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SEIZING CANADA'S MOMENT:

MOVING FORWARD IN SCIENCE, TECHNOLOGY AND INNOVATION 2014

Canada

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PRIME MINISTER'S MESSAGE

Prime Minister of Canada

Stephen Harper

The success of our economy, the prosperity of our communities and the well-being of our families depend on advancing cutting-edge science, technology and innovation in Canada.

While our Government has already significantly ramped up support for Canada's quest for knowledge, we recognize that remaining competitive in the global marketplace of ideas demands a long-term commitment and strategy.

That is why we are launching *Seizing Canada's Moment: Moving Forward in Science, Technology and Innovation*, a new strategy that leverages the expertise and resources of post-secondary institutions, industry and government to translate brilliant theories and ideas into applications that will improve the day-to-day lives of Canadians and generate economic growth and jobs across the country.

For years Canadian researchers, inventors and entrepreneurs have expanded the boundaries of knowledge and experience, building a proud, progressive and strong country. As Canada approaches the 150th anniversary of Confederation, our Government is proud to build on that remarkable foundation through new investments in science, technology and innovation that will be of benefit to this generation and an invaluable inheritance for generations to come.

MINISTER OF STATE'S MESSAGE

Minister of State (Science and Technology)

Ed Holder

Today, science, technology and innovation drive the prosperity of nations. Canada has great strengths in this regard including many of the world's brightest minds; as a result, Canada is well-positioned to seize its moment on the world stage, ensuring long-term jobs, opportunities and prosperity for Canadians.

Our Government, under the leadership of Prime Minister Stephen Harper, has made record investments in science, technology and innovation to push the boundaries of knowledge, create jobs and opportunities, and improve the quality of life of Canadians.

While the global economy remains fragile, Canada has come a long way. We boast a welcoming and predictable business environment thanks to low taxes, a sound banking sector and a modern regulatory framework.

In *Seizing Canada's Moment: Moving Forward in Science, Technology and Innovation*, our government is delivering on our commitment to renew Canada's science and technology strategy with a vision to strengthen Canada's position as a global leader in scientific research and innovation.

The renewed strategy builds on two existing pillars, People and Knowledge, and introduces a third pillar, Innovation.

People Pillar: We will inspire, develop, attract and retain the highly talented researchers needed to meet the demands of the modern global economy both in the lab and in the boardroom while encouraging young Canadians to seek rewarding careers in science, technology, engineering and mathematics.

Knowledge Pillar: We will tackle national and global challenges by supporting world-leading research through legacy investments like the Canada First Research Excellence Fund for the long-term economic benefit of Canada.

Innovation Pillar: We will encourage greater partnerships among Canadian businesses, universities and colleges to drive innovation and encourage the adoption of new processes and technologies that help Canadian businesses prepare to compete and win in the global marketplace.

Our government's renewed science, technology and innovation strategy will strengthen Canadian science and business to ensure they remain world-leading. I look forward to sharing the excitement of new Canadian discoveries, breakthroughs and innovations along with the boundless promise they hold for Canadians.

EXECUTIVE SUMMARY

Introduction

On the eve of the 150th anniversary of Confederation, Canada stands at the threshold of a new era of achievement. Our nation has long been a pioneer in scientific and technological achievement with a quality of life that is envied around the world. From the development of kerosene in the 1840s, Sir Frederick Banting's and Dr. Charles Best's discovery of insulin in 1921 and Bombardier's invention of the snowmobile in the 1930s, to the development of the Canadarm in the 1980s and the BlackBerry in the 1990s, Canada has a proud legacy of innovation and scientific breakthroughs.

This is a legacy our Government will continue to build upon through the combination of a strong marketplace framework and unprecedented investments in science, technology and innovation. Totalling some $11 billion in new investments since 2006, our support thus far has powered Canadian leadership in research, science and technology. It has helped provide consumers with the products and services they need, as well as assisted in delivering social benefits in areas such as health, responsible resource development and safety. With targeted investments and strategic support, we are enabling our economy to turn ideas into jobs, growth and enhanced quality of life for Canadians.

These new investments in science, technology and innovation were guided by the strategic direction set out by Prime Minister Stephen Harper with the release of a Science and Technology Strategy, *Mobilizing Science and Technology to Canada's Advantage*, in 2007. The Strategy provided a comprehensive plan to make Canada a leader in science and technology, research and innovation. It featured an ambitious agenda to make investments in this area more strategic, efficient and accountable for delivering results.

The results so far have been impressive: Canada has become a prime destination for top researchers and skilled workers from around the world, and we rank first among G7 nations in spending on research and development in universities and colleges as a share of Gross Domestic Product (GDP).

The world, however, has changed since the Strategy was first released. The forces of globalization, disruptive technologies and demographic changes are creating increased pressure on Canadian researchers and businesses to strive for excellence and innovate to compete. Like any time of change, this period brings new risks and exciting new opportunities.

The time is right to capitalize on our strengths. As global markets continue to recover from an extended recession, our record of prudent fiscal management and solid business fundamentals has put Canada in an excellent position to continue to invest in science, technology and innovation while remaining on the road to a balanced budget.

As such, this new strategy, *Seizing Canada's Moment: Moving Forward in Science, Technology and Innovation*, serves as both a progress report on what we have achieved so far, and as a commitment to keep science, technology and innovation at the forefront of government policy for years to come. Economic Action Plan 2014 represented a significant down payment toward this objective, including measures such as the new Canada First Research Excellence Fund, support for internships in high-demand fields and further investments in business accelerators and incubators.

The Challenges

Canada is well positioned in today's global knowledge-based economy, while the pace of scientific discovery and technological innovation continues to accelerate. Here at home and around the world, businesses, research institutions and governments are challenged to adjust their strategies to keep up with change.

Today, the world's industrialized countries are working hard to stay ahead of the innovation race. At the same time, emerging economies are investing heavily in science, technology and innovation (ST&I) and their companies are globalizing quickly. Countries around the world are competing to attract and retain multinational companies within their borders and also incorporate their domestic companies into global value chains. At the same time, the ever-increasing complexity of global challenges – in areas such as climate change, energy and health – require international research collaborations across many disciplines. All these factors create pressures on Canadian businesses in both traditional and emerging sectors to adjust their approach and strategies to ensure long-term success.

Also influencing the global economic environment is the emergence over the past decades of new technologies with major transformative impacts. We see this especially in the way information and communications technologies have changed how we live and work. To keep up, nations must swiftly develop and adapt to newer platform technologies (such as nanotechnology and additive manufacturing), harness large and complex data systems ("big data") and adopt "open science" policies to foster collaboration. The availability of state-of-the-art research and digital infrastructure is also critically important for success. The challenges are complex and the stakes are high, yet nations that excel in these areas will have significant competitive advantages in the years ahead.

Here in Canada, the gains we have made in growing our knowledge base and fostering a highly-skilled workforce through our investments under the 2007 Strategy and recent new measures introduced to respond to the external Review of Federal Support to Research and Development, have

been many. Our ST&I ecosystem will feel the full impact of these measures over time, but in the meantime, we must do more to respond to the pressures of globalization, an aging population and the pace of technological change.

The unique challenge Canada faces is to leverage our strengths and expand our strong entrepreneurial spirit into a broader business innovation culture. Traditionally, we have had great success in creating innovative new start-ups. Now, Canada needs more Canadian firms to foster innovation-based growth and to expand into global markets.

Seizing Our Moment

The 2014 Strategy continues and builds upon the 2007 Strategy. It will be guided by the same core principles as the original: **Promoting World-Leading Excellence, Focusing on Priorities, Fostering Partnerships** and **Enhancing Accountability.**

In addition to maintaining these core principles, the 2014 Strategy retains the **People** and **Knowledge** pillars from the earlier framework, but enhances and broadens the Entrepreneurial pillar to encompass **Innovation**.

The 2014 Strategy also updates the research priorities by adding a fifth priority, advanced manufacturing, to the previously established priorities of natural resources and energy, health and life sciences, information and communications technologies and by augmenting the environment priority to include agriculture.

People Pillar: The 2014 Strategy is based on the principle that at the heart of great science, technology and innovation are the researchers, developers and innovators – the men and women who drive change. As such, the Strategy aims to strengthen the skills and capacity that keep Canada at the forefront of research and innovation. This includes promoting an interest in science in our youth, encouraging innovative entrepreneurs to bring their ideas to life and supporting the researchers who are making ground-breaking discoveries and pushing the frontiers of knowledge. It centres on our support for universities, colleges and polytechnics so they can develop, attract and retain tomorrow's leaders and experts. It also underscores the importance of international connections – both at the personal and institutional levels – that help Canada tap into the strengths of other countries.

Knowledge Pillar: The 2014 Strategy builds on our existing emphasis on supporting research and scientific capacity in universities, colleges and polytechnics. As stated in Economic Action Plan 2014, we will make Canada a world leader in targeted research areas to create long-term economic advantages. We will strengthen support for excellence in discovery-driven and applied research and will ensure that Canada has the infrastructure needed to foster world-class science, technology and innovation. Under the Strategy, research will become more open, accessible and transparent to the public and end users. Canada will continue to be a world-leader in discovery research. The Strategy also highlights the importance of support for the critical research performed in federal laboratories.

Innovation Pillar: Building on the development of highly-skilled Canadians and world-class research, the 2014 Strategy puts innovation front and centre – in fostering business innovation, in building synergies with Canada's research capacities and in using its skilled and innovative workforce. It emphasizes the need for business of all sizes to define and implement for themselves the science, technology and innovation they require to compete nationally and internationally. The Strategy builds upon Digital Canada 150, our Government's recently announced plan to guide Canada's digital future. It will also seek to close the persistent innovation gap that has hindered the transfer of ideas from the laboratory to the factory floor and the store shelf. The Strategy will also encourage businesses to work with partners in the innovation system, including by making Canada's world-class research infrastructure, expertise and researchers available to them. It will encourage scaling up successful programs and consolidating program offerings to improve access and increase impact. The Strategy also emphasizes the need for Canadians to protect their intellectual property and enhances Canada's access to global markets.

Conclusion

The 2014 Strategy sets out a path for the next few years, while looking to Canada's 150th anniversary and beyond. It places in context the initiatives to support business innovation introduced in Economic Action Plan 2012 and 2013 and the significant investments made in Economic Action Plan 2014. Above all this, it is a call to action for the players in the Canadian innovation system – whether they be in the research community, the business community, or different levels of government – to work together to achieve the goal of making Canada a scientifically and technologically innovative nation capable of leading the world.

1.0 INTRODUCTION

"Don't keep forever on the public road, going only where others have gone, and following one after the other like a flock of sheep. Leave the beaten track occasionally and dive into the woods. Every time you do so you will be certain to find something that you have never seen before. Of course it will be a little thing, but do not ignore it. Follow it up, explore all around it; one discovery will lead to another, and before you know it you will have something worth thinking about to occupy your mind. All really big discoveries are the results of thought."

— Alexander Graham Bell (May 22, 1914)

Alexander Graham Bell understood the array of forms in which innovation may manifest – in the ingenuity of using electricity and diaphragms to transmit the sound of the human voice, but also at a more basic level, in the curiosity to explore beyond the beaten track. Bell knew that unexpected observations can sometimes lead to big discoveries. The famed innovator made these comments during an age when electricity and telecommunications were transforming societies and individuals profoundly. Today, these observations are just as prescient in a world in which curiosity, application and innovation have even wider ranging impacts on so many different aspects of our lives.

More than a century later, it is clear that science, technology and innovation play a crucial role in economic prosperity and quality of life. At the 2012 World Economic Forum in Davos, Prime Minister Stephen Harper emphasized that innovation holds the key to addressing societal and economic challenges. From preparing for an aging population to providing consumers with quality products at lower prices or developing our resources responsibly and improving productivity and competitiveness, there is no doubt, science, technology and innovation power the economy in Canada and around the world.

That's why our Government has made science, technology and innovation top priorities. Since 2006, we have invested more than $11 billion in new resources to support discovery-driven and applied research, knowledge and skills development, research infrastructure and innovative activities in the private sector. These investments are creating jobs, growth and long-term prosperity for Canadians. They are also helping us address important societal challenges such as the treatment of chronic diseases, protection of the environment, maintenance of food safety and adaptation to climate change.

To focus our efforts in these areas, the Prime Minister announced the Science and Technology Strategy in 2007. *Mobilizing Science and Technology to Canada's Advantage* linked the competitive energy of Canada's entrepreneurs to the creative genius of our researchers. It identified Canada's people, knowledge and entrepreneurial advantages and set out how federal science and technology policy and programs could be more strategic, efficient, effective and accountable for delivering results.

The Strategy sought to make Canada more productive and competitive by positioning our researchers at the leading-edge of knowledge creation and by developing, attracting and retaining a highly-skilled workforce to build a modern national economy.

The Strategy also underscored the central role Canada's private sector plays in mobilizing and commercializing knowledge to develop the products, services and technologies that create a productive, sustainable and competitive society.

In parallel with the 2007 Strategy, our Government has been hard at work supporting business innovation by helping establish the conditions that encourage investment and economic growth. We have expanded trade opportunities, lowered taxes, made it easier to start a business, reduced red tape, modernized regulations, maintained a strong financial system and welcomed skilled immigrants.

These building blocks are now in place, but change is constant in today's world. We must continually adapt our approach to building up economic and social success. As the Science, Technology and Innovation Council has argued, Canada needs to "aim higher and aspire for global leadership."[1]

While Canada shows research and development strengths in some industrial sectors, the overall outcomes for business continue to be less than the competition in other countries, with adverse impacts on our productivity and, potentially, on Canadians' long-term prosperity.

Having built a framework to position Canada as a global science and technology leader through the 2007 Strategy, the time has come to take our approach to science, technology and innovation to the next level. Canada's future growth and prosperity will depend on our ability to build on our advantages in people and knowledge and address our innovation challenges.

A Legacy of Innovation

Throughout our history as a nation, Canadians have been pioneers in scientific and technological achievement. We have turned research and ideas into products, jobs and a healthier, safer world. Here are some of Canada's successes:

1860s – steam automobile

1870s – telephone / standard time

1880s – rotary railroad snowplow

1890s – basketball

1900s – Robertson screw / Marquis wheat / AM radio

1910s – echo sounding / hydrofoil speed record

1920s – insulin treatment for diabetes / snowblower / electric variable pitch aircraft propeller

1930s – snowmobile / first electron microscope in North America / portable two-way radio

1940s – voltage-controlled electronic music synthesizer / first g-suit flown in combat / co-discovery of carbon-14

1950s – co-invention of alkaline dry battery / external heart pacemaker / cobalt bomb radiation therapy

1960s – Alouette scientific satellite / co-invention of charge-coupled device

1970s – IMAX motion picture system / Anik domestic communication satellites

1980s – Canadarm / automated synthesis of DNA sequences

1990s – BlackBerry

2000s – D-Wave One: world's first commercially available Quantum computer

2010s – ATLAS subatomic particle sensor (Higgs Boson) / monoclonal antibodies for Ebola treatment / detection of microbes in deep Precambrian rocks / high-pressure direct injection natural gas diesel engine.

[1] Science, Technology and Innovation Council: Aspiring to Global Leadership, 2012 report on the state of Canada's science, technology and innovation system, Media Release (Ottawa May 21st, 2013).

Canada's Economic Action Plan 2014: The Road to Balance

Economic Action Plan 2014 lays the foundation for this Strategy update and charts our course for the years ahead by targeting investments in science, technology and innovation. Some investments include:

- A new Canada First Research Excellence Fund of $1.5 billion over ten years to help Canadian post-secondary institutions to achieve global excellence;
- New investment of $46 million per year to the granting councils to support advanced research and scientific discoveries and the Research Support Fund (formerly Indirect Costs Program);
- A further $222 million over five years to support Canada's national laboratory for particle and nuclear physics (TRIUMF) to continue ground-breaking discoveries;
- Another $40 million for internships in high-demand fields and an additional $8 million to Mitacs to support post-doctoral industrial R&D fellowships;
- An additional $15 million over three years to the Institute for Quantum Computing;
- New funding of $10 million over two years in support of social innovation research projects at colleges and polytechnics to address the research needs of local community organizations;
- Long-term support for the Canadian automotive sector by providing $500 million over two years to the Automotive Innovation Fund;
- Additional support of $90.4 million over four years to the Forest Industry Transformation Program; and
- Another $40 million over four years to the Canada Accelerator and Incubator Program.

2.0 WHERE CANADA STANDS

The 2007 Science and Technology Strategy – *Mobilizing Science and Technology to Canada's Advantage* – positioned Canada well in the world-wide race for knowledge, skills and competitiveness. Even during the ensuing period of global economic uncertainty, Canada's economy has remained strong, in part because of strategic investments in key areas, including science, technology and innovation.

Today, Canada is internationally recognized for research strengths across most areas of scientific pursuit both in terms of quantity and quality of science done. A diversity of research capacity can be found across the country, often with a focus on local economic strengths and regional innovation clusters. Canadians on the whole are highly-educated and skilled. Canada has become a magnet for knowledge workers – top experts and leaders are staying in Canada, skilled and educated youth are entering the workforce and talented people are coming to Canada to study and work.

Notwithstanding all these strengths, the global environment has changed dramatically since the 2007 Strategy was published. Canada's businesses face certain domestic innovation and global challenges. We must do more as a country to encourage a business innovation culture – the management of risk, the desire to experiment with new technologies and processes and the willingness to explore new business horizons.

2.1 Canada's Business Innovation Challenge

At the most fundamental level, the performance of an economy is best measured by the standard of living of its citizens. In the short-term, economies or companies may prosper because of advantages conferred by factors such as the prices of their exports or strength of currencies, but in the long-term, standard of living is determined by the ability of an economy to turn inputs into outputs efficiently (i.e., its productivity), as compared to competitors in other countries. Recent data from the OECD show that in 2012, Canada's labour productivity stood at 73 percent of the U.S. level, down from 82 percent in 2000. The comparatively low rate of Canada's current productivity growth indicates that our economy can and needs to be more competitive.

> The proportion of Canada's overall R&D effort undertaken by the business sector fell from 56.7 percent in 2006 to 52.3 percent in 2012 – well below the OECD average of 67.9 percent. OECD, *Main Science and Technology Indicators*, 2014-1.

At the same time, the performance of our business sector has been strong. For most of the past 20 years, in spite of recent declines, corporate profits have remained higher than those of the U.S.[2] Canada's position in an integrated North American market and its endowments in natural resources, coupled with the strength of the energy and other commodities markets, have enabled our firms to maintain a solid performance.

During the early 2000s, the abundance of Canadian labour and a low dollar masked the need for productivity growth. More recently, incomes in Canada have been boosted by the demand for commodities in China and other emerging economies. These factors have offset Canada's productivity levels in manufacturing. This cannot be sustained indefinitely. If productivity growth does not pick up, the effect will be felt on corporate performance and jobs.

Successful innovation by businesses, not-for-profit organizations and governments requires that we put into place corporate strategies based on fostering innovation. However, innovation is a complicated process that is neither defined by a simple formula or playbook, nor easily measured.

[2] TD Economics Calculations, October 2013.

Sometimes, innovation comes directly from advances in science and technology, but it can also stem from other sources. Even innovation that comes from R&D rarely follows a straight path from lab to marketplace. The results of curiosity-driven research are not known in advance, so capitalizing on the outcomes is risky and depends as much upon the skill, vision and adaptability of the innovator, as on the quality of the research itself.

An idea or invention, however radical or creative, is not an innovation unless it is put to use. A strong science and technology base supports innovation but alone is not its *cause* and not all innovation has a base in science and technology. Innovation requires creative firms or individuals to see an opportunity, take a risk, and often it involves experimenting with different practices, methods and processes.

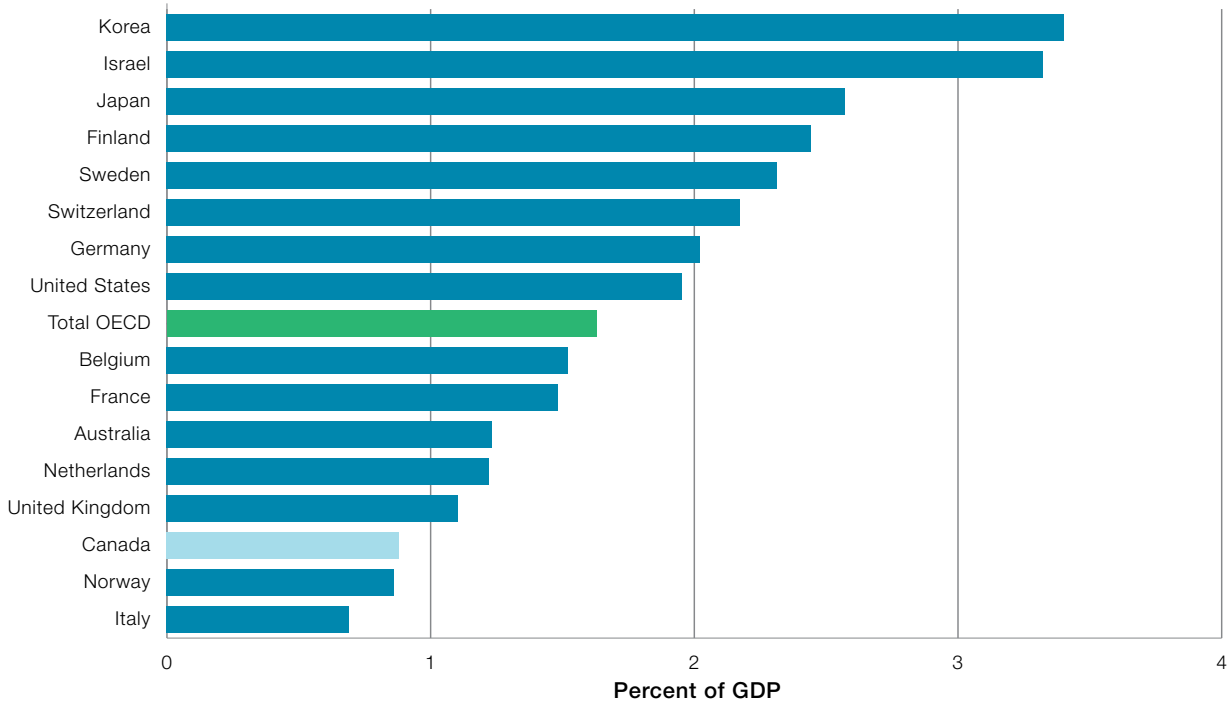
> Innovation is the "implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations." *OECD, Oslo Manual*.

Ultimately, creating a widespread and sustainable innovation climate in Canada will require the transformation of Canada's strong entrepreneurial spirit into a wider business innovation culture. We have to broaden our current strength in creating innovative new start-ups, to include the innovation-based growth of firms into larger enterprises with a presence in global markets. This will mean implementing innovation-based competitive strategies to sustain the health and viability of enterprises over the long-term.

While measuring innovation is difficult, R&D spending is one way to gauge a country's commitment to it.[3] Despite Canadian federal and provincial governments providing some of the world's most generous incentives to encourage business R&D and innovation, Canada's overall performance is below the OECD average on this measure.

We see that while businesses in OECD countries spend an average of 1.63 percent of GDP on R&D, in Canada, the figure was only 1.11 percent in 2006 ($16.5 billion) and this fell to 0.88 percent ($16.2 billion) by 2012. Out of 34 OECD countries, this drop takes us from 16th to 22nd place.

Business Expenditures on Research and Development as a Percentage of GDP, Selected OECD Countries, 2012 or Latest Available Year



Source: OECD, Main Science and Technology Indicators 2014/1, June 2014.

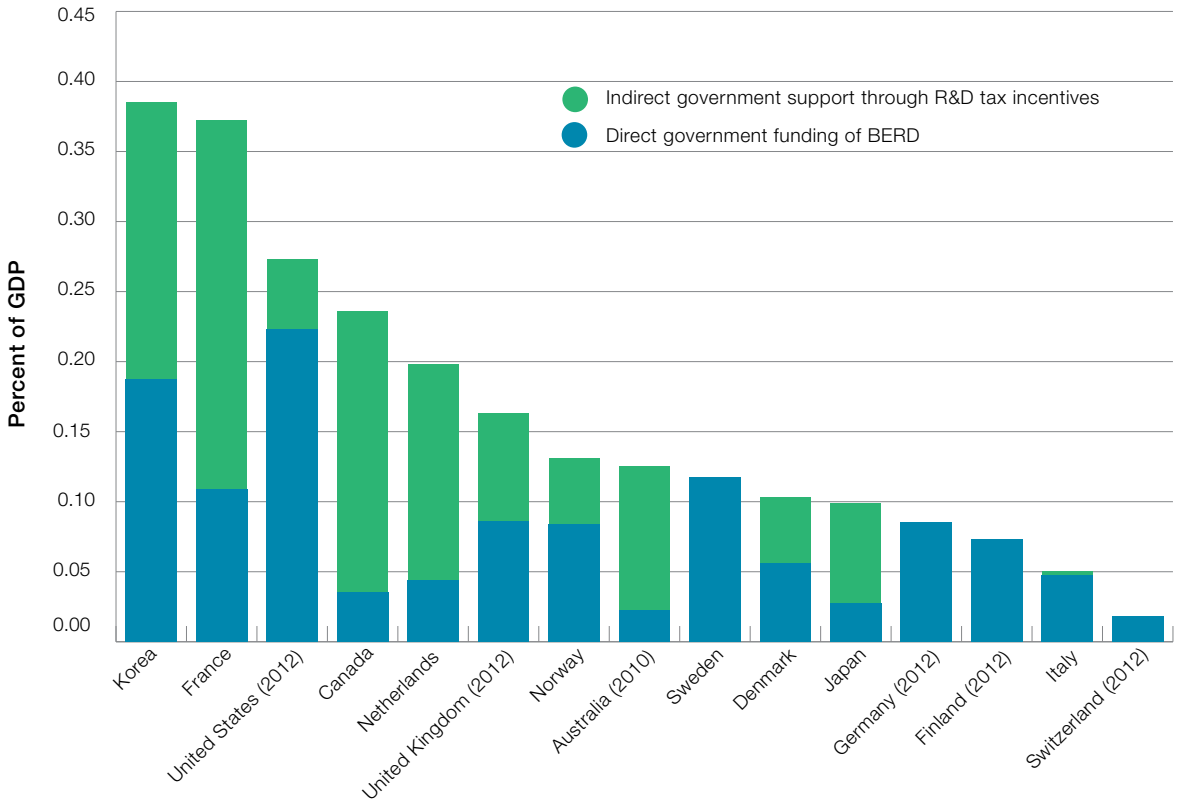
[3] Investment in R&D is often used as an imperfect proxy measure for commitment to innovation. Other initiatives, such as Statistics Canada's Survey of Innovation and Business Strategy or the European Community Innovation Survey attempt to capture the broader scope of innovation activities such as marketing or organizational innovation. Nevertheless, R&D expenditures remain the most widely-used indicator at the moment.

What gets measured, gets done

The Conference Board of Canada believes Canadian businesses need to do a better job of measuring their innovation performance and competitiveness. In a 2013 report entitled *Metrics for Firm-Level Business Innovation in Canada*, the Board documents the value of measurement-based management of firm-level innovation to enhance corporate performance. It found that, by using innovation metrics effectively, firms can fine-tune their innovation activities, increase their innovation success rates, and contribute to more productive and competitive companies.

To gain some insight into these imbalances and how to rectify them, in 2010 the federal government launched an independent external Review of Federal Support to Research and Development. Chaired by Tom Jenkins, then Executive Chairman of OpenText Corporation, the Panel was charged with analyzing federal government business R&D programs and recommending how to adapt our approach to better stimulate the growth of innovative firms.

Direct and Indirect Government Funding of Business R&D and Tax Incentives for R&D, Selected OECD Countries, 2011



Note: The estimates of R&D tax incentives do not cover sub-national R&D tax incentives. Germany and Switzerland do not provide R&D tax incentives. Finland and Sweden recently introduced R&D tax incentive schemes for companies for which cost estimates of foregone revenues are not yet available.

Source: OECD, Science, Technology and Industry Outlook 2014.

The Panel found that a number of factors influence a firm's decisions concerning R&D and innovation, including the structural characteristics of the company and industry in which it operates; the intensity of competition it faces; its business ambition; and the climate for new ventures and its understanding of customer needs and opportunities.

Although many of these factors are not directly connected to government policies or programs, initiatives to improve framework conditions can have an influence on many of them. Since 2006, the intent of government policies in areas such as trade, competition, regulatory reform, skills development, tax and other policies has been to encourage firms and people to innovate.

Informed by the recommendations of the Panel, Canada's Economic Action Plans 2012 and 2013 were built around a new approach to promoting business innovation – one that emphasizes active business-led initiatives and focuses on fostering the growth of innovative firms. To that end, they included measures such as the transformation of the National Research Council, a doubling of the Industrial Research Assistance Program and the launch of a new Venture Capital Action Plan. (See Chapter 7).

Innovation Canada: A Call to Action

A six-member expert panel (Jenkins Panel) was appointed in October 2010 by the Government of Canada. Over the course of a year, it met with more than 160 stakeholders across Canada, received 228 written submissions, surveyed over 1,000 businesses, and consulted with numerous experts in Canada, Europe, Australia, Asia and the United States.

Key findings of the Jenkins Panel include:

- Canadian businesses find the Scientific Research and Experimental Development (SR&ED) tax incentive program complex, costly and has long approval times;
- Relative to peer countries, Canada relies much more on R&D tax incentives, compared to direct spending programs that support innovative firms and public-private collaborations;
- Companies find it difficult to navigate the many federal programs that promote business innovation, and this may create inefficiencies;
- Canada lags behind peer countries in leveraging government procurement to promote private-sector innovation;
- Unlike peer countries, Canada does not have an organization that acts as a central hub for business-driven research;
- Canada's risk capital sector needs further development to effectively support the growth of innovative companies; and
- Canada needs a stronger whole-of-government approach to innovation.

2.2 Pressure to Act: The Global Context

In both traditional and emerging sectors, Canadian researchers and businesses must innovate to compete and survive in response to globalization and emerging economies, disruptive technologies and demographic change.

Globalization and Emerging Economies

Globalization and increased trade liberalization has created unprecedented opportunities for businesses to diversify and expand abroad, and it has also exposed Canadian firms to increased competition. In order to set themselves apart in today's fiercely competitive world, Canada's most successful and innovative firms are adding value to their goods and services through innovation.

Since one in five Canadian jobs depends on exports, free trade agreements with emerging markets like South Korea and developed economies like the European Union are essential. Opening new markets to Canadian goods, services and investment is crucial to our prosperity.

Globalization also increases pressure among developed countries to attract and keep high value-added activities, such as R&D, within their borders. Several factors affect how multinational companies shift or re-distribute their R&D mandates between countries, including: the presence of top universities, the quality of people available, market potential and the fiscal environment.[4]

Newly developed economies like China, India and Brazil are making substantial research and technology investments. They have rapidly-growing scientific establishments that contribute strongly to their competitiveness. These countries are shifting quickly from low-value production to higher value-added activities, bringing them into direct competition with developed countries like Canada. In addition, many of Canada's competitors with well-developed innovation cultures (e.g., Australia, the European Union) are investing significant resources into R&D networks with emerging economies.

Disruptive Technologies

Just as information and communications technologies have transformed the way we live now, disruptive technologies are creating entirely new fields with exciting possibilities for social and economic benefits. Areas such as additive manufacturing, genomics and nanotechnology can provide unparalleled opportunities for early adopters. Those who embrace these kinds of platform technologies early will leap ahead of their competitors to increase Canadian opportunity and jobs.

Technological advances in the natural resources sector, especially in energy, are also delivering research-based solutions to environmental challenges. Clean technology, in particular, can play an important role in environmental protection by helping businesses and industry reduce their environmental impact and improve their competitiveness. This fast-growing international market has great potential for those Canadian resource firms who drive these advances.

However, in an ever-more competitive world, developing and deploying disruptive technologies is risky and those who do not sufficiently protect their intellectual property in a new idea or innovation may not reap its full benefits. Intellectual property can have many strategic uses, from providing the freedom to operate, to protecting products and markets from

Additive Manufacturing: 3-Dimensional Printing

Additive Manufacturing builds 3D objects by adding layer-upon-layer of material. The technology relies on the development of nanomaterials and new materials including plastics and metal alloys. It has the potential to dramatically increase business competitiveness by:

- Optimizing part designs to improve their efficiency or decreasing their weight;
- Reducing or eliminating waste (by as much as 90 percent);
- Reducing energy consumption (by as much as 50 percent for metal parts);
- Reducing the need for warehousing; and
- Enhancing the value of local production – particularly in remote regions.

In Canada, the National Research Council along with universities, colleges and research institutes, is collaborating with leading firms to evaluate novel designs and applications enabled by additive manufacturing. Their findings could have applications in the automotive, aerospace and other Canadian manufacturing sectors.

[4] European Commission, "Internationalisation of business investments in R&D and analysis of their economic impact," Luxembourg: Publications Office of the European Union, 2012. http://ec.europa.eu/research/innovation-union/pdf/internationalisation_business-rd_analytical-report.pdf

competitors and facilitating collaboration. Canada's innovation support programs need to help Canadian entrepreneurs develop the skills and knowledge they need to benefit from the commercial advantages of intellectual property. This need is particularly acute for small and medium-sized enterprises, many of which enter new markets without adequately having thought through their intellectual property strategy.

The disruptive technologies that affect us the most today come from the world of information and communications. As we use our mobile devices to board planes, download books and magazines and stream videos, we drive change across society. And the disruptive impact of the advance of technology in these areas is far from spent. Experts have indicated that the "Internet of Things" – independent communications between smart devices and parts – will introduce another digital revolution. Additionally, the ability to create and use huge data sets, known as "big data" offer new opportunities for discovery and the creation of new products and services. The growing use of "big data" will create new opportunities for businesses but also challenges the way we collect and share data, in both the public and private sector. It also puts pressure on our digital infrastructure to keep up.

Digital Canada 150, released in April 2014, outlines an ambitious path forward for Canadians to take full advantage of the opportunities of the digital age. It is designed to be inclusive, capable of responding to the demands of fast-changing times and able to provide Canadians with the tools, the protections and the skills they need to fully embrace the opportunities of a digital future. It forms the foundation that will drive Canadian leadership in science, technology and innovation.

Demographic Changes

The pressure for change is also coming from the trends that we see among people, both in Canada and abroad. Demographic projections for many developed economies, including Canada, suggest that the coming decades will be marked by a sharp decrease in the proportion of the population that is of traditional working-age.

While Canada has one of the world's best-educated populations, keeping up with the changing skills required of an innovative economy is a constant challenge. We will need a workforce with the right mix of skills that can adopt new technologies and practices in the workplace. And with fewer people available to work, it will be increasingly important to prepare for an innovative economy that can sustain Canada's standard of living.

Today's young people will work in jobs that are very different from those of their parents. They will be called upon to communicate differently, to collaborate with others with diverse skills and backgrounds and to adapt to constant change. They will need both a strong educational base and on-going training to provide them with the soft skills needed for working with others and the hard skills associated with science and technology.

Canada begins this new era from a solid foundation. Recent results from an international survey assessing students' competencies in literacy, math and science, indicate that Canadian youth perform above the OECD average.[5] However, with other countries placing a premium on education, Canada's performance in science and mathematics must keep pace.

Young people's attitudes toward these subjects are also of potential concern. Only two in five say they would be interested in working in science, technology, engineering and mathematics professions. While education falls within provincial jurisdiction, the federal government can foster and promote an interest in science, technology, engineering and math among young Canadians outside the classroom.

[5] Programme for International Student Assessment, OECD.

3.0 SEIZING CANADA'S MOMENT

Today, Canada has the necessary ingredients for building an innovation economy: world-class research strengths, a highly-educated and skilled workforce and one of the best business environments on the planet. Canada must seize this moment and leverage our many advantages by promoting global research leadership, strengthening our skills and abilities as well as pushing for world-leading business innovation.

3.1 Principles and Framework

The 2007 Science and Technology Strategy was built around four core principles. **The 2014 Strategy will continue to be guided by these same principles:**

Promoting World-Leading Excellence

Our Government will ensure that our policies and programs inspire and assist Canadians to perform at world-leading levels of scientific and technological excellence. We must create an environment of healthy competition to ensure that funding supports the best ideas.

Focusing on Priorities

While Canada is well-positioned to rise to the challenge of global competitors, with much of the infrastructure, knowledge and skills required for success, the next step is to build on this strong base by focusing on strategic areas where Canada can be a world leader. The goal is to target funding strategically in areas of opportunity that will build national strengths.

Encouraging Partnerships

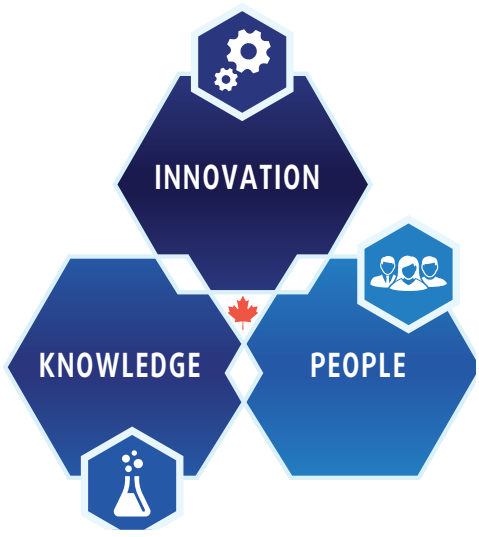
Partnerships between the business, academic, and public sectors both at home and abroad are essential to assuring world-class Canadian successes and to accelerate the pace of discovery and commercialization in this country. The cost, complexity and pace of scientific achievement demand the creation of smart partnerships, through which the unique capabilities, interests and resources of various stakeholders can be brought together for greater success. The goal of fostering partnerships is to support science and technology collaboration and align the roles and responsibilities of the federal public sector with other orders of government and the private sector so we can together generate greater social and economic opportunities.

Enhancing Accountability

The strategic importance of science and technology to Canada merits rigorous and disciplined accountability mechanisms to ensure value for money. Stronger governance and reporting practices will help to deliver the results that really make a difference in people's lives. Accountability is key because it puts the responsibility on those who are supported by public funds to demonstrate to taxpayers that they are achieving results.

Operating on these four principles, our Government has made investments in science, technology and innovation that are helping Canadian businesses turn knowledge into commercial advantage and new jobs. This is bolstered by our world-class research and the development, attraction and retention of people able to contribute and lead innovation.

In addition to reinforcing the Pillars introduced in the 2007 Strategy, the 2014 Strategy will expand on this framework with concrete new actions:



People Pillar: We will develop, attract and retain highly-qualified and skilled individuals, as well as top experts and leaders needed for Canada to thrive in the global knowledge economy. We will promote science and technology skills in youth, expand opportunities for entrepreneurs and leaders to mobilize their skills and knowledge in the workplace and enhance opportunities for innovators and researchers whose ambitions and creativity generate discoveries that improve social and economic outcomes for Canadians.

Knowledge Pillar: We will strengthen support for excellence across the spectrum of discovery-driven and applied activities by investing in research and infrastructure. We will achieve world-leading research strengths in recognized areas of current advantage and emerging opportunity. We will continue to support federal science-based institutions to perform research to deliver on regulatory, public policy and operational mandates such as public health, responsible resource development, environmental protection, transportation safety and public security. We will make federally funded research more open and transparent to the public and to end users.

Innovation Pillar: We will help bring new ideas and knowledge to market by stimulating more demand for innovation from firms of all sizes and influencing more innovation-focused business strategies. We will make it easier for businesses to work with partners, including government, in the innovation system and foster collaborations based on industrial-demand that encourage newly emerging as well as established industries to look for solutions from Canada's research institutions. We will build on Digital Canada 150, our recently announced plan to guide Canada's digital future. We will emphasize the need for firms to protect their intellectual property and enhance Canada's access to global markets.

Canada's Key Players in Science, Technology and Innovation

Our Government cannot achieve these goals alone. Canada's system has diverse players, each vital to success. All players have a direct interest in sharing the leadership and commitment that will make Canada thrive.

Universities, colleges and polytechnics develop Canada's future experts, leaders, entrepreneurs and shop-floor innovators. Universities also perform the bulk of discovery-driven research in this country, while colleges and polytechnics help businesses to conduct time-sensitive applied research.

The non-profit sector, including organizations such as health charities, provides significant funding in support of R&D performed by universities.

The business sector transforms knowledge and ideas into goods, services and technologies that build an innovative and competitive economy. It brings new ideas to market and provides hands-on job training in the marketplace.

Provincial and territorial governments understand local needs and harness regional assets. They create the conditions for their jurisdictions to compete and prosper. They are responsible for primary and secondary education. They fund universities, colleges, general and vocational colleges in Quebec (CÉGEPS) and polytechnics; support research in those institutions as well as in the private sector; foster a competitive business environment through marketplace framework policies and support regional innovation networks.

The federal government underwrites research and innovation activities throughout the system through loans, grants and contributions to entrepreneurs, businesses, researchers, students and research facilities. We also have put in place tax measures to encourage investment in research and development as well as marketplace framework policies that create a competitive environment to support innovative businesses.

Federal regional development agencies deliver targeted programs at the regional and local levels to enhance innovation, business and community economic development. The federal government participates in international initiatives to tap into global wells of knowledge, talent and major research facilities. It also performs its own science and technology to support government mandates and the evidence-based policies and regulations that protect Canadians, strengthen the marketplace and safeguard the environment.

The following graphic illustrates the broad nature of federal government activity in support of Canada's science, technology and innovation ecosystem and the general role of key federal players as well as organizations that deliver federal support.

FEDERAL PARTNERS

1 Federal Economic Development Initiative for Northern Ontario, Atlantic Canada Opportunities Agency, Federal Economic Development Agency for Southern Ontario, Western Economic Diversification Canada, Canada Economic Development for Quebec Regions, Canadian Northern Economic Development Agency

2 Canadian Institutes of Health Research, Natural Sciences and Engineering Research Council of Canada, Social Sciences and Humanities Research Council of Canada

3 Health Canada, Public Health Agency of Canada, Fisheries and Oceans Canada, Environment Canada, Transport Canada, International Development Research Centre, Canada Science and Technology Museum, Canadian Museum of History, Canadian Museum of Nature, Library and Archives Canada, Atomic Energy of Canada Limited, Natural Resources Canada, Canadian Space Agency, Communications Research Centre Canada, Industry Canada, NationalResearch Council Canada, Statistics Canada, Agriculture and Agri-Food Canada, Canadian Food Inspection Agency, Canada Border Services Agency, Public Safety Canada, Royal Canadian Mounted Police, Aboriginal Affairs and Northern Development Canada, National Defence, Department of Foreign Affairs, Trade and Development, Parks Canada, Public Works and Government Services Canada, Defence Research and Development Canada

3.2 Enhancing Accountability and Transparency

Strong governance and reporting practices help deliver and demonstrate results. Requiring accountability and transparency in the use of public funds puts the responsibility on those who are supported by tax dollars to show how these investments make a measurable difference in people's lives. With public resources, it is important for people and organizations funded with taxpayer dollars to demonstrate a net benefit for Canadians. A focus on demand-driven research for innovation will further encourage the use of public investments to create and sustain jobs and growth.

This was recognized in the 2007 Strategy in part through the creation of the Science, Technology and Innovation Council. As an external advisory body, the Council reports on the results of Canada's science, technology and innovation performance. Over the past five years, the Council has increased transparency and accountability through three *State of the Nation* reports on Canada's system. The reports have also enabled the federal government to measure and monitor Canada's innovation performance over time.

We also enhanced the accountability and value for money of the granting councils and the National Research Council by changing the way they are governed. The National Research Council, the Natural Sciences and Engineering Research Council and the Social Sciences and Humanities Research Council have separated the roles of President and Chair and diversified council membership. The granting councils, in turn, have revised their conflict of interest and integrity policies. And, in December 2011, the three granting councils launched a Tri-Agency Framework: Responsible Conduct of Research to enhance the quality and rigour for the oversight of the research they fund.

To ensure a better return on investment at the program level for joint initiatives of the three granting councils, our Government established a Private Sector Advisory Board to provide advice on several industry-focused programs, including the Centres of Excellence for Commercialization and Research, the Business-Led Networks of Centres of Excellence and the College and Community Innovation Program. The Board assesses whether the programs meet the needs of Canadian businesses, support projects that are of high priority to Canada and yield significant economic, social, health and environmental benefits.

In concert with the implementation of the 2007 Strategy, our Government launched the Open Government Strategy in 2011. That same year, Canada joined the Open Government Partnership, a group of 63 countries working together to develop and implement ways to make their governments more open, accountable and responsive to citizens. In 2012, our Government released Canada's Action Plan for Open Government structured along the three streams of Open Information, Open Data, and Open Dialogue.

The process of ensuring that the research we fund delivers benefits to Canadians and the continuous search for better ways to improve the measurement of performance and results are complex tasks.

Looking forward, our Government will continue to work with other jurisdictions in Canada and internationally to strengthen performance indicators.

3.3 Reducing the Administrative Burden

Ensuring research funding is adjudicated and administered efficiently and effectively is a long-standing challenge in Canada and around the globe. Some level of administrative effort is always necessary to ensure a rigorous peer review process. It is also critical to promote accountability for federal dollars spent, as well as compliance with the various guidelines and requirements governing the conduct of research. At the same time, an excessive administrative burden can result in scientists and researchers wasting energy, time and resources on paperwork, rather than on advancing science – an inefficient and unproductive use of resources.

A range of players are involved in funding research at post-secondary institutions and in regulating or administering the conduct of research. This can include post-secondary institutions, federally funded organizations, federal departments and agencies, provincial governments and regulatory bodies, standard setting organizations, charitable foundations, as well as industry and international bodies.

Such complexity calls for concerted action on the part of all stakeholders in Canada's research ecosystem to enhance efficiency and reduce the administrative burden on researchers, releasing them to concentrate their efforts on generating breakthrough ideas.

Our Government will work with the post-secondary sector and other research-funders to reduce the administrative burden associated with research so it will be the lowest in the G7, while maintaining a strong commitment to uphold our high standards of research excellence and accountability and to govern the conduct of research and protect the health, safety and privacy of Canadians.

To accomplish this, we will:

- Expand the current efforts of funding agencies supported by the federal government to improve client service, harmonize and simplify administrative requirements as well as align and integrate funding opportunities.
- Reach out to research funders and administrators as well as standard-setting organizations and regulatory bodies outside the federal family to identify and pursue opportunities to increase the efficiency and effectiveness of our research enterprise.
- Investigate actions such as aligning reporting requirements, adopting common standards and promoting mutual recognition or harmonization of regulatory requirements where possible.

4.0 FOCUSING ON PRIORITIES

A strong knowledge base allows Canada to respond to social and economic challenges, and leads to unexpected discoveries and breakthroughs. This requires federal support across all disciplines that include both discovery and application driven research. It also requires that Canada's research strengths are leveraged to gain a competitive edge in areas critically important to Canada.

"...The Canadian advanced manufacturing sector must adapt to a whole new era of fast-paced technological change, particularly in the fields of digital technology, materials, bio- and nano-technology, and big data...the weight of manufacturing in Canadian R&D is so important that it is imperative for the government to make it a national S&T priority. Therefore CME recommends that Canada's S&T strategy include advanced manufacturing as a priority."

- Canadian Manufacturers and Exporters (CME)
CME submission to Science, Technology and Innovation Consultation (posted on CME website, February 7, 2014)

The 2007 Strategy identified four research priorities – **Environment, Natural Resources and Energy, Health and Life Sciences** and **Information and Communication Technologies.**

In the years since, we have targeted investments in these priority areas and we are already seeing a great return on these investments. In 2012, the Council of Canadian Academies' follow-up assessment on the state of science and technology affirmed Canada's leadership in these four broad research areas. **Our government will continue to sustain and enhance the nation's advantages in these strategic areas.**

However, we understand the need to adopt high-potential platform technologies that transform industries and yield strong social and economic benefits. So we are adding **Advanced Manufacturing as a new priority**. Advanced manufacturing can include disruptive and enabling technologies such as new materials (e.g., composites, biotechnology and nanotechnology), as well as new methods of design and production (e.g., simulation, automation, additive manufacturing). Firms that embrace advanced manufacturing will have a powerful tool to deliver high value-added activities and products.

Equally important is to continue to research and innovate in Canada's strong traditional sectors. Agriculture encompasses a broad range of activities including technological development, genomic research, and manufacturing. **Agriculture has been added to the Environment priority to focus research resources on this vital sector.**

With advice from the Science, Technology and Innovation Council, we have identified areas of particular focus within each of the five research priorities that are of strategic importance to Canada.

Research Priorities	Focus Areas
Environment and Agriculture	• Water: Health, Energy, Security • Biotechnology • Aquaculture • Sustainable methods of accessing energy and mineral resources from unconventional sources • Food and food systems • Climate change research and technology • Disaster mitigation
Health and Life Sciences	• Neuroscience and mental health • Regenerative medicine • Health in an aging population • Biomedical engineering and medical technologies
Natural Resources and Energy	• Arctic: Responsible development and monitoring • Bioenergy, fuel cells and nuclear energy • Bio-products • Pipeline safety
Information and Communications Technologies	• New media, animation and games • Communications networks and services • Cybersecurity • Advanced data management and analysis • Machine-to-machine systems • Quantum computing
Advanced Manufacturing	• Automation (including robotics) • Lightweight materials and technologies • Additive manufacturing • Quantum materials • Nanotechnology • Aerospace • Automotive

These focus areas are relevant both to Canada's key economic sectors and societal challenges. **By targeting them, we will encourage a greater integration of innovative technologies, products and processes and, by extension, create greater benefits for Canadians and key Canadian sectors.**

For example:

- Research in neurodegenerative and chronic diseases (e.g., Alzheimer's, arthritis, cardiovascular disease) can address health-related challenges associated with an aging population.
- Research in water can improve the sustainability of our fresh water resources, and reduce water usage in the agriculture, mining and energy sectors.
- Bio-energy research presents opportunities for innovative renewable energy sources and sustainable bio-based products for Canada's forestry sector.
- Advances in biomedical engineering and medical technologies will create new opportunities and markets for Canada's pharmaceutical and medical devices sector.
- Lightweight materials and technologies can reduce costs, improve environmental sustainability and enhance safety and reliability in many sectors, such as aerospace and defence.
- The use of computers and mobile devices can advance Canada's digital economy by providing innovative communications solutions to connect rural, northern and remote communities.
- Information and communications technologies offer a wide range of new tools and instruments to profoundly change the technological, organizational, marketing and institutional foundations of the services sector.

These research priorities and focus areas address the needs of Canada's key industrial sectors, such as space, robotics, aerospace and automotive. Advanced manufacturing will provide higher-value added services, such as R&D, design and after-market support, that link to opportunities in global value chains. Automation, 3D printing and advanced data management, for instance, can revolutionize the way manufacturers operate in both traditional and emerging industrial sectors.

In a changing world, our research priorities cannot remain static. **To inspire Canada's innovators to take the next leap forward in ST&I or capitalize on a new opportunity, our Government will review and identify emerging areas of comparative advantage to inform medium- and long-term planning.**

Advanced Manufacturing

Advanced manufacturing technologies including automation, robotics, biotechnology and nanotechnology are rapidly developing, high-technology areas that cut across multiple traditional industries.

They provide competitive advantage to manufacturers by enabling the development of premium, differentiated products and they represent new, more effective processes for existing products.

These new processes, business models, product design and materials are driving gains in productivity and are crucial to ensure the competitiveness of Canadian firms on the global stage.

Advanced manufacturing firms are improving productivity to compete for global mandates. These firms are:

- Capital intensive, making investments in disruptive technologies (such as additive manufacturing and automation);
- Adopting new business models including providing services and other higher-value added activities;
- Linking into growing emerging markets through participation in global supply chains; and
- Providing products to meet world markets' needs at the right price, produced with the latest technologies.

These activities make Canadian firms more competitive and help grow jobs and opportunities for Canadians.

"Internet of Things" Untapped Potential for Canadian Business

The "Internet of Things" (IoT) is considered among experts as the next wave in the communications revolution and Canadian businesses are posed to embrace it. According to the Telus / International Data Corporation Internet of Things Study 2014: The Connected Canadian Business, released in July 2014, some 30 percent of medium and large businesses surveyed plan to deploy IoT technology in the next 24 months.

IoT – the evolution of machine-to-machine (M2M) technology – is a network of uniquely identifiable end points (or things) that communicate without human interaction, most commonly over a wireless network. It is the use of sensors, actuators and data communications technology built into physical objects—from roadways to pacemakers—that enable those objects to be tracked, coordinated or controlled across a data network or the Internet. The systems collect, analyze and act on information in real time and are being deployed to create "smart" connected businesses, homes, cars and cities. Cisco, which opened Toronto's Internet of Everything Innovation Centre in March 2014, has predicted that the Internet of Everything will generate up to $19 trillion dollars of global economic opportunity over the next decade.

Canada's Science, Technology and Innovation Strategy positions our country well for the upcoming opportunities through our priorities, including:

- Machine-to-machine connectivity;
- Cybersecurity;
- Quantum computing and materials;
- Advanced manufacturing;
- Communications networks and systems; and
- Advanced Data Systems.

As device communications and complexities grow, Canada is well positioned with its priorities, highly-skilled people and world-class researchers to capitalize on this opportunity.

Emphasizing Key Technologies

The aerospace and space sectors make critical contributions to Canada's prosperity and security. To keep government policies and programs relevant and in step with changing global conditions, the Aerospace Review (Emerson Panel) was launched in February 2012. In examining research priorities, the Panel noted that, "*a 'sweet spot' exists where there is a confluence of the tools vital to Canada's future, rising demand in the global marketplace, and the technologies and products conceived and tested by Canadian researchers and businesses.*" Research priorities in information and communications technologies and advanced manufacturing will support Canada's space and aerospace industries in gaining a competitive edge in the global marketplace.

5.0 GROWING CANADA'S TALENT

People are at the heart of discovery and innovation. They are the most effective agents of change and we are committed to fostering ambition and ingenuity in our society. Our Government will continue to support those who make ground-breaking discoveries and push the frontiers of knowledge. As well, we will support those with the drive and know-how to take new ideas and use them to resolve problems, create and offer new products and services as well as find new ways of doing things.

Taking Stock of People

Reviewing Canada's performance and the overall outcomes of our investments and achievements, Canada's people advantage is clear. We have:

- A sought-after destination for some of the world's brightest minds with a "brain gain" of researchers over the past decade;
- Researchers and scientists with global ties, networks, research collaborations and partnerships who have linkages and access to other scientifically advanced countries;
- A highly-skilled and educated workforce with the highest share of university and college graduates among working-age populations in the OECD;
- A responsive immigration system providing international student graduates with a pathway to permanent residency;
- A strong emerging skills base with Canadians continuing to perform at the top tier globally in reading, mathematics, problem-solving and science; and
- Robust growth in the number of science and engineering doctoral degrees granted in Canada.

5.1 Record of Support for People

Because people are a country's greatest asset, the 2007 Strategy set out to attract and retain home-grown experts, returning Canadians, as well as newcomers from abroad.

Several initiatives are already helping to make it happen:

- The Canada Excellence Research Chairs help Canadian universities bring the world's most accomplished researchers to Canada and build a critical mass of expertise with an emphasis on priority areas. For each Chair, universities receive up to $10 million over seven years, which they must match.

- World-leading programs such as the Banting Postdoctoral Fellowships and the Vanier Canada Graduate Scholarships have enabled Canadian academia to attract and retain the world's brightest emerging researchers. The Banting's $10 million annual budget supports up to 140 post-doctoral fellows at a value of $70,000 per year for two years. And with a budget of $25 million per year,

the Vanier Graduate Scholarships support up to 500 scholars annually with awards valued at $50,000 a year for three years. Together, these Canadian awards are among the world's most prestigious for doctoral students and post-doctoral fellows. They are aimed at strengthening the ability of Canadian universities to attract and retain world-leading research talent and support the development of the research leaders of tomorrow.

Today, over one-fifth of our 1,750 Canada Research Chairs and all 22 Canada Excellence Research Chairs come from other countries. Moreover, many are returning Canadians – almost 130 to hold a Canada Research Chair and 3 to hold a Canada Excellence Research Chair. Beyond their skills and ideas, these world-class researchers bring their global networks, research collaborations and partnerships, extending the breadth and depth of Canada's global ties.

Personalized Medicine to Treat Pain

Dr. Luda Diatchenko is a Canada Excellence Research Chair at McGill University and a world-renowned expert in the genetic basis of human pains, developing approaches to personalized medicine. By researching genetic mechanisms that are at the root of pain, she hopes to accelerate treatment for the approximately 20 percent of Canadians who suffer from chronic pain. Chronic pain is the number one reason that people seek health care and also the primary concern of patients with long-term illnesses.

- The Canada Graduate Scholarships encourage Canadians to pursue advanced education and conduct research. Through annual program investments of $132 million, 2,500 Masters and 2,500 Doctoral awards are supported yearly. This enables students, across all disciplines, to develop the skills needed to become future research leaders and highly-qualified personnel across all sectors of the economy.

Michael Smith Foreign Study Supplements support Canadian graduate students in building global linkages and international networks through short-term research experiences abroad.

Supported by a Vanier Scholarship, Dr. Brittany Rasmussen uncovered a new target for therapeutic strategies to control glucose levels in diabetes, and help to improve the lives of diabetic individuals. Her findings were published in the prestigious journal *Cell Metabolism* in January 2014.

Our Government also places a heavy emphasis on inspiring and empowering the great minds of tomorrow. As such, we encourage young people to obtain industry-relevant research and entrepreneurial experience through a variety of initiatives, such as:

- Investments in the Mitacs' Accelerate Program to help graduate students and post-doctoral fellows across Canada get industrial research experience through internships while helping to solve industry challenges. Mitacs received federal funding for this program beginning in 2008 with an average annual investment of $7 million. And in Economic Action Plan 2012, we doubled support to the program with a commitment of an additional $35 million over five years, increasing the number of internships supported to more than 1,900 per year.
- Under our Youth Employment Strategy, we have made new investments in the Career Focus program to help youth make the transition into the labour market. Economic Action Plan 2012 provided funding for an expected 3,000 additional paid internships in high-demand fields. Since 2006-2007, the Youth Employment Strategy has helped over 611,800 young Canadians.

- New investments in Futurpreneur (formerly the Canadian Youth Business Foundation) to help young entrepreneurs grow their companies. Economic Action Plan 2013 provided $18 million over two years to the Foundation. It reports investing in 5,600 entrepreneurs whose businesses have created 22,100 jobs and $157 million in tax revenue.
- The new Canada Job Grant, introduced in Economic Action Plan 2013, will help connect Canadians with available jobs and ensure that Canadians obtain the skills employers are seeking to strengthen business innovation.

Our Government has also made significant progress in implementing long-overdue reforms to Canada's immigration system. Changes have been designed to attract greater numbers of skilled and entrepreneurial newcomers with the education and experience our economy requires. For example, we have improved the Canadian Experience Class by providing international student graduates with a pathway to permanent residency and increased the responsiveness of the immigration system by better aligning it with the needs of the labour market. Our Government has also been working with the provinces, territories and other stakeholders to strengthen labour market information partnerships.

Yukon College Shares PhD Student with Industry

Guillaume Nielsen, a PhD student with the Institut National de la Recherche Scientifique, is working with industry and Yukon College's Centre for Northern Innovation and Mining to see how local bacteria can be used at mine sites to remove heavy metals from water, a process called bio-remediation. He will begin his research at the Yukon Research Centre and then apply his findings at the Keno Hill mine site. Support from Mitacs' Accelerate and the Yukon Research Centre are making this happen.

Mitacs

Mitacs is a not-for-profit research organization that builds linkages between academia and industry to promote high-quality research and innovation across Canada. Mitacs leverages federal funding with support from provincial governments, companies and universities. The Government of Canada supports three Mitacs programs:

- **Accelerate** supports research internships for graduate students and post-doctoral fellows. Interns further develop their skills and gain relevant industry experience by working on real world business problems. Host organizations gain access to graduate interns, guided by an academic supervisor, who work on research and development projects designed to address the needs of business.
- **Globalink** builds a bridge between Canada and international partners, establishing Canada as an international nexus for research excellence through the mobility of university students. The program aims to achieve this goal by attracting highly-promising students from around the world to Canadian universities and by allowing Canadian students to take advantage of training opportunities abroad. By linking foreign and Canadian students with research expertise, training and networking opportunities, Globalink helps to build international networks and contribute to the reputation of Canadian education and research.
- **Elevate** offers post-doctoral fellowships to recent PhD graduates. During the two-year program, individuals receive vital business, research and development, and management training. They carry out a collaborative, applied research project with industry, along with the involvement of an academic mentor. The program facilitates the transition of post-doctoral fellows between academia and industry.

5.2 Moving People Forward: Next Steps

Canada will be a place where curiosity is encouraged, our youth are inspired by science, technology and innovation, and where the best and brightest minds from around the world come to share in our aspirations of pushing the frontiers of knowledge and making ground-breaking technology advancements to help Canada succeed in the global economy.

Over the past decade, Canada has enjoyed a "brain gain" of highly-skilled workers. This means our top experts and leaders are staying in Canada, skilled and educated youth are entering our workforce and we are also attracting new people to study and work here. These people are driving discovery and innovation through their ingenuity and determination to find solutions to society's challenges. We want to continue this trend and make Canada a place where curiosity is encouraged and people are inspired to solve problems and bring ideas to life.

Our Government looks to grow a highly-trained and skilled workforce by:

- Preparing our people for innovation;
- Encouraging science-to-industry jobs;
- Supporting global connections; and
- Fostering an innovation culture.

5.2.1 Preparing our People for Innovation

Our Government will encourage more young people to pursue education and choose careers in science, technology, engineering and math disciplines and raise awareness of the inherent value of science, technology and innovation.

We will accomplish this by:

- Promoting science, technology, engineering and math skills development. We will add another $10.9 million per year from existing sources to support science promotion activities through programs like PromoScience, which support organizations such as Let's Talk Science | Parlons Science;
- Providing more and better information to young Canadians about employment opportunities in high-demand fields;
- Working more closely with educators and industry to address the persistent under-representation of women in these disciplines; and
- Enhancing learning opportunities and instructional resources for educators in critically important areas like science, technology, engineering and math through initiatives such as PromoScience.

Space Academy for Aspiring Astronauts

With the support of the Natural Sciences and Engineering Research Council's PromoScience program, the Institute for Space Science, Exploration and Technology at the University of Alberta, lets Space Academy Trainees explore the many areas of space with real space scientists over the summer. Trainees design and launch model rockets, make galaxies, build interactive robots, experience virtual reality, simulate working at mission control and take pictures of earth by sending a camera 30 km into the atmosphere on a weather balloon.

5.2.2 Encouraging Science-to-Industry Jobs

Our Government will continue to provide record support to Canadian universities, colleges and polytechnics so they can develop, attract and retain tomorrow's research leaders and experts.

We will accomplish this by:

- Continuing to support scholarships and fellowships, research chairs, foreign study supplements, international student exchanges and industry-relevant internships. For example, through Economic Action Plan 2014, we are investing an additional $8 million over two years in Mitacs to expand industrial R&D training of post-doctoral fellows through its Elevate program. This investment is expected to support an average of 120 post-doctoral fellows per year to develop their

communication, leadership, management and other critical business skills in order to prepare them to become leaders of business innovation in Canada.

Our Government will focus federal investments in youth employment by reviewing the Youth Employment Strategy to align it more effectively with the evolving realities of the job market so that young Canadians gain the real-life work experiences needed to develop the technological skills increasingly required for jobs.

We will also strengthen youth programming by dedicating $40 million for up to 3,000 full-time internships for university, college and polytechnic graduates in high-demand fields between 2014-15 and 2015-16. Of this amount, $30 million will be provided to the National Research Council-Industrial Research Assistance Program to support youth internships in small and medium-sized businesses undertaking technical R&D projects. The remaining $10 million will be delivered by the realigned Youth Employment Strategy.

Business and Science Skills Create Employment Opportunities

Dr. Haleh Vahedi participated in a two-year Mitacs Elevate post-doctoral fellowship from 2011 to 2013 in a collaboration between the University of Toronto and Snowbush-Semtech IP, a supplier of semiconductor devices for computer, communications and industrial applications, located in Toronto, Ontario. Through her fellowship, Dr. Vahedi participated in a series of workshops prepared by Mitacs that included essentials for business communication, networking and project management. These workshops allowed Dr. Vahedi to hone her workplace interpersonal skills and to better plan and predict the resources and time required to efficiently complete projects. The new electrical circuit that she designed offered Snowbush-Semtech the potential to improve signal integrity which helps position the firm to be a leading supplier of next generation data communication products. At the end of the Mitacs fellowship, Snowbush-Semtech recognized the valuable skill set that Dr. Vahedi possessed and hired her full-time as an analog designer.

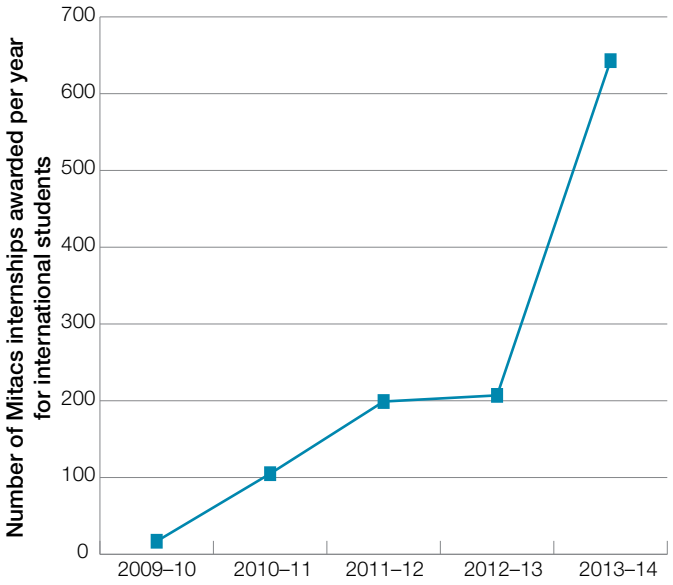
Getting hired after participating in a Mitacs program is nothing new, in fact it has been a frequent occurrence for Mitacs Accelerate interns. Based on a 2013 longitudinal survey of past Accelerate interns, Mitacs estimates that roughly 1,450 interns have been hired by their industry partner. The survey also concluded that more than 650 interns started their own firms. Industry partners have provided ample rationale as to why the Accelerate program is popular with them. They reported the number of outcomes from Accelerate internships as follows: new product developed or anticipated (504), new processes developed or anticipated (672), patent applied for or anticipated (216) and, in 97 percent of cases, the company reported increased interest in collaborating with the academic sector.

5.2.3 Supporting Global Connections

A key element of our Government's ambitious plan for international trade and investment expansion, known as the Global Markets Action Plan, is the International Education Strategy (IES). The IES focuses on attracting more international students and researchers to Canada and developing strategic partnerships with key countries. It also seeks to foster institutional partnerships including research collaboration and student mobility between Canadian and foreign educational institutions, as well as improve coordination among federal, provincial and territorial governments and education stakeholders, including the private sector.

Recent IES initiatives include $20 million over three years for Mitacs to deliver internships for international students to come to Canada and for Canadian students to develop their international contacts by studying abroad. It will also support graduate fellowships for international interns to pursue graduate studies in Canada.

International Student Internships Awarded through Mitacs Globalink



Source: Industry Canada compilation based on Mitacs data.

International Student Recruitment through Mitacs Globalink

Wanyao Zhao, an electrical engineering student from the Beijing Institute of Technology, was attracted to Canada to participate in a Globalink Research Internship in the summer, 2012. His positive experiences in Canada convinced Wanyao to return to Canada after completing his undergraduate degree. In the fall of 2013, Wanyao became an international Master's student in the Department of Electrical and Computer Engineering at the University of Toronto.

Our Government will enhance Canada's global position in higher education through the Global Markets Action Plan and the International Education Strategy.

To accomplish this, we will:

- Double the number of international students by 2022;
- Enhance the marketing plan to brand Canada as an international education destination and partner for study and research;
- Evaluate current scholarships programs to ensure Canada is attracting the best and brightest in the world to study and remain in Canada;

New initiatives like the **Canada First Research Excellence Fund** will highlight research excellence in post-secondary institutions and further promote Canada as a top destination for the world's best researchers and students.

- Make greater efforts to retain talented international students and researchers as part of a highly-skilled workforce; and
- Coordinate the international marketing of federally-supported scholarships, including the Vanier and Banting awards, as well as Mitacs Globalink scholarships and internships.

Canadian Tire Innovations

Canadian Tire sought to change how it looked at innovation by working with Communitech. The Canadian Tire Hub in Waterloo's Incubator Communitech is now bringing in hundreds of students to deliver technology solutions and foster a new innovation culture by using technology to position their company as a retail leader.

5.2.4 Fostering an Innovation Culture

Our Government will increase corporate management capacity by working with business schools to foster a business innovation culture that embraces risk and growth strategies.

To accomplish this, we will:

- Work with Canadian organizations that have a track record of developing innovative firms, entrepreneurs and highly-skilled workers, such as the Canadian Accelerator and Incubator Program award recipients. This will help build on mentorship and partnership between firms of all sizes to develop and manage innovation strategies.
- Award a Canada Excellence Research Chair in the 2015 competition to research areas related to business sector innovation.

- Improve the immigration system through the Start-Up Visa Program to recruit more foreign entrepreneurs with the potential to build dynamic Canadian companies that can compete on a global scale.
- Replace the Immigration Investor Program and Entrepreneur Program with an Immigrant Investor Venture Capital pilot project.
- In partnership with provinces, territories and stakeholders, continue to improve foreign credential recognition processes and address the demand for skilled workers in additional occupations.

6.0 MAINTAINING CANADA'S LEADERSHIP IN KNOWLEDGE

Science and technology are essential to Canada's long-term prosperity and the quality of life of Canadians. When researchers push the frontiers of knowledge, they endow society with ideas and discoveries that shed light on the world around us and open doors to previously unimagined possibilities. Canada's world-class research facilities – combined with our top-tier researchers and scientists and their growing access to global pools of knowledge and expertise position Canada for ever greater success in the future.

Taking Stock of Knowledge

A review of Canada's performance and the overall outcomes of our investments and achievements confirm Canada's achievements.

- We are ranked 1st among G7 nations in spending on R&D in universities and colleges relative to the size of our economy (OECD, Main S&T Indicators 2014-1).
- We have an internationally-recognized research community, producing more scientific articles than most industrialized countries – one of the highest number of scientific publications per capita in 2012 (calculation based on data from the Observatoire des sciences et des technologies (Thomson Reuters – Web of Science) and OECD).
- Our active researchers have a relatively high share of the top-cited scientific articles. With less than 0.5 percent of the world's population, Canada produces over 4 percent of the world's research papers and nearly 5 percent of the world's most cited papers (State of S&T in Canada, 2012, based on Science-Metrix calculations).
- We boast highly-regarded government scientists who inform decision-making and perform regulatory functions that support government priorities and ensure the health, safety and security of Canadians.
- Our Government has put in place leading-edge research and infrastructure programs to support partnerships between universities and college researchers, businesses and international organizations.

Canadian Researchers Help Discover the Origins of the Universe

More than 150 Canadian scientists and students were involved in one of the major experiments contributing to the high-profile scientific discovery of the Higgs Boson – an elementary particle associated with the origins of the universe. Canada's National Laboratory for Particle and Nuclear Physics (TRIUMF) worked with other international partners from the European Organization for Nuclear Research (CERN) to prove the theories on how particles operate. This discovery is expected to provide insight into how the universe works, open doors to new fields of research in physics and lead to new technology.

6.1 Record of Support for Knowledge

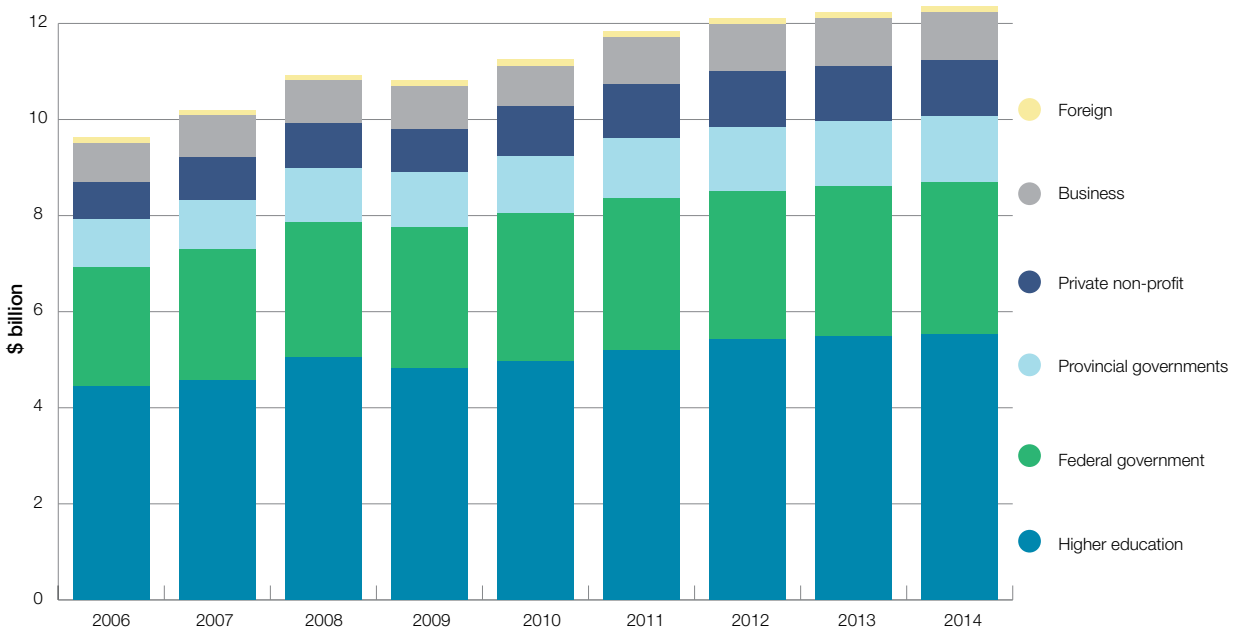
The 2007 science and technology strategy was successful in strengthening support across the full spectrum of research endeavours.

We boosted support for discovery-driven and applied research with increased investments in the three federal granting councils – the Canadian Institutes of Health Research, the Natural Sciences and Engineering Research Council and the Social Sciences and Humanities Research Council. This includes the Research Support Fund (formerly known as the Indirect Costs Program) and the Canada Foundation for Innovation. The chart below shows the evolution of federal investments in higher education R&D since 2006.

World-Leading Homeless Research Strategy – At Home | Chez Soi

Canada invested $110 M over four years to support the At Home | Chez Soi research demonstration project across five major Canadian cities which provided a housing-first approach. The project had strong results in helping Canadians, increasing from 32 percent to 73 percent the number of homeless staying in stable housing. It also greatly reduced public costs, with more than $2 in emergency and social costs saved for every $1 spent. As a result, Economic Action Plan 2013 expanded the program to $600M over five years.

Higher Education Expenditures on Research and Development by Funding Sector, 2006-2014



Source: Statistics Canada, Cansim Table 358-0001, 2014.

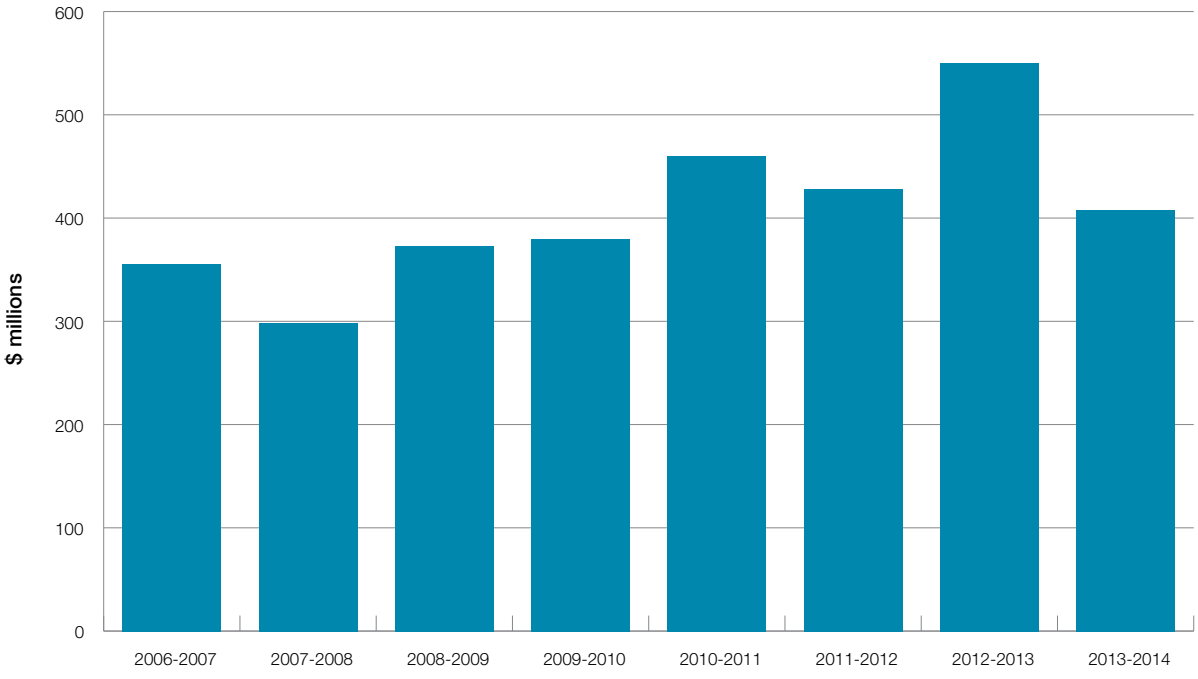
We have also provided significant additional support to arm's-length not-for-profit organizations and other institutes that deliver a broad range of innovation-related activities across Canada; from world-class academic research to the commercialization of research breakthroughs. These organizations include Genome Canada, the Canadian Institute for Advanced Research, Canada's National Laboratory for Particle and Nuclear Physics (TRIUMF), the Perimeter Institute for Theoretical Physics, the Thunder Bay Regional Institute (Cyclotron) and the Institute for Quantum Computing.

In addition, our Government boosted support to organizations such as the Canada Foundation for Innovation and Canada's Advanced Research and Innovation Network (CANARIE) to ensure that Canada's research infrastructure is world-class.

Through Genome Canada, Canadians are taking prominent roles in a number of international projects, including:

- The Structural Genomics Consortium, a public-private partnership led by the University of Oxford and Dr. Aled Edwards at the University of Toronto, which supports leading-edge research on the three dimensional structures of proteins of therapeutic importance to humans, has attracted participation and investment from public and private partners, including nine major pharmaceutical companies.
- The International Barcode of Life Project, a partnership involving over 250 researchers from 25 countries, is led by Dr. Paul Hebert at the University of Guelph, who is spearheading an effort to construct an extensive DNA barcode reference library that will be the foundation for a rapid DNA-based identification system for all multicellular life. While the barcode library continues to be developed, this technology has already led to applications for identifying invasive species and food contamination which could generate significant benefits for Canada's forestry and agricultural industries.
- The International Rare Disease Research Consortium teams up researchers and organizations investing in rare diseases research in order to achieve two main objectives by the year 2020, namely to deliver 200 new therapies for rare diseases and the means to diagnose most rare diseases.
- The International Cancer Genome Consortium coordinates large-scale cancer genome studies from around the world related to tumours from 50 different cancer types that are of societal importance globally for the ultimate purpose of improving cancer diagnosis and treatment.

CFI Disbursements 2006-2007 to 2013-2014



Source: Industry Canada compilation based on CFI data.

Federal scientists and researchers perform world-class work that is integral to providing evidence for policies, regulations and protecting and serving Canadians' economic, social and health interests. Here too, we have seen great success in the past years. In fact, Canadian federal departments and agencies have averaged over 4,000 publications in the natural sciences and engineering fields annually and in 2011, federal researchers published 10 percent more in these fields than they did five years earlier.[6]

The Canmet Materials laboratory at Natural Resources Canada is a prime example of federal scientists contributing to both economic and policy goals. The materials lab collaborates with universities and industry, and contributes to public policy, such as its research on materials that improve pipeline safety and reliability. We are also building a new Canadian High Arctic Station, a world-class, year-round, multi-disciplinary science and technology hub to strengthen Canada's leadership in Arctic research.

Putting geospatial information to work for Canadian industry

Natural Resources Canada manages and provides geospatial information used by mapping companies that enhances the competitiveness of Canada's natural resource sectors. By playing a national and global leadership role, government researchers are helping Canadian companies compete globally and develop our natural resources responsibly.

Even in the midst of the recent global economic downturn, our Government made additional investments in science, technology and innovation to provide short-term economic stimulus which contributed, at the same time, to supporting our science and technology objectives. These included:

- A $250 million investment to upgrade and modernize federal laboratories doing research in fields including health, safety, security, transportation, environmental protection and heritage. As well as helping federal departments deliver their core regulatory responsibilities, these projects provided short-term stimulus in regions across Canada.
- A $2 billion Knowledge Infrastructure Program to support research and development facilities at Canada's colleges, polytechnics and universities. The program financed 520 projects at 241 institutions across Canada. Projects were sponsored in 190 communities in all regions of the country. Federal funding leveraged an additional $3 billion in private sector and provincial spending across Canada.

Knowledge Infrastructure Program (KIP) Investments from Coast to Coast to Coast

Capilano University in **British Columbia**, boasts a new $33 million digital media/film development centre which provides 20 new classrooms with a capacity of 760 students, multiple offices and meeting rooms and an advanced sound stage/screening room with a capacity of more than 200. The facility allows Capilano U to provide students a combination of technical, creative and business skills that it feels are essential to entrepreneurial development in film production, animation and visual effects.

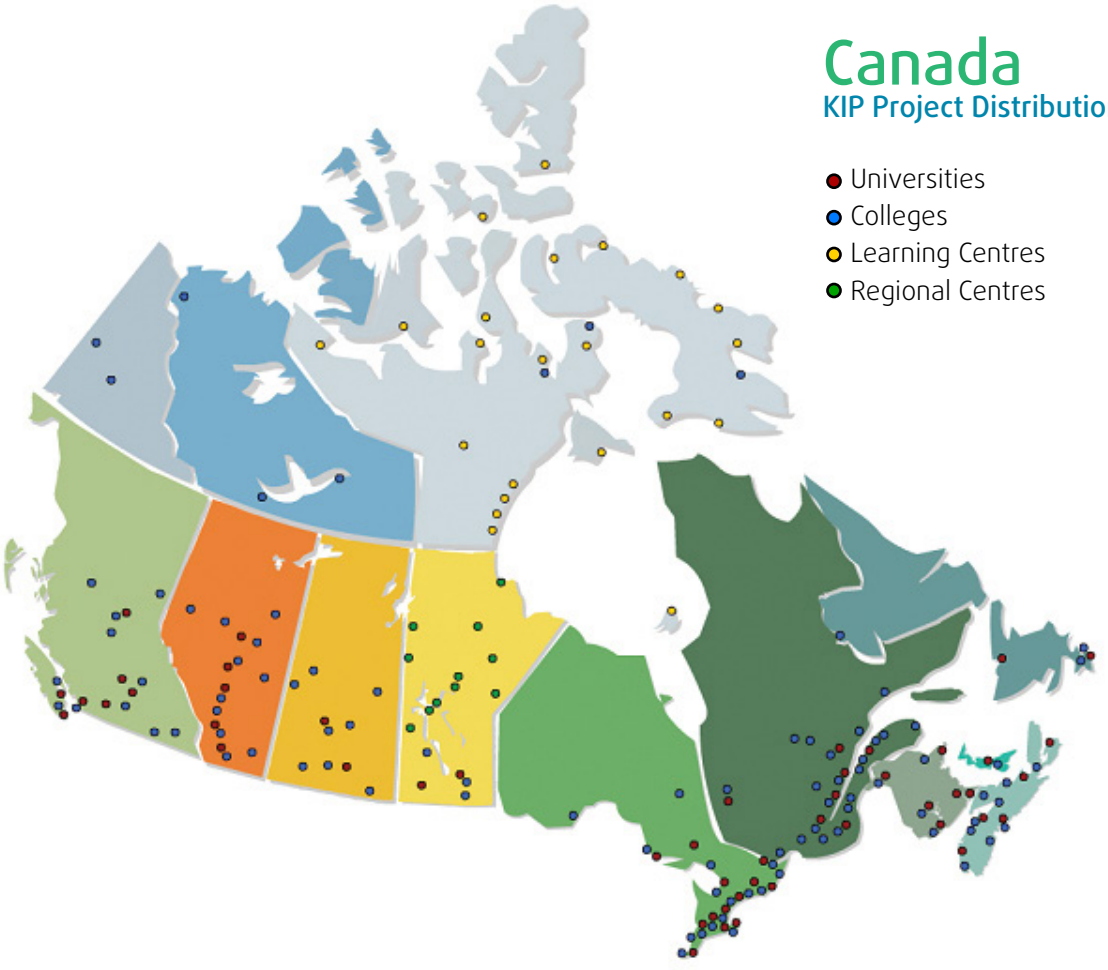
At Mount Royal University's Lincoln Park Campus in **Alberta**, the construction of a 4,700 square metre, 3-floor, expansion of the Science and Technology Wing expanded the labs space for training in new tissue culture, hard and soft rock geology, and cellular biology, chemistry, anthropology and archaeology labs, and faculty offices. The expansion to the facility is designed to meet Leadership in Energy and Environmental Design (LEED) certification, and help the institution meet a key commitment necessary to complete its transition from a college to a university.

[6] Observatoire des sciences et des technologies.

A new Centre for Health Sciences at Toronto, **Ontario**'s Waterfront expands George Brown College by roughly 40 percent, adding instructional and training spaces such as dental labs, radiology clinics and simulation centres to support an estimated 3,500 additional students. The $175-million facility that expanded its capacity also houses dedicated research and incubation spaces to assist the College in fostering industry partnerships and improving its applied research capacity. Designed to LEED Gold specifications, it reduces energy usage by 30 percent and water consumption by 40 percent.

At the Centre for Industry Innovation and Incubation at École de technologie Supérieure in Montréal, **Quebec**, 11 floors of vacant space were renovated to create an industry innovation and incubation centre. This project provides internal and external researchers with a modern building equipped with high-tech tools and equipment. It improves ties between the school and its industrial partners as well as brings the various partners working in innovation and technology marketing closer together.

The new Sir Wilfred Grenfell Academic Building at Memorial University in Corner Brook, **Newfoundland**, greatly expands instructional and research capacity of the science department. The $23-million facility increases research and computer laboratory spaces by 50 percent and 30 percent respectively, along with additional classrooms to support increased enrolment to the university.



Nunavut Arctic College installed new information technology systems and networking hardware to link the three college campuses along with 25 community learning centres to improve training and instructional opportunities in the North. New fibre optic cables enable internet connectivity for all 25 remote northern communities, connecting them to the main satellite and at a much broader bandwidth. Six high-end video conferencing terminals connected remote communities and enabled distance learning in areas where it is not practical for students to relocate. The new infrastructure will benefit local communities by making the Community Learning Centres open to all community members so that everyone can benefit from the improved connectivity.

Yukon College constructed a permanent Pelly Crossing campus to replace the outdated mobile trailer. The new, one-storey, 2,500-square foot building boasts classrooms, a computer lab, a mobile science lab and video conference equipment for delivering distance education. This new facility enables the College to offer courses and training opportunities that address the needs identified by the local Selkirk First Nation, such as resource management and trades training.

The Combined Technologies Project at the Université Sainte-Anne in **Nova Scotia** installed renewable energy generating capacity to the campus, through the combined use of solar, wind and biomass systems to supply a significant portion of the institution's heating and electricity needs. During the system's first year of operation, it achieved a 71.6 percent reduction in carbon dioxide emissions when compared against 2008 levels.

6.2 Moving Knowledge Forward: Next Steps

Canada will continue to be recognized world-wide for its research excellence and knowledge infrastructure. We will be a nation where our talented researchers and entrepreneurs can pursue their aspirations and ideas for the benefit of Canadians and people around the world.

In recent years, both the quantity and quality of the science we do in Canada have increased. A strong knowledge base in this country has allowed Canada to respond to social and economic challenges as they emerge.

Our Government will continue to support and deepen research across a broad spectrum of disciplines that include both discovery- and application-driven research.

We will also seize the opportunities of the digital age and make federally-funded science more open and transparent.

We will create a stimulating research environment that attracts private sector partners and trains tomorrow's experts and innovators. And we will strengthen federal research to continue to support good and sound policy-making.

Canadian Leadership on the World Stage

Dr. Nahum Sonenberg, professor of biochemistry at McGill University, received the prestigious 2014 Wolf Prize in Medicine, awarded by the Wolf Foundation in Israel, for his pioneering work in the discovery of the mechanism of protein synthesis.

This has opened up new avenues to treat diseases like diabetes, cancer, polio, hepatitis, as well as neurological disorders like autism, learning and memory.

Dr. Sonenberg shares this prize with Victor Ambros of the Harvard Medical School and Gary Ruvkun of the University of Massachusetts Medical School.

This Prize is recognized as a prestigious award in medicine along with the Nobel Prize and the Lasker Award.

Our Government will foster R&D excellence through:

- Increasing Research Excellence in Post-Secondary Institutions;
- Promoting Open Science;
- Supporting Cutting-Edge Infrastructure; and
- Strengthening Federal Research to Support Policy-Making.

6.2.1 Increasing Research Excellence in Post-Secondary Institutions

Our Government will continue to provide record support across the full spectrum of research endeavours in universities, colleges and polytechnics, including the enhancement of established networks and the fostering of new collaborations among post-secondary institutions, researchers and companies, as well as government scientists and engineers.

This will be achieved by initiatives that include:

- Creating a new Canada First Research Excellence Fund of $1.5 billion over 10 years to help Canadian post-secondary institutions excel globally in research areas that create long-term economic advantages for Canada. The new Fund, to be administered by the Social Sciences and Humanities Research Council on behalf of all the granting councils, will be available to all post-secondary institutions on a competitive, peer-reviewed basis. Stakeholder input has informed the design of the Fund.

"[Economic Action Plan 2014] represents a visionary investment in research excellence and innovation that will ensure Canada remains competitive globally. This funding will allow the University of Alberta and our peers to attract the best and brightest to advance the scientific discoveries, solutions and ideas that will benefit Canadians for generations to come."

- Indira Samarasekera
President, University of Alberta
(quote from University of Alberta news release, February 11, 2014)

- New funding of $37 million per year for the granting councils with a focus on supporting advanced research and scientific discoveries, distributed as follows:
  - $15 million per year to the Canadian Institutes of Health Research to expand the Strategy for Patient-Oriented Research, create the Canadian Consortium on Neurodegeneration in Aging and for other health research priorities;
  - $15 million per year to the Natural Sciences and Engineering Research Council for advanced research in the natural sciences and engineering; and
  - $7 million per year for the Social Sciences and Humanities Research Council (SSHRC) to underwrite advanced research in social sciences and humanities.

"It is important that our country continues to support fundamental research and world-class infrastructure through the tri-councils and the Canada Foundation for Innovation programs, yet support milestone-driven research and structuring initiatives for the R&D ecosystem such as networks of excellence."

- Dr. Diane Gosselin
President and CEO of CQDM
(excerpt from CQDM's submission to the Science, Technology and Innovation Strategy Consultation, February 2014)

- Providing additional support of $9 million per year for the Research Support Fund (formerly the Indirect Costs Program), bringing the total annual budget to $342 million. We will continue to work with organizations, including the Association of Universities and Colleges of Canada, to improve the results, awareness and performance measurement of these vital investments.
- Investing an additional $222 million over five years, starting in 2015-16, in Canada's national laboratory for particle and nuclear physics (TRIUMF) to support the Facility's world-leading research and international partnership activities.
- Supporting the Institute for Quantum Computing with an extra $15 million over three years to advance its strategic plan.

Forging Vibrant Urban Neighbourhoods

Giving voice to the marginalized has been the life's work of Tom Carter, an internationally recognized expert on urban policy and housing issues. Carter has spent over 25 years contributing his expertise to grassroots community groups and organizations dedicated to inner-city revitalization and other critical issues facing Canada's urban poor.

The insights from his ground-breaking research—spanning critical issues ranging from rural and inner-city housing to Aboriginal communities and urban poverty—continue to play a major role in generating practical solutions for many communities in Canada and abroad. Through his SSHRC-funded Winnipeg Inner-City Research Alliance, Carter partnered more than 50 community groups with established researchers, to better understand urban decline, evaluate the effectiveness of key initiatives, and inform policy to meet the real, everyday needs of residents. Over the project's seven years, Carter and his team developed programs and policies that have led to higher employment, better skills training, and improved infrastructure.

6.2.2 Promoting Open Science

As part of a government-wide initiative to broaden the breadth and depth of information available online through the Action Plan on Open Government, our Government will advance open science policies and practices for publicly funded research by increasing public access to the results of government funded research.

This will showcase the world-class work of Canada's scientific community and at the same time deliver on the Digital Government pillar in Digital Canada 150. An implementation plan will be developed to promote open science, including both open access and open data initiatives, within the activities of science-based departments and agencies, as well as those of granting councils and the International Development Research Centre.

Integrated access to data and information on the St. Lawrence global ecosystem

The St. Lawrence Global Observatory partnership, based in Rimouski, Quebec, provides access to data and information from a network of federal, provincial, academic and other organizations for the sustainable management of the St. Lawrence ecosystem. The data collected from submerged sensors, buoys, fixed instruments and remote sensing on shipboard surveys are processed, validated and interpreted before being integrated into data bases and information models that are disseminated by the Observatory.

Specifically, our Government will:

- Implement a Tri-Agency Open Access Policy requiring that the results of federally-funded research be made available within 12 months;
- Make available online consolidated lists of recently published research authored by federal scientists and develop and implement policies to promote open access of federal science through science.gc.ca;
- Implement open data initiatives in the granting councils and in science-based departments and agencies to promote broad-based access to federally-funded data and research results in a timely manner; and
- Invest $3 million over three years in the Canadian Digital Media Network to create the Open Data Institute. The Institute will play a pivotal role in aggregating large datasets, informing the development of interoperability standards and stimulating the commercialization of new data-driven apps.

Open Science

On April 4, 2014, as part of the launch of Digital Canada 150, the Government of Canada committed to publish a new iteration of Canada's Action Plan on Open Government, with a new Open Science initiative to facilitate open access to publications and related data resulting from federally-funded research in order to accelerate research, drive innovation and benefit the economy.

6.2.3 Supporting Cutting-Edge Infrastructure

Our Government will enhance Canada's research capacity through investments in transformative infrastructure projects that underpin world-class research and enrich Canada's research landscape.

This will be achieved by initiatives that include:

- Working with partners to develop a digital research infrastructure strategy to create a world-leading research and innovation ecosystem in Canada. This will also serve to advance Digital Canada 150 by positioning Canada as a global leader in "big data." We will include new policies on research data management and storage, and a coordinated long-term approach to the funding and provision of high speed networking, high performance computing and software tools, to be developed by the Canada Foundation for Innovation, CANARIE and Compute Canada. Digital Canada 150 included a commitment of $50 million for the Canada Foundation for Innovation to invest in high performance computing and storage in support of these efforts.
- Working with partners to review our approach to investing in major science initiatives in order to strengthen long-term planning and coordination among institutions and funders.

Building Canada Plan 2013 Supports World-Class Research Infrastructure

Following on the success of the 2007 Building Canada Plan, Economic Action Plan 2013 announced a new Building Canada Plan, including over $53 billion in new and existing funding for provincial, territorial and municipal infrastructure. This Plan establishes a new Building Canada Fund to support infrastructure projects of national, regional and local significance in communities across the country in a broader range of categories including innovation, connectivity and broadband. This new fund increases potential projects for federal and provincial support in innovation where provinces and territories can access up to $10 billion of federal matching funds to support world-class research infrastructure.

Federal Government Invests in Leading-Edge Research Networks

CANARIE manages Canada's only ultra-high-speed backbone research network, which facilitates leading-edge research and big science across Canada – crucial to the use of high-performance computing facilities. It is Canada's inter-provincial and international research and education network that links some 1,100 institutions in Canada with each other and with many leading research centres in other countries. CANARIE works with researchers and developers in many scientific disciplines, across 12 regional networks in Canada, and with 100 international peer networks in more than 80 countries.

Created in 2006 through funding from the Canada Foundation for Innovation, Compute Canada has delivered advanced research computing capabilities to support researchers from over 30 member research universities representing every province across the country. With its four regional computing consortia, Compute Canada integrates high performance computing systems, research expertise and tools, data storage and resources with academic research facilities across Canada. Its high-speed computing is capable of running extremely complex and large-scale applications. While historically this capability was essential in only a few fields such as sub-atomic physics, genomics and climate modeling, the increasingly international nature of research collaboration and the exponential increase in data creation, advanced research computing is becoming a fundamental requirement in virtually all research disciplines. Compute Canada collaborates closely with CANARIE to ensure that researchers across Canada have high-speed access to its advanced computing network.

6.2.4 Strengthening Federal Research to Support Policy-Making

Much of the work performed by federal researchers not only informs good and sound decisions on public policy and government priorities, it also contributes in meaningful ways to the well-being of Canadians.

Recognizing the inherent value in federal research, our Government will bolster its policy-making capacity in several ways.

We will:

- Support federal laboratories and scientific facilities across Canada so they can continue to effectively deliver on our Government's core public policy and regulatory responsibilities, including through new investments of $380 million announced in 2014 for major repairs and upgrading of federal laboratories and research facilities;
- Lead the way in the field of genomics research by supporting the Genomics Research & Development Initiative to co-ordinate activities of federal science-based departments and agencies with an investment of almost $100 million over five years to continue this program, which helps provide better food and water safety, and management of natural resources;
- Launch a National Disaster Mitigation Program through an investment of $200 million over five years starting in 2015-16, to better protect Canadians and their homes. This program will support investments in structural mitigation measures, such as infrastructure to control floods that can reduce the impact of severe natural disasters. It will also draw on the latest research to better inform us of the risks Canada faces and the technologies our country could use to mitigate these risks.

7.0 ENCOURAGING CANADA'S BUSINESS INNOVATION

Over the past seven years, our Government has established strong market frameworks including tax incentives and program funding to encourage private sector investment in science, technology and innovation. The advantages these actions and investments offer to Canadian businesses have only begun to influence our country's private sector business strategies.

Taking Stock on Innovation

Canada's performance, confirmed in the outcomes of federal investments and achievements, reinforces that there is much on which to build:

- One of the best countries for business to grow and create jobs (Forbes);
- The soundest banking system in the world (World Economic Forum);
- Solid economic fundamentals through improved framework policies that foster business investment and growth – Canada now has the lowest overall tax rate on new business investment among G7 nations;
- Among the most generous government support to business R&D, including both direct and indirect support;
- Global research and development strengths in industrial sectors including aerospace, information and communications technologies, oil and gas extraction, and pharmaceuticals (CCA State of Industrial R&D 2013);
- Second place (up from 6th place) in the 2014 Bloomberg Rankings as one of the top locations to do business (Jan. 2014), ahead of the US, Germany, Japan and the UK, and just behind Hong Kong; and
- Relatively high impact of Canadian industry patents, cited about 20 percent more than the world average (CCA State of Industrial R&D 2013).

7.1 Record of Support for Innovation

To mobilize knowledge from the lab to the marketplace, to address business challenges and to seize new societal opportunities, our Government has built bridges between businesses of all sizes, universities, colleges, polytechnics and federal researchers.

For example, we created the Business-Led Networks of Centres of Excellence which support large-scale business-led national research networks. Our Government also launched the Centres of Excellence for Commercialization and Research to support centres of excellence in priority areas. By October 2013, 21 Centres and four Business-Led Networks of Centres of Excellence had been established. In fiscal year 2011-2012, alone, the Centres of Excellence for Commercialization

and Research helped create 2,483 new jobs and 39 new companies.

We have also enhanced partnerships between industry and the applied research capacity of Canada's colleges and polytechnics through initiatives such as:

- The College and Community Innovation Program Innovation Enhancement Grants which have helped more than 500 companies partner with Canadian colleges since 2008;
- An investment of $25 million by the Canada Foundation for Innovation to enhance colleges' research capacity through state-of-the art, industry-relevant research infrastructure;
- Funding 22 College Industrial Research Chairs at $1 million each in disciplines where there is an important industrial need;
- Improving productivity and innovation of small and medium-sized enterprises by investing $24 million to establish 21 Technology Access Centres at Colleges, supporting applied research and business access to college expertise, technology and equipment; and
- Expanding the programs offered through the Natural Sciences and Engineering Research Council to provide targeted partnerships that help companies advance R&D, find highly-qualified people and build relationships with researchers in universities, colleges and polytechnics.

"The College and Community Innovation Program which sponsors college and polytechnic applied research is a good example of programs that foster industry-academic partnerships. The College-University Idea to Innovation Program is another exemplar that links university scientists with college and polytechnic applied research capacity. This supports a made-in-Canada approach to getting ideas out to markets, while fostering greater skills transference between graduate and undergraduate students at universities, polytechnics and colleges."

- Robert Luke, PhD, Vice President, Research and Innovation, George Brown College (excerpt from George Brown's submission to the Science, Technology and Innovation Consultation, February 2014)

McMaster Automotive Resource Centre

Federal investments are supporting cutting-edge work at the McMaster Automotive Resource Centre, located at the university's McMaster Innovation Park. In 2011, the Federal Economic Development Agency for Southern Ontario committed up to $11.5 million to help transform a former appliance warehouse into a state-of-the-art research centre that brings together academic, government and industrial partners to develop sustainable solutions for the automotive industry. In addition, the Canada Foundation for Innovation awarded up to $800,000 for cutting-edge research equipment to further automotive research efforts at the centre. These funds complement the relocation of Natural Resources Canada's CANMET Materials Technology Laboratory from Ottawa to McMaster Innovation Park.

Dr. Ali Emadi, Canada Excellence Research Chair in Hybrid Powertrain, is using the Centre to build the next generation of cost-effective, energy-efficient cars. The awarding of Dr. Emadi's Chair is one of nine projects at McMaster supported through the Natural Sciences and Engineering Research Council. Federal funding of $39.0 million leveraged another $32.4 million from partners including General Motors, Chrysler, Ford, Toyota and IBM. These investments are drawing national and international attention from the auto sector as a place to drive new knowledge and technologies that can create jobs in Canada.

Review of Federal Support for Business R&D

In response to the Jenkins Panel findings and advice highlighted in Chapter 2.1, our Government implemented policy changes to provide a more comprehensive and coordinated suite of business innovation support programs focused on industry needs. We also removed obstacles and barriers to innovation, and addressed gaps in the current program and policy mix.

We shifted the balance towards more direct support by:

- Simplifying the Scientific Research and Experimental Development Tax Credit and improving its predictability.
- Doubling the National Research Council's Industrial Research Assistance Program to support more small and medium-sized enterprises that create high-value jobs.
- Transforming the National Research Council to emphasize business-driven innovation that supports Canadian firms more effectively. Inspired by the Fraunhofer system of institutes in Germany and the UK Catapult networks, the refocused National Research Council is providing businesses with world-class infrastructure, technical expertise and the people they need to develop their innovative ideas.
- Creating a Concierge service that helps small and medium-sized enterprises to navigate federal programs and financial supports available. The service includes a web portal offering information and assistance in accessing programs.

We also strengthened Canada's venture capital environment and positioned the government as a 'first-time buyer' to help Canadian suppliers get their ideas to market:

- The $400 million Venture Capital Action Plan increases private sector investments in early-stage risk capital, and supports the creation of large-scale venture capital funds led by the private sector.
- The Canada Accelerator and Incubator Program helps to develop promising entrepreneurs and start-up firms.
- The Business Development Bank of Canada partners with business accelerators and will make $100 million available to co-invest in start-ups that graduate into new businesses. To date, $4.5 million has been invested in 29 companies and $8 million in two accelerators, which is on track to achieve the $20 million target for fiscal 2014.
- The Build in Canada Innovation Program supports the testing of innovative goods and services and their procurement by federal departments and agencies. By March 2013, 61 innovators had signed contracts to test their products and services valued at more than $22 million.
- The National Procurement Strategy for R&D has shifted the approach to allow government to be a first client for new, innovative services and products that address a need or provide a necessary service or technology.

Sector-Specific Challenges

Our Government is also addressing challenges specific to certain industries in different parts of the country by supporting innovative ideas and investments. These include:

Aerospace and Space

- Investments of $1.15 billion in the Strategic Aerospace and Defence Initiative, which are expected to leverage an additional $2.1 billion in investment from Canadian aerospace and defence firms to develop new technologies.
- Investments in space exploration technologies and advanced robotics that are positioning Canada as a key player in existing and future international space exploration missions.

"The government has acted on some of the key elements of the Canadian Chamber of Commerce's Top 10 initiative for restoring Canada's competitiveness. The result will be a stronger economy and more jobs. [Economic Action Plan 2014] presents the continuity of a plan for economic growth that builds on Canada's economic and fiscal advantages. The measures announced by the government will help Canadian businesses prosper and compete."

- Perrin Beatty, President and CEO, Canadian Chamber of Commerce (quote from Canadian Chamber of Commerce news release, February 11, 2014)

Manufacturing and Automotive

- The Automotive Innovation Fund, which strengthens Canada's world-class automotive industry in Canada.
- An investment of $200 million to launch the Advanced Manufacturing Fund to support large scale manufacturing activities in Ontario.

Renewable Resources

- Investments in the forestry, agricultural and energy sectors that help firms find innovative and sustainable ways to do business.
- Successive investments to support and transform the forest industry and facilitate projects that use new technologies to create non-traditional high-value forest products and renewable energy. These include the four-year $100 million Forest Industry Transformation initiative announced in Economic Action Plan 2010 and another $92 million over two years announced in Economic Action Plan 2013.
- Investment of $3 billion over five years under the Growing Forward 2 agreement with the provincial and territorial governments to support innovation, competitiveness and market development in the agricultural sector.
- Natural Resources Canada's six year, $795 million Clean Energy Fund to support clean energy research, development and demonstration projects, including carbon capture and storage.

"The success of Canadian agriculture in supplying us with safe, nutritious, abundant and inexpensive food for the past 125 years has been largely due to the investment the federal and provincial governments have made in agricultural research."

- Lianne Dwyer, Vice President, Agricultural Institute of Canada (appearance before Standing Senate Committee on Agriculture and Forestry, March 6, 2012)

Health

- The delivery of medical isotopes through alternative technologies which ensures Canada has a stable, secure supply of medical isotopes and Canadians have access to the health care they need. Initiatives include:
    - The Isotopes Technology Acceleration Program, announced in Economic Action Plan 2012 of $25 million over four years, to advance the development of alternative technologies (cyclotrons and linear accelerators) to nuclear reactors for isotope production;
    - A McMaster University project received $11 million in funding through the Knowledge Infrastructure Program to renovate and upgrade the McMaster nuclear reactor and adjacent nuclear research building to accommodate new laboratories and research space as well as an increased commercial production of medical and industrial isotopes; and

- Economic Action Plan 2011 supported the construction of a cyclotron for the production of medical isotopes at the Thunder Bay Regional Research Institute with a $4 million investment.

- The co-sponsorship of Applied Public Health Chairs by the Public Health Agency of Canada and the Canadian Institutes of Health Research which stimulates innovative approaches to public health issues while developing future population and public health researchers. This program initially funded 15 Applied Public Health Chairs for a total investment of $15 million over 5 years.

- The Canadian Institutes of Health Research's new Strategy for Patient-Oriented Research which brings innovative diagnostic and therapeutic approaches to the point of care, providing greater quality, accountability, and accessibility of care. The Strategy proponents are a coalition of federal, provincial and territorial partners – all dedicated to the integration of research into care.

International Partnerships

Canadians are recognized as global research leaders and effective collaborators that produce significantly more research at a world-class level than other countries per capita. Being connected to the world's many research intensive countries is critical for Canada to be a leader in science, technology and innovation. To achieve this, our Government has:

- Solidified Canada's partnerships with global science and technology leaders by maintaining 12 international science and technology agreements, including funded agreements with India, China, Brazil and Israel, and negotiating new arrangements with Korea, Chile, Sweden, and the United Kingdom. These partnerships facilitate the mobility of top people and enhance the commercialization of technology;

- Renewed the International Science and Technology Partnerships Program, in 2010, which supports industrial R&D partnerships with India, China, Brazil and Israel;

- Initiated a series of Memoranda of Understanding, technical collaborative research agreements and cooperative activities by the National Research Council with several key public research partners in countries, such as Japan;

- Maintained a leading role in the EUREKA networks, the largest network of its kind enabling collaborative R&D amongst businesses, research centres and universities in 40 countries. The new science and technology arrangements further enhance Canadian access to technologies, markets and foreign direct investments;

- Launched new international activities such as the Canada-India Research Centre of Excellence, which is supported through the Networks of Centres of Excellence program; and

- Facilitated student and researchers exchanges and training, coordinated funding for international research teams, and contributed to multilateral research initiatives through the granting councils.

Investment and Competition

Through concerted efforts, our Government provides a solid and predictable environment for businesses to invest and grow. To accomplish this, we have maintained a strong financial sector, lowered taxes, eliminated tariffs on machinery and equipment, reduced red tape and eased unnecessary regulatory burdens on Canadian businesses.

We have also modernized Canada's intellectual property regime to align it with international best practices and to reduce the administrative burden on innovators. This includes passing the *Copyright Modernization Act*, which introduced more effective intellectual property rights enforcement measures with the *Combating Counterfeit Products Act*. We are also in the process of ratifying several key international intellectual property treaties.

To encourage more competition among Canadian firms and open Canada's markets and give consumers more choice, our Government has also amended the *Telecommunications Act* in order to lower prices in Canada's wireless sector and provide greater consumer choice. The changes include the introduction of monetary penalties for companies that violate rules on tower sharing, deployment of spectrum and service to rural areas and the prevention of concentration of wireless spectrum.

Additionally, to expand trade opportunities with the world's most dynamic and growing markets, we have been negotiating trade and investment agreements. We reached an historic milestone in October 2013, when we achieved an agreement-in-principle on a Comprehensive Economic and Trade Agreement with the European Union, the largest market in the world. We have also negotiated Canada's first ever free trade agreement with an Asian market through the

Canada-Korea Free Trade Agreement. This historic agreement will especially benefit the information and communications technologies, aerospace, agricultural and agri-food and other sectors and will significantly boost trade and investment ties between the two countries, creating jobs and opportunities for Canadians in every region.

7.2 Moving Innovation Forward: Next Steps

Drawing on the skills and knowledge of Canadians as well as our strong research capacity, Canada will be a place where businesses embrace innovation and successfully compete on the world's stage. Businesses will adopt the latest technological advancements and foster partnerships within the science and technology community to bring ideas from the lab to the global marketplace.

Building on the development of highly-skilled Canadians and world-class research, we are placing innovation front and centre – in fostering business innovation, in building synergies with Canada's research capacities and in using its talented and innovative workforce. This represents a change in our approach to supporting business innovation to one that focuses on business-led initiatives and targets federal resources more effectively to stimulate the growth of innovative firms. To compete, Canadian firms will increasingly need to rely on innovation to set them apart.

We are on the right path to unlocking Canada's potential to become a global leader in innovation. Our Government's actions here will continue to be guided by the advice of the Jenkins Panel.

Our Government will put innovation front and centre to stimulate greater business innovation by:

- Becoming a Digital Nation;
- Mobilizing Knowledge;
- Growing Innovative Firms; and
- Improving Access to Global Markets.

7.2.1 Becoming a Digital Nation

Today, we are living in a transformational digital age where there are few jobs, few sectors, few aspects of our lives that remain untouched by information and communications technologies. Our Government has an essential role to play by establishing, through effective public policies, the right conditions to encourage and help Canadians take full advantage of the transformational possibilities that the digital future holds.

Our Government will help connect all Canadians to the opportunities afforded by a digital world.

We will:

- Foster a digital economy through Digital Canada 150 which promotes a growing and innovative ICT sector in Canada, providing Canadians with the right skills, and businesses with the right incentives, to embrace opportunities in an increasingly connected world;
- Work to strengthen partnerships with the private sector to help ensure that their systems and the information they contain, including valuable intellectual property, are secure as outlined in Canada's Cyber Security Strategy.

Becoming a Digital Nation

Digital Canada 150 envisions a country by 2017 that will be at the forward edge of the digital age.

- We will connect Canada so that all Canadian families benefit from cutting-edge technologies;
- We will protect Canadians from online threats and misuse of digital technology;
- We will support creators and protect their rights, while expanding access to uniquely Canadian content;
- We will encourage an innovative information and communications technologies sector and increase the adoption of digital technologies by other sectors, while ensuring that all sectors will have workers skilled in their use; and
- We will lead by example and adopt new technologies to serve Canadians more effectively by providing easier and improved access to federal information and services.

7.2.2 Mobilizing Knowledge

Our Government will encourage closer connections between the public and private sectors. This will empower firms to leverage their investments in R&D by seeking solutions with universities, colleges, polytechnics and government laboratories.

This will be achieved by initiatives that include:

- Promoting the Business Innovation Access Program, a pilot credit notes program launched in March 2014, which allows small and medium-sized enterprises to pay for research, technology and business development services at universities, colleges and other non-profit research institutions of their choice. This helps hundreds of businesses to commercialize their products or services more quickly and effectively. We will consider making the program permanent and expanding it, if it proves successful.
- Building on the National Research Council-Industrial Research Assistance Program Concierge Service to make it easier for companies and academic researchers engaged in industry-focused research to navigate and access federal business-facing programs, resources and networks. In addition to linking small and medium-sized enterprises with experts in federal departments, academic institutions and other research and commercialization organizations, the range of concierge services will be expanded to offer a new focus on intellectual property and technology transfer.

"If we are serious in our objective of improving Canada's innovation performance, we need to break down barriers and make the development of collaborative innovation ecosystems a key component of Canada's S&T strategy going forward."

- Scott Smith, Director, Intellectual Property and Innovation Policy, Canadian Chamber of Commerce (excerpt from Canadian Chamber of Commerce submission to the Science, Technology and Innovation Consultation, January 27, 2014)

- Investing in research priorities and focus areas – including the newly-created advanced manufacturing research priority. This will help build a critical mass of expertise in research and commercialization through targeted competitions in the granting councils, as well as the programs of the transformed National Research Council.
- Launching a $10 million, two-year pilot initiative to support social innovation research projects at colleges and polytechnics to address the research needs of local community organizations in areas such as education, integration of vulnerable populations and community development.
- Enhancing public and private linkages with global innovation networks through initiatives such as:
    - Canada's recent membership in EUREKA – an international network of over 40 countries that brings together small and medium-sized enterprises, large companies, research centres, universities and other innovators to work together on market-driven industrial R&D;
    - The Centres of Excellence for Commercialization and Research and the Networks of Centres of Excellence programs, which support networking and international partnerships by its funded centres and networks.
- Evaluating the outcomes of the Technology Demonstration Program and consider the potential of using a similar program design in other key industrial sectors.
- Refining and enhancing federal programs and policies that support the mobilization of academic research. We will build on successful programs and policies to increase linkages among leading-edge research institutions and business to improve knowledge transfer and commercialization outcomes. We will also track the success of academic-private interactions and monitor their contribution to a vibrant economy.
- Encouraging partnerships between federal laboratories and businesses to help firms realize their innovation ambitions by increasing industry-driven partnerships and opening access to our world-class research infrastructure, expertise and people. We will also review the incentives, authorities and responsibilities to maximize the mobilization and commercialization of ideas generated in federal laboratories.

The Fine Art of Computer Science

University of Calgary computer scientist, Sheelagh Carpendale draws on her background in fine arts, design and computer science to study how people interact with information to design easier ways to visually represent complex data. Dr. Carpendale and her team are creating interactive tabletop applications that function through natural human actions, such as touch, and take people through complicated subjects in a logical and intuitive way.

Her partnership with Calgary-based SMART Technologies, supported through the Natural Sciences and Engineering Research Council's suite of partnership programs, has influenced the design of their interactive whiteboards and prompted SMART Technologies to include interactive tabletops as part of their multi-touch displays now being used in classrooms and offices around the world. The collaboration continues, with patent applications for three-dimensional, tabletop interaction techniques invented by Dr. Carpendale. SAP and Microsoft Research, among others are taking note of her work.

Transforming the National Research Council

Most industrialized nations have Research and Technology Organizations that drive technology commercialization and increase business expenditures on R&D resulting in high quality jobs and increased productivity.

The National Research Council is organized into portfolios aligned with Canadian priorities and its research is refocused into programs that address real problems and challenges identified by Canadian industry. Research is responsive to industry demand and lowers technology development risk to solve short-term technological challenges. Preliminary estimates show industry will invest over $650 million between 2014-15 and 2018-19 to partner with the NRC.

One of the Council's first programs is directed at personalized medicines to treat illness or disease based on a person's own body. The Biologics Program will develop new treatments for cancer and other diseases. The recent announcement of a three-year multi-million dollar agreement with the Council and Zymeworks Inc. to develop ground-breaking therapies for the fight against cancer, as well as inflammatory and autoimmune diseases will help position the company as a strong global competitor in biotherapeutics development. This creates jobs in Canada and contributes to better health outcomes for Canadians.

Meeting the immediate needs of industry also means looking longer-term at emerging technologies that underpin the future of Canadian industry. The Council's new model ensures strategic investments supported by foresight are made in R&D areas that enable its researchers to remain ahead of the curve and maintain a forward looking perspective on technologies and capabilities critical to Canada's future prosperity.

7.2.3 Growing Innovative Firms

Our Government is committed to establishing a widespread business innovation culture among our firms.

We want to see business of all sizes define and implement for themselves the science, technology and innovation they require to compete nationally and internationally. To support these efforts, **we will strengthen support for business innovation so more Canadian firms embrace innovation-based strategies**. This will be achieved by initiatives that include:

- An additional $40 million over four years to increase the reach of the Canada Accelerator and Incubator Program as part of the Venture Capital Action Plan. This will bring the program's total funding to $100 million. The extra funds will help more entrepreneurs to create new companies and realize the potential of their ideas through intensive mentoring and other resources to develop their business;
- Long-term support for the Canadian automotive sector through an additional $500 million over two years for strategic research and development projects under the Automotive Innovation Fund;
- Another $90 million, over four years to the Forest Industry Transformation program to help Canadian forestry companies demonstrate the viability of innovative technologies that improve efficiency, reduce environmental impacts and create high value-added products;

"The Government of Canada recognizes that to remain competitive in the global economy, entrepreneurial talent and investment in Canada must grow, and this can only happen if entrepreneurs have access to the tools they need to create jobs and grow their business."

- Adam Chowaniec, Chairman, Startup Canada (quote from Startup Canada news release, February 12, 2014)

Canada's Venture Capital Action Plan

Recognizing the importance of the venture capital industry to Canada's future productivity growth, Economic Action Plan 2012 announced resources to support Canada's venture capital industry, including $400 million to help increase private sector investments in early-stage risk capital, and to support the creation of large-scale venture capital funds led by the private sector. Announced in January 2013, the Venture Capital Action Plan includes:

- $250 million to establish new, large private sector-led national funds of funds (a funds of funds portfolio consists of investments in several venture capital funds) in partnership with institutional and corporate strategic investors, as well as interested provinces.
- Up to $100 million to recapitalize existing large private sector-led funds of funds, in partnership with willing provinces.
- An aggregate investment of up to $50 million in three to five existing high-performing venture capital funds in Canada.
- Additional resources to continue developing a robust venture capital system and a strong entrepreneurial culture in Canada.

Accelerating the Growth of Small and Medium-Sized Enterprises

The National Research Council-Industrial Research Assistance Program helps Canadian small and medium-sized enterprises grow by:

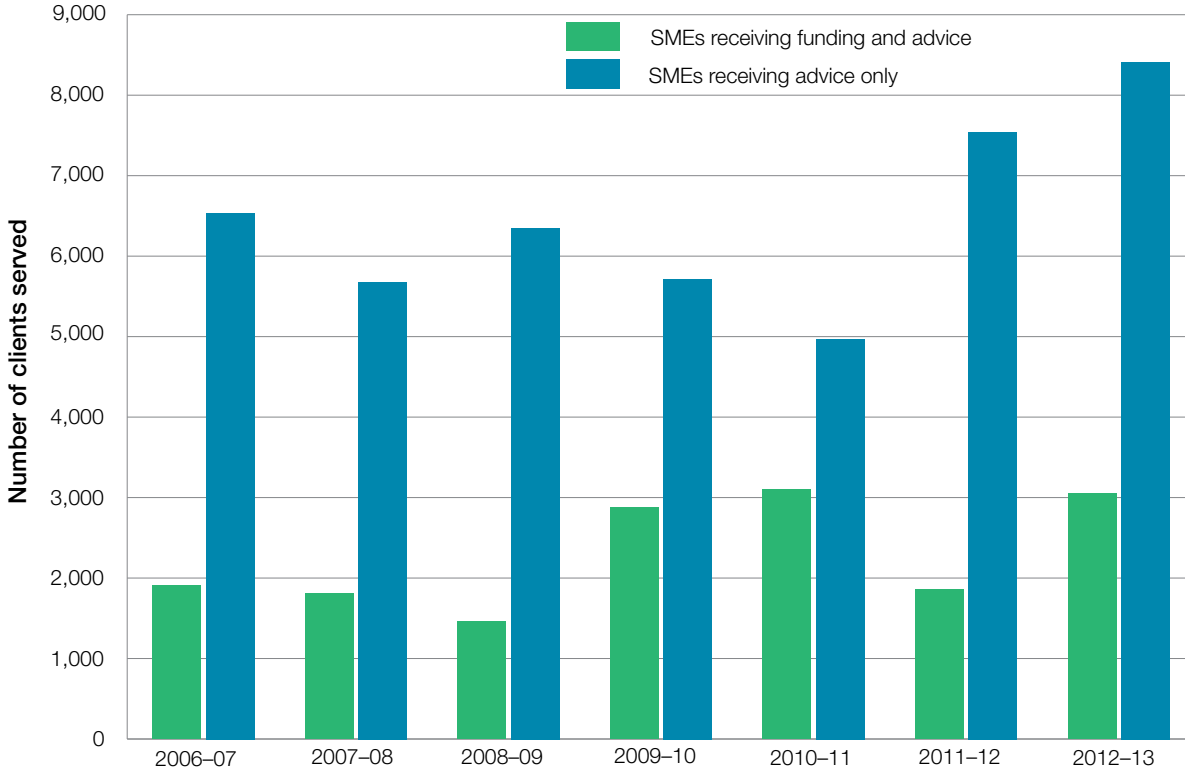
- providing direct financing support for business R&D;
- offering advice through a national network of Industrial Technology Advisors; and
- tapping into national and international innovation networks.

The Program also supports job creation in Canadian small and medium-sized enterprises through the Youth Employment Program by assisting with the employment of post-secondary graduates. In 2014-15, it is estimated that the Program will provide $179 million to 2,200 small and medium-sized enterprises to support 9,000 sustainable jobs.

The Industrial Research Assistance Program is also delivering three new programs:

- a Concierge Service;
- Canada Accelerator and Incubator Program; and
- Business Innovation Access Program.

Support for Small and Medium-Sized Firms from the National Research Council 2006 to 2013



Source: National Research Council, 2014.

- Regionally-based innovation programs through the federal regional development agencies that address business needs and support regional diversity and economic growth. These investments make businesses more competitive, help them diversify their markets and customer base and create high-quality jobs. Examples include:
    - Refocusing Atlantic Canada Opportunities Agency innovation programs to support the commercialization of ideas, technologies, products and services;
    - Delivering support to entrepreneurs and small and medium-sized enterprises in Quebec through Canada Economic Development for Quebec Regions to strengthen their innovative capacity and commercialization efforts;
    - Delivering support through FedNor to encourage businesses in Northern Ontario to adopt, adapt and commercialize new technologies, to foster technology linkages between business and institutions, to advance technological R&D and to promote community innovation initiatives;
    - Delivering FedDev Ontario's Southern Ontario Prosperity Initiatives and the Advanced Manufacturing Fund to help businesses transform ideas into products and increase their productivity;
    - Launching Western Economic Diversification's Innovation Initiative for small and medium-sized enterprises to move new and innovative technologies from the later stages of R&D to the marketplace; and
    - Fostering growth and development in the North through the Canadian Northern Economic Development Agency support for diversified, sustainable and dynamic local businesses and economies.

Seizing the Sea's Potential in Atlantic Canada

A growing recognition of the health benefits of fish oils and good old fashioned research has turned a once tiny business into the world's leading supplier of marine-based dietary supplements and bulk nutraceutical ingredients. Researchers at Ocean Nutrition Canada Limited (ONC), of Dartmouth, Nova Scotia discovered a breakthrough technology that transformed fish oil into a fine powder. Starting out with just four employees, ONC now has more than 400 worldwide and was acquired by Royal DSM, a global life and materials sciences company in July 2012. Atlantic Canada Opportunities Agency funding has helped ONC to purchase new equipment, develop new technology, expand facilities and undertake marketing activities.

We will also maximize the impact of federal business innovation programming by scaling up successful approaches, consolidating programs with similar objectives and reducing duplication so that it is easier for business to access federal programs.

Our Government will work to encourage businesses – especially Canada's small and medium-sized enterprises – to protect their intellectual property. More than just helping firms to develop new ideas and innovate, support programs should assist businesses in protecting intellectual property as it is produced. For example:

- The National Research Council and the Business Development Bank of Canada will each undertake pilot projects that encourage their clients to develop intellectual property strategies.
- The Business-led Networks of Centres of Excellence and the Centres of Excellence for Commercialization and Research support outreach to researchers and businesses to raise awareness of intellectual property, including through peer-to-peer networks.
- The Canadian Intellectual Property Office will address the main barriers to intellectual property so firms can maximize the value of their innovations.

Additionally, **we will continue to roll out the new Space Policy Framework**, partnering with industry and the Canadian space research community to leverage existing resources and encourage further technology development opportunities. Funding will be targeted to areas of Canadian strength such as robotics, optics, satellite communications and space-based radar.

Our Government will continue efforts to reduce administrative burden through our Red Tape Reduction Plan. The Plan combines system-wide reforms and targeted action to tackle issues that frustrate businesses, stifle innovation and restrict investment. This commitment includes completing the Administrative Burden Baseline Initiative to count the number of federal regulatory requirements on business. We are also following through on our commitment to legislate the One-for-One Rule – Canada has become the first country to introduce legislation for such a rule.

Under the Defense Procurement Strategy, **we are applying the Industrial and Technological Benefits Policy, including a weighted and rated Value Proposition**. This policy will ensure that purchases of defense equipment and services results in economic growth, innovation and success in export markets. This gives our Government more flexibility to improve economic outcomes from defence procurement projects, leading to high value-added business activity for Canadian industry.

Monitoring and Managing Flood and Drought Conditions

Together, government and industry have produced a space-based radar tool for monitoring and managing emerging flood and drought conditions on agricultural lands. With funding from the Canadian Space Agency, Array Systems Computing Inc. packages models produced by an Agriculture and Agri-Food Canada science team into a software toolkit that provides near real-time production of high resolution RADARSAT-2 soil moisture maps.

These data allow the department to focus in on regions of concern and provide information about emerging drought or excess moisture situations to enable proactive management decisions by farmers. The same technology could be used to estimate and verify the extent and severity of impact after adverse weather events.

Bridging the Commercialization Gap through "Made in Canada" Innovations

A procurement program, Build in Canada Innovation Program was created as a pilot in 2010 to boost innovation in Canadian firms, and to help companies bridge the pre-commercialization gap for their innovative products and services. Building on the early pilot program success, Economic Action Plan 2012 allocated additional funding for three years and, as of 2016, $40 million will be dedicated to it annually. The program provides the opportunity for innovators to: sell their pre-commercialized goods and services to the Government of Canada; connect with potential clients in federal government departments; get feedback on the use of their innovations in an operational setting; and enter the marketplace with a successful application of their innovations. The Program targets innovations in the environment; safety and security; health; enabling technologies; and the military.

Nova Scotia's Ocean Sonics and Instrument Concepts was awarded a $297,000 contract for its icListen device, used to detect and notify border security staff of boating activity and transmit data to off-site locations. The company also developed a special buoy that keeps the device upright at the bottom of the ocean and a radio system at the surface that transmits the collected data. Such information is useful for plotting shipping lanes or recording the sounds of animals rarely heard or seen by humans. The boat traffic monitoring aspect is new for the company and it expects more business diversity to come both through government and the private sector.

7.2.4 Improving Access to Global Markets

With the march toward global trade liberalization continuing unabated, and one in five Canadian jobs tied to exports, there is no doubt that Canada's long-term prosperity is dependent upon the success of our firms on the international stage.

Our Government will continue to promote Canada's innovation advantage in key international markets through the Global Markets Action Plan.

The Plan recognizes the importance of economic diplomacy as a driving force behind our international activities by providing Canadian businesses with the opportunities, services and tools to maximize their competitive advantage abroad, and mobilize Canada's network of Trade Commissioners, Canada Technology Accelerators, and international science and technology agreements with priority markets, such as China, Israel, India and Brazil.

8.0 MOVING FORWARD

Canadians can take pride in our country's international reputation for research excellence. We have built a globally envied reputation for sound economic management and solid fiscal fundamentals. In recent years, we have invested strategically and prudently in priority areas that are delivering results for Canadians. Our workforce is among the most-skilled and best-educated in the world. The time is right to build on these strengths: we want to see Canada's science, technology and innovation grow from world-class to world-leading.

Taken together, the actions outlined in this strategy will help create the conditions for Canada to flourish in today's knowledge-based world. To support Canada's long-term competitiveness and prosperity, we must maximize Canada's ST&I strengths and foster more demand for innovation from businesses of all sizes and across all sectors of the economy. Canadian firms must invest in R&D to develop innovative ideas, access new markets and bring solutions to challenges in our daily lives.

Our Government will continue to enhance Canada's competitive advantage through strengthened investments in science, technology and innovation that deepen our world-class knowledge base, produce highly-qualified and skilled people, and drive Canadian leadership in global research excellence. We will work to maximize the return on tax dollars and find ways to open access to publically-funded research results and data.

Our Government will also move forward with a more targeted approach to promoting business innovation through business-led initiatives that better respond to private sector realities. This approach also requires that we sustain and strengthen Canada's people and knowledge assets – essential building blocks of an innovative economy. Supported by this solid foundation, Canadian businesses will be positioned to innovate, create high-paying jobs, access new markets and generate prosperity for all Canadians.

Strength in Partnerships

All players in the ST&I system have a shared interest in Canada's success. Each must do what it does best so that, together, we can leverage one another's assets for the benefit of all Canadians.

For our universities, colleges and polytechnics, this means continuing to push the frontiers of knowledge. They must mobilize knowledge to solve Canadian industry and societal problems, while continuing to contribute to the development of our highly-qualified and skilled people.

For our private sector, it means an increased willingness to innovate and take risks. It means the confidence to capitalize on our knowledge base and workforce to develop more creative ways of doing business. Getting this right will result in innovative technologies, products and services that add value, enhance productivity and create high-paying jobs.

For provincial and territorial governments, it means fostering the economic and social strengths that are grounded in their respective regional realities.

For federal government science, it means delivering on regulatory mandates and supporting the safety and well-being of all Canadians. It also means looking for opportunities to support commercialization of the results of federal research.

By bringing people together from the academic, corporate and public sectors, and building on one another's advantages, we can find creative solutions to some of our biggest challenges – from overcoming regional and sectoral issues, to improving health care delivery, to developing Canada's natural resource wealth responsibly. Most promisingly, we can launch a new generation of innovations that improve Canadians' standard of living and quality of life.

As Canada's 150th anniversary approaches, we must harness the power of the many advantages Canada enjoys thanks to a strong, stable and vibrant science, technology and innovation ecosystem. Together, we will seize this moment and build a brighter future for all Canadians.

APPENDIX: GLOSSARY OF TERMS

Advanced Manufacturing is the incorporation of technology (specifically: computer-controlled or micro-electronics-based equipment) into the design, manufacturing or handling of a product. Typical applications include computer-aided design, computer-aided engineering, flexible machining centres, robots, automated guided vehicles and automated storage and retrieval systems.

Applied research is an original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective. The results of applied research are intended primarily to be valid for a single or limited number of products, operations, methods, or systems. Applied research gives operational form to ideas. The knowledge or information derived from it is often patented but may be kept secret.

Biotechnology, according to the Organisation for Economic Co-operation and Development definition, is the application of science and technology to living organisms, as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services.

CANARIE (Canada's Advanced Research and Innovation network) designs and delivers digital infrastructure, and drives its adoption for Canada's research, education and innovation communities. CANARIE's roots are in advanced networking, which continues to evolve the national ultra-high-speed backbone network that enables data-intensive, leading-edge research and big science across Canada and around the world. One million researchers, scientists and students at over 1,100 Canadian institutions, including universities, colleges, research institutes, hospitals, and government laboratories have access to the CANARIE Network. Established in 1993, CANARIE is a non-profit corporation, with the major investment in its programs and activities provided by the Government of Canada.

The **Council of Canadian Academies** is an independent, not-for-profit organization that supports independent, authoritative, and evidence-based expert assessments that inform public policy development in Canada. The Council's work encompasses a broad definition of science, incorporating the natural, social and health sciences as well as engineering and the humanities. The Council's operations are supported by the Government of Canada. This allows the federal government to refer up to five questions per year to the Council for assessment. The Council may also conduct assessments outside of its agreement with the government.

Digital Canada 150 is Canada's ambitious path forward to take full advantage of the opportunities of the digital age. Digital Canada 150 encompasses 39 new initiatives that build on our Government's successful measures for a more connected Canada. It includes five key principles:

- Connecting Canadians – an effective digital policy is one that connects Canadians through high-speed internet access and the latest wireless technologies
- Protecting Canadians – Canadians will be protected from online threats and misuse of digital technology
- Economic Opportunities – Canadians will have the skills and opportunities necessary to succeed in an interconnected global economy
- Digital Government – the Government of Canada will demonstrate leadership in the use of digital technologies and open data
- Canadian Content – providing easy online access to Canadian content will allow us to celebrate our history, arts and culture and share it with the world

Discovery-driven research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view. Discovery-driven research analyzes properties, structures, and relationships with a view to formulating and testing hypotheses, theories or laws. The results of discovery-driven research have no direct or immediate commercial benefits, but are usually published in scientific journals or circulated to interested parties.

Discovery-driven research can be split into two categories:

- pure discovery-driven research is carried out for the advancement of knowledge, without seeking long-term economic or social benefits or making any effort to apply the results to practical problems or to transfer the results to sectors responsible for their application;
- oriented discovery-driven research is carried out with the expectation that it will produce a broad base of knowledge likely to form the basis of the solution to recognized or expected, current or future problems or possibilities.

Disruptive technologies (also known as disruptive innovations) produce radical or abrupt changes that challenge existing business models and transform larger social, economic, environmental or governance systems. These technologies can be stand-alone, combinations of existing technologies, multi-faceted technologies with disruptive applications or genuine disruptive technologies with no historical context. They can come in any field or emerge from any scientific discipline, but they typically share four characteristics:

- They are existing technologies that are rapidly advancing or undergoing drastic breakthroughs technologically. Disruptive technologies typically demonstrate a rapid rate of change in capabilities in terms of price/performance relative to substitutes, or they constitute drastic breakthroughs that drive accelerated rates of change. Example: personal computers replacing minicomputers; digital photography replacing chemical photography.
- Their potential scope of economic impact is horizontal and global; across sectors, industries and geographic borders. Examples: the rise of the internet; desktop publishing replacing traditional publishing.
    - They have the potential to generate massive and unexpected economic impacts (both positive and negative). The value at stake is large in terms of profit pools that might be disrupted, additions to GDP that might result, and capital investments that might be rendered obsolete (e.g., steamships replacing sailing ships; automobiles replacing rail transport).
    - They have the potential to dramatically and unexpectedly change the status quo in other, non-economic ways. Disruptive technologies can transform how people live, disrupt the nature of work, and force governments to create an environment in which citizens can continue to prosper, even as their lives are being disrupted by the technologies. Examples: refrigerators replacing ice houses; cell phones replacing landline phones.

Innovation is the use of new ideas, products or methods where they have not been used before, and can be defined as a new or significantly improved product (good or service) introduced to the market, or the introduction within an enterprise of a new or significantly improved process.

Innovations are based on the results of new technological developments, new technology combinations, or the use of other knowledge, acquired by the enterprise. The innovations may be developed by the innovating enterprise or by another enterprise. However, purely selling innovations wholly produced and developed by other enterprises is not included as an innovation activity, nor is introducing products with purely aesthetic changes.

The **Jenkins Panel** was created in 2010, when the Prime Minister appointed Tom Jenkins, then-Executive Chairman of OpenText Corporation, to lead an independent, external Review of Federal Support to Research and Development, and provide advice on how to improve Canada's support to business innovation. In October 2011, the Expert Panel (informally known as the "Jenkins Panel") submitted a report (*Innovation Canada: A Call to Action to the Government*) with findings and recommendations on how to improve support for innovative businesses and help them grow into larger, globally competitive companies.

The **Knowledge Infrastructure Program (KIP)** was a government funding program announced in 2009 that provided close to $2 billion for the repair, maintenance and construction of university and college facilities. By leveraging $3.2 billion from project partners, the program led to a $5.2-billion investment in infrastructure at post-secondary institutions. A total of 515 projects were completed under the Knowledge Infrastructure Program.

Mitacs is a not-for-profit research organization that builds linkages between academia and industry to promote high-quality research and innovation across Canada. Mitacs leverages federal funding with support from provincial governments, companies and universities to promote collaborative, academic-industrial R&D, and the development of future innovation leaders through long-term development of skilled human capital.

The National Research Council (NRC) is the Government of Canada's premier organization for research and development. It partners with Canadian industry to take research impacts from the lab to the marketplace, where people can experience the benefits. Its market-driven focus delivers innovation faster, enhances people's lives and addresses some of the world's most pressing problems.

The **Organisation for Economic Co-operation and Development (OECD)** groups 34 Member countries sharing a commitment to democratic government and the market economy. With active relationships with some 70 other countries, non-government organisations and civil society, it has a global reach. Best known for its publications and its statistics, its work covers economic and social issues from macroeconomics, to trade, education, development and science and innovation.

The OECD plays a prominent role in fostering good governance in the public service and in corporate activity. It helps governments to ensure the responsiveness of key economic areas with sectoral monitoring. By deciphering emerging issues and identifying policies that work, it helps policy-makers adopt strategic orientations. It is well known for its individual country surveys and reviews.

The **Private Sector Advisory Board (PSAB)** is a body of trusted, seasoned, strategic industry advisors comprised of respected Canadian industry leaders. PSAB was established by the Networks of Centres of Excellence by request of the Government of Canada in 2007. PSAB provides the NCE Steering Committee with expert advice and recommendations during the Centres of Excellence for Commercialization and Research (CECR) and Business-Led Networks of Centres of Excellence (BL-NCE) competition processes. PSAB evaluates proposals based on their ability to create a strategic, long-term economic advantage for Canada.

Research and Development (R&D), sometimes also called research and experimental development, refers to creative work undertaken on a systematic basis in order to increase the stock of knowledge (including knowledge of man, culture and society), and the use of this knowledge to devise new applications.

The **Science, Technology and Innovation Council (STIC)** is an independent advisory body mandated by the Government of Canada to provide confidential advice on science, technology and innovation (ST&I) policy issues. This advice helps inform government policy development and decision making. STIC is also mandated to produce biennial, public State of the Nation reports that benchmark Canada's ST&I performance against international standards of excellence. These reports provide a common evidence base for understanding Canada's ST&I system.

TRIUMF is Canada's national laboratory for particle and nuclear physics. It is a world-class subatomic physics research laboratory located on the campus of the University of British Columbia. TRIUMF is one of three subatomic research facilities in the world that specialize in producing extremely intense beams of particles. The heart of the facility is the world's biggest cyclotron, which is used to accelerate 1,000 trillion particles each second.