geothermal, smart energy and solid waste solutions etc.)

An overseas example of such a 'living demonstration project' is the Ecolonia development in the Netherlands involving the construction of a residential complex of 101 single family dwellings built in an energy-saving, environmentally conscious manner. The dwellings were designed to be suitable for mass production, not targeted toward a specific group, and making use of as many 'natural' elements as possible.⁶⁷

In British Columbia there are several high profile international opportunities where local expertise and technologies can be showcased. These include in addition to GLOBE 2004 (and subsequent biennial GLOBE Series events) the 2006 World Urban Forum and Habitat+30 events in Vancouver, and the 2010 Olympic Games. The World Urban Forum will involve an international conference, a trade show/exposition on urban issues, an awards/best practices program, a series of field visits and study tours etc., that will showcase Vancouver designs, services, technologies, culture and arts related to sustainable urban environments. Habitat+30 will be a reprise of the original World Habitat event which took place in Vancouver in 1976.

The 2010 Winter Olympic Games will be an important focal point for a series of international events and demonstration projects between now and the actual games that will showcase Vancouver's achievements in corporate environmental responsibility and sustainable urban design and management. Indeed, the concept behind the winning

⁶⁷ Details on this and many other similar projects are available at web site of the European Good Practice Information Service
<http://www3.iclei.org/egpis/citylist.htm>

Canadian bid for the 2010 games was "the first Sustainable Olympics". Sustainable concepts, technologies and environmental management practices will be central to the planned legacy of the games. Already these concepts are being worked into the design of facilities, the necessary transportation systems upgrades, and in the development of sustainable principles and practices that will be transferable to any type of sporting event. For Vancouver and Whistler, the 2010 games will provide several high profile opportunities for technology showcase demonstration sites such as suggested with respect to the environmental village concept outlined above.

In general it was suggested that the most effective approach to demonstration projects was to support projects that: built on our market strengths; encouraged the formation of partnerships between governments and industry; removed impediments to innovation; encouraged the private sector to provide the technologies and expertise needed to solve real world problems; and created a climate of innovation and experimentation.

PROVIDING INNOVATION INCENTIVES FOR EARLY ADOPTERS

Research conducted for the GVRD's Economic Development Strategy Group and the Sustainable Region Initiative included a report by Jeb Brugmann, former secretary-general of the International Council for Local Environmental Initiatives.⁶⁸ Brugmann recommended a number of strategies for building sustainable industries, including several involving incentives for the early adoption of innovative technology. These include:

- ❖ Establish a regional business leaders' forum to provide focused private sector leadership and a voice on key sustainability issues and opportunities facing Greater Vancouver.
- ❖ Develop cluster (or sub-cluster) strategies to support local business growth and attraction in sustainability areas where further research confirms the existence of distinct regional capacities and advantages (i.e. sustainable agriculture, sustainable tourism, the hydrogen economy, sustainable forest products and sustainable building and design).
- ❖ Develop targeted programs to support the re-design, re-engineering, and retrofitting of production processes and product

⁶⁸ Profiting from Sustainability: p. 6

lines to increase business resource efficiency and waste reduction in specific sectors, particularly those that face intense competition from other city-regions or that compromise local liveability objectives.

- ❖ Develop more effective mechanisms for regional strategy and cooperation between government, business, university and research communities, and the non-profit community that do not necessarily depend upon a central role for regional government.

One suggestion worth considering is to link infrastructure renewal dollars to the degree of innovation and local content an organization (i.e. municipality) has included in its funding submission. This could create a stronger presence for local entrepreneurs in local markets without being perceived as a hand-out to the industry.⁶⁹

A series of focused workshops and seminars might also be considered on environmental technologies and services for industries and municipalities. These events could enhance the branding of Western Canada environmental solutions; reinforce our human and intellectual capital by attracting and keeping our local talents; improve operational efficiency; explore strategies to mitigate the risks for environmental technology entrepreneurs and their municipal clients; further promote and develop environmental technology innovation; better identify new market opportunities; and facilitate access to capital for environmental technology companies.

ATTRACTING INVESTMENT FINANCING AND VENTURE CAPITAL

Part of the support to SMEs in the sector should include guidance on how to prepare a financial offering or business plan for potential investors or government support agencies. This is absolutely crucial in order to convince potential investors that the technology and/or company in question is a safe prospect. Part of the process of attracting venture capital to this sector will be the ongoing support provided to individual companies to prepare their presentations and supporting documentation in order to overcome concerns about risk, performance capabilities, potential liabilities or managerial acumen.

Even more fundamental, however, is the need for visibility. As noted, many promising technologies simply go unnoticed by the financial

⁶⁹ Source: Anton Kuipers, Director, Leading Edge British Columbia

community for want of showcase venues. To deal with this problem, it is suggested that high profile investor forums be initiated to bring potential investors from across North America and Asia to Vancouver on a regular basis in search of opportunities. These forums could be held as part of regular environmental business events such as the GLOBE Series, or be fashioned as independent undertakings. In any event, they should take place at a minimum of once a year, and should be underwritten if necessary in the initial years to help gather the necessary momentum to put British Columbia on the 'green investment map.' This could become a regular high profile event for the sector and an important piece in building the "British Columbia brand for environmental excellence."

Again the caution is worth noting that few high technology start ups are successful in attracting venture capital financing. Well thought out business plans and funding proposals are essential. However, they do not guarantee successful financing. Investor confidence in the technology in question, the potential markets, and the technical and managerial skills of the company are paramount considerations.

Another mechanism that could be considered is the provision of fiscal incentives to stimulate capital investment in the environmental business sector. Such measures

PROVIDING MENTORING FOR SME ENVIRONMENTAL ENTERPRISES

All survey respondents have noted the problems faced by small and medium sized enterprises in the sector: small size, limited financial and technology development resources, and difficulties in servicing distant clients/markets. There are many generic small business assistance programs and guides available for such firms - on-line or at local academic institutions. Very few focus on helping small start up enterprises bridge the divide between technological and scientific expertise (generally well developed) and financial or business skills (generally in short supply). Simon Fraser University has made some important initial strides in this regard, but there is need for more focussed mentoring to guide companies through the difficult early stages of product development and commercialization. Preferably, this assistance should be delivered through (or jointly with) environment industry associations.

Whatever industry support programs are developed, they must help bring these enterprises together (through consortiums) to increase their

capacity to partner with larger firms bidding for work in domestic and international markets. The World Bank and other international development agencies insist that executing agencies form solid working relationships with local partners. Local partners bring extensive local knowledge and support to any project and can play a key role in establishing, developing and maintaining a professional relationship with the executing agency.

Recent experience has shown that research and development grants, low-interest loans and other financial assistance measures have limited value in terms of helping SME's to stay the course. As one respondent noted in a stakeholder review meeting, every dollar spent on R&D could lead to an additional \$3 required for a successful pilot project and eventually \$7 to develop a commercial product. An additional \$10 for marketing and advertising could be required before the technology in question achieves a profitable rate of market penetration.

The point of this anecdotal observation was not that governments should fund every potentially viable new technology proposal to this extent. Rather, the point is that small companies need mentoring and support in a variety of forms over the long term. Any technology development support strategies developed in the wake of the planned Environmental Technologies Forum will have to deal with these realities and should provide some or all of the following:

- ❖ Up-to-date market intelligence information relevant to the sectors/markets of the firms in question;
- ❖ Current information on pending Requests for Proposals" of other bid opportunities for the firms/sectors in question;
- ❖ Networking supports to facilitate the formation of partnerships, bidding consortia, and other mutually beneficial relationships;
- ❖ Business opportunity assistance in the form of local purchase preferences for innovative technologies developed by British Columbia-based enterprises;
- ❖ Opportunities to showcase emerging new technologies, processes and products developed by small enterprises through demonstration projects, achievement awards, or trade fair events;
- ❖ Guidance in the preparation of product development and commercialization plans for venture capital financing purposes;

- ❖ Access to technology verification resources that are beyond the capacities of individual firms to undertake on their own; and
- ❖ Assistance in providing the necessary knowledge-based workers needed by small enterprises to sustain operations through their difficult early years.

Simply funding research and development in the laboratory is not sufficient to bring the technology in question to the marketplace.

8.0 CONCLUSIONS AND RECOMMENDATIONS

Several conclusions may be drawn from this review of the environmental business sector in British Columbia. These are:

1. British Columbia has a broadly-based and vibrant environmental business sector with expertise and innovative technological strengths in a number of areas, notably clean water and wastewater remediation; energy and alternative energy systems such as fuel cells, clean fuel technologies, biomass co-generation systems; sustainable community development; green building design and construction; eco-industrial networking; and sustainable resource management.
2. This sector is supported by a growing network of government-industry clusters and specialized centres of excellence enabling smaller firms in the industry to work together and with select government agencies, academic and other research institutions. Such clusters are present in the fuel cell technologies sector and are being considered with respect to the water/wastewater sector, and the green building sector.
3. These clusters in turn are supported by an increasing number of innovations in the industry, fostered in part by excellent university programs, skilled patent and trademark law firms, a growing number of research laboratories and technology testing facilities, as well as readily available expertise in market intelligence and environmental marketing.
4. Taken together the environmental business marketplace in British Columbia quickly becomes very large and diverse. It is almost impossible to estimate either the size or the potential revenue base of this more broadly defined environmental technology and services market. The problem is not the lack of opportunity. Rather, the problem is choosing the most viable market opportunities and removing any impediments to the development of technologies and competencies needed to realize these opportunities.
5. There are a number of other factors affecting the environmental technology and service marketplace. These include: the changing nature of industry perspectives with respect to environmental stewardship and sustainability; concerns of both industry and governments over compliance with respect to environmental regulation and associated liability issues; the pervasive impact of all

aspects of climate change and the need to adapt to a new set of global realities; changing public attitudes with respect to health and the environment; the environmental impacts associated with the need to expand and/or replace our aging infrastructure; and the growing demand for urban sustainability and improved quality of life.

6. On the basis of our demonstrated strengths, and taking into account these other related factors, the most opportune areas for British Columbia's environmental technology and related sectors appear to be:
 - ❖ Alternative energy systems, including fuel cells, clean fuel technologies, small scale hydro and biomass co-generation systems;
 - ❖ Contaminated site remediation and brownfield reclamation;
 - ❖ Green building design, technologies and products;
 - ❖ Sustainable communities and integrated environmental solutions;
 - ❖ Urban environmental management systems; and
 - ❖ Water/wastewater technologies, services and solutions.
7. These opportunity areas are both local and international. However, there are impediments that must be dealt with before these potential opportunities can be fully realized. These include in particular:
 - ❖ Strengthening international recognition of British Columbia's environmental business excellence;
 - ❖ Establish where appropriate supportive industry clusters;
 - ❖ Creating appropriate venues for practical demonstration projects;
 - ❖ Promoting venture capital financing and investment in innovative technologies developed in BC;
 - ❖ Overcoming resistance to change factors in key domestic markets; and
 - ❖ Providing consistent support for technology development and commercialization particularly for small and medium sized enterprises.

RECOMMENDATIONS

The strategies recommended to overcome these impediments and to realize the market opportunities identified include:

- ❖ **Establishing a marketing initiative to build international recognition of British Columbia's environmental excellence** – through collaborative programs involving technology demonstration, testing and certification; market development and networking; and national and international promotion in order to attract new customers and new investment to the sector.
- ❖ **Establishing (where appropriate) Centres of Excellence** or industry clusters where experts in environmental technology development and verification can work with academic, marketing, business development and financial management organizations to facilitate the development and deliver innovative technologies, services and environmental solutions required in the national and international marketplace.
- ❖ **Encouraging demonstration projects** – particularly involving large scale, real-world urban demonstration sites where Western Canadian environmental technologies, products and services can be tested and showcased in order to attract new international customers and to foster their adoption by local industries and municipal governments.
- ❖ **Encouraging venture capital and investment financing** - by removing or reducing the risk factors associated with technology verification and commercialization; by providing fiscal incentives to stimulate capital investment in the environmental business sector; and by supporting specialized technical conferences and venture capital venues where investors and potential customers can interact with government agencies, technology research and development organizations, industry and professional associations to see what British Columbia's many environmental business sectors have to offer.
- ❖ **Providing incentives for innovation** – by undertaking the research needed to identify and remove barriers to the adoption of innovative technologies and integrated environmental solutions by municipalities, other government agencies and by major industry players in British Columbia.

- ❖ **Mentoring environmental enterprises** – by working with individual firms and industry associations to improve environmental technology development and commercialization; to provide the tools needed to penetrate new markets; and to establish mutually supportive and dynamic networks that enable the delivery of flexible solutions and technologies for local, regional and international customers.

At the Environmental Technologies Forum it is hoped that one or more strategic initiatives recommended herein will be adopted to help enterprises in British Columbia and across Western Canada to pursue the business of the environment.

9.0 CONTRIBUTORS

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10. Information Sources

Air Quality Management

1. Health and Air Quality 2002 – Phase 1: Methods for Estimating and Applying Relationships between Air Pollution and Health Effects - FINAL Report, Prepared for British Columbia Lung Association by Dr. David V. Bates, University of British Columbia (Emeritus), et al, May 2003, Available at www.bc.lung.ca/airquality.pdf
2. Lower Fraser Valley Ambient Air Quality Report 2001, Greater Vancouver Regional District, Policy and Planning Department October 2002, Available at www.gvrd.bc.ca
3. Overview – GVRD Air Quality Management Plan: Creating Our Future - Steps to a More Livable Region, Greater Vancouver Regional District, 1994, Available at www.gvrd.bc.ca

Climate Change

1. “BC Hydro Climate Change Initiatives”, Presentation by Bruce Sampson, Vice-President, Sustainability, BC Hydro, University of British Columbia, January 10, 2003. Available at www.sdri.ubc.ca/documents/
2. Canada’s Third National Report on Climate Change 2001: Actions to Meet Commitments under the United Nations Framework Convention on Climate Change, Government of Canada, Minister of Public Works and Government Services, 2001
3. Climate Change Policy Position, Canadian Association of Petroleum Producers, November, 2002. Available at www.cappmember.net
4. Fourth Annual Alberta Technology Report, Ernst & Young, Ipsos Reid, ICET Alliance, 2002
5. Climate Change Impacts and Adaptation in British Columbia: Briefing Prepared for the Senate Standing Committee on Forestry and Agriculture, Dr. Stewart J. Cohen, Science Advisor to the British Columbia Office of the Canadian Climate Impacts and Adaptation Research Network (C-CIARN), December 10, 2002
6. Progress Report: Canada’s First National Climate Change Business Plan, Canada’s National Implementation Strategy on Climate Change (NIS), Government of Canada, September 2001, Available at www.nccp.ca
7. Targeting Climate Change, Sustainability Report, ALCAN INC., Montreal, Available at www.alcan.com

Contaminated Sites

1. “Backgrounder - Government Improves System for Contaminated Sites” Press Release, British Columbia Ministry of Water, Land and Air Protection, May 13, 2003. Available at www.gov.bc.ca/wlap
2. Cleaning up the Past, Building the Future: A National Brownfield Redevelopment Strategy for Canada, National Round Table on the Environment and the Economy, 2003, Available at: www.nrtee-trnee.ca/
3. Final Report of the Minister’s Advisory Panel on Contaminated Sites, British Columbia Ministry of Water, Land & Air Protection, Vancouver, January 2003
4. Report of the Auditor General of British Columbia, 2002/03 Report 5, Managing Contaminated Sites on Provincial Lands, Available at www.gov.bc.ca

5. Contaminated Soil Remediation Technologies Cluster Analysis: A Study of British Columbia Based Companies, British Columbia Environment Industry Association (BCEIA), December, 2003. Draft 8.

Energy

1. 2003 Canadian Oil & Gas Industry Outlook Survey Deloitte & Touche, June, 2003, Available at www.deloitte.ca
2. An Inventory of Sustainable Energy Funds, United Nations Environment Programme (UNEP) Division of Technology, Industry and Economics (DTIE) and the Basel Agency for Sustainable Energy (BASE), Final Review Draft/September 18, 2001), Available at www.ecosecurities.com
3. Annual Energy Outlook 2001 With Projections to 2020, U.S. Department of Energy, Energy Information Administration, Office of Integrated Analysis and Forecasting December 2000, Available at www.eia.doe.gov/oiaf/aeo/
4. British Columbia Offshore Oil and Gas Team Project Plan, May 2003, Available at <http://www.em.gov.bc.ca/subwebs/oilandgas/>
5. Clean Coal Technology: Current Progress, Future Promise, National Mining Association, Washington, March 2003, Available at www.nma.org
6. Cleaner Hydrocarbons: Technology Challenges and Opportunities For The Western Canadian Hydrocarbon Energy Sector, Cleaner Hydrocarbon Technology Futures Group, February 2003, Available at www.ptac.org
7. Electricity: Industry as a Partner for Sustainable Development Series, A report prepared by E7 Network Expertise for the Global Environment, Montreal, 2002, Available at www.e7.org
8. Environmental Challenges and Opportunities of the Evolving North American Electricity Market, Secretariat Report to Council under Article 13 of the North American Agreement on Environmental Cooperation, Joseph M. Dukert, Montréal, June, 2002, Available at: www.cec.org
9. Energy in Canada 2000, Natural Resources Canada, Office of Energy Efficiency 2000, Available at energy-publications.nrcan.gc.ca
10. Energy for Our Future: A Plan for BC, Government of British Columbia, 2002, Available at www.gov.bc.ca/em/popt/energyplan.htm
11. Green Energy Study for British Columbia - Phase 2: Mainland, BC Hydro, Green & Alternative Energy Division, Engineering Report No. E44 October 2002
12. International Energy Outlook 2001, U.S. Department of Energy Office of Integrated Analysis and Forecasting, Washington, 2001. Available at www.eia.doe.gov/oiaf/ieo/index.html
13. News Release: "Record Power Purchase Yields \$800 Million in Investment", Office of the Premier, Ministry of Energy and Mines and BC Hydro, Sept. 26, 2003, Available at www.bchydro.com.
14. Poised For Profit: How Clean Energy Can Power the Next High-Tech Job Surge in the Northwest, Climate Solutions, November, 2001, Available at www.climatesolutions.org
15. Small Hydro Study Prepared for BC Hydro by Sigma Engineering Ltd., Available at www.BCHydro.com
16. Spudding Innovation: Accelerating Technology Deployment in Natural Gas and Conventional Oil, Prepared for the AERI Oil & Gas Industry Research & Development Challenges & Opportunities Project by PTAC Petroleum Technology Alliance Canada and Deep Blue Associates Inc., Calgary, 2003.

Environment Industry

1. Canada's Environment Industry: An Overview, Environmental Affairs Branch, Industry Canada, January 2002. Available at <http://strategis.ic.gc.ca/>
2. Environment Industry, Sector Competitiveness Frameworks Series, Business and the Environment, Industry Canada, Available at strategis.ic.gc.ca/
3. Environment Industry Survey: Business Sector 2000, Statistics Canada, Environment Accounts and Statistics Division, Cat. No.16F0008XIE, 2002. Available at <http://www.statcan.ca/cgi-bin/downpub/freepub.cgi>
4. Environmental Trends in British Columbia 2002, British Columbia Ministry of Water, Land and Air Protection, 2002, Available at www.wlapwww.gov.bc.ca/
5. Industry Profile on Vancouver's Environmental Sector: Study conducted by the Vancouver Economic Development Commission November 2003. Available at www.vancouvereconomic.com
6. Market Intelligence Report of Environmental Technology Opportunities in Canada, Calibre Strategic Services (SK) Inc., May, 2002. Quoted in Cities of Tomorrow: The National Centre for Sustainable Urban Environmental Management, Sustainable Communities Institute, Strategic Business Plan. Available at www.jump.ca/emis
7. Positioning for Growth in the 21st Century: The State of BC's Environment Industry, GLOBE Foundation of Canada, Vancouver, 1999, Available at www.globe.ca
8. The Canadian Environment Industry at a Glance, Industry Canada, Strategis, 2000, Available at <http://strategis.ic.gc.ca/environment>
9. The Status of Environmental Programs in British Columbia in 2002, Paul West, School of Environmental Studies, University of Victoria, Ministry of Advanced Education, Centre for Curriculum, Transfer and Technology, 2002 Available at <http://www.c2t2.ca/>
10. Western Canada's Environmental Industry - At a Glance. Industry Canada, Statistics Analysis and Industry Profiles 2003. Available at www.strategis.ic.gc.ca/epic/

Forest Sector

1. Accelerating Forest Sector S&T Renewal, Forest Products Association of Canada, 2002, Available at www.fpac.ca
2. Forest Sector Renewal: Putting the Pieces Together, Forest Sector Innovation Response, Forest Products Association of Canada, September, 2002, Available at www.fpac.ca/
3. Technology and the BC Forest Products Sector, Prepared by Ernst & Young Forestry Group for the Committee of the Forest Products Research Network Forum, Vancouver BC, July 1998, Available at <http://www.scbc.org/pdf/>
4. Towards Sustainability In The Canadian Forest Products Industry, 1992 – 2002, Forest Products Association of Canada, 2002, Available at www.fpac.ca

Fuel Cells

1. 2003 Fuel Cell Industry Survey: Survey of 2002 Financial Results of North American Public Fuel Cell Companies. Price Waterhouse Coopers, 2003. Available at www.pwc.com/ca
2. "Canadian Fuel Cell Activities" Presentation by Christopher Curtis for Connecticut Clean Energy Fund Fuel Cell Investment Summit, March 18, 2003. Available at www.fuelcellscanada.ca/
3. Canadian Fuel Cell Commercialization Roadmap, Industry Canada, 2003. Available at www.strategis.ic.gc.ca/

4. Fuel Cells: The Opportunity for Canada. Price Waterhouse Coopers, June, 2002, Available at www.pwc.com/ca
5. Economic Impact of Industrial Hydrogen Activity in Canada. Prepared for the Transportation Energy Technology Program, CANMET Energy Technology Centre by Sypher Mueller International Inc. and NRCan, Ottawa, June 2002.
6. The Canadian Fuel Cell Industry: A Capabilities Guide. Fuel Cells Canada, 2002, Available at www.fuelcellscanada.ca

General

1. Access to Capital: The Street View: Summary Report, BC TIA Capital & Investment Committee, September, 2003, Available at www.bctia.org
2. An Integrated Strategy for British Columbia's Technology Clusters: A White Paper, British Columbia Technologies Industry Association, October, 2003. Available at www.bctia.org/files/White_Paper/
3. Canada's National Environmental Indicator Series 2003, Environment Canada, 2003, Available at www.ec.gc.ca/soer-ree
4. Environmental Protection Expenditures in the Business Sector 2000, Statistics Canada, Catalogue # 16F0006XIE, August 2003. Available at www.statcan.com
5. Environmental Tax Shift: A Discussion Paper for British Columbians, Amy Taylor and Mark Jaccard, School of Resource and Environmental Management and Nancy Olewiler, Department of Economics, Simon Fraser University, Vancouver, October, 1999. Available at <http://www.emrg.sfu.ca/articles/EnvTaxShift5.pdf>
6. Green Technologies: Markets, Competition and Barriers: New Paradigms for Natural Resources, Dan Yurman, 1994 dyurman@igc.apc.org
7. The Biotechnology Cluster in Vancouver, J. Adam Holbrook, Simon Fraser University, Centre for Policy Research and Technology, 2003.
8. Technology and Environment: Towards Policy Integration, OECD, Directorate for Science, Technology And Industry, Committee for Scientific and Technological Policy, 1999. Available at www.oecd.org/dataoecd/58/2/1898311.pdf

Green Buildings

1. A Strategic Framework for Green Building in Greater Vancouver, Report of the Green Buildings Task Group, Sustainable Region Initiative, Phase 2, Greater Vancouver Regional District, 2003, Available at www.gvrd.bc.ca
2. Agenda 21 for Sustainable Construction in Developing Countries: A discussion document, The International Council for Research and Innovation in Building and Construction and United Nations Environment Programme, International Environmental Technology Centre UNEP-IETC, Pretoria, 2002, Available at www.csir.co.za
3. Guide to Value Analysis and the Integrated Green Design Process, Green Buildings BC – New Buildings Program, May 2001, Available at www.greenbuildingsbc.com/
4. "The Building Sector: Kyoto is Easy: Towards Sustainable Development", Presentation at the University of British Columbia, Peter Busby, Busby + Associates Architects, October 1, 2003. Available at www.busby.ca
5. The Costs and Financial Benefits of Green Buildings: A Report to California's Sustainable Building Task Force, Greg Kats, Capital E Inc., Principal Author, October 2003, Available at: http://eetd.lbl.gov/EMills/PUBS/PDF/Green_Buildings.pdf

Infrastructure and Cities

1. A Choice Between Investing in Canada's Cities or Disinvesting in Canada's Future, TD Bank Financial Group Special Report, April, 2002, Available at: www.td.com/economics/
2. A Sustainable Urban System: The Long-term Plan for Greater Vancouver, cities^{plus} The Sheltair Group Inc., Vancouver, 2003, Available at www.Sheltair.com
3. Advancing Federal Government Objectives in Urban Regions, A Position Paper prepared by the Greater Vancouver Regional District (as approved by GVRD Board, December 14, 2001), Available at www.gvrd.bc.ca
4. Canada's Urban Strategy: A Blueprint for Action Final Report, Prime Minister's Caucus Task Force on Urban Issues, November 2002
5. Cities in Transition - Executive Summary: A Strategic View of Urban and Local Government Issues, The International Bank for Reconstruction and Development and World Bank Infrastructure Group, 2000, Available at www.worldbank.org
6. Economy and Sustainability: Proposals for Action, Summary Report of the Regional Economic Strategy Group, Greater Vancouver Regional District, Sustainable Region Initiative, May 2003, Available at www.gvrd.gc.ca
7. Environmental Quality In Canadian Cities: The Federal Role, National Round Table on the Environment and the Economy, State of the Debate on the Environment and the Economy Series, 2003, Available at www.nrtee-trnee.ca
8. Innovative Technologies for Canada's Civil Infrastructure Systems, Town Hall Meetings - Phase II Background Material, Canadian Society for Civil Engineering, December, 2002, Available at www.csce.ca/
9. Meeting the Urban Challenge, Population Information Program, Center for Communication Programs, Johns Hopkins University Bloomberg School of Public Health, Baltimore, Volume XXX, Number 4, Fall 2002
10. Profiting from Sustainability: Economic Opportunities for Greater Vancouver, A Regional Economic Issues Paper for the Sustainable Region Initiative, by Jeb Brugmann, City-States Urban Strategies Consulting, April 2003, Available at www.gvrd.bc.ca
11. Sustainable Cities Initiative (SCI) Global Needs, Canadian Solutions: Presentation, Industry Canada, Sustainable Cities Initiative, Available at www.sci.ic.gc.ca
12. Strategic Commitment to the Environment by Municipal Corporations: A Best Practice by the National Guide to Sustainable Municipal, Municipal Corporations Issue No. 1.0, July 2003, Available at www.infraguide.gc.ca/docs
13. Strategies and Tools for Urban Environmental Improvement, Human Settlements Programme, International Institute for Environment and Development, London, 2001, Available at www.ied.org
14. Tackling the National Infrastructure Deficit: Pre-Budget Submission to the House of Commons Standing Committee on Finance, Association of Consulting Engineers of Canada, September 2002, Available at www.acec.ca/en/policies/Submission
15. The State of the World's Cities Report 2001, United Nations Centre for Human Settlements (Habitat), Nairobi, 2001, Available at www.unhabitat.org
16. Urban Environmental Priorities Annex E, Making Sustainable Commitments — An Environment Strategy for the World Bank, October, 2003, Available at www.worldbank.org
17. Why Cities Matter: Policy Research Perspectives for Canada, Neil Bradford, Canadian Policy Research Networks Inc., Ottawa, 2002. Available at: <http://www.cprn.org>

Sustainable Development

1. Mobility 2001: Executive Summary, World Business Council for Sustainable Development, Sustainable Mobility Project, 2002, Available at www.wbcscdmobility.org
2. A Strategic Framework for Green Building in Greater Vancouver, Report of the Green Buildings Task Group, Sustainable Region Initiative, Phase 2, Greater Vancouver Regional District, 2003, Available at www.gvrd.bc.ca
3. World Development Report 2003: Overview - Sustainable Development in a Dynamic World. The International Bank for Reconstruction and Development/World Bank, 2002

Water/wastewater

1. Environmental Indicator: Mitigating Environmental Impacts in British Columbia, "Wastewater Treatment across Canada in 1999", BC Ministry of Water, Land and Air Protection, 2002. Available at http://wlapwww.gov.bc.ca/soerpt/pdf/9mitigation/Mitigation_2002.pdf
2. Global Water Outlook to 2025: Averting an Impending Crisis, Mark W. Rosegrant et al, International Food Policy Research Institute, Washington, D.C., 2002, Available at www.ifpri.org/media/water2025.htm
3. Market Brief Opportunities for Canadian Companies in IFI-Financed Water and Sanitation Projects, Department of Foreign Affairs and International Trade, Report prepared by Ranjani Sankaran, Office of Liaison with International Financial Institutions (OLIFI), Canadian Embassy, Washington, Available at <http://www.infoexport.gc.ca>.
4. Measuring Regional Capacity in Sustainable Technologies, Water & Wastewater Sector in Western Canada Western Economic Diversification Canada and the Government of British Columbia, 2003
5. SWOT Analysis of the Water-Related Environmentally Sustainable Technologies in British Columbia: An Executive Summary, Prepared by the Centre for Sustainable Communities Canada for the BC Environment Industry Review, Sept. 11, 2003. Selected excerpts from certain of the individual studies undertaken as part of this project were made available for this report. More information on these studies and access to information contained therein may be obtained from the Centre for Sustainable Communities Canada.
 - ❖ Water-related Environmentally Sustainable Technology An emerging Industrial Cluster with Export Opportunities in Western Canada: SWOT and Cluster Analysis, Prepared by: Shawna L. Reibling and Dr. Gregory Finnegan, NovaTec Consultants, for the Centre for Sustainable Communities Canada, July 2003.
 - ❖ Venture Capital and the Environmentally Sustainable Technologies Sector: Interpreting Attitudes, Investment Interest and Capacity, Prepared by: Walton Consulting Ltd. for the Centre for Sustainable Communities Canada, June 2003
 - ❖ Canadian Patents and the Challenge of Measuring Innovation in the Water Technologies Sector, Prepared by: Dr. Gregory Finnegan, NovaTec Consultants and Shawna L. Reibling, for the Centre for Sustainable Communities Canada, June 2003
 - ❖ University Programs in Canada: With an Environmental Engineering and Related Water Technologies Programs, Prepared by: Dr. Gregory Finnegan,

10 Information Sources

- NovaTec Consultants and Shawna L. Reibling, for the Centre for Sustainable Communities Canada, July 2003
- ❖ Patent, Trade-mark and Intellectual Property Law Firms in British Columbia, Prepared by: NovaTec Consultants for the Centre for Sustainable Communities Canada, June 2003
 - ❖ Water and Wastewater Sector Programs and: Funding Mechanisms available to Companies and Organizations in Western Canada: A: Federal Government and other National Organizations, Prepared by: Strategies for Change for the Centre for Sustainable Communities Canada, June 2003
 - ❖ Water and Wastewater Sector Programs and: Funding Mechanisms available to Companies and Organizations in Western Canada: B: International Organizations, Prepared by: Strategies for Change for the Centre for Sustainable Communities Canada, June 2003
6. Water Treatment Products & Devices Market Report, Industry Sector Analysis, U.S. Department of Commerce, Commercial Service Report ID: 75400, prepared by Richard Vinson, US Consulate in Halifax, 2001. Available at <http://www.buyusainfo.net/>
 7. World Water and Food to 2025: Dealing with Scarcity, Mark W. Rosegrant, et al, International Food Policy Research Institute, Washington, D.C., 2002, Available at <http://www.ifpri.org/pubs/books/water2025/water2025.pdf>