

# The Innovation Equation

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*When We Invest – We Win!*

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**“It is clear from the Innovation Strategy of the Government of Canada, that the federal government intends to increase the levels of funding support available to Canadian universities. British Columbia must be much more aggressive than it has been in past to ensure appropriate levels of those investments are brought to British Columbia. The Panel takes the position that capturing at least 15-20% of all available federal funding should be targeted as the right objective.”**

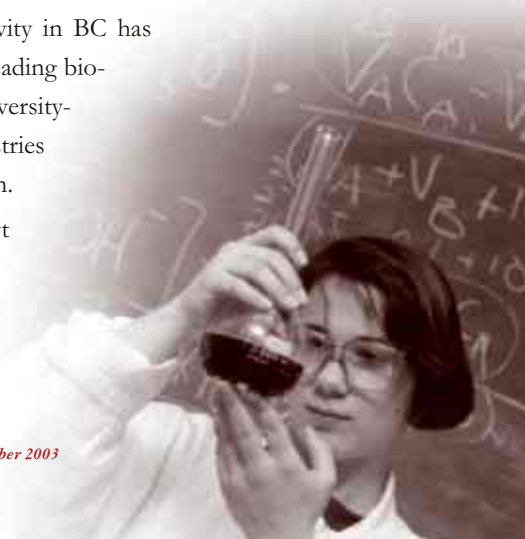
Source: BC Progress Board, Learning to Win – “Ready, Set, Go” December 12, 2002

Knowledge and innovation are playing an increasingly critical role in determining the economic and social prosperity of British Columbia. Investment, jobs, incomes and our society are directly impacted by the strength and vitality of knowledge-based sectors and institutions. British Columbia is not alone in facing revolutionary changes. Every nation, province or state is considering or implementing strategies to respond to the challenges and opportunities presented by the knowledge economy. There are early adapters and leaders in this new economy and these jurisdictions are already reaping benefits from their investment. British Columbia is moving in the right direction. Further strategic investments in research will quickly bring British Columbia to a national leadership position.

Research is the lifeblood of a knowledge-based economy and outstanding research-intensive universities are the wellspring of scientific discovery and creativity needed to underpin a vibrant economy. Their success coupled with a strong entrepreneurial culture will position British Columbia to become a world-leader in knowledge-based business and industry. Now is an exciting time for research in British Columbia! The essential pieces are coming together – the infrastructure to facilitate interdisciplinary collaboration and world-class investigation, outstanding researchers with a growing record of excellence and achievement and a sense of momentum that great things are happening here.

The significance of the link between research and economic activity in BC has become increasingly clear in recent years. Many of the province's leading biotechnology and high tech companies are direct “spin offs” of university-based research. Furthermore, many of BC's traditional resource industries now look to our universities as a source of innovation and revitalization.

The Government of British Columbia has demonstrated clear support for the role research and development must play in the diversification of the provincial economy. Through the BC Knowledge Development Fund, the Province has positioned universities to leverage significantly increased levels of federal funding to BC.



The consistent matching of funds available through the Canada Foundation for Innovation (CFI) and the aggressive pursuit of a full BC share of all research opportunities available through the Canadian Institutes of Health Research, and from other federal granting agencies, has generated a rising level of optimism about the potential for research in BC.

British Columbia's Life Sciences initiative and the provincial investment in the Leading Edge Endowment Fund, strongly suggests that British Columbia understands – and is prepared to deliver upon – the benefits of the innovation equation.



## Three Objectives

The quality of research in British Columbia has always been high and the commercialization productivity levels achieved by our universities has been consistently excellent. The problem has been a university research infrastructure that is comparatively smaller than other parts of the country. To address this issue – and to strengthen BC's innovation potential for the future – three key objectives must be addressed:

1. BC's universities, with support from the Province, should be expected to capture 15-20% of all research funding available from federal sources;
2. British Columbia must continue to aggressively establish a national leadership position in university-based research and, by no later than 2010, should be at least 3rd amongst provinces in research activity; and
3. Given that great research is not possible without great minds, BC should build upon existing strengths by attracting the next generation of research-intensive graduate students from British Columbia, from the rest of Canada and from other countries.

## The Challenge

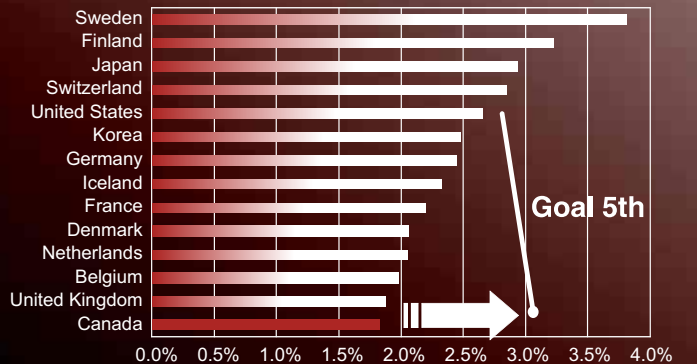
A broad consensus that university research is a long-term national investment in the social and economic well-being of the nation has led to a new funding strategy focused on enabling public and private sector investments in support of research infrastructure, personnel and projects. The expected high returns from research and innovation, and from university research in particular, will likely generate strong demand for more research, more researchers and greater research productivity in the coming decade. In Canada, as in many OECD countries, investment in university research is increasingly driven by the recognition that, without proper support for research and innovation in the transition to a global economy, the economic and social well being of the nation will be compromised. No other G7 nation relies so heavily on its universities for its research capacity. However, the most recent data indicates Canada is in 14th place in GERD/GDP spending amongst OECD countries, lagging significantly behind the United States, Japan and all other G7 countries except Italy.

It is important to note that our international position has been improving and the federal goal is to have Canada move to 5th position by 2010. The Association of Universities and Colleges of Canada (AUCC), Industry Canada memorandum of understanding states “universities are responsible for the strategic coordination of the research efforts that will deliver these benefits and are collectively committed to contribute to the research and innovation objectives as detailed in the AUCC Action Plan; among other elements, this includes doubling the amount of research performed by universities and a tripling of commercialization performance.” BC’s universities unequivocally support this goal. Canada must gain ground internationally and BC must close the R & D investment gap within Canada if we are to be successful as a province and country. In BC, 36% of our research is carried out in our universities, however, the province lags behind most of the country in research and development funding. When measured on the basis of research intensity for university-based research BC’s position has been improving but we still rank 7th among the provinces when measured for its investment in university based research.

It is even more important to have a clear sense of what progress must be achieved if our province is to be as successful as we believe we can be.

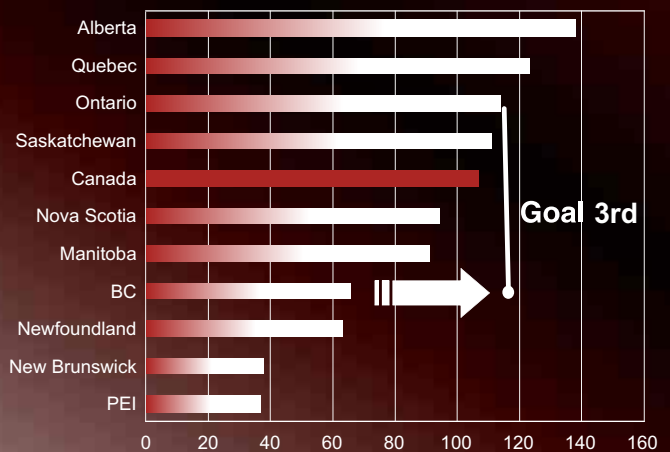
To grow the ideas that will secure BC a leadership position in the new economy The University Presidents’ Council takes the position that BC should become one of the top three R & D provinces in Canada within seven years.

**Figure 1.** Canada Ranked 14th out of 30 OECD Nations in GERD to GDP Ratios



Source: Canada, Statistics Canada, Science and Innovation Surveys Section  
All others, OECD Main Science and Technology Indicators 2001, 1999 data

**Figure 2.** The National Average in Per Capita University-based Research Funding



Source: AUCC, 2003

Important progress has been made on the innovation front. The Provincial Government has made investments in the Leading Edge Endowment Fund which will further enhance the province's capacity for research in medical, social, environmental and technological disciplines. And after several years of comparative decline, BC's universities have now had the benefit of 2-3 years of impressive success in attracting national research funding to our province. Due to provincial matching of CFI funding through the BCKD Fund and backing by the private sector, BC researchers have been extremely successful in securing more than our share of funding on a per capita basis from this important research investment initiative. The British Columbia Knowledge Development Fund, is a significant factor, which has made it possible for us to achieve our recent impressive successes and is critical to maintain strong performance levels in achieving provincial research and development objectives.

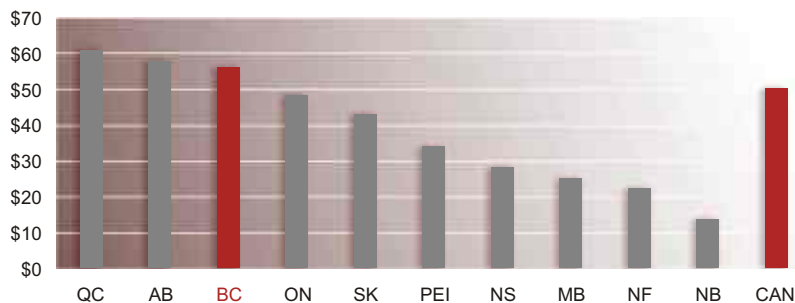
BC universities have proven, when proper investments are made, British Columbia has the capacity to be highly successful in competing for funding available at the national level as noted below. *When We Invest – We Win!*

■ **British Columbia Knowledge Development Fund \$100M (BCKDF):** Permits public post-secondary institutions, teaching hospitals, and affiliated non-profit research agencies to invest in research infrastructure.

■ **Leading Edge Endowment Fund \$45M:** To establish 20 BC Leadership Chairs based on a cost sharing arrangement with the private sector as part of the New Era Agenda at public post-secondary institutions across the province.



**Figure 3. CFI Funding Per Capita**



Source: Ministry of Advanced Education, 2002

## Why It Matters?

Our BC universities are generating major returns on the federal and provincial investments in their research programs. These returns take the form of knowledge transfer for the social and economic benefit of society – locally, provincially, nationally and internationally. Arguably the primary means of knowledge transfer is through the education and training of highly qualified personnel through the engagement of post-doctoral, graduate and undergraduate students in faculty research projects. These students are the new generation of leaders on whom the vitality and success of BC's knowledge-based economy depend. It is for this reason that we place special emphasis in this report on the need for increased support for graduate students. Our research is also a major resource for the development of evidence-based public policy.

Moustafa Mohamed would say that his idea is a simple one. Nevertheless, his invention has already garnered four patents and has the potential to have a big impact on everyday life. The UNBC Physics professor has invented a magnetic sensor that could be used for everything from counting fish in a stream to triggering traffic signals or detecting a burglar during a break-in.

Dr Mohamed was part of a research project for which he needed to come up with a tool to measure rock movement along streambeds (to measure the impacts of spring run-off on salmon habitat). The sensor he created doesn't require electricity, can take an environmental pum-



meling, and is more sensitive than the sensors used in anti-lock braking systems. Basically the sensor works by detecting movement of an object through a magnetic field. He is currently working on adapting the tool – small enough to fit in the palm of a hand – to counting fish and transmitting signals via the internet or satellites right to researchers' offices.



A hiker lost on the North Shore Mountains May 24 is no doubt thankful that volunteer search and rescue members found him quickly. His relief can be also attributed to the fact that he had SFU Communications Professor Peter Anderson in his corner. Anderson is not a member of the rescue team, but it was his internet-based emergency communications technology that made the fast rescue possible.

The benefits here are still to be fully realized and we welcome the opportunity to work more closely with government and public sector agencies to ensure that knowledge transfer is maximized, duplication of effort avoided, and policy is informed by the best ideas and the strongest evidence.

The capacity to realize economic and social benefits through knowledge transfer to the private sector continues to increase as a result of funding programs that require industrial partners, the success of technology transfer offices within our universities, the catalytic effect of research parks, and the realization of mutual benefit through successful joint ventures. Westport Innovation, Inc. for example, has produced a diesel engine that runs on natural gas and still maintains the efficiency of the diesel cycle. Their products are on the market and they have strategic alliances with Cummins Diesel, Ford, Izuzu (and others.)

Canada may have another energy resource, thanks to a discovery made by a UVic ocean researcher. UVic geophysicist Dr. Ross Chapman and the crew of Canadian Coast Guard Ship John P. Tully traveled to Barkley Canyon, just off Ucluelet, in June where they found the largest amount of methane hydrates ever discovered on the seafloor off Canada.

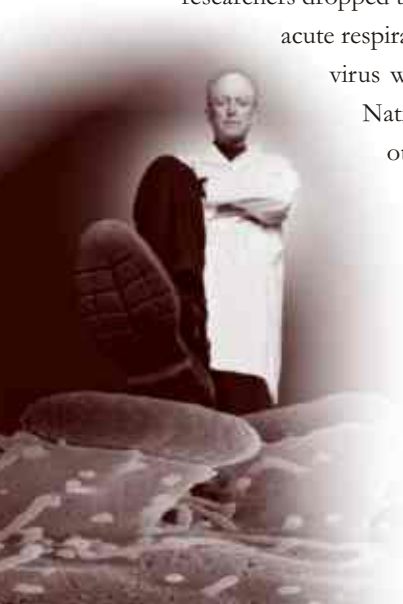
The finding has two major implications. First of all, methane hydrates are a potential alternative energy source. Secondly, scientists suspect its release from the ocean floor during earthquakes may add to greenhouse gas levels in the Earth's atmosphere.

Methane gas has gained ground against other sources of energy such as coal, hydroelectric power and nuclear energy. It stands out as a readily available and cheap fuel, and its characteristics could make it the energy source of the future.

Researchers at British Columbia universities are leading the way in several areas of study whether it is mapping the genomic sequence of SARS, developing a vaccine for E.coli or founding the field of health economics.

This spring (2003), at the Michael Smith Genome Sciences Centre, Dr. Marco Marra, and a team of world-class researchers dropped their usual work to focus on a sample of a coronavirus from a patient with severe acute respiratory syndrome. The team was the first to break the genomic code of the SARS virus with collaboration from the BC Centre for Disease Control and the Winnipeg National Microbiology Laboratory. This sequence is posted on their website so that other SARS researchers may use it to help develop tests that will either help identify this disease more quickly or understand how to control the spread of this serious disease.

Dr. Brett Finlay of UBC has made a major breakthrough on E.coli – the deadly bacteria responsible for the Walkerton water crises in 2000. As a result of his work, we have a much better understanding of the complex relationship between E.coli and their host cells.



A true example of research making the jump from the lab bench to the marketplace. Finlay has used this new knowledge to develop a vaccine that will eliminate the growth of the deadly pathogen in cattle. The vaccine is now in a large-scale clinical trial and is being tested on 75,000 animals across Canada.

A recent study, jointly conducted by the Vancouver Economic Development Commission, BC Biotech and Discovery Parks Inc., based on the June, 2002 Brookings Institution Report, Signs of Life: The Growth of Biotechnology Centers in the US, demonstrated that "Greater Vancouver and Southern Vancouver Island constitute Canada's fastest growing biotechnology region and places amongst the largest biotechnology communities in North America." 70% of the companies in the biotech sector are based on an academic discovery. During 1991 to 2001, Vancouver was third behind Boston and San Francisco in creating new biotech start-ups.

The FY2001 AUTM (Association of University Technology Managers) survey showed that the BC Universities accounted for only 8.2% of the R & D funding in Canada, but accounted for 14.5% of the new inventions, 20% of the patents applied for and issued, and 30% of the new companies created.

■ **Patents and Licences Issued  
in BC's Public Universities, 2002**

Total Sponsored Research	\$305.9M
Licence Revenue	\$11.3M
Patents Filed	240
Patents Issued	100
Number of Licences	374



■ **Direct and Indirect Impact  
of Research Income Generated  
From Spin Off Companies**

Spin-Off Companies	\$263.4M
Induced Companies (excluding spin-offs)	\$190.0M
<b>Total Income Generated</b>	<b>\$454.4M</b>



## Our Graduate Students – An Emerging Opportunity

Many factors impact upon the quality of university-based education and research – the learning environment, the abilities and motivation of students, the physical infrastructure – but none exceeds the importance of recruiting and sustaining high quality faculty. In the next seven years, BC universities will face enormous challenges in recruiting sufficient numbers of faculty to meet both the demand created by anticipated enrolment increases and to address the succession pressures resulting from planned retirements of faculty members. In addition, there will be increased competition for new faculty as jurisdictions in other provinces and US are making substantial investments to attract the “best and the brightest.”

If the national innovation strategy is successful in encouraging a greater emphasis on research and development, the demand for university graduates with research training will grow even more rapidly than in the past decade. Universities' success in attracting and retaining a greater portion of the PhD market will depend in large measure on their ability to offer challenging career opportunities in a supportive and stimulating environment. Top researchers and scholars, both faculty and



graduate students, are drawn to places where there is a critical mass of talent and expertise in their own areas of research. Substantial depth, in terms of human capital and supportive infrastructure, is a magnet for talent.

Increased levels of support for students are essential to attract more students to apply for graduate studies. While our universities will make every effort to capitalize on federal programs, such as the new Canada Graduate Scholarships Program, increased provincial support is vital if we are to compete to recruit and retain the best students in the face of the funding programs offered in other provinces such as Ontario and Quebec.

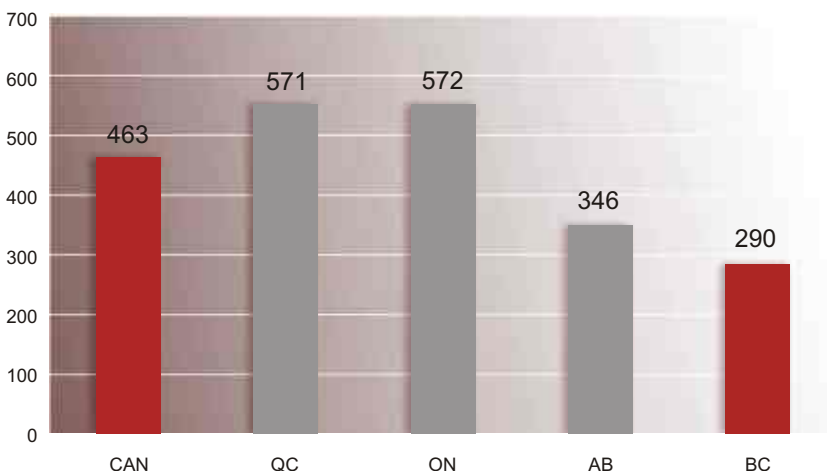
The significant Life Science cluster now developing in BC shows considerable promise for innovative transformation in forestry, fisheries and other industries that have served the province for generations. However, leading edge research can only be conducted by the best and brightest minds – the next generation of highly skilled and talented researchers.

To meet this challenge BC will need to devote considerable effort to increase the number of graduate students generally and, more specifically, the numbers of highly qualified graduate students pursuing research-intensive graduate degrees. We are currently well behind other leading Canadian provinces in degrees produced, and in attracting acceptable levels of research investment. In key fields, BC is ranked 5th or lower in the production of PhDs in engineering, applied science and the health professions.

Last year in British Columbia only 2,837 students completed a graduate degree, not nearly enough to support the province's economy. The major contributions to BC made by our graduate students through their research in the life sciences, engineering and other fields underscores the potential that could be realized if additional investments were made to expand our programs. It's a start that can only lead the province to thrive economically if research is supported and enhanced.

As Figure 4 demonstrates, British Columbia has one of the smallest research communities in the country and our historical level of provincial investment in graduate programs has been consistently low. This must change. Without strong graduate programs to carry out the research necessary for the new economy we will not have the innovative potential necessary to compete nationally or globally. The historic under-investment in graduate programs is a challenge in Canada as a whole but one that is especially acute in BC where relative to some other provinces the under-funding of graduate students is particularly problematic.

**Figure 4.** Research Workforce per 100,000 Population, 1998



Source: Stats Can

## What Does the Future Look Like?

The government of Canada has recognized the key role research plays in the new economy and over the past five years has made substantial investments in research and development. In February 2003, the federal budget addressed some of the missing links in terms of research support.



- ✿ The addition of a permanent \$225 million fund to contribute to the indirect costs of federally funded research is a major breakthrough. While it will not cover all the associated indirect costs, it finally provides recognition of an important research initiative for which universities have been seeking support for many years;
- ✿ \$105 million annually to create the new Canada Graduate Scholarships Program; and
- ✿ \$125 million annually, beginning in 2003-2004, to increase the budgets of Canada's three research granting councils.

These initiatives demonstrate that the Federal Government is making important investments to promote growth and ensure future competitiveness.

The positive atmosphere in BC's research community is also strengthened by investments the Government of British Columbia has made in:

- British Columbia Knowledge Development Fund – which allows BC's researchers to leverage research resources into the province from federal initiatives;
- The Leading Edge Endowment Fund;
- Michael Smith Health Research Foundation in Genome BC; and
- New capital infrastructure, which will support the expansion of medical education and medical research in British Columbia.

The province has laid the foundation for success with substantial investments in life sciences research; however, much of the potential for growth remains undeveloped.

Other provinces have been very successful in leveraging disproportionate shares of the available federal funding to their respective universities in an effort to expand their capacity for innovation. In Ontario, Quebec,

and Alberta these initiatives are closely linked with long term economic strategies that recognize the connection between innovation and knowledge-based economic activity.

To ensure at minimum **“Our Fair Share”** of those investments are brought to British Columbia BC universities plan to be much more aggressive in attracting federal funds, but cannot do it alone.

## When We Invest - We Win!

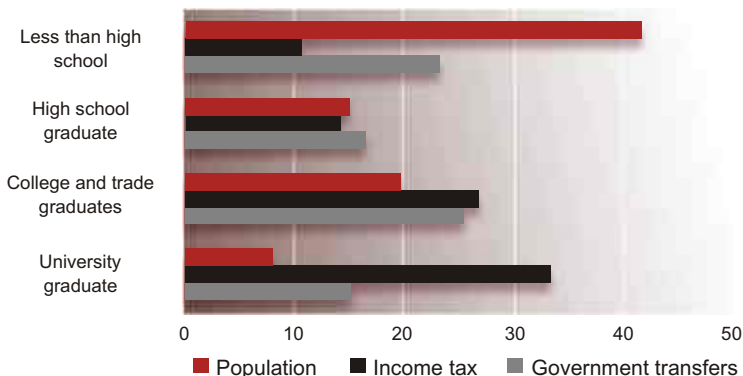
British Columbia has a strong university system, but the system is small compared to other provinces. University access must be expanded significantly to meet increasing student demand, but this increase will provide a corresponding benefit to developing knowledge and innovation. In particular, expanding graduate access will pay substantial dividends because graduate students are integral to the research mission of the universities. Graduate students are the faculty and researchers of the future, and as noted earlier, there is a critical supply challenge ahead for recruiting new faculty.

Figure 5 clearly demonstrates the kinds of returns that governments can expect to yield from investing in post-secondary education. University graduates comprise only 15% of the population over the age of 18, but contribute one-third of all income taxes – or twice their “population share.”

Tax revenues from university graduates also figure prominently in the nation's ability to fund all social programs including health, post-secondary education and social welfare.

Without such revenues sustaining growing health care costs in the future would not be possible. Education and innovation are key factors in improving our national productivity, which in turn will lead to a higher standard of living and more wealth for the country.

**Figure 5.** Investing in universities provides returns to graduates



Source: Statistics Canada, Survey of labour and income dynamics, 1977

The provinces are the primary source of general financial support for universities through the provision of core funding for teaching, students and facilities. Core funding also contributes to university research as institutions allocate some of their resources to support research activities. In recent years, the provinces have also assumed a growing role in providing direct support for the research function of universities. The successes of the initiatives addressed in this submission will depend upon the extent to which the core resources of our universities are maintained. Universities' ability to meet the increased demand for research and highly qualified personnel will largely depend on the resources available to support an internationally competitive environment for research and research training. If universities are to play a full role in doing our part to help position our province for excellence for the remainder of this decade and beyond – a role our universities believe we must play – essential conditions will require:

- ***Enhancing Research Capacity:*** Increased research and development investment with the objective of securing at least 15-20% share of the available federal funding.
- ***British Columbia Knowledge Development Fund (BCKDF):*** Ongoing financial support of the BCKDF which allows British Columbia's universities to engage opportunities available through the Canada Foundation for Innovation.
- ***Provincial Matching Scholarship Program:*** The Province should provide annual funding support at the same level for every new Canada Graduate Scholar that BC universities can bring to the province. This new fund would be an essential element if BC were to be competitive with other provinces who will be aggressively pursuing the best and the brightest students through the \$105M Federal Graduate Scholarships Program.

There is no question that investments in university research and education will yield:

- New discoveries that will transform our collective thinking, that will generate new social and economic opportunities and that will have a transformative impact upon the lives and the potential of British Columbia; and
- Important increases in the production of highly-skilled graduates, including those in the critical shortage areas.

British Columbia can become a leading research province in Canada within seven years by making the essential investments in universities. The essential conditions set out in the previous section represent the first year that will build upon the base of the BC Knowledge Development Fund and the excellence of British Columbia's universities. To lead the nation, the Government of British Columbia and the universities must work together on a seven-year investment strategy that addresses research needs effectively.



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