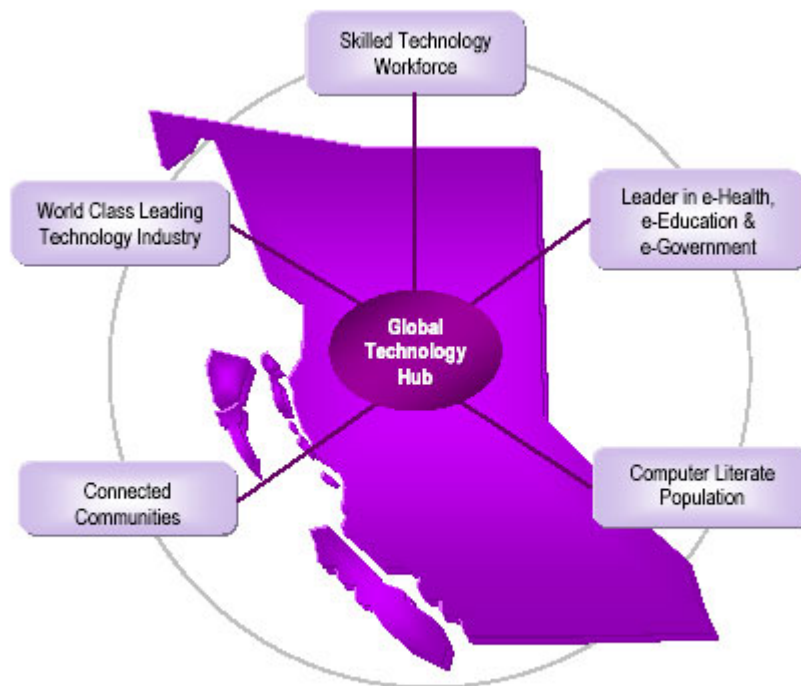


4th REPORT

MARCH 27, 2003

PREMIER'S TECHNOLOGY COUNCIL



We believe that with strong cooperation between the provincial government and private enterprise, British Columbia will be one of the world's top ten technology centres by 2006.

Every effort has been made to consider all information obtained and to be as accurate and consistent as possible in our use and analysis of all research materials. However, errors or omissions may have occurred. Please notify the Premier's Technology Council of any significant inaccuracies by e-mail at:

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EXECUTIVE SUMMARY

This is the 4th Report of the Premier's Technology Council (PTC or Council). The release of this report part way through the PTC's second year of operation follows a demanding first year of activity that produced three reports containing 59 recommendations for government's consideration. The PTC remains firm in its resolve to make British Columbia a world-class technology centre. It urges implementation of all of its past recommendations and will continue to work closely with government to address them.

Each year the PTC will be rotating some of its members in order to get differing perspectives. This year we have added five new members - Reg Bird, Denis Connor, Dan Muzyka, Darcy O'Grady, and Gerri Sinclair. Five other members have offered to step down to make space available - Greg Aasen, Barbara Alexander, Amos Michelson, Firoz Rasul, and Jim Yeates.

With this new group, we have also moved from four specific Task Groups to a broader range of focus. This is because much of the first year centered on bridging the digital divide and on government services and operations. In the second year, we intend to focus on monitoring the government's progress in meeting the recommendations put forth in those respective areas, as well as accelerating the growth of the technology industry in this province. To do this the PTC will be reporting semi-annually rather than quarterly.

The Premier's Technology Council is pleased to note the Innovation Agenda put forward by the Province to be implemented in cooperation with the Federal Government. We feel that this is a strong step forward. The Agenda highlights some of the commitments made by the Province in response to PTC recommendations on research, the Leading Edge Endowment Fund for research chairs at post-secondary institutions as well as doubling the number of IT grads in the province. The PTC is particularly pleased to note that one of our highest priorities, provision of broadband service to all British Columbia communities, is one of the Agenda's key thrusts. We look forward to continuing to work with the provincial government in addressing this and other important innovation and industry development initiatives.

For this report, the PTC reviewed its past work and decided to highlight several important areas for priority consideration by government in the coming year. The first, broadband service to all British Columbia communities, as mentioned is being addressed. However, the PTC stresses that broadband is more than a life sciences tool. Broadband access will promote commerce, foster industry development, improve education and bridge the increasing gap for many communities in the information age. It will also, among other things, help enable telehealth which is another PTC priority. This includes adopting and implementing a common health information technology infrastructure and standards, and

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establishing an e-Health Task Force represented by government and health care professionals.

There are also several industry development areas of great importance. Venture capital, one of the essential ingredients for growing a high technology industry, remains a high priority with the PTC. While we had hoped for passage last fall, we urge early passage of previously recommended amendments to the Small Business Venture Capital Act, to address concerns such as expansion of the labour fund pool and tax credits.

Marketing and promotion also remain high priorities and the PTC recommends development of a provincial branding and marketing strategy that underscores the technology and innovation strengths in British Columbia's economy. These strengths include not only information technology and life sciences, but also new media, wireless and alternative energy. These five sectors should provide the basis upon which marketing and promotion of the British Columbia technology sector is implemented. The PTC also recommends creation of a technology industry marketing plan for the purpose of providing a sustained marketing effort of our technology industry and business climate.

In its First Quarterly Report, the PTC identified E-learning as an area it intended to address. That report stated, "E-learning can bring the classroom to the student. Distance should not be a barrier to accessing any educational programs. K-12 students, college or university students, companies retraining workers, or lifelong learners seeking new skills, can all be aided through distance learning on-line". The PTC is examining the subject from several perspectives and is now only part way along in its work. We intend to have a full report by next summer. However, at this time we identify some initial findings on one aspect of the subject, developing an online learning industry. They are: online learning credentialing development to expand the credentialing capacity of existing institutions; accreditation of private sector/not-for-profit training products to a high standard; and creating an online learning community through the tool of a self-managed online learning portfolio that places accountability for the learning path in the hands of the learner.

As previously stated, the PTC intends to focus on accelerating industry growth. The 4th Report begins that task in several important areas - the fuel cell industry, new media and wireless. These three areas, along with information technology and life sciences, have been identified by the PTC in the past as sectors where the Province has considerable strengths. Each has the potential to become a vibrant technology cluster with worldwide impact. This report describes some recent work by the Council and identifies some initial findings and early conclusions. However more work and consultations with various groups including government needs to be done. The PTC plans to issue sector or cluster findings and recommendations in future reports. In addition, the Council will be addressing subjects that cross

sectors and support cluster development. These include taxation policy, human resource development, capital and so on.

Fuel Cell Cluster

The Province is a recognized world leader in fuel cells and related technologies. Maintaining this leadership will provide significant economic, social and environmental benefits to the province. The people and the economy of British Columbia can capitalize on past and present government investments in this technology by taking a pro-active approach to industry development.

The fuel cell industry is already generating significant economic benefits for the province. In 2000/01 the industry employed approximately 1,200 people. Investment in innovation at \$130,000 per employee is extremely high, with approximately \$156 million spent on research and development in 2000/01. Revenues in the industry are growing rapidly, with over 80% coming from exports of products and services. Global demand for fuel cell products is estimated to reach \$46 billion per year by 2011.

To take advantage of the province's strengths and to develop a vibrant, world-leading industry cluster, the PTC, in cooperation with Fuel Cells Canada, is leading an effort to develop a fuel cells strategy. This British Columbia Fuel Cell Strategy should leverage the province's front running capabilities in:

- Research and development
- Fuel cell stack and sub-system development
- Product development and systems integration
- Parts production
- Manufacturing systems
- Fuel, reformer and fueling systems integration and development
- Financial, engineering and consulting services

Details and specific recommendations of the strategy will be presented in a future Premier's Technology Council report.

New Media and Wireless Clusters

Presently, there are over 500 new media companies in British Columbia, employing over 12,000 highly-skilled workers. Approximately 95% of these employees possess a post-secondary education, with 72% earning over \$40,000 per year. In 2001, total revenues for the new media sector exceeded \$2 billion in British Columbia. Nationally, British Columbia's new media sector, centered in Vancouver, outpaced Toronto's in terms of revenue per person in the population. Accordingly, British Columbia is in a position to take a leadership role in the development and support of a robust new media cluster.

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British Columbia's wireless sector also has a successful history of innovation and commercialization. The province is home to about 120 thriving wireless companies, the largest concentration in Canada. According to the recently published 2002 BC Wireless Industry Survey by PricewaterhouseCoopers, commissioned by the Wireless Innovation Network Society of British Columbia (WINBC), the wireless sector in British Columbia is well positioned to play a leadership role in the global market. This survey also noted that the province "consists of a cluster of larger diversified firms competing on an international basis, and smaller entrepreneurial companies targeting commercial operations in the near future." British Columbia's wireless sector employs approximately 1,500 people, and is expected to double by the end of 2004.

The PTC strongly believes that British Columbia has the potential to build world-class new media and wireless clusters. The PTC is encouraged by industry-led discussions that have taken place to date and recognizes the need to continue the dialogue and work towards formulating specific recommendations for the growth of these clusters. The Council will continue to investigate the new media and wireless sectors and will present its findings and recommendations in a future report.

Other PTC Activities

Innovation on all fronts will continue to be the watchword in developing and sustaining British Columbia's position as a global technology hub. The creative and entrepreneurial forces of its innovation community will be critical drivers. The PTC views the public sector as an equal partner in the innovation community. In acknowledgement of the importance of recognition and reward mechanisms to help accelerate and reinforce an innovation culture change, the PTC concludes its 4th Report with a position of strong support for the Premier's Awards program presently under development in government.

From November 13-15, 2002, the Premier's Technology Council helped conduct a Leading Edge marketing and investment mission to Northern California. Led by the Premier, a delegation of 35 leaders from over 30 British Columbia high-tech companies undertook the trip to promote British Columbia's competitive advantages to California investors and high-tech companies.

The objective of the mission was to attract both financial and human capital to British Columbia and to help grow strategic sectors. It provided the opportunity to showcase successful local technology companies, as well as draw attention to British Columbia's competitive advantages. Delegates made a number of valuable contacts, explored opportunities and took away some key lessons.

The PTC sees this mission as an important step in both marketing British Columbia and encouraging local industry development. The PTC is pleased to note that future missions are anticipated.

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The Premier's Technology Council had a prolific first year. It conducted extensive consultations throughout the province with industry, community groups and the general public. It hosted two high-profile events - an Information Technology (IT) Procurement Symposium and an e-Health Roundtable. It produced three reports containing 59 recommendations to government. The PTC is eager to see all of its recommendations addressed and will continue to work closely with government to tackle them.

As the PTC enters its second year, its members reaffirm their commitment to the goal of making British Columbia a top technology centre in the world. The PTC's objectives remain unchanged and its practice of collaboration and cooperative effort with industry, the community at large and government will continue.

This year we have added five new members to provide some fresh perspective- Reg Bird, Denis Connor, Dan Muzyka, Darcy O'Grady, and Gerri Sinclair. Members are chosen for their leadership, commitment and firm belief in the future of British Columbia. These are outstanding people who we thank for offering their energy and counsel to the people of British Columbia.

Five other members have offered to step down to make space available - Greg Aasen, Barbara Alexander, Amos Michelson, Firoz Rasul, and Jim Yeates. These are five extraordinary people whose leadership, dedication and commitment will be missed. We thank them for their service to the Province.

With this new group, we have also moved from four specific Task Groups to a broader range of focus. This is because much of the first year centered on bridging the Digital Divide and on government operations. In the second year, we intend to focus on monitoring the government's progress in meeting the recommendations put forward in those respective areas, as well as accelerating the growth of our technology industry. Members will now lead initiatives in key areas of interest, creating teams and drawing upon expertise as required. This reflects that members are executives who are used to driving issues and leading groups.

To accelerate growth of the technology industry, PTC activities will center on sector development or cluster building based on priorities identified in previous reports. The sectors are:

- Alternative energy
- Information Technology
- Life sciences
- New Media
- Wireless

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Council members will also address subject areas that cross all sectors and assist in cluster development. Some of these are:

- Taxation policy
- People recruitment
- Capital including venture capital

Other subjects also under consideration include:

- e-Learning
- The online learning industry
- University/Industry collaboration
- Emerging technologies

The Council has also moved from quarterly to semi-annual reporting. The 4th Report is the first of two reports planned for this year. The 5th Report should be released during the summer of 2003.

In the past year, the government established a comprehensive process to monitor implementation of PTC recommendations. We are pleased to note the high degree of interest government has in the activities of the PTC and the priority it assigns to addressing our recommendations. We are also pleased to note the government's Innovation Agenda as one more step forward in a continual process. The Agenda highlights several commitments the government has made in response to PTC recommendations. These include: a commitment to fund research in the province; establishment of the Leading Edge Endowment Fund for research chairs at post-secondary institutions; and doubling the number of IT graduates from British Columbia universities, colleges and institutes.

Of major significance to the PTC, the Agenda contains government's commitment to address one of our highest priorities, which is the provision of broadband service to all British Columbia communities. We look forward to continuing to work with the province so that broadband service is provided, not simply as an enabler for life sciences but as a key tool for commerce, industry development, education, health care, and telehealth among other things.

In November 2002, the Premier's Technology Council helped organize and conduct a marketing and investment mission to Northern California. Led by the Premier, a delegation of 35 leaders from over 30 British Columbia high-tech companies undertook the trip to promote British Columbia's competitive advantages to California investors and high-tech companies.

The mission was in response to a government commitment to conduct annual Leading Edge marketing missions to promote British Columbia technology and investment and help make the province one of the world's leading technology centres. The purpose of this trip was to attract both financial and human capital to British Columbia and to help grow local information communications technology

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and life science sectors. Supported by the Canadian Consulate Trade Office for San Francisco and Silicon Valley, the mission met with major venture capital firms, law firms and other stakeholders of the business community.

The delegation took the opportunity to showcase successful local technology companies, as well as draw attention to British Columbia's competitive advantages, such as its highly skilled workforce and excellent technology research. In addition, British Columbia's recent tax and regulatory changes were highlighted. This was a welcome surprise to many including the Canadian expatriate community.

During the visit, delegates made a number of valuable contacts and explored opportunities in the Bay Area. Valuable lessons were learned in areas such as raising venture capital in the United States, launching startups, operating successful cross-border businesses, key differences between Canadian and US markets, and the importance of promoting both companies and British Columbia's business climate in the Bay Area.

The PTC sees this mission as an important step in both marketing British Columbia and encouraging local industry development. The PTC is pleased to note that future visits are anticipated.

Over the past several months, PTC members have been examining priorities and working closely with leaders throughout the Province in several key areas. These areas are the technology sectors or potential clusters the PTC believes must be supported and developed if the Province is to become a global technology hub. The sectors are - information technology, life sciences, alternative energy, new media and wireless. The 4th Report begins the process of examining these priority sectors as well as some other topics. The report addresses the following:

- PTC recommended priorities for government for the coming year
- e-Learning and an online learning industry in the province
- Alternative energy and growing the British Columbia fuel cell industry
- New media and wireless clusters in British Columbia
- Public Service Awards - rewarding innovators in the public service

The PTC reports are available online at the government's web site at http://www.gov.bc.ca/prem/popt/technology_council/.

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THE PREMIER'S TECHNOLOGY COUNCIL

PRIORITY RECOMMENDATIONS

Premier's Technology Council conducted a year-end examination of its work to identify areas where it felt early government action was important. While it will continue to advocate implementation of all its recommendations and will work closely with government to address them, the Council highlights several items for priority consideration by government in the coming year:

- Broadband
- Government Operations - Telehealth
- Industry Development
 - Venture Capital
 - Marketing and Promotion

Broadband

The Premier's Technology Council places a high priority on **the provision of broadband services to all communities in British Columbia and the ability of all communities to have public access to the Internet should they wish it.**

In its First Quarterly Report, the PTC defined **broadband** as 1.5 megabits per second (download) and **community** as anywhere in British Columbia with a place name and a public school or health care facility or a library. The Council later identified 361 communities. It also determined that by the end of 2003, the private sector was expected to provide broadband service to 80% of British Columbians living in approximately 150 communities. This meant that 20% of the population living in over 200 communities would not have service. At the time of writing this report, new figures show that the private sector has exceeded earlier projections and that 173 communities now have broadband. However, many of the remaining 188 small communities will not obtain broadband service because there is no business case for the private sector to provide it.

In its Second Quarterly Report, the PTC recommended that the Province upgrade and extend its government network, Shared Provincial Access Network for British Columbia (SPAN/BC), to ensure broadband service in those communities where the private sector is unlikely to go. Provision of service may include landline or wireless technologies, depending on the remoteness of the community. It will also require that government establish a mechanism to measure progress. The Council also recommended that the capability for public access to the Internet be available in all communities.

Again, the Council is pleased to note broadband priority in the provincial government's Innovation Agenda and the commitment to work cooperatively with the Federal Government.

The Premier's Technology Council reiterates its earlier recommendations and emphasizes that provision of broadband service to all British Columbia communities is a high priority. It recommends that the Province and the Federal Government work together to complete this task in the next three years.

Government Operations

The top priority for implementation is Telehealth. In two of its reports, the Council considered several aspects of government operations and made a number of strong recommendations on province-wide Information Technology (IT) standards for health authorities, an e-health/telehealth strategy and IT procurement. The PTC re-emphasizes the importance of addressing all of its earlier recommendations. For this year, the Council recommends that government focus on the following:

- **Adopt and implement common health information technology infrastructure and standards**
- **Establish an e-Health Task Force composed of both government representatives and health care professionals with a mandate to include:**
 - **coordinating and leveraging current e-health initiatives, including clinical and educational telehealth projects**
 - **implementation of an Electronic Health Record (EHR), in conjunction with other levels of government and across ministries. This standard EHR would be adopted by all Health Authorities, institutions and businesses providing health care services in the province**
 - **addressing the licensure, liability and billing issues and the resulting changes required to existing policy or legislation to enable health care givers to participate in telehealth**

Industry Development

A. VENTURE CAPITAL

One of the essential ingredients in the development and growth of high-tech industry is the availability of capital. Venture capital has been mentioned by the PTC in previous reports and considers it a high priority.

To address concerns such as expansion of the labour fund pool and tax credits, the PTC urges government to quickly pass the Council's recommended amendments to the *Small Business Venture Capital Act (SBVC Act)*. They are:

- Expand the tax credit budget legislated under the SBVC Act from \$50 million to \$100 million annually
- Introduce an investment model under the SBVC Act that does not require the registration of a separate venture capital corporation (VCC) to facilitate investment and tax credits under the programs in order to allow direct investment, cut red tape and reduce program registration costs
- Increase the total amount of capital one business may receive under the program (beyond the current \$3 million) to better reflect the capital needs of many early stage technology companies
- Increase the employee threshold limit for a small business from 75 to at least 150
- Allow approval for common investment regimen, such as multi-tranche investments over multiple years based on attainment of established milestones
- Allow program investors the option to invest directly from their self-directed retirement savings plans
- Make the tax credit incentives available for program investment within 60 days after the calendar year
- Increase program flexibility in program capital investment beyond simple common or preferred shares
- Provide VCC investors up to 24 months to complete investments

B. MARKETING AND PROMOTING BRITISH COLUMBIA

Council members feel strongly that to achieve the goal of making British Columbia one of the world's top ten technology centres, every opportunity possible must be taken to promote the province.

Accordingly, in the coming year, the PTC recommends that government address its key recommendations on branding, which are:

- Develop a provincial branding and marketing strategy that feature technology and innovation as key drivers supporting British Columbia's image as a place with a sustainable and vibrant economy, including resource and knowledge-based industries, and an unparalleled quality of life
- Develop a strong macro-image positioning British Columbia as a desirable technology destination for investors, employees and site selectors
- Develop and execute its provincial branding strategy in consultation with the technology community

More specifically, the PTC and industry sector groups will work with the government on marketing and promotion initiatives. Some of the elements to be explored include:

- Marketing and promotion missions led by the Premier
- A marketing and promotion plan developed from government analyses of the five key emerging industry sectors in British Columbia - information technology, life sciences, new media, alternative energy and wireless. The plan would provide for a sustained marketing effort of the province's technology industry and business climate. Among other things, it would include:
 - Developing and executing a branding strategy and marketing plan for the British Columbia technology community
 - Creating an inward-bound information capability for prospective corporate recruits to the province

E-LEARNING AND AN ONLINE LEARNING INDUSTRY IN BRITISH COLUMBIA

Introduction

In its First Quarterly Report, the PTC identified E-learning as an area it intended to address. The report stated, "E-learning can bring the classroom to the student. Distance should not be a barrier to accessing any educational programs. K-12 students, college or university students, companies retraining workers, or lifelong learners seeking new skills, can all be aided through distance learning on-line". The PTC is examining the subject from several perspectives. At this time the Council is prepared to identify some initial findings on one aspect of the subject - developing an online learning industry.

For several months the PTC has been conducting consultations with stakeholders in government, post-secondary institutions and industry to investigate development of a leading online learning industry in British Columbia. It was widely agreed that the development of this industry will serve to capitalize on the talents and resources that reside in the province, producing value that meets the growing needs of the knowledge-based economy both at home and abroad.

Industry Canada has defined 'online learning' as education and training delivered and supported by networks such as the Internet and intranets. Currently, there are approximately 5,000 companies worldwide engaged in online learning, with no single vendor accounting for more than 5% of the market¹. In 2002, the online learning industry in the United States generated US\$10.3 billion in revenue. It is expected to grow as much as 700% to US\$83.1 billions by 2006².

TeleCampus Online Course Directory (<http://www.telecampus.edu>), a central repository of online courses, reported that nearly 2,000 online courses were offered worldwide in 1997. This number has increased to 66,107 courses as of March 2002. This represents courses from 36 countries or 1,952 institutions. Canada offered the most courses after the US, that is, 12,620 Canadian courses offered by 167 Canadian institutions³. Although the online learning industry in British Columbia is in its infancy, it is strong and growing. Nationally, British Columbia ranks second, behind New Brunswick, in terms of the number of courses per capita. With positive action British Columbia has the potential of

¹ Stacey, Paul. "E-Learning: April 28th 2000." <http://www.bctechnology.com/statics/pstacey-may0100.html>

² Sam S. Adkins. The 2002 US Market for E-Learning Simulation: Executive Summary. <http://www.brandon-hall.com>

³ TeleCampus Online Course Directory. March 2002. <http://courses.telecampus.edu/periodic-stats/March2002.pps>

becoming the national leader in online learning and a significant player in the world.

Initial Findings

At this time, the PTC is only part way through its examination of the subject and expects to issue its full findings and recommendations in the 5th Report in the summer of 2003. At this time, however, some preliminary findings are offered to stimulate discussion. They are:

- Evidence shows that a great opportunity exists. The potential number of learners (students), globally, is large and the current amount of quality content is limited. To achieve the objectives of more credentialed/enabled citizens and an increasingly successful online learning industry, we need to implement strategies that increase the number of online students and at the same time increase the number of quality programs available.
- The PTC believes that, to gain an edge, we must have a first-rate credentialing capacity. That is, we must develop a process or review mechanism to certify the quality of learning content contributed by existing provincial institutions and from non-profit and for-profit organizations. Quality content is imperative in attracting learners.
- Whoever gets the critical mass of something - quality online content or a community of credential-seeking online learners, will draw the critical mass of the other.
- The primary interest of a learner is to obtain a well-branded credential that provides access to a specific type of work, educational program, and/or financial assistance.
- Adults in the workforce or in transition have the greatest need for online learning services.
- High school graduates also have a high need for online learning courses and programs. They seek access to courses and/or programs unavailable to them either at their local or chosen post-secondary institution or in the absence of an available post-secondary institution.
- Significant barriers exist that prevent public and/or private education providers from adapting their programs quickly to provide for the shifting educational requirements of individuals and/or industry.
- No US states and no Canadian provinces have a well-branded online credentialing capacity that favors industry.
- Opportunities for development of an 'online learning industry' in the province come from being more aggressive than other jurisdictions in the future capacity-building of the sector.

Initial Conclusions

The Council emphasizes that a more complete report on online learning will be made next summer. Some initial conclusions that have emerged from discussions held to date are offered to stimulate discussion. These leverage existing institutional and online initiatives to significantly increase the credentialing capacity of the province. They provide a means for private sector and not-for-profit associations to have their courses accredited and provide a quality assurance set of standards to protect learners. Training in instructional design and clear standards will improve the quality of content and credentialing services. More learners will be able to earn the credentials they require to pursue the careers that interest them. The portfolio community provides a means for individuals to manage their own future and for the province to track and evaluate the success of the online learning initiative. As a critical mass of online learners and credentialing programs develops, a very positive environment for an online learning industry will emerge.

1. ONLINE LEARNING CREDENTIALING DEVELOPMENT

To increase the number of quality courses available, we need to expand the credentialing capacity of existing institutions. A way of doing that, which is evolving from discussions, is to offer existing post-secondary institutions a premium 'bump-up' in any program's Full-Time Equivalent (FTE) funding (e.g. 110% FTE for 20% net enrollment increase) corresponding to the increase in distance FTE students completing existing accredited seat-based courses online. The content of each course would be translated to the web according to prescribed standards and available through distance technologies. Course credit could be managed by the course instructor. Registration, administration, and student services could be provided through whoever has registered the student and is providing the credential.

2. PRIVATE SECTOR/NOT-FOR PROFIT PROGRAM ACCREDITING BOARD

To develop a credible industry and to effectively expand the selection of quality course content available to online learners, it is essential that a set of high standards and a quality assurance process for private sector and not-for-profit developed courses and credentialing programs exist. It is also critical to establish provincial standards and instructional capacity for online instructional design. A concept, emerging from discussions, is to appoint a credentialing 'Board'. The board should have strong representation from universities to ensure British Columbia standards for accreditation remain high. This Board will assume responsibility for quality development of the credentialing and

content capacity. A key provision of this Board will be the establishment of an effective process for assessing the quality of private sector and not-for-profit sector educational courses and credentialing programs.

3. ONLINE LEARNING COMMUNITY/SELF-MANAGED ONLINE LEARNING PORTFOLIO

Developing the industry requires establishment of an accessible market. That can be done, in part, by creating a self-management tool to enable a growing community of online learners. However, industry viability will also depend on the existence of accountability measures. To do that, evidence is emerging that we need to create and promote an Online Learning Community for people accessing online learning programs in British Columbia. The key attribute will be an 'Online Learning Portfolio' within our provincial infrastructure, designed for individuals to manage and maintain records of their emerging professional capacity. The portfolio could include:

- Courseware, registration services, administrative services, and student support services
- A personalized course selection calendar
- An information service relating to emerging courses, programs, and financial aid services
- Access to career and educational management skill development training; a 'personal experience registry' for records of personal credentials, experiences, skills, and networks
- Links to provincial education number tracking, and a variety of discussion forums for classes and program participants to utilize

Conclusion

The PTC emphasizes the preliminary nature of the online learning industry material. The Council will continue to work with all stakeholders (including the government) to more fully address the subject. We hope to conclude our investigation in time for the Council's 5th Report, which should be issued during the summer of 2003.

ALTERNATIVE ENERGY: GROWING THE BRITISH COLUMBIA FUEL CELL INDUSTRY

Introduction

In previous reports, the PTC has advocated support and development of five sectors - information technology, life sciences, new media, wireless, and alternative energy. The Council reemphasizes the importance of these sectors in the development of British Columbia as a leading global technology hub.

The Province is a recognized world leader in fuel cells and related technologies. Maintaining this leadership will provide significant economic, social and environmental benefits to the province. The people and the economy of British Columbia can capitalize on past and present government investments in this technology by taking a pro-active approach to industry development.

The fuel cell industry is already generating significant economic benefits for the province. In 2000/01, the industry employed approximately 1,200 people. Investment in innovation at \$130,000 per employee is extremely high, with approximately \$156 million spent on research and development in 2000/01. Revenues in the industry are growing rapidly, with over 80% coming from exports of products and services. Global demand for fuel cell products is estimated to reach \$46 billion per year by 2011.

Challenges remain for the development of the worldwide industry. These include: reduction in product costs; development of a fueling infrastructure for transportation uses; development of a skilled work force; increased public awareness of the benefits fuel cells; and the creation of supportive government policies and regulations. British Columbia faces the additional challenge of fierce competition from the aggressive policies and programs at state and federal levels in the US, Japan, and Europe that support technology development and market access for their own fuel cell sectors.

A Provincial Fuel Cell Industry Strategy

If the province is to maintain its leading position, industry, government and academe must partner to develop and implement an aggressive provincial Fuel Cell Strategy. This strategy will build on a strong history of government/industry collaboration and leverage our present strengths. It should include: government policies and programs to accelerate development and commercialization; activities that increase public awareness of the benefits of the technology; programs that enhance skills development; and development of supportive codes, standards and

regulations. Implementing this Strategy will ensure that the province and the taxpayers reap the benefits of recent government investments in the sector, including:

- Economic growth with knowledge-based employment
- Growth in value-added exports
- Reduced pollution, reduced greenhouse gases, and reduced health care costs
- Leadership in sustainable development and climate change solutions
- Enhanced energy efficiency and energy diversity
- Enhanced innovation capacity

THE AGENDA OF THE PROVINCIAL GOVERNMENT

In formulating the following proposal, a broader economic and social context has been used to align the proposal with the full agenda of the government. In particular, the proposal attempts to address the following major areas of this agenda:

- Fiscal restraint
- Transitioning the British Columbia economy to a sustainable knowledge economy by fostering the development of new and existing clusters
- Expansion of the hydrocarbon energy industry in the post-Kyoto environment
- Obtaining 50% of incremental electrical power from 'green' sources
- Improving the competitiveness of the other resource industries
- Developing a long term response at the provincial level to the challenge of climate change
- A leaner more effective government that delivers its services in the most cost effective manner

Since expanding the energy industry in the post-Kyoto environment is also high on the agenda of the Alberta government, areas and programs of common interest with that province are also addressed. In particular, the "Sustainable Hydrocarbons" proposal presently being discussed in the energy ministries of both provinces is considered.

THE PROPOSAL

If British Columbia is to maintain its leading position, urgent action is needed. We recommend combining the strengths of the provincial and federal governments, industry and academia to develop and implement an aggressive British Columbia Fuel Cell Strategy that parallels and builds on a similar National Fuel Cells Strategy. The basis of this British Columbia Strategy will be initiatives that overcome the challenges facing the industry, achieving the goal of continued

leadership, thus allowing the province to accrue the immediate and long-term benefits to be gained from the earlier investments in this critical new industry.

This British Columbia Fuel Cell Strategy should leverage the province's leading capabilities in:

- Research and development
- Fuel cell stack and sub-system development
- Product development and systems integration
- Parts production
- Manufacturing systems
- Fuel, reformer and fueling systems integration and development
- Financial, engineering and consulting services

Specifically, activities in the provincial strategy should include:

- **Enhanced support for research and development**
 - Carried out by the private sector and in public institutions (in collaboration with industry). This will ensure a level playing field with international competitors.
- **Support for market focused demonstration projects**
 - In both public and private sector applications.
 - In real life situations that validate product reliability and output, “ruggedize” the product, provide quality assurance data, and help manufacturers make the necessary alterations to earn commercial success.
- **The British Columbia government becoming an early adopter of fuel cell products**
 - Government departments and crown corporations being real customers raises the profile and supports the development of markets.
 - Shows substantive leadership to the world.
 - Uses resources that would be spent on less innovative solutions.
 - Might be combined with an ‘unsolicited proposals’ program for all technology related purchases of the government.
- **Accelerate the development of harmonized codes and standards**
 - Government and Industry collaboration to remove regulatory obstacles to the introduction of fuel cell products and systems.
- **Incentives that support and reward growth and investment**
 - Encourage the early adoption of fuel cell and related products and systems by providing fiscally neutral tax based incentives, such as the income tax payback approaches used in Michigan.
 - Consider programs having an initial cost but longer term substantial savings to the treasury.

- **Development of infrastructure**
 - Build upon investments already made by BC Hydro and others.
 - Supports the 2010 Olympic bid and implementation.
- **Ensure the availability of a highly skilled, well-trained workforce**
 - Industry/government collaboration with secondary and post-secondary institutions to define and implement appropriate education and training at all levels in the post-secondary system.
 - Lets British Columbia residents take maximum advantage of the job opportunities created by the fuel cell industry.

Results

A successful industry/government partnership to implement such a Fuel Cell Strategy will provide the impetus for the industry to maintain its current global leadership and capture a significant share of the growing international markets for fuel cell and related products and systems. Results from the successful implementation of such a strategy will include:

- **Innovation**

The industry currently invests approximately \$130,000 per employee on research and development. To maintain our leading position, this investment in innovation must continue. The fuel cell sector will be a key factor in meeting British Columbia's goals for growing its knowledge-based industries.
- **Employment**

Employment in the fuel cells sector was 1,200 people in 2001, and is projected to grow by over 49% to 1,800 people in 2003. Such growth in high paying, knowledge- and technology-intensive jobs will continue if British Columbia maintains its leading position in the global market and supports the target of 10,000 jobs by 2010, as discussed in Appendix A.
- **Environment/Health**

Fuel cells provide superior efficiency over conventional technologies with little or no emissions. They can utilize carbon-based and renewable energy sources. The cumulative effect of increased volumes of fuel cell applications in portable, stationary and transportation applications will lead to reduced levels of pollution and greenhouse gases. British Columbia's leadership in the fuel cells sector will assist in reducing the health care

costs associated with air pollution. It will also provide leadership in meeting the long-term global challenges related to greenhouse gases.

- **Value-Added Exports for Energy Self-Sufficiency**

At the present time, 80% of products and services developed in the Canadian fuel cell sector are exported. With global markets projected to reach \$46 billion by 2011, and over \$2 trillion in 2021, British Columbia leadership will provide value-added exports for the province, while allowing customer jurisdictions to develop energy self-sufficiency.

Conclusion

While the Premier's Technology Council advocates creation of a joint strategy to turn the technical lead we enjoy into a thriving, profitable industry, we recognize that this will not be enough. Clearly specific actions will be needed, possibly including government financial investment. The Council will continue to work with key stakeholders to identify specific recommendations needed to achieve our goals. It plans to provide recommendations in future reports, possibly as early as the next report in the summer of 2003.

A more detailed report on the fuel cell industry is contained in Appendix A.

THE NEW MEDIA AND WIRELESS SECTORS IN BRITISH COLUMBIA

This section of the report is a preliminary discussion on ways to stimulate growth of new media and wireless clusters in the province.

New Media

With the convergence of multiple media formats and the growth of the Internet, new media and wireless have emerged as significant industries. British Columbia is home to burgeoning new media and wireless sectors and includes a number of internationally recognized organizations.

New Media, as defined by the Canadian Radio and Telecommunications Commission (CRTC), "encompasses, singly or in combination, and whether interactive or not, services and products that make use of video, audio, graphics and alphanumeric text, and involving, along with other more traditional means of distribution, digital delivery over networks interconnected on a local or global scale."⁴ This is a broad definition that is still taking shape as the sector evolves.

New Media companies in British Columbia are in the business of web design, development and management, interactive games, content development and application software, multimedia development and production, and delivery. Presently, there are over 500 new media companies in British Columbia, employing over 12,000 highly-skilled workers. Approximately 95% of these employees possess a post-secondary education, with 72% earning over \$40,000 per year.

In 2001, total revenues for the new media sector exceeded \$2 billion in British Columbia. Most of these revenues came from a small number of large companies. The remaining revenues were generated by small and medium enterprises, which comprise roughly 95% of the sector. Since the majority of companies in this sector are in the early stages, with 65% being in operation for less than five years, their growth is heavily dependent upon access to capital. The growth rate for this sector is expected to be approximately 30% over the next 2-3 years. Nationally, British Columbia's new media sector, centered in Vancouver, outpaced Toronto's new media sector in terms of revenue per population. Accordingly, British Columbia is in a position to take a leadership role in the development and support of a robust new media cluster.

4 CRTC Final Report: New Media. Telecom Public Notice CRTC 99-14. Broadcasting Public Notice CRTC 1999-84. May 17, 1999.

In August 2002, the 40 representatives of the new media sector in British Columbia met with federal officials to discuss strategies for accelerating the growth of the sector. In this discussion, access to capital, tax incentives, marketing British Columbia's new media sector, and protection of intellectual property were some of the issues identified. Based on these issues, a number of recommendations emerged, which federal officials took away for consideration. These recommendations included branding and marketing Canada's innovation internationally, supporting the growth and development of small and medium enterprises, and reviewing intellectual property rights for digital content.

Another recommendation called for the support and promotion of collaboration and technology transfer mechanisms, such as university-industry liaison offices. The New Media Innovation Centre (NewMIC) was recognized as one such existing mechanism. NewMIC, a collaborative research facility that is a joint initiative of industry, academia and both the provincial and federal governments, serves to help nurture British Columbia's new media sector by educating students and supporting research and development and new ventures.

Wireless

Complementing new media, British Columbia's wireless sector has a successful history of innovation and commercialization. The province is home to about 120 thriving wireless companies, the largest concentration in Canada. According to the recently published 2002 BC Wireless Industry Survey by PricewaterhouseCoopers, commissioned by the Wireless Innovation Network Society of British Columbia (WINBC), the wireless sector in British Columbia is well positioned to play a leadership role in the global market. This survey also noted that the province "consists of a cluster of larger diversified firms competing on an international basis, and smaller entrepreneurial companies targeting commercial operations in the near future." The report found that of the 67 companies that responded to the survey, \$253 million of revenues were generated in 2001, with 61% of that generated outside of Canada.

British Columbia's wireless sector employs approximately 1,500 people, and is expected to double by the end of 2004. The survey also found that 71% of the employees in this industry were educated to a university level or higher, with 72% reporting an average salary of more than \$50,000 per year. Seventy-six percent of respondent companies reported being involved in the wireless industry for less than five years, with 59% indicating that they would be seeking financing in excess of \$3 million over the next two years. Many cited the ability to execute on sales, obtain funding, and access target markets and customer bases as being critical success factors.

The PTC strongly believes that British Columbia has the potential to build world-class new media and wireless clusters. The PTC is encouraged by industry-led discussions that have taken place to date and recognizes the need to continue the dialogue and work towards formulating specific recommendations for the growth of these clusters. The Council will continue to investigate the new media and wireless sectors and will present its findings and recommendations in a future report.

REWARDING INNOVATORS IN THE PUBLIC SERVICE

The subject of recognition or awards was raised by the Council in the context of cultural or fundamental change in the public service. Members expressed the view that most large organizations, government included, faced difficulty in making substantive changes to an established culture. Positive reinforcement through an awards or recognition program could help accelerate and reinforce desirable change. A mechanism is needed to acknowledge the people who bring about change or innovation. It should be done so that the general public as well as peers are aware of the acknowledgment. It should also be a celebration of innovation.

The Council subsequently learned that the government has recently completed an extensive recognition review. This is one item, among many, to address renewal of the public service. The review concluded that existing formal recognition programs are well targeted and generally well received. However, one of the gaps identified was the lack of a 'pinnacle' program or event. To address this gap, the Premier's Awards have been proposed.

Premier's Awards

The purpose is to hold a pinnacle event or gala affair to showcase to the public and peers the best examples of public sector innovation and excellence. Awards would be open to the broader public service including core ministries, crown corporations, and members of the health and education sectors. There would be one award in each of four categories - leadership, service excellence, innovation and partnership. The innovation category, for example, would recognize a fundamental shift in the way business is conducted that produces substantial benefits. This awards concept is similar to that used in a number of other jurisdictions, including the United Kingdom, which has a very comprehensive and highly successful program.

The Premier's Technology Council supports the government's recognition concept, believing it to be an important part of a larger effort to improve and modernize the public service. The Council further recommends adoption of the Premier's Awards in all the proposed categories, especially the innovation category. We believe that this recognition will help accelerate and reinforce desirable cultural change.

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CONCLUSION

The Premier's Technology Council continues to be encouraged by the collaboration and cooperation of industry, the community at large, and government to help make British Columbia a leading global technology centre. As it enters its second year of operation, the Council will persist in championing this goal, which it strongly believes is achievable by this vibrant province. Since its last report, the Council has determined a number of priorities for the government to consider in the coming year. In addition, it has begun to examine e-learning, including online learning, as well as fuel cells, new media, wireless and other areas.

For the coming year, the Council identified several priority areas for government consideration. These include: broadband and Internet access to all communities, telehealth to improve delivery of health services to all regions of British Columbia, increasing venture capital in the province, and provincial marketing and branding for our technology industry. By stressing the importance of broadband availability in all communities of the province, supporting more effective and efficient delivery of health services, facilitating easier access to capital, and branding the province, these priorities serve to drive growth in British Columbia's expanding knowledge-based economy. The Council continues to advocate the implementation of these priorities as well as its other previous recommendations, and will work closely with government to tackle them.

British Columbia is home to an emerging 'online learning' industry that is both rich in talent and resources. Predicted to have a high growth rate and a global market, online learning represents a significant opportunity for British Columbia to take the lead. Consultations on the subject with government, public post-secondary institutions, and industry have thus far indicated that a positive environment for developing a strong and competitive online learning industry in British Columbia can be created by developing online learning credentialing, establishing a private sector/not-for-profit program accrediting board, and creating an online learning community/self-managed online learning portfolio. The Council will continue to examine online learning and work with stakeholders to finalize its recommendations.

To become a global technology hub, it is important to focus development and marketing on areas of strength. The PTC believes that British Columbia has five technology areas that have the potential to become world-leading clusters. These five - information technology, life sciences, alternative energy, new media and wireless - will be the focus of future Council efforts. Future reports will present more detailed examinations of each.

Future reports will also examine some subjects that cross all sectors and are critical to cluster development. Some of these are: taxation policy, people recruitment and availability of capital.

CONCLUSION

British Columbia has become a recognized world leader in fuel cells and related technologies. Locally, the industry employs many skilled workers and attracts millions of dollars in research and development. Fuel cells are expected to grow into a global multi-billion dollar industry. However, many challenges associated with commercialization and infrastructure development remain. Moreover, British Columbia's fuel cell industry faces fierce international competition. Accordingly, the Council supports the partnership of industry, government, and academia to create and implement a joint Fuel Cell Strategy. Such a strategy, when implemented, will ensure that the province realizes the economic, social, academic and environmental benefits from having a globally competitive fuel cell industry.

The new media and wireless sectors are ones in which the province has considerable strengths and where there is unlimited potential. Specific recommendations to support these industries will be made in a future report.

The Provincial Government of British Columbia has undergone significant change and innovation. Such change and innovation is often accelerated and reinforced through awards and recognition programs. The Council acknowledges the government's completion of an extensive recognition review, which determined that existing formal recognition programs are both well targeted and well received. Furthermore, the Council supports the government's move to implement the Premier's Awards, which will showcase the best examples of public sector leadership, service excellence, innovation and partnership.

The Council expects to publish its 5th report in the summer of 2003.

APPENDIX A: BRITISH COLUMBIA'S FUEL CELL INDUSTRY

World Leadership in Sustainable Growth

Prepared For

**Premier Gordon Campbell
&
The Premier's Technology Council**

by

**Denis Connor, Executive Chairman, QuestAir Technologies
(with the assistance of Fuel Cells Canada)**

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*A British Columbia Fuel Cell Industry Future**

THE BC SCENE TODAY

The BC fuel cell industry employs over **1,200** people. Ballard's Nexa unit is the basis for the Coleman PowerMate, the world's first fuel cell consumer product for back-up power applications. Ballard and other fuel cell industry companies in BC are actively participating in early demonstrations of both stationary and mobile fuel cell systems. Ballard fuel cell engines are being installed in over 30 buses for use in 10 European cities. QuestAir purification units are being used in five hydrogen refueling sites in Canada, the United States and Japan. Major automotive and energy companies, such as Ford and Shell, are making strategic investments in the BC fuel cell industry.

THE BC SCENE IN 2010

BC fuel cell companies have over \$3 billion in sales and employ **10,000** people. The BC Hydro sponsored HY-Way, a centerpiece of the sustainable 2010 Winter Olympics, provides hydrogen for the fuel cell vehicles used to transport athletes and dignitaries to the various venues in Vancouver and Whistler. The Olympics provides a showcase for BC's commitment and leadership in the initial stages of the global transition to a hydrogen economy. Over 20,000 fuel cell vehicles, the majority powered by Ballard engines, are in operation worldwide. Over two Gigawatts of stationary power systems, the majority using QuestAir gas management systems, are supplying power with much reduced carbon dioxide and no criteria emissions.

THE BC SCENE IN 2020

Over **30,000** people are employed in the BC fuel cell industry. Over 25% of all vehicles are fuel cell powered, with from 50% to 100% carbon dioxide emissions reductions depending on the source of the hydrogen ... 50% if from natural gas, or 100% if from the renewable or carbon sequestered sources that are coming on-stream. Natural gas, and gasified coal, sewage and garbage feed the high temperature fuel cell systems that provide 50% of the new and replacement power for the highly distributed power grid. Vehicles parked at home and at work, controlled by the worldwide General Hydrogen arbitrage system, provide a massive new source of distributed power, substantially reducing power system investments.

THE BC SCENE IN 2030

Over **50,000** people are employed by the BC fuel cell cluster and the renewable energy industry it has enabled. The rolling stock of vehicles in BC is largely fuel cell powered, as are the stationary power systems. Both use either hydrogen

pipelined from carbon sequestered fossil fuel sources, or electrolytic hydrogen generated from renewable power sources. Renewable energy sources, such as wind and solar, begin to grow rapidly now that fuel cells can use stored hydrogen to provide power to the grid when these intermittent sources are not available. Greenhouse gas emissions from all transportation and stationary power sources are declining dramatically.

*The following sources were used to develop the above projections:

- A National Vision of America's Transition to a Hydrogen Economy - To 2030 and Beyond, United States Dept. of Energy, Feb 2002.
- Energy Needs Choices and Possibilities - Scenarios to 2050, Royal Dutch/Shell Group, 2001.
- Fuel Cells: The Opportunity for Canada, by PricewaterhouseCoopers, June 2002.

Executive Summary

British Columbia is a recognized world leader in fuel cells and related technologies. Maintaining this leadership will provide significant economic, social, and environmental benefits. British Columbia can capitalize on prior government investment in this technology by a pro-active approach to industry development.

The British Columbia Climate Change Panel, of which the author is a member, was formed to advise the British Columbia Cabinet on ways to respond to the global climate change issue. It will be recommending that to achieve a 2030 future in which climate change is being effectively addressed, the first action of government should be a long-term commitment to achieving a sustainable economy. A key element in achieving such sustainability will be a plan to transition to a hydrogen-based energy and transportation system. The BC Fuel Cell Industry Future given above is one of the futures envisioned by the Panel for key sectors of the British Columbia economy. Fuel cells and hydrogen technology figure prominently in the very low emission futures envisioned for these sectors in 2030.

Fuel cells are the most efficient way to convert fuels into electricity. For any fossil fuel source, one gets more electricity with less carbon dioxide and virtually no criteria emissions. In addition to superior efficiency with little or no emissions, fuel cells offer other significant benefits including the ability to utilize hydrogen from renewable energy sources, power modules tailored to user needs permitting power without transmission lines, and quiet operation.

The fuel cell industry is already generating significant economic benefits for the province. In 2000/01, the industry employed approximately 1,200 people. Investment in innovation at \$130,000 per employee is extremely high, with approximately \$156 million spent on research and development in 2000/01. Revenues in the industry are growing rapidly, with over 80% coming from exports of products and services.

Global demand for fuel cell products is estimated to reach \$46 billion per year by 2011. Commercialization is driven by the value characteristics of fuel cells delineated above. However, challenges remain for the worldwide industry. These include: reduction in product costs; development of a fueling infrastructure for transportation uses; development of a skilled work force; increased public awareness of the benefits of fuel cells; and the creation of supportive government policies and regulations. British Columbia faces the additional challenge of fierce competition from the aggressive policies and programs at state and federal levels in the US, Japan and Europe. They support technology development and market access for their own fuel cell sectors, and provide incentives to attract BC fuel cell companies to relocate.

If the province is to maintain its leading position, industry, government and academia must partner to develop an aggressive provincial Fuel Cell Strategy. This Strategy will build on a strong history of government/industry collaboration and leverage our present strengths. It should include: government policies and programs to accelerate development and commercialization; activities that increase public awareness of the benefits of the technology; programs that enhance skills development; and the development of supportive codes, standards and regulations. Key measures will include fuel cell demonstration programs, a targeted fuel cell procurement policy for governments, plus incentives to private sector purchasers of fuel cells. These measures, which demonstrate government leadership toward a sustainable hydrogen economy, would enable achievement of the 2010 future and put the province well on the road towards the 2030 futures described for the BC Fuel Cell Industry. Implementing this Strategy will ensure that the province and the taxpayers reap the benefits of recent government investments in the sector, including:

- Knowledge-based employment growth of tens of thousands of jobs
- Growth in value-added exports
- More competitive existing sectors by early adoption of energy efficient power sources
- Enhanced energy efficiency and energy diversity throughout the economy
- Reduced pollution, reduced greenhouse gases, and reduced health care costs
- Leadership in sustainable development and climate change solutions
- Enhanced innovation capacity

The British Columbia Fuel Cell Industry: Leadership in Sustainable Growth

INTRODUCTION

British Columbia has world-leading capabilities in most areas of the developing fuel cell industry, including companies and public sector organizations focused on:

- Research and development
- Fuel cell stack and fuel cell systems development
- Product development and systems integration
- Parts production
- Manufacturing systems
- Fuel, reformer and fueling systems integration and development
- Financial, engineering and consulting service suppliers

FUEL CELLS: THE BENEFITS

Fuel cells are electrochemical devices that enable the chemical energy of fuels to be converted directly into electricity. Fuel cells can offer significant benefits over traditional energy technologies including:

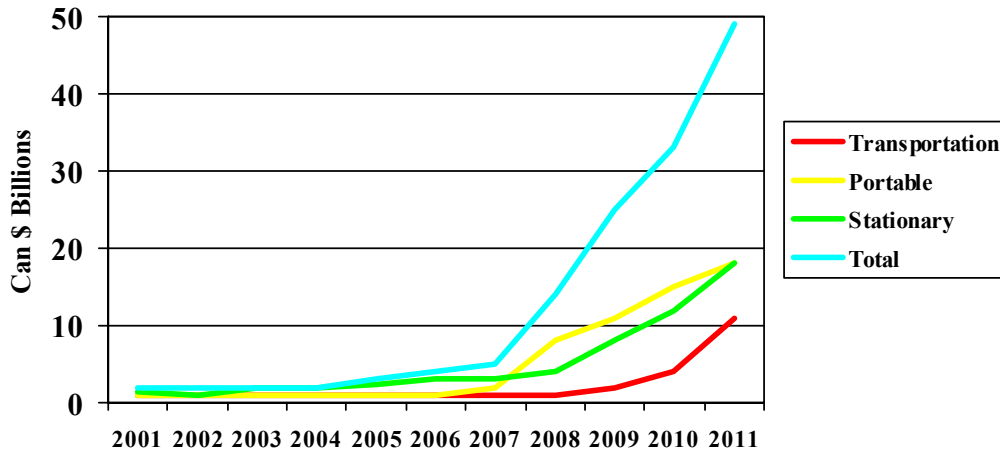
- Superior fuel efficiency
- Utilization of fossil fuels, biofuels, or hydrogen from renewables
- Lower carbon dioxide and no criteria emissions compared to combustion engines
- Distributed power with no transmission lines and little or no noise impact
- Versatility in portable, stationary, and transportation applications
- Low maintenance costs due to few moving parts
- Modularity allowing for low cost, high volume manufacturing

GLOBAL DEMAND

Global demand for fuel cell products is estimated to be \$46 billion per year by 2011. Of the three key market segments, the stationary market is projected to be the largest (\$17.9 billion), followed by the portable market (\$17.6 billion), and the early phase of transportation applications (\$10.3 billion). By 2021, the global market could reach \$2.6 trillion per year with transportation becoming a major component⁵.

⁵ PricewaterhouseCoopers, "Fuel Cells: The Opportunity for Canada". June 2002. Fuel Cells Canada, "The Canadian Fuel Cell Industry: A Capabilities Guide". June 2002.

Global Fuel Cell System Market Projections



THE CHALLENGES

The BC and the global fuel cell industry face a number of critical challenges in the development and commercialization of fuel cell components, stacks, systems and products, including:

- Continued reduction in product costs and improvements in durability/reliability
- Development of appropriate fuelling infrastructures
- Ensuring the availability of a skilled workforce
- Improving public awareness and acceptance of fuel cells and hydrogen
- Supportive government policies and regulations

The BC Fuel Cells Industry

HISTORICAL PERSPECTIVE

British Columbia, specifically the lower mainland around Vancouver, is home to over 1,200 workers directly employed in the fuel cells and hydrogen industries. The area is the home of the earliest corporate fuel cell development activities in Canada. Over the past twenty years, it has grown to the point where it has, arguably, the largest concentration of fuel cell expertise in the world. It is also an excellent example of the dynamics of cluster building, whereby the existence of core capabilities can enhance growth in a new industry.

The BC cluster has developed from the early activities of Ballard Power Systems. Founded in 1982, the company now has 1,000 employees - approximately 300 of which are located outside the province. Ballard has established relationships with a wide variety of local suppliers and customers, which themselves have established relationships with others in the region. Some employees from Ballard Power Systems have moved on to found new corporations, while others now work for other companies and organisations in the area. Ballard Power Systems and the region remain largely focussed on PEMFC (Proton Exchange Membrane Fuel Cell) technology; however, other complementary core competencies are increasingly important, including: parts and systems development, systems integration, fuelling infrastructure systems development, engineering, consulting and financial services.

Government support was critical to the early success of the BC cluster. Recognizing the long-term benefits of fuel cell technology, both the provincial and federal governments provided early financial support to the industry. Critically, support has been extended not just for research and technology development, but also for demonstration projects. These demonstration projects allowed significant progress to be made in data collection, knowledge of product performance, and in testing the robustness of products as they are prepared for commercial production. At the present time the region continues to benefit from some limited support for demonstration activities. However, this ends in 2003, with no replacement in sight.

As the industry has grown, large multinationals, including DaimlerChrysler, Ford, Shell Hydrogen, BOC Gases, BASF, and Mitsubishi, have made strategic investments in local companies. Leading service suppliers, such as BC Hydro, have developed new expertise and products for the growing fuel cell industry. Local venture capital companies have increased their interest and commitment to the industry, and specialized financial institutions have been established. Given the dominant size and importance of its industry, British Columbia was an appropriate site for headquarters of Fuel Cells Canada when it was established in 2000. Similarly, Vancouver was selected as the headquarters for the National Research Council's National Fuel Cells Program and Research Centre. It must be

emphasized however, that both of these organizations, as national institutions, provide support and services to industry stakeholders across the country.

University activity has been a part of the cluster development in the region. For many years the major activities occurred at the Institute for Integrated Energy Systems (IESVic) at the University of Victoria. It has a well established graduate program in fuel cell technology, along with core research facilities. Significant research is also carried out at Simon Fraser University in Burnaby. Recently the University of British Columbia has begun to focus on the sector, establishing a small facility and adding fuel cell researchers to its already strong clean energy and sustainable development research capacity. The University College of the Fraser Valley has joined Fuel Cells Canada in investigating early opportunities for developing training programs for the industry.

EMPLOYMENT

As of October 2001, an estimated 1,200 people were directly employed by the BC fuel cell industry, with additional jobs supported in sectors that supply and service the industry⁶. All of this employment occurs in the Lower Mainland and Greater Victoria areas. Forecast employment for 2003 is expected to be over 1,800 - a growth rate of 49%.

Current indications are that the British Columbia workforce in the fuel cells and hydrogen sector is well educated. Seventy-eight percent of the 2001 workforce had a post-secondary education. Of the total, 22 percent had community college education while 55 percent had university education.⁷

REVENUES

Revenues of the surveyed firms reached \$67.5 million in 2001. Eighty-two percent of these revenues were based on exports, with sales of equipment (77%) being the mainstay of the growing industry. Revenues for the BC industry are projected to reach \$104 million by 2003 - a growth of 70%.⁸

⁶ PWC and Sypher Mueller. The information compiled in this "Profile" has been obtained from three sources: **1**. The PricewaterhouseCoopers Study "Fuel Cells: the Opportunity for Canada" June 2002; **2**, the Sypher Mueller/NRCAN survey and Report "Economic Impact of Industrial Hydrogen Activity in Canada" June 2002; and **3**, information collected by Fuel Cells Canada. Information for Sypher Mueller and for PricewaterhouseCoopers was collected in 2001 and reflects the state of the industry at that time.

It is important to note that there is limited statistical information available on the BC fuel cell industry, and virtually none on similar activities outside of the country. The numbers for all categories except employment have been taken from those accounting for activities in "Western Canada" in the Sypher Mueller/NRCAN report. While this Report refers to the area west of Ontario as "Western Canada", given the methodology of the survey and the dominance of BC activities in the Canadian context these numbers can be taken as a reasonable proxy for indicative BC activities.

⁷ Sypher Mueller/NRCAN p. 14

⁸ Ibid. pp.7-11

RESEARCH AND DEVELOPMENT

Continued research and development is critical to the development and commercialization of fuel cell and hydrogen products and systems. In the 2001 survey R&D expenditures were significantly higher than revenues - reaching \$156 million, and representing \$130,000 per employee. These expenditures are expected to double by 2003. The sector is a significant player in the British Columbia innovation scene, accounting for 87% of total Canadian R&D expenditures in the industry. It also compares well with other emerging BC industries such as biotech, which in 2001 employed 3,300 people and had estimated R&D expenditures of \$120 million (\$36,363 per employee).

Traditionally, much of the R&D has been carried out by the industry - in some instances leveraging support from the federal or provincial governments. Ongoing institutional research activities have been carried out at the National Research Council Innovation Centre in Vancouver, the Institute for Integrated Energy Systems at the University of Victoria and at Simon Fraser University. The University of British Columbia is actively adding fuel cell researchers to its already strong clean energy and sustainable development research capacity. Such public institution activity is expected to increase over the next few years to meet with the growing needs of the industry.

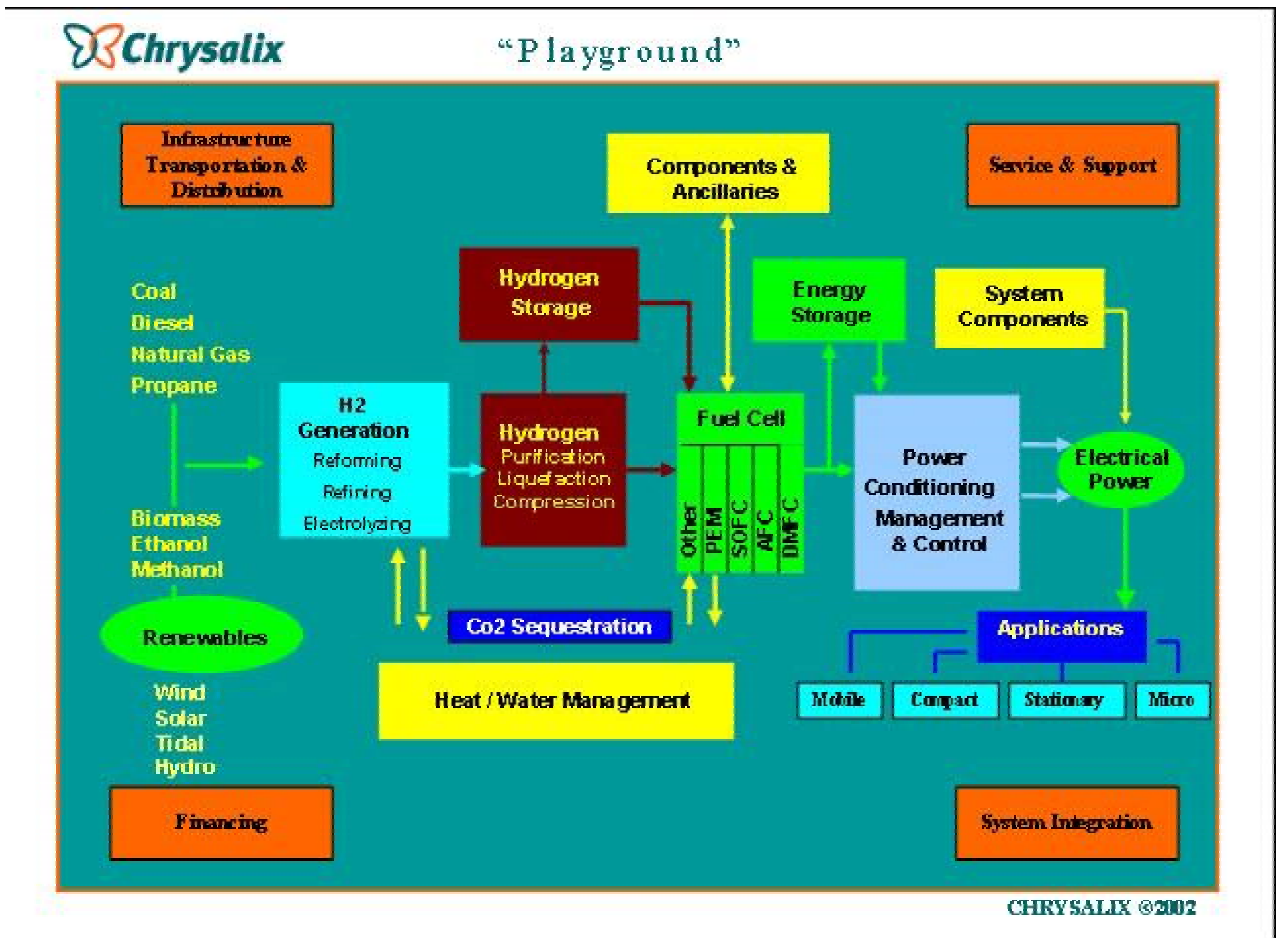
Fuel Cells Industry
Economic Benefits to BC

	Current (2000-01)	Projected (2002-03)	Growth (%)
Revenue	\$67.5 M	\$103.9 M	70
R&D Expenditure	\$155.7 M	\$308.5 M	99
Industry Size	\$223.2 M	\$412.4 M	90
Total Direct Employment	1,200	2,639	49

As the table indicates, the growing fuel cell industry provides significant economic benefits to British Columbia. More importantly, the growth rate is significant and, as long as the industry continues to invest and government provides a conducive development climate, it should continue to grow at an accelerated rate for the perceivable future.

INDUSTRY STRUCTURE

Worldwide, the fuel cell and hydrogen industry is at the nascent stage. The structure of the industry reflects this early stage of development, as does the lack of statistical information and analyses of this new industry. The diagram below provides the conceptual framework for the developing industry. It defines the scope of activities of Chrysalix, a Vancouver-based, fuel cell centric, venture capital firm funded by Ballard and seven major multinationals.



In British Columbia and elsewhere, the industry is characterized by a relatively low number of small companies (under 500 employees) engaged exclusively in the sector. These companies receive over 50% of revenues derived from the fuel cell and hydrogen related activities. There is a much larger range of companies involved to a much smaller degree in the supply of parts, systems and services.

There is a symbiotic relationship between the various players as well as the layers of the industry. The number and intensity of the interrelationships are growing as the industry grows in scope and scale. Of significant interest is the increasing number of large corporations - domestic and international - that are beginning to participate in the sector as strategic investors. The entry of these stakeholders confirms the long-term growth potential for the sector, as well as providing the manufacturing, marketing and management experience needed for the industry to successfully mature.

It has already been noted that most industry revenues are due to export sales. While this reflects the realities of the large overseas markets and their support for new technology adoption, it is important to note that foreign market opportunities

are directly related to targeted government support for the introduction and early purchase of these new technologies. In recent years the same degree of support has not been available in Canada, or in British Columbia.

Fuel Cell Producers and Systems Integrators

There are seven companies in BC whose primary focus or goal is fuel cell production and/or system integration. They include:

Company	City	Fuel Cell Applications		
		Stationary	Portable	Transport
Angstrom Power Inc.	North Vancouver		X	
Ballard Power Systems Inc.	Burnaby	X	X	X
Cellex Power Products Inc.	Richmond			X
MagPower Systems Inc.	Delta	X	X	X
Palcan Fuel Cell Co. Ltd.	Burnaby			X
PEM Fuel Cells Inc.	Vancouver			X
PowerDisc Development Corporation Ltd.	Chilliwack			X

Reflecting the current situation throughout the world, most of these companies are relatively small - falling into the Canadian definition of SME's (under 500 employees). The larger companies usually have less than 500 employees engaged in fuel cell and related activities. The exception to this situation is Ballard Power Systems Inc., which has approximately 1,000 employees, most of whom are directly employed in activities related to fuel cells and or systems development and integration.

Many BC producers have formed domestic and international strategic alliances with international automotive and energy supply companies that will be users of fuel cell technology. These alliances and partnerships provide access to the financial resources, technical, manufacturing and marketing skills, and market access that are required as the industry moves into the commercialization of products and systems.

Suppliers, Service Providers and Fuelling Infrastructure

As the following table shows, there are more firms and organizations in BC besides fuel cell producers that are involved in the fuel cell industry. These include a number of companies focused on developing the fuelling infrastructure.

Some of these firms are closely aligned with one or two of the producers, but most are involved with many of the industry's players. Many of these companies are

APPENDIX A: BRITISH COLUMBIA'S FUEL CELL INDUSTRY

also providing parts, systems and/or services to foreign stakeholders as well as those in BC and the rest of Canada.

Parts and Systems Suppliers to the Fuel Cell Industry	Fuelling Infrastructure	Fuel Cell Service Providers
QuestAir Technologies Inc. Xantrex Technology Inc. Greenlight Power Technologies Inc. Azure Dynamics Corp. Cimtex Industries Ltd. Pathway Design & Manufacturing Inc.	BC Hydro/PowerTech Methanex Corporation General Hydrogen Corp. Praxair Inc. IMW ENRG (PFC eFuels Inc.)	Chrysalix Energy Management Inc. GrowthWorks Ltd. Ventures West Management Inc. NORAM Engineering Keen Engineering Ltd. PricewaterhouseCoopers BC Research Inc. Fuel Cells Canada National Research Council Canada Inst. for Integrated Energy Systems (UVic)

Note: Some companies are involved in more than one area.

A brief profile of many of the companies listed in the above two tables is contained in the Annex.

THE LINKAGES THAT DEFINE THE BRITISH COLUMBIA FUEL CELL INDUSTRY CLUSTER

Industry Clusters

Michael Porter, the leading authority on industry cluster theory has described clusters as “critical masses in one location with unusual competitive success in specific fields”.⁹ Successful clusters usually include a wide range of organizations and agencies, and include, among other characteristics:

- Linkages among firms and their supporting technological infrastructure
- Proximity to supportive educational, financial, business and institutional resources
- Self-sufficiency in key inputs, including skilled employees, components and systems, engineering, marketing and financial resources
- Access to government institutions and resources

Fuel cell and hydrogen industry clusters are at their nascent stage (mature industry clusters are often considered to have at least 15,000 employees).

⁹ Porter, Michael, “Clusters and the New Economics of Competition,” *Harvard Business Review* (Nov-Dec 1998) p. 80.

However, it is clear from the Historical Perspective section above that such a cluster is growing in the Lower Mainland. Indeed, the area arguably has the largest concentration of fuel cell expertise in the world, as well as the only real developing cluster. This industry cluster provides a core capability that can, with aggressive policy and program support from government, and accelerated participation by industry, continue to ensure BC's leading role in this developing industry.

The BC Cluster and Some Linkages

The BC cluster companies focus on mainly on Proton Exchange Membrane (PEM) fuel cell technology products and systems. This is the technology best suited for transportation and small stationary applications. As an outgrowth of this transportation focus there is also a focus on the hydrogen generation and purification systems needed for refuelling vehicles, i.e. the refuelling infrastructure.

Some critical cluster activities and relationships among BC companies include:

- **Core technology developers and systems integrators**
 - **Ballard Power Systems Inc.** - PEM products and systems
 - Early funding by Ventures West
 - Strategic partners - Ford and DaimlerChrysler
 - Strategic investor in QuestAir and Chrysalix
 - **Cellex Power Products Inc.** - PEM systems
 - Early funding by Ventures West and GrowthWorks
 - Strategic partner - Methanex
 - **Angstrom Power Inc.** - Novel PEM fuel cell architecture
 - Based on technology developed at IESVIC/UVic
 - Early funding by Chrysalix, Ventures West and GrowthWorks
- **Suppliers of specialized products and systems**
 - **QuestAir Technology Inc.** - Hydrogen purification systems
 - Early funding by Ventures West and GrowthWorks
 - Strategic partners - BOC Gases, Ballard, Shell Hydrogen
 - **Greenlight Power Technologies** - Fuel cell test equipment
 - Ballard was a lead customer for test equipment
 - Later stage funding by Ventures West and GrowthWorks
 - Just acquired by Hydrogenics who will transfer their test business from Toronto to Vancouver
 - **Xantrex Technology Inc.** - Power conversion electronics
 - Founded by Mossadeq Ummedaly - former Ballard CFO
 - Based on Statpower a Ventures West company
 - Acquired similar US companies
 - **MRT** - Membrane reformer for hydrogen production
 - Based on UBC developed technology
 - Strategic partner - NORAM Engineering

- **Fueling infrastructure and storage**
 - **General Hydrogen Corporation** - Vehicle power arbitrage system
 - Founded by Geoff Ballard and Paul Howard
 - Strategic partners - General Motors, Air Products
 - **Methanex Corporation** - Methanol for fuelling fuel cells
 - Worldwide promotion of methanol use in fuel cells
 - Strategic investor in Cellex
 - **BC Hydro (Powertech)** - Hydrogen refuelling systems and test
 - Supplied hydrogen for Ballard bus tests in Vancouver
 - Does testing of high pressure hydrogen storage tanks
 - Promoting the 2010 Olympics HyWay concept
- **Specialised services**
 - **Chrysalix Energy Management Inc.** - Seed venture capital and incubation for fuel cell companies
 - First VC fund provided by Ballard, Shell Hydrogen, Duke Energy (formerly Westcoast Energy), BASF, BOC Gases, Mitsubishi, and a large US Aerospace firm (TBD)
 - Funded Angstrom and four US fuel cell companies
 - **Ventures West Management Inc.** - Venture Capital
 - Key initial funder of Ballard, QuestAir, Cellex, Angstrom, Greenlight, Xantrex, etc.
 - **GrowthWorks Inc.** - Venture Capital
 - **Fuel Cells Canada** - National industry organization
 - Founded by the CEO's of Ballard, Methanex, QuestAir and Ventures West to promote the industry in BC and Canada
 - Canada-wide membership of over 50 companies
 - Running fuel cell demonstration program with Western Economic Partnership Agreement (WEPA) funding
 - **NORAM Engineering** - Consulting engineering
 - Shareholder in BCRI, QuestAir and MRT
- **Government institutions**
 - **National Research Council** - Fuel cell research and facilities
 - National fuel cell research program directed from Vancouver with Advisory Board chaired by Denis Connor with industry and academic members drawn from BC and elsewhere
 - Hydrogen capable test facility provision to QuestAir, etc.
 - Western Economic Diversification
 - Industry Canada
 - British Columbia Ministry of Competition, Science and Enterprise
- **Universities**
 - University of Victoria (IESVic)
 - University of British Columbia
 - Simon Fraser University
 - University College of the Fraser Valley
- **Testing facilities**
 - BC Hydro (Powertech)

- National Research Council's National Fuel Cell Centre
- **R&D organisations**
 - National Research Council's National Fuel Cells Centre
 - British Columbia Research Inc. (BCRI)

These relationship structures are a key reason why the BC fuel cell cluster is looked on by other jurisdictions as the model to emulate.

The Role of Government

Governments have played an important role in the development of the BC fuel cell industry. Over the period 1982 through 2006, past and planned government support to the fuel cells industry totals approximately \$179 million in grants, contributions and loans. Although substantial, it should be noted that during the period from 1995 to 2002, sector companies and their employees provided tax revenues to the federal and provincial governments of over \$200 million through PST/GST, personal income tax, capital gains taxes on exercise of options, and corporate taxes.

In the main, government support has been provided to companies and institutions on a project by project basis. Overall policy objectives guiding support have been related to innovation, clean technologies, energy efficiency and greenhouse gas abatement. Departments most prominent in industry support include Natural Resources Canada, the National Research Council (and IRAP), the Department of National Defense, Western Economic Diversification (WED) and Industry Canada. Over the last five years support from the federal government includes:

- WEPA demonstration projects (WED jointly with the British Columbia government). This funding provided \$13 million in assistance to demonstration projects carried out in BC, along with some support to Fuel Cells Canada
- Climate Change Action Fund/Technology Early Action Measures funding for a variety of demonstration projects
- About \$40 million in total investments by Technology Partnership Canada for fuel cells research and development at Ballard Power Systems and QuestAir Technologies Inc.
- \$20 million incremental funding for the NRC fuel cell testing and demonstration program - most of which will be targeted at providing equipment staff and infrastructure support for the National Fuel Cell Centre on the UBC Campus. It will also allow the NRC to expand its contributions to train people for the fuel cell sector and enhance its activities as a showcase for innovative BC companies.

On the provincial side, in 1996 the Province signed an \$8.6M strategic partnering agreement with Ballard under which BC Transit purchased fuel cell buses for \$2.4M, the Province provided grants totaling \$4.76M for R&D, and purchased stock warrants for \$1.44M, which were held by the government's Transportation

Financing Authority (TFA). The majority of the warrants were subsequently exercised and sold for a net gain on the sale of around \$10M.

The only support to the fuel cell industry in the last five years has been through the \$6.5M provincial contribution to the \$13M WEPA fuel cell initiative with the federal government. In April 2000 BC Transit purchased three bus engines for \$4.6M as part of the WEPA. The balance of provincial support for the initiative was delivered by BC Hydro's hydrogen and fuel cell activity (\$1.9M).

INTERNATIONAL COMPETITORS

During this same period when the tax revenues and gains on the sale of shares accruing to Canadian governments from the emerging fuel cell industry have been greater than the support they have provided, other jurisdictions have recognized this sector's substantial economic and environmental potential. They are now actively challenging Canada's leading position through policies and programs that aggressively support fuel cell development and market access for their own companies and institutions. In addition, some states like Michigan and Ohio have explicit policies to lure companies from areas such as British Columbia to the sponsoring jurisdiction.

Examples of programs include:

United States

State Initiatives

- California - incentives, emission targets and demonstration activities including California Fuel Cell Partnership
- Michigan NextEnergy - \$50 million over next for 3 years, includes 700 acre tax-free research zone
- Ohio Fuel Cell Initiative - \$103 million over three years
- Connecticut Clean Energy Fund - approximately \$9.5 million in 2002

Federal Initiatives

Programs driven by performance goals and cost reduction targets:

- The National Vision of America's Transition to a Hydrogen Economy and Technology Roadmap
- Freedom Car: \$150M US for 2003
- Tax credits of \$1000/Kw for stationary fuel cells (pending decision)
- Office of Energy Efficiency and Renewable Energy - \$75 million in 2002 for:
 - Demonstration fuel cell program - \$47.4 million
 - Demonstration hydrogen program - \$29 million
- Fiscal 2003 - plans for five-year research, development and demonstration program - at increased levels

APPENDIX A: BRITISH COLUMBIA'S FUEL CELL INDUSTRY

- Office of Fossil Energy - DOE Fossil Energy Fuel Cell Program - 2002 budget \$50 Million. Includes SECA demonstration program and Vision 21
- Total federal for 2003 - approximately \$275 million

European Union

From 1999 - 2002 fuel cell and hydrogen research, development and demonstration support included:

- Research and Development: 77 million Euros
- Demonstration: 50.5 million Euros
- Total: 127.5 million Euros

These programs have received matching funding from EU member states and therefore the total EU funding to fuel cell research, development and demonstration is estimated at 70 million Euros per year.

Future: 6th Framework Program (2002-2006)

- Estimated 1.5 billion Euros dedicated to fuel cells and hydrogen initiatives
- Also the EU has created targets including 5% of road transport to be hydrogen by 2020
- Targets for fuel cell cost reductions for fuel cell stationary power systems of less than 1000 Euros/Kw
- Launched High Level Group to outline actions necessary for a vibrant fuel cell industry and sustainable hydrogen economy - with ability to target additional expenditures of up to 2.61 billion Euros

Germany

Energy Research and Energy Technology Program

- From 1990 to 2003 - amounted to 180 M Euros
- 15 M Euro per year in the National Research Centers, Juelich and DLR
- ZIP - Investing into the Future Program: 120 M for energy research and demonstration projects of which 60 M Euros dedicated to fuel cells and hydrogen from 2001 to 2003

Current annual funding to fuel cells is approximately 35 million Euros.

Singapore

Clean Energy for Singapore: The SINERGY Fund - \$44.2 million available for 2002/03.

Japan

As an extension of their on-going WE-NET program they have provided R&D and demonstration funding for hydrogen energy and fuel cell research of \$280 million for fiscal 02/03 with increased levels of funding from 2003 to 2006. Specific initiatives include programs in stationary, mobile, and infrastructure systems research, development and demonstration, plus early purchase programs by government users.

A Proposal to the British Columbia Government for a Fuel Cell Industry Strategy

THE AGENDA OF THE PROVINCIAL GOVERNMENT

Except for the Futures Scenario at the start of this document, the focus above has been on the fuel cell industry. However, in formulating the following proposal, a broader economic and social context has been used to align the proposal with the full agenda of the government. In particular, the proposal attempts to address the following major areas of this agenda:

- Fiscal restraint
- Transitioning the BC economy to a sustainable knowledge economy by fostering the development of new and existing clusters
- Expansion of the hydrocarbon energy industry in the post-Kyoto environment
- Obtaining 50% of incremental electrical power from 'green' sources
- Improving the competitiveness of the other resource industries
- Developing a long term response at the provincial level to the challenge of climate change
- A leaner more effective government that delivers its services in the most cost effective manner

Since expanding the energy industry in the post-Kyoto environment is also high on the agenda of the Alberta government, areas and programs of common interest with that province are also addressed. In particular, the "Sustainable Hydrocarbons" proposal presently being discussed in the energy ministries of both provinces is considered.

THE PROPOSAL

If BC is to maintain its leading position, urgent action is needed. We recommend combining the strengths of the provincial and federal governments, industry and academia to develop and implement an aggressive BC Fuel Cell Strategy that parallels and builds on a similar National Fuel Cells Strategy. The basis of this BC Strategy will be initiatives that overcome the challenges facing the industry, achieving the goal of continued leadership, thus allowing the province to accrue the immediate and long-term benefits to be gained from the earlier investments in this critical new industry.

This BC Fuel Cell Strategy should leverage the province's leading capabilities in:

- Research and development
- Fuel cell stack and sub-system development

- Product development and systems integration
- Parts production
- Manufacturing systems
- Fuel, reformer and fueling systems integration and development
- Financial, engineering and consulting services

Specifically, activities in the provincial strategy should include:

- **Enhanced support for research and development**
 - Carried out by the private sector and in public institutions (in collaboration with industry). This will ensure a level playing field with international competitors.
- **Support for market focused demonstration projects**
 - In both public and private sector applications.
 - In real life situations that validate product reliability and output, “ruggedize” the product, provide quality assurance data, and help manufacturers make the necessary alterations to earn commercial success.
- **The British Columbia government becoming an early adopter of fuel cell products**
 - Government departments and crown corporations being real customers raises the profile and supports the development of markets.
 - Shows substantive leadership to the world.
 - Uses resources that would be spent on less innovative solutions.
 - Might be combined with an ‘unsolicited proposals’ program for all technology related purchases of the government.
- **Accelerate the development of harmonized codes and standards**
 - Government and Industry collaboration to remove regulatory obstacles to the introduction of fuel cell products and systems.
- **Incentives that support and reward growth and investment**
 - Encourage the early adoption of fuel cell and related products and systems by providing fiscally neutral tax based incentives, such as the income tax payback approaches used in Michigan.
 - Consider programs having an initial cost but longer term substantial savings to the treasury.
- **Development of infrastructure**
 - Build upon investments already made by BC Hydro and others.
 - Supports the 2010 Olympic bid and implementation.
- **Ensure the availability of a highly skilled, well-trained workforce**
 - Industry/government collaboration with secondary and post-secondary institutions to define and implement appropriate education and training at all levels in the post-secondary system.
 - Lets BC residents take maximum advantage of the job opportunities created by the fuel cell industry.

Results

A successful industry/government partnership to implement such a Fuel Cell Strategy will provide the impetus for the industry to maintain its current global leadership and capture a significant share of the growing international markets for fuel cell and related products and systems. Results from the successful implementation of such a strategy will include:

- **Innovation**
The industry currently invests approximately \$130,000 per employee on research and development. To maintain our leading position, this investment in innovation must continue. **The fuel cell sector will be a key factor in meeting BC's goals for growing its knowledge-based industries.**
- **Employment**
Employment in the fuel cells sector was 1,200 people in 2001 and is projected to grow by over 49% to 1,800 people in 2003. Such growth in high paying, knowledge- and technology-intensive jobs will continue if BC maintains its leading position in the global market and supports the target of 10,000 jobs by 2010 given in the Futures scenario at the start of this document.
- **Environment/Health**
Fuel cells provide superior efficiency over conventional technologies with little or no emissions. They can utilize carbon-based and renewable energy sources. The cumulative effect of increased volumes of fuel cell applications in portable, stationary and transportation applications will lead to reduced levels of pollution and greenhouse gases. British Columbia leadership in the fuel cells sector will assist in reducing the health care costs associated with air pollution. It will also provide BC leadership in meeting the long-term global challenges related to greenhouse gases.
- **Value-Added Exports for Energy Self-Sufficiency**
At the present time 80% of products and services developed in the Canadian fuel cell sector are exported. With global markets projected to reach \$46 billion by 2011 and over \$2 trillion in 2021, BC leadership will provide value-added exports for the province, while allowing customer jurisdictions to develop energy self-sufficiency.

Conclusion

British Columbia is a world leader in the development and commercialization of fuel cell stacks, systems and services. A BC Fuel Cell Strategy developed through government, industry and academic collaboration, can provide the impetus to maintain international competitiveness as the technology achieves full commercialization. Such a Strategy can also serve broader policy goals of the government.

For example, the British Columbia Climate Change Panel was formed to advise the British Columbia Cabinet on ways to respond to the global climate change issue. It will be recommending that to achieve a 2030 future in which climate change is being effectively addressed, the first action of government should be a long-term commitment to achieving a sustainable economy. A key element in achieving such sustainability will be a plan to transition to a hydrogen-based energy and transportation system. The BC Fuel Cell Strategy would be an important first stage in such a plan.

The Strategy would build on a strong history of government/industry collaboration and leverage our present strengths. It should include: government policies and programs to accelerate development and commercialization; activities that increase public awareness of the benefits of the technology; programs that enhance skills development; and development of supportive codes, standards and regulations. Key measures will include fuel cell demonstration programs, a targeted fuel cell procurement policy for governments, plus incentives to private sector purchasers of fuel cells. These measures, which demonstrate government leadership toward a sustainable hydrogen economy, would enable achievement of the 2010 future and put the province well on the road towards the 2030 future described for the BC Fuel Cell Industry. Implementing this Strategy will ensure that the province and the taxpayers reap the benefits of recent government investments in the sector, including:

- Knowledge-based employment growth of tens of thousands of jobs
- Growth in value-added exports
- More competitive existing sectors by early adoption of energy efficient power sources
- Enhanced energy efficiency and energy diversity throughout the economy
- Reduced pollution, reduced greenhouse gases, and reduced health care costs
- Leadership in sustainable development and climate change solutions
- Enhanced innovation capacity

Annex: Profiles of British Columbia companies in the Fuel Cell Industry

This material is taken from the Fuel Cells Canada web site and is somewhat promotional in nature. The Premier's Technology Council is not endorsing any specific company or organization. The profiles have been included to illustrate the extent of activity that exists in Canada, particularly British Columbia, in this new and dynamic sector.

FUEL CELL PRODUCERS AND SYSTEMS INTEGRATORS

Ballard Power Systems, Ballard Power Systems is recognized as the world leader in developing, manufacturing and marketing zero-emission proton exchange membrane (PEM) fuel cells. Ballard is commercializing fuel cell engines and components for the transportation market, electric drives for both fuel cell and battery powered electric vehicles, power conversion equipment for microturbines and other distributed generation technologies, fuel cell power generation equipment for markets ranging from portable power products to larger stationary power generation products and is a Tier 1 automotive supplier of friction materials for power train components. Ballard's proprietary technology is enabling automobile, electrical equipment and portable power product manufacturers to develop environmentally clean products for sale. Ballard is partnering with strong, world-leading companies, including DaimlerChrysler, Ford, ALSTOM and EBARA, to commercialize Ballard® fuel cells. Ballard has supplied fuel cells to Honda, Nissan, Volkswagen, Yamaha, Cinergy, Coleman Powermate and Matsushita Electric Works, among others.

Cellex Power Products is a leading developer of fuel cell based power products for use in premium power applications. Cellex develops proprietary system and component technology and integrates third party fuel cell stacks, fuel processors and other components into commercial products. Specifically, Cellex is developing fuel cells based power products to be used as the power source for powered industrial vehicles. Cellex was founded in 1997 and is based in Vancouver, BC, Canada.

MagPower Systems Inc. has developed a magnesium-air fuel cell, "MagGen", which is designed to be a primary, alternative and emergency power source. Current development also includes a unit designed in a joint development with BC Hydro, which will recharge 125-volt lead acid batteries and in some areas replace them altogether. The extended product line is anticipated to include a fully automated system for the home, an efficient and economical primary power source for third world countries, a primary power source for boats and a power source for all back-up applications that currently use lead-acid batteries.

Palcan Fuel Cell Technologies has developed technologies for prototyping, manufacturing and testing PEMFC stacks and systems, operated on pure hydrogen and air and ranging from 100W to 5 kW. Palcan is also developing and manufacturing unique rare earth metal hydride hydrogen storage products. A three-way fusion of these products with electronics will produce an integrated power system series of products branded under the name Palpac Power Systems. This system will initially be targeted at the electric bike, small electric vehicle and portable power market.

PEM Technologies is a Canadian company specializing in the development and commercialization of PEM fuel cell technologies. A PEM fuel cell scooter has been successfully developed. A PEM fuel cell motorcycle and a PEM fuel cell forklift are currently in development for demonstration. PEM has also developed low-cost, high-quality key components such as a bipolar plate, membrane and catalyst for fuel cell applications.

PowerDisc Development Corporation Ltd. is a research and development company focused on the development and commercialization of PowerDisc engines, proprietary PEM fuel cell stacks and hybrid propulsion systems utilizing the PowerDisc engine. The company is working closely with the National Research Council of Canada under the National Fuel Cell Program and several complimenting companies to develop its products. PowerDisc's product line will consist of a variety of PowerDisc engines ranging from 20-200 kW, PEM fuel cell stacks and hybrid propulsion systems.

SUPPLIERS

There are a number of other companies in Canada who derive a significant share of their revenue from the sale of products and services to the fuel cell producers. Some rely exclusively on the Canadian fuel cell producers as their market while others also have an export component, selling to fuel cell producers in other countries. Examples of these companies include:

Azure Dynamics Corp. Azure Dynamics Corporation is an innovative company that has developed proprietary hybrid electric vehicle technology for retrofit and new vehicle power trains in the light and medium duty commercial vehicle category. Azure's intellectual property combined with interchangeable, off-the-shelf components provides an affordable and effective solution for fleet managers in applications such as postal and courier delivery fleets as well as utility vehicles and shuttle buses. Azure's proprietary adaptive control systems achieve optimal efficiency and vehicle performance while also making significant reductions in emissions and energy consumption.

Cimtex Industries Ltd. is a full-service manufacturer of machined and fabricated metal and plastic components for a range of industries including aerospace, telecommunications and other advanced technology manufacturing. The company's services include prototype design and development, machining, fabrication, assembling and testing.

Greenlight Power Technologies is a leading global supplier of testing and diagnostic equipment to the fuel cell industry. Its current product line includes test stations for fuel cell stacks, components, fuel reformers, electrolysers and fuel cell systems. Its commercially available testing technology is used in testing stationary, portable, and automotive fuel cell applications in the PEM, molten carbonate and solid oxide chemistries. Greenlight's research and development activities are focused on on-board and off-board diagnostic equipment for fuel cell applications. Its extensive 13 year track record includes supplying over 300 pieces of fuel cell test equipment to the world's premier fuel cell stack manufacturers, component manufacturers, system integrators and research organizations.

NORAM specializes in the development, commercialization and supply of electrochemical processes. The privately owned company is known for its vision, innovation, and quick response. It is a major shareholder of BC Research, a technology incubator, located at the University of British Columbia. NORAM is a multi-disciplined firm experienced in the design and operation of electrochemical plants with loads between 5 and 200 MW. Expertise includes plant modeling, handling of hazardous chemicals, materials of construction, storage and pumping systems, material and heat balance, heat exchangers, flow batteries, shunt currents and grounding of electrolytes, power rectifiers, inverters, power quality and grid-connection. NORAM is focused on stationary power applications for fuel cells. The firm is evaluating opportunities where hydrogen is produced as a byproduct in existing electrochemical processes. NORAM also contributed to the development of a Fluidized Bed Membrane Reactor (FBMR) technology, which converts natural gas into high-purity hydrogen, on demand.

Pathway Design & Manufacturing Inc. is a custom supplier to the fuel cell industry, specializing in the design and manufacture of plastic products. With a full-service machine shop in-house, Pathway offers tooling, prototyping, production machining services as well as injection moulding and vacuum forming.

SMC Pneumatics (Canada) Ltd. is an industry leader that has committed itself to aiding and participating in the development of fuel cell applications. Our cutting edge products and extensive R&D structure allow SMC to continually provide collaborative solutions designed to improve fuel cell systems, fuel cell manufacturing automation systems and related test equipment.

QuestAir Technologies Inc. has developed proprietary gas purification technology that is being applied to several large existing and emerging world markets, including industrial hydrogen production and stationary and automotive fuel cells.

QuestAir's proprietary fast-cycle pressure swing adsorption ("PSA") technology allows the developers of fuel cell systems to increase the efficiency of their products, and offers a compact, cost effective gas purification solution to QuestAir's industrial customers and developers of hydrogen refueling infrastructure. QuestAir is a private company based in Burnaby, British Columbia whose shareholders and strategic partners include Shell Hydrogen, Ballard Power Systems and The BOC Group.

Universal Dynamics' diversified team reduces "time to market" with cost effective outsourced engineering and software development services to fuel cell related companies. Universal Dynamics' proven record of success extends from plant facility power and hydrogen distribution infrastructure through testing and data acquisition/analysis software systems to custom development of automated manufacturing machinery. Our support role accelerates development by allowing key staff to concentrate on growing their core expertise as companies evolve from R&D through prototyping to manufacturing. Our hands on approach allows customers to focus on their high priority development activities and be confident that essential background services and support functions are addressed.

Xantrex Technology Inc. develops, manufactures, markets and supports leading advanced power electronic and control products for distributed power, mobile power and programmable power markets. The company's technologies support applications ranging from 50 watts to over 1 megawatt. Products include DC to AC inverters, precision DC power supplies, and fuel cell control systems.

SERVICE PROVIDERS

There are a number of organizations that are service providers to the fuel cell industry, including some that are exclusively focused on the industry. In addition to Fuel Cells Canada, other examples are:

Chrysalix Energy Limited Partnership is an early stage private equity venture capital firm focusing on the fuel cell industry and is a joint venture between Ballard Power Systems, BASF Venture Capital, The BOC Group, Duke Energy, The Mitsubishi Corporation and Shell Hydrogen. Operating independently, Chrysalix is building great new fuel cell companies and offers a unique value proposition to its start up clients throughout the business planning, start-up and operations phases of development.

Colliers International has developed industry specific technical expertise for the fuel cell industry to ensure our clients receive appropriate and cost effective real estate solutions. Offering first class commercial real estate services in 14 cities across Canada, Colliers International also has more than 250 offices in 51 countries on 6 continents worldwide. Connected through our global database

system and web site, we provide you with instant access to our local market experts anywhere your business takes you.

Dundee Securities Corporation is part of the Canadian-owned company, Dundee Wealth Management Inc., listed on the TSE (TSE: DW). We have over \$13.5 billion of assets under our management and administration with a network of 360 Investment Advisors and Sales Representatives. We are an independent, fully integrated, research-driven investment dealer with extensive institutional and retail distribution capabilities. We are committed to providing value-added research and advisory services, concentrating on sectors where we have specialized knowledge and expertise.

Energy & Marine Branch, Industry Canada mandate is to bolster the government's commitment to work with the energy equipment and service sector, the shipbuilding and industrial marine sector and other stakeholders through support activities including trade promotion and trade policy, investment attraction, innovation, sustainable development and connectedness. The Branch's activities in the fuel cell sector include facilitating a fuel cells commercialization roadmap, undertaking sector analyses, developing a fuel cell awareness session and working with the fuel cell industry to respond to the Canadian government's Innovation Strategy.

Fuel Cells Canada is a non-profit, national industry association. It is the prime source of services and support to Canadian corporations, educational institutions and business alliances promoting, developing and deploying fuel cell and related products and services in Canada.

Gowlings LLP has provided clients for over twenty years with a broad range of legal and intellectual property agency services. Today, as one of Canada's largest national law firms, Gowlings has offices across Canada - Vancouver, Montreal, Ottawa, Toronto, Hamilton, Waterloo Region, and Calgary - and abroad in Moscow. Gowlings has an internationally recognized high-tech practice group that comprises both intellectual property and business law professionals. This group is very active serving clients in the fuel cell industry, and provides a wide range of legal services, from the protection and exploitation of technology by patents and licensing, to corporate finance, international trade, and corporate/commercial law.

GrowthWorks, with over \$700 million in assets, is a recognized leader in venture capital and fund management with expertise in raising and investing capital. GrowthWorks' funds under management have made investments in 300 small and medium sized businesses in Canada primarily in emerging sectors.

Heliocentris Energy Systems is a world leader in providing fuel cell and hydrogen technology systems for education, outreach and demonstration. With over 30 products to choose from, Heliocentris products cover the range from inexpensive demonstration products for middle schools and junior high schools, through to

powerful computer-interfaced fuel cell systems for colleges and universities. In addition to fuel cell products Heliocentris has developed lesson books that present curriculum material for Chemistry and Physics classes from grades 9 through 12. These lesson books enable teachers to teach to the standards of Chemistry and Physics through demonstration and experiments with fuel cells and hydrogen technology equipment. The lesson books have been correlated to National, State and Provincial science standards.

HSBC Bank Canada is an indirectly-held, wholly-owned subsidiary of HSBC Holdings plc, which is headquartered in London, England. It is the largest international bank and seventh largest bank overall in Canada with 160 offices. HSBC Bank Canada is a principal member of the HSBC Group, which has more than 6,500 offices in 78 countries and territories and is one of the world's largest banking and financial services organizations.

The **Institute for Integrated Energy Systems at the University of Victoria (IESVic)** promotes feasible paths to sustainable energy systems by developing new technologies and perspectives to overcome barriers to the widespread adoption of sustainable energy systems. IESVic areas of expertise are fuel cells modelling, design and testing; cryofuels; energy systems analysis and energy policy development. Research and development services offered to partners include: product design; manufacturing; computational modeling and simulation; testing; engineering mechanics; electro-chemistry; market analysis; socio-economic and energy systemics studies.

James Hoggan and Associates Inc. is one of Canada's leading public and investor relations firms with specific expertise in the alternative energy sector. Current clients include Ballard Power Systems Inc., Stuart Energy Systems Corp., QuestAir Technologies Inc., Fuel Cells Canada and the California Fuel Cell Partnership. JHA has the industry experience necessary to develop and implement successful programs for both long-term public and investor relations initiatives and specific short-term issues facing clients. JHA has affiliations with independent public relations firms in financial centres worldwide.

Korn/Ferry International recently conducted a National search for the President of Fuel Cells Canada and have partnered with a number of fuel cell companies over a period of six years, performing global search at both the Senior Executive and Board levels. The speed of change, the rapid advancement of technological innovation, the declining demographics in the middle to senior management range and the increased globalization of business have created unprecedented demand for superior management skills. Korn/Ferry, because of its leadership position and depth of talented, dedicated professionals, is better positioned than any competitor to help companies manage this escalating demand for human capital. The strength of our brand allows us to attract quality talent worldwide, while our investment in technology affords us the ability to identify, assess and secure exceptional talent for our clients quickly and efficiently.

KPMG LLP is the professional services firm of choice to many of Canada's fuel cell leaders. Our fuel cell clients are supported by multi-functional experts from our Technology, Industrial and Natural Resources Practices. Our priority is helping our clients achieve their strategic priorities and growth objectives, whether through venture capital, mergers, acquisitions, strategic alliances or IPOs. We can offer you the best resources from our local, national and international networks. KPMG International's member firms have more than 108,000 professionals, including 7,000 partners, in 159 countries. Our mission is to turn knowledge into value for the benefit of our clients, our people and our communities.

The National Research Council of Canada. The mission of the National Research Council Canada is to develop core competencies relevant to the long-term strategic technology needs of Canadian industry. Its Innovation Centre in Vancouver, BC acts as a hub for research programs, laboratories, scientific and technical expertise, networking and financial assistance for the fuel cell industry in Canada. It showcases the country's fuel cell technologies and is a champion for linking fuel cell regional clusters into a Pan-Canadian fuel cell cluster.

Marsh Canada Ltd. is the world's leading risk and insurance services firm. Our one overriding mission is to create and deliver risk solutions and services that make our clients more successful. More than 35,000 colleagues serve clients in over 100 countries from more than 400 owned-and-operated offices. Marsh Canada Ltd. is a subsidiary of Marsh & McLennan Companies, Inc. (MMC), a global professional services firm with annual revenues exceeding \$10 billion. In addition to Marsh, MMC is the parent company of Putnam Investments, one of the largest investment management companies in the United States; Mercer Consulting Group, a major global provider of consulting services; and MMC Capital, a global private-equity firm.

McCarthy Tétrault LLP is Canada's largest law firm, with offices in every major Canadian financial and business centre. Our lawyers are based in Vancouver, Calgary, London, Toronto, Ottawa, Montréal and Québec. We also have an international presence with offices in New York City and London. With more than 700 highly-skilled lawyers, McCarthy Tétrault LLP has earned its reputation as one of Canada's most prestigious law firms.

National Bank Financial (NBF) is a full-service, fully-integrated investment dealer with approximately 3,000 employees. NBF's investment banking and institutional sales offices are located in Canada, U.S., Britain, and Switzerland. NBF's Power Technology team is comprised of scientific, engineering and financial experts who have a specialized understanding of the sector. This understanding serves as a critical bridge between our industry clients and investor contacts. NBF's services to industry participants include private placements of equity, initial public offerings, follow-on offerings, credit and debt products, and mergers and acquisitions advisory services.

PricewaterhouseCoopers LLP understands and supports the fuel cell industry in Canada and around the world. PricewaterhouseCoopers' Alternative Energy network of professional staff, drawn from 150,000 people in 150 countries, has a firm grasp of the issues facing companies in the industry as it evolves towards commercialization. We are continually expanding our knowledge and client base with the goal of being the pre-eminent advisor to the industry in local, national and global markets.

TD Securities Inc., Investment Banking group provides financial advisory services in Equity and Debt Financing, Mergers & Acquisitions, Divestitures and Risk Management. Our capital-raising services include placements of common equity, preferred shares, private equity and private debt securities, and bank debt including syndications and bridge financings. TD Securities' Energy Technology Group consists of 16 investment banking and equity research professionals based in Vancouver, Calgary, Toronto and New York and has been involved in raising over \$435 million in private and public equity for Energy Technology companies in the last 18 months.

The **University College of the Fraser Valley** is the major adult educational resource for the communities of the Fraser Valley. UCFV is a comprehensive educational institution, offering bachelor's and associate degree programs, academic and applied diplomas and certificates, trades training and continuing education. Fuel Cell technology is an important focus for our applied research in alternative energy solutions. We offer a wide array of applied research expertise in partnership with government and the business community. Our on-site Industrial Technology advisor with the NRC IRAP program is available to assist companies in undertaking research and appraising new or existing technologies. In addition the ITA plays a key role in fostering extensive interaction between our academic and business communities.

Ventures West Management Inc. has a distinguished track record of funding some of Canada's leading technology companies. In the Power Technology Sector, Ventures West's was a lead investor in Ballard Power, QuestAir, Cellex, Statpower (sold to Xantrex), Inverpower (sold to Satcon), Astropower, Greenlight Power, NxtPhase, and Serveron. Ventures West today has over \$400 million under management with offices in Vancouver, Toronto and Ottawa. We continue to actively pursue early stage investments in the fuel cell sector.

FUELLING INFRASTRUCTURE

In addition to these companies acting as suppliers to the industry, a number of corporations across Canada are involved in the development of the fuel

infrastructure necessary for the success of fuel cell applications. Examples of these organizations are as follows:

BC Hydro uses renewable electricity and has an extensive distribution network to produce hydrogen for industrial, transportation and portable power markets. Hydrogen is part of its diversification strategy to move the company into the sustainable energy market. BC Hydro and its research subsidiary, Powertech Labs Inc., are positioning to be major contributors to the emerging hydrogen economy through the sale of hydrogen and commercialization of hydrogen technologies.

Duke Energy (formerly Westcoast Energy) is one of the largest North American players in the natural gas industry. Situated in Vancouver, the company operates a \$15-billion network of natural gas gathering, processing, transmission, storage, and distribution assets, as well as electric power generation, international, financial, information technology, and energy services businesses. With operations across North America, and more than one million natural gas distribution customers throughout Canada, the company is expanding into new markets including the fuel cell sector through the founding of Chrysalix Energy Management with Ballard Power Systems and Shell Hydrogen.

General Hydrogen Corporation develops technologies and invests in companies that will facilitate the development and introduction of the hydrogen infrastructure and the emergence of the Hydrogen Age. It selects and manages these investments both for their strategic importance and for their potential to achieve substantial capital gains and income streams. The company has a 25-year Strategic Alliance with General Motors Corporation to focus on advancing fuel cell related technologies.

Methanex Corporation is the world leader in methanol production and marketing and has been actively involved in the fuel cell industry for several years. Methanex is working with some of the world's leading companies to advance the commercialization of fuel cell technology and introduce methanol as a cost-competitive and environmentally-friendly fuel alternative.

Glossary

Fuel cell: An electrochemical generator in which the reactants are stored externally and may be supplied continuously to the cell.

Hybrid cell: Electrochemical cell in which one of the two active reagents is in the gas phase and may be supplied from an external source. A hybrid cell occupies an intermediate position between closed cells and fuel cells.

Hybrid system: A power system consisting of two or more power generating subsystems (e.g., the combination of a wind turbine and a photovoltaic system).

Hydrocarbon: A chemical compound consisting of hydrogen and carbon formed in a variety of bond structures, such as oil, methane, propane, butane, etc.

Membrane: The separating layer in a fuel cell that acts as electrolyte (an ion-exchanger) as well as a barrier film separating the gases in the anode and cathode compartments of the fuel cell.

Proton Exchange Membrane Fuel Cell (PEMFC or PEFC): A type of acid based fuel cell in which the exchange of protons (H^+) from the anode to the cathode is achieved by a solid, aqueous membrane impregnated with an appropriate acid. The electrolyte is called a proton-exchange membrane (PEM). The fuel cells typically run at low temperatures ($<100^\circ C$) and pressures ($< 5 \text{ atm}$).

Reformer: A vessel within which fuel and other gaseous recycle stream(s) (if present) are reacted with water vapor and heat, usually in the presence of a catalyst, to produce hydrogen rich gas for use within the fuel cell power plant.

Solid Oxide Fuel Cell (SOFC): A type of fuel cell in which the electrolyte is a solid, nonporous metal oxide, typically ZrO_2 doped with Y_2O_3 , and O^{2-} is transported from the cathode to the anode. Any carbon monoxide (CO) in the reformat gas is oxidized to carbon dioxide (CO_2) at the anode. Temperatures of operation are typically $800 - 1000^\circ C$.

Stack: An assembly of parallel plates or cells.

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APPENDIX B: NEW MEDIA AND WIRELESS SECTORS IN BRITISH COLUMBIA

The following is an excerpt from a presentation provided by the New Media Innovation Centre (NewMIC).

A NEW MEDIA CLUSTER IN BRITISH COLUMBIA

A strategy for achieving economic prosperity and positioning Canada
for global success
A proposal from: New Media Innovation Centre

THE KEY MESSAGE

The New Media Sector, which includes next generation wireless technologies, is one of three sectors in BC equally poised to drive economic prosperity through innovation. Along with Life Sciences and Fuel Cells technologies, New Media is well positioned to deliver BC and Canada unique international branding and global competitiveness in key knowledge-based industries.

WHAT IS NEW MEDIA

- Convergence and integration of multiple media formats (voice, graphics, data, video/film and image) to present broadband interactive information by leveraging the Internet and Web
- The core of new media is Internet and Web services technology for:
 - Creation
 - Dissemination
 - Distribution
 - Capturing
 - Manipulationof digital, multimedia and broadband (**including wireless**) content and applications
- A large group of companies' revenues are derived from commercialization of new media products and services, e.g.:
 - Electronic Arts
 - IBM
 - TELUS
 - Radical
 - Exponentia
 - Rainmaker
 - Sierra Wireless
 - Nortel
 - Nokia

- Most other companies rely heavily on the applications of new media applications, products and services to gain productivity improvement, create a competitive advantage, achieve excellence in product promotion and marketing strategy, and deliver richer experiences
- New media is **truly** an enabler -- impacts life science, health and medical, education and learning, bio-infomatics, environment and sustainable development, community development, just to mention a few

WHY FOCUS ON NEW MEDIA

- New Media Sector is at a crossroads -- where the Canadian electronics and communications industry was 20 years ago:
 - Already established
 - Vibrant and rapidly growing
 - It is the next wave of economic growth
- The New Media community continues to contribute a large number of high-tech jobs and employees with a significant number being from the youth and female populations
- A country's prosperity will depend on its ability to successfully produce and adopt new media technology and products
- No industry can thrive without being a part of the new media revolution
- A PricewaterhouseCoopers survey of the new media industry in the Year 2001 indicates:
 - 65% of businesses are less than 5 years old
 - 40% of businesses employ less than 10 people
 - 86% of the workforce has an average age between 25-34
 - 51% of businesses expect 100% growth over the next 2 years
- The Dot.com crash no doubt has had an impact but the sector remains strong and vibrant
- The sector has the potential to be the "economic Engine" for Canada
- The international race is fierce in this area - each of the G8 countries is heavily investing in the new media sector for fostering economic growth
- Canada already has a leadership in new media but we need to be aggressive and invest in the sector to maintain leadership
- It is the enabler for all other economic clusters

"Korea [South] was a poor country because it missed the industrial revolution but Korea will definitely not miss the new media and broadband revolution ... it is vital for the country's prosperity."

Dr. Hangsuk Kim, Executive VP, Korea Telecom
PTC Regional Conference, Whistler, 2002

NEW MEDIA SECTOR – THE OPPORTUNITY

Content and New Media Applications Industry:

- Over 500 companies are thriving in BC in a broadly defined new media sector
- The sector employs (in 2001) about 12,000 individuals in the province
- Total revenues (in 2001) from the sector are in excess of 2 Billion
- With 30 percent growth over the next 2-3 years in the industry sector, which is achievable, the sector can create an additional 4,000 jobs and a \$600M incremental revenue base in the province
- Various surveys and projections predict doubling the size of the industry in the next 3-4 years

Note: there is no one comprehensive database available currently to derive accurate statistics. The above figures are based on a synthesis of information from a variety of sources

BC NEW MEDIA SECTOR – THE OPPORTUNITY

New Media Wireless Industry:

- BC has a 25 year history of innovation and commercial success in wireless
- Nearly 150 wireless companies are thriving in BC. BC has a large concentration of wireless companies, more than any other province in Canada
- Although there are some very successful large companies like Sierra Wireless, TELUS, MDSI, a large portion of the companies are in the SME category employing 5-10 staff
- More than half the U.S. domestic work force will be mobile by 2006, creating an enormous demand for wireless data/internet solutions that propel wireless devices, applications and service providers (AMI Partners, Inc.)
- World wide revenues from broadband wireless will reach more than \$12 billion in five years (the U.S. will account for \$9 billion) (ARC Group)
- Wireless phones are among the fastest growing consumer product in history. By 2003, more than 16 million Canadians will be mobile customers (IDC)

BC and Canadian wireless companies have a huge opportunity to capture a significant share of the rapidly growing domestic and global wireless market. Focus and innovation in this sector are critical to position Canada for global success.

WHY A NEW MEDIA CLUSTER IN BC

Key components of a successful cluster:



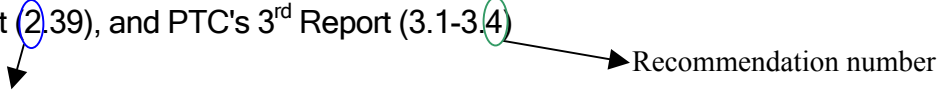
- BC has significant and unique strengths in major components of the cluster model and these are nationally recognized
- 25% of the Canadian new media companies reside in BC -- Electronic Arts, Sierra Wireless, Rainmaker and Nokia are only examples of key anchor new media companies in BC
- BC has some of the top academic institutions to provide “best of breed” new media talents
- It is logical and natural for BC to be the “cluster” for a national initiative in new media and interlink other regional and national centres as appropriate
- NewMIC already exists in BC and has been very successful in championing the growth of the new media sector

APPENDIX C: SUMMARY OF RECOMMENDATIONS

Note: This is a list of recommendations made by the PTC in this and all previous reports. They are listed by report and have been numbered based on the order in which they appeared in the original report. For ease of reference, we have also listed them by topic (see below).

For example:

Recommendations on IT Procurement can be found in PTC's Second Quarterly Report (2.39), and PTC's 3rd Report (3.1-3.4)



Represents the PTC's report edition:

- 1 is the First Quarterly Report
- 2 is the Second Quarterly Report
- 3 is the 3rd Report
- 4 is the 4th Report

INDEX - TOPICS

A.	Utilizing SPAN/BC Network	: 2.1, 2.5
B.	Private Service Providers' Network	: 2.4, 2.6, 2.7
C.	Broadband Demand Aggregation	: 2.2, 2.3
D.	Public Access Availability	: 2.8, 2.11, 2.14, 2.15
E.	Public Access Sustainability	: 2.9, 2.10, 2.13
F.	Improve Public Awareness on Public Access and Benefits of e-Government	: 1.8, 2.12
G.	Province-wide Health IT Standards	: 2.16-2.20, 2.22, 2.23, 2.26
H.	e-Health and Telehealth Strategy	: 2.21, 2.24, 2.25, 3.5
I.	IT Procurement	: 2.39, 3.1-3.4
J.	Venture Capital - Changes to SBVC Act	: 2.27-2.36, 3.6
K.	Research and Development	: 1.1, 1.2, 2.37
L.	Attracting Talent to BC (Recruitment)	: 1.3-1.6, 2.38
M.	British Columbia - Provincial Branding	: 2.40-2.42
N.	Marketing British Columbia	: 1.7, 2.43-2.45
O.	Alternative Fuels	: 4.2
P.	Rewarding Innovators in the Public Service	: 4.3

Note: Recommendations 4.1.a,b,c restate previous recommendations and are not repeated in the above index.

4th Report

THE PREMIER'S TECHNOLOGY COUNCIL PRIORITY RECOMMENDATIONS

4.1 Continue to work to implement all previous PTC recommendations with priority consideration of the following by government in the coming year:

a. Broadband

Provide broadband services to all British Columbia communities. Work with the federal government to accomplish this in the next three years.

b. Government Operations - Telehealth

Make telehealth a top priority and continue work to adopt and implement common health information technology infrastructure and standards, and establish an e-Health Task Force.

c. Industry Development

1) Venture Capital-

Work to pass the PTC's previously recommended amendments to the Small Business Venture Capital Act (SBVC Act).

2) Promoting British Columbia -

Develop a provincial marketing strategy and take every opportunity possible to promote the province. This includes:

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| a) Marketing and promotion missions led by the Premier | province's technology industry and business climate. Among other things, it would include: |
| b) A marketing and promotion plan developed from government analyses of the five key emerging industry sectors in British Columbia - information technology, life sciences, new media, alternative energy and wireless. The plan would provide for a sustained marketing effort of the | i. Developing and executing a branding strategy and marketing plan for the British Columbia technology community.
ii. Creating an inward-bound information centre for prospective corporate recruits to the province. |

ALTERNATIVE ENERGY

4.2 Combine the strengths of the provincial and federal governments, industry and academia to develop and implement an aggressive British Columbia Fuel Cell Strategy that parallels and builds on a similar National Fuel Cells Strategy. Activities in the provincial strategy should include:

- a) Enhanced support for research and development carried out by the private sector and in public institutions (in collaboration with industry).
- b) Support for market focused demonstration projects in both public and private sector applications. This should include real life situations that validate product reliability and output, “ruggedize” the product, provide quality assurance data, and help manufacturers make the necessary alterations to earn commercial success.
- c) The British Columbia government becoming an early adopter of fuel cell products. Government departments and crown corporations being real customers raises the profile and supports the development of markets.
- d) Accelerate the development of harmonized codes and standards. Government and industry collaboration is necessary to remove regulatory obstacles to the introduction of fuel cell products and systems.
- e) Incentives that support and reward growth and investment such as:
 - 1) Encourage the early adoption of fuel cell and related products and systems by providing fiscally neutral tax based incentives, such as the income tax payback approaches used in Michigan.
 - 2) Consider programs having an initial cost but longer term substantial savings to the treasury.
- f) Development of infrastructure which includes building upon investments already made by BC Hydro and others.
- g) Ensure the availability of a highly skilled, well-trained workforce. This involves conducting industry and government collaboration with secondary and post-secondary institutions to define and implement appropriate education and training at all levels in the post-secondary system.

REWARDING INNOVATORS IN THE PUBLIC SERVICE

4.3 Accelerate and reinforce desirable change in the public sector by adopting the Premier’s Awards in all the proposed categories (leadership, service excellence, innovation and partnership), especially the innovation category.

3rd Report

IT- PROCUREMENT

- 3.1. Examine the scope of its current procurement reform initiative to ensure it adequately addresses the unique nature of IT procurement and permits adoption of a benefits-driven procurement model based, above all, on the business objectives rather than the technology requirements of government.
- 3.2. Identify a senior government official to drive both a strategy and implementation process around IT procurement reform. This official will also be responsible for fostering development and adoption of new IT procurement tools and models; facilitating government-wide and industry education; and championing support throughout government.
- 3.3. Create a joint government and industry task group to address the wide range of issues associated with IT procurement reform, with particular attention to the prioritized list of issues and proposed solutions emanating from the Procurement Symposium as well as the larger list of tactical and strategic issues identified by the PTC during its consultative process.
- 3.4. Continue the momentum. Hold a follow-up IT procurement symposium within 120 days. The joint industry/government event should include a progress report from government outlining its response to the set of recommendations contained within this report, as well as future plans, deliverables, and timelines.

E-HEALTH

- 3.5. Establish an e-Health Task Force composed of both government representatives and health care professionals to address the recommendations arising from the e-Health Roundtable. In addition, the mandate of the e-Health Task Force would include:
 - coordinating and leveraging current e-health initiatives, including clinical and educational telehealth projects;
 - the implementation of an Electronic Health Record (EHR), in conjunction with other levels of government and across ministries. This standard EHR would be adopted by all Health Authorities, institutions and businesses providing health care services in the province;
 - address the licensure, liability and billing issues and the resulting changes required to existing policy or legislation to enable health care givers to participate in telehealth; and

- conduct a community consultation process to identify specific telehealth applications that will address critical needs in each community.

VENTURE CAPITAL

- 3.6. To meet the acute need for seed and early stage venture capital within the province, the PTC strongly recommends that the proposed amendments to the SBVC Act be passed by the legislature prior to the beginning of 2003. Failure to do so will discourage and inhibit the facilitation of more early stage capital within British Columbia, and will put us further behind other jurisdictions.

Second Quarter Report

UTILIZING SPAN/BC NETWORKS

- 2.1 Upgrade and extend SPAN/BC so it is capable of delivering advanced broadband network infrastructure to the communities of British Columbia.
- 2.5 Find ways to open up SPAN/BC to allow communities to take advantage of the government's broadband infrastructure in those communities where the private sector is unlikely to provide high speed Internet access to citizens and businesses.

PRIVATE SERVICE PROVIDERS' NETWORKS

- 2.4 Investigate all potential levers including - but not limited to - aggregating public demand, so that it can prompt service providers to extend and update their current telecommunications network infrastructure.
- 2.6 Reform procurement policy to allow for flexible, creative and competitive procurement models that will stimulate the private sector to upgrade and expand their broadband network infrastructure, as well as encourage the entry of local service providers, such as community-based networks, into the marketplace. To this end, two or three communities should be identified as pilot sites for further detailed planning, and implementation.

APPENDIX C: SUMMARY OF RECOMMENDATIONS

- 2.7 Conduct a Request for Information that solicits vendor and community stakeholder reaction to these recommendations, and taps into the innovative and creative potential for public-private partnerships that exists in the marketplace.

BROADBAND - DEMAND AGGREGATION

- 2.2 Aggregate total public sector demand (including core government, health authorities, schools, etc) where feasible to upgrade and expand SPAN/BC so that it will be capable of providing next-generation broadband infrastructure to the communities of British Columbia.
- 2.3 Investigate fully the economics as well as the potential benefits or obstacles inherent in aggregating public sector demand.

PUBLIC ACCESS AVAILABILITY

- 2.8 Make sure that there is public access to the Internet in every community in British Columbia.
- 2.11 Develop a complete map-based inventory of all public access sites by community to determine if the levels of public access and location of sites are appropriate for the size and demographics of the population.
- 2.14 Work with the First Nations of British Columbia and the federal government to bring information technology, including public Internet access, to remote First Nations communities in British Columbia.
- 2.15 Determine if the province's 58 sCAT locations and if existing PLNet facilities could be used by the public to access the Internet.

PUBLIC ACCESS SUSTAINABILITY

- 2.9 Work closely with the federal government to coordinate the allocation of scarce public dollars for public access. demographics and usage patterns), the number of sites, the number of public access terminals, the available bandwidth, and the hours of operation.
- 2.10 Find ways to sustain existing public access sites in the province and meet the growing public demand by increasing, where necessary (based on

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| 2.13 Increase staffing levels at public access sites through programs like Youth@BC, through partnering with Industry Canada's CAP Youth program, or through | use of the Labour Force Development Agreement with the federal government to train unemployed individuals to work at access sites |
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IMPROVE AWARENESS ON PUBLIC ACCESS

- 2.12 Improve awareness and visibility of public access.

PROVINCE-WIDE HEALTH IT STANDARD

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| 2.16 Continue meetings between the executive of the new Health Authorities and the Ministry of Health Services and Ministry of Health Planning to discuss province-wide health information and information technology standards that will apply to all six Health Authorities as they move to restructure and consolidate. | 2.17 Ensure each of the Health Authorities appoints a person to be responsible for information management and technology with the task of implementing the appropriate standards in collaboration with the Ministry of Health Services and the other health authorities. |
| | 2.26 Extend its standards beyond just ministries to its agencies and other government service providers. |

Ensure that the designated chief information and technology officers of each authority work with the Ministry of Health Services and Ministry of Health Planning and other appropriate ministries to establish integrated technology standards province-wide. At a minimum these information and technology officers should:

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| 2.18 Establish a consolidated provincial strategy for Health Information Management and Information Technology (IM/IT). | 2.22 Identify policy changes needed to support the electronic delivery and management of health services. |
| 2.19 Adopt and implement common health information technology infrastructure and standards. | 2.23 Recognize information technology development as a strategic investment. |
| 2.20 Evaluate and seize opportunities for moving towards shared services where practical and cost-effective. | |

E-HEALTH AND TELEHEALTH STRATEGY

Ensure that the designated chief information and technology officers of each authority work with the Ministry of Health Services and Ministry of Health Planning and other appropriate ministries to establish integrated technology standards province-wide. At a minimum these information and technology officers should:

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| <p>2.21 Develop a provincial strategy to facilitate Telehealth and electronic health record initiatives in consultation with medical and continuing</p> | <p>education units of the colleges and universities.</p> |
| <p>2.24 Facilitate the advancement of key e-health and Electronic Health Record initiatives.</p> | |
- 2.25 Establish a British Columbia e-Health Think Tank composed of e-health visionaries, not senior IT staff, who will examine the applications side of e-health, since it will be compelling applications that drive down costs and improve the delivery of health services to the remote and rural regions of the province.

IT PROCUREMENT

- 2.39 The provincial government should expedite its efforts to rewrite its Policy and Legislative Framework around Procurement Reform so as to result in more streamlined, flexible, and cost-effective processes for both government and the British Columbia supplier community, ensuring fair and open procurement throughout the province. The government should also develop procurement policies and educational programs for both ministries and the supplier community which will provide British Columbia-based technology companies with the tools and skills required to compete more effectively for government contracts.

VENTURE CAPITAL - CHANGES TO SBVC ACT

Accelerating 'Early Stage' Technology Investment

The provincial government should proceed promptly with the following streamlining amendments to the *SBVC Act* to address the need for early stage capital investment in technology companies:

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| <p>2.27 Expand the tax credit budget legislated under the SBVC Act from \$50 million to \$100 million annually.</p> | <p>require the registration of a separate VCC to facilitate investment and tax credits under the programs in order to allow direct investment, cut red tape</p> |
| <p>2.28 Introduce an investment model under the SBVC Act that does not</p> | |

APPENDIX C: SUMMARY OF RECOMMENDATIONS

- and reduce program registration costs.
- 2.29 Increase the total amount of capital one business may receive under the program (beyond the current \$3 million) to better reflect the capital needs of many early stage technology companies.
- 2.30 Increase the employee threshold limit for a small business from 75 to at least 150.
- 2.31 Allow approval for common investment regimen, such as multi-tranche investments over multiple years based on attainment of established milestones.

Levelling the Playing Field for Tax Credit Investment in British Columbia

The provincial government should enable small businesses and venture capital managers participating under the *SBVC Act* to raise and invest venture capital, with the assistance of tax credits, under the same conditions that are presently offered to the one Labour Sponsored Venture Capital Corporation (LSVCC) operating in British Columbia and other LSVCCs operating throughout Canada.

To achieve parity with labour sponsored funds, the task group recommends the following amendments be made to the *SBVC Act*.

- 2.32 Allow program investors the option to invest directly from their self-directed retirement savings plans.
- 2.33 Make the tax credit incentives available for program investment within 60 days after the calendar year.
- 2.34 Increase program flexibility in program capital investment beyond simple common or preferred shares.
- 2.35 Provide VCC investors up to 24 months to complete investments.
- 2.36 Open up the tax credits provided to the sole LSVCC to competition by allowing other venture capital firms to enter the market to create a more dynamic venture capital community.

RESEARCH AND DEVELOPMENT

- 2.37 The provincial government should take steps to create an e-learning chair.

ATTRACTING TALENT TO BRITISH COLUMBIA (RECRUITMENT)

- 2.38 The provincial government should work with the federal government to change immigration rules so that spouses of employees moving to British Columbia can work here automatically.

BRITISH COLUMBIA PROVINCIAL BRANDING

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| 2.40 Develop a provincial branding and marketing strategy that feature technology and innovation as key drivers supporting British Columbia's image as a place with a sustainable and vibrant economy, including resource and knowledge-based industries, and an unparalleled quality of life. | 2.41 Develop a strong macro-image positioning British Columbia as a desirable technology destination for investors, employees and site selectors. |
| | 2.42 Develop and execute its provincial branding strategy in consultation with the technology community. |

MARKETING BRITISH COLUMBIA

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| 2.43 Target its technology industry marketing effort at key audiences that include decision makers in technology investment, site selection and highly skilled workers. | alternative energy and new media. |
| 2.44 Focus its technology industry marketing strategy initially on four sectors known as areas of strength within the province: biotechnology, wireless, | 2.45 Focus its marketing strategy to attract highly skilled workers or those individuals that may be predisposed to move to Canada such as expatriate Canadian and British Columbia technology workers and members of communities that are already represented in British Columbia. |

First Quarter Report

PUBLIC AWARENESS ON THE BENEFITS OF E-GOVERNMENT

- 1.8 Educate British Columbians about the benefits of being fully connected, including access to relevant Internet-based applications and information, and increasing e-government services.

RESEARCH AND DEVELOPMENT

- | | |
|---|--|
| 1.1 Double the number of computer science and electrical engineering graduates from BC post-secondary institutions. | 1.2 Establish 20 British Columbia Research Chairs in the fields of medical, social, environmental, and technological research. |
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ATTRACTING TALENT TO BRITISH COLUMBIA (RECRUITMENT)

Attract senior professionals to accelerate industry growth by:

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| 1.3 Making changes to immigration policy. | 1.5 Implementation of a competitive provincial stock option program for BC workers. |
| 1.4 Establishing an Info-Office to aid in the recruitment of out of province technology workers and relocation of technology companies to BC. | 1.6 Resolution of cross-boarder security issues with the US. |

MARKETING BRITISH COLUMBIA

- 1.7 Establish a domestic and international campaign to promote British Columbia's quality of life, superior infrastructure, education system, technology community and business-friendly environment.

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APPENDIX D: PTC MEMBERS, STAFF & ACKNOWLEDGEMENTS

PTC Members

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ONLINE LEARNING INDUSTRY

The Premier's Technology Council would like to express its gratitude to those who have participated in discussions and consultations on online learning. As the Council continues its work on the subject, it looks forward to work with these and others in the community.

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