



CANADA'S NEW GOVERNMENT

MOBILIZING  
SCIENCE AND  
TECHNOLOGY  
*to Canada's Advantage*

2007

Canada 





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# MESSAGE FROM THE PRIME MINISTER



*Stephen Harper*  
*Prime Minister*

Canada's New Government understands how crucial science and technology is to building a strong economy that provides good jobs and higher living standards to families and workers.

We recognize that all Canadians—not just our scientific, technical, and business communities—have a stake in us getting it right.

That's why I believe that *Mobilizing Science and Technology to Canada's Advantage*—a bold, new framework to guide Canada's science and technology policy for the future—will help us meet the many and exciting challenges that lie ahead.

I invite you to join me in making Canada a world leader in science and technology and a key source of entrepreneurial innovation and creativity.

Stephen Harper  
Prime Minister







# MESSAGE FROM THE MINISTER OF INDUSTRY



Courette/Ottawa

Maxime Bernier  
Minister of Industry

The fundamental importance of science and technology to our economy and quality of life is recognized in *Advantage Canada*—our new economic plan. Launched in November 2006, *Advantage Canada* is designed to make Canada a world leader. Central to *Advantage Canada* is the need to increase our private-sector research and development investments, increase the practical applications of our

research in Canada, and create the best-educated, skilled, and most flexible workforce in the world.

Our new strategic plan for science and technology—*Mobilizing Science and Technology to Canada's Advantage*—builds upon *Advantage Canada*. It provides an overall guide for future government science and technology decision-making.

The most important role of the Government of Canada is to ensure a competitive marketplace and foster an investment climate that encourages the private sector to innovate.

We are building this economic climate through low and stable inflation rates and by reducing the government debt burden, reducing unnecessary regulation, attracting foreign investment, cutting red tape, enhancing internal trade and labour mobility, and creating a competitive tax environment. Other important instruments also encourage private-sector investment in R&D and advanced technologies.



Governments have a responsibility to create the right conditions and opportunities for businesses, universities, and other scientific organizations to be successful. That's exactly what our new science and technology strategy is designed to do.

Let's create a new culture of scientific and technological achievement in our country, and bring new ideas and innovations to the world.

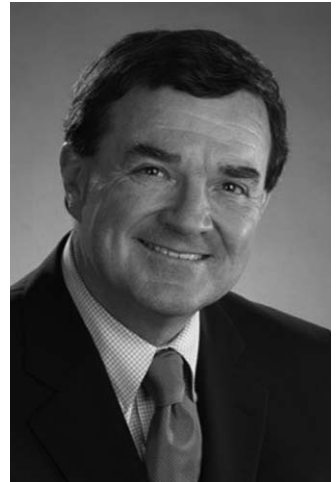
Maxime Bernier  
Minister of Industry



# MESSAGE FROM THE MINISTER OF FINANCE

Science and technology are essential to the everyday lives of Canadians. They are crucial to building a prosperous economy and promoting a better quality of life across the country. This was recognized in *Advantage Canada: Building a Strong Economy for Canadians*, our long-term economic plan to make this country a world leader today and for future generations.

Canada's New Government understands the far-reaching implications of science and technology discoveries and applications, and the endless possibilities they provide: greater educational and professional opportunities, greater prosperity for individuals and families, and healthier communities.



*The Honourable James M. Flaherty,  
Minister of Finance*

*Mobilizing Science and Technology to Canada's Advantage*, also known as the S&T Strategy, recognizes that the Government of Canada plays an important role in ensuring a competitive marketplace and creating an investment climate that encourages the private sector to compete against the world on the basis of its innovative products, services, and technologies.

The Government of Canada will do its part by creating a new climate of innovation and discovery in our nation.



This is a forward-looking Strategy that will result in lasting benefits for all Canadians. It will help provide individuals, families, and communities with a cleaner and safer environment, better medicines and health care, stronger research and educational opportunities, greater prosperity, and wider horizons for our children's dreams.

The Honourable James M. Flaherty  
Minister of Finance



# EXECUTIVE SUMMARY

Canada has a long and proud history of research excellence and scientific success. From the discovery of insulin, to the design of Research in Motion's BlackBerry, Canadian innovations are making important differences in people's lives and changing the world for the better.

Science and technology comes into almost every aspect of our lives, helping us to solve problems and create opportunities. Scientific discoveries and new technologies provide solutions to many of the issues most important to Canadians, giving us the knowledge and the means to preserve the quality of our environment, protect endangered species, improve our health, enhance public safety and security, and manage our natural and energy resources. Scientific and technological innovations enable modern economies to improve competitiveness and productivity, giving us the means to achieve an even higher standard of living and better quality of life.

In November 2006, Canada's federal government released *Advantage Canada*, an economic plan to make Canada a world leader for current and future generations. *Advantage Canada* is based on the premise that Canada already has tremendous strengths—including the drive and ingenuity of our people, the relative strength of our fiscal position, and our strong research base. It also recognizes that Canada can and must do more to turn our ideas into innovations that provide solutions to environmental, health, and other important social challenges, and to improve our economic competitiveness.

This science and technology (S&T) strategy—*Mobilizing Science and Technology to Canada's Advantage*—is the government's plan to achieve these goals. It sets out a comprehensive, multi-year science and technology agenda. The S&T initiatives announced in the Budget Plan 2007 demonstrate the government's commitment to take early action to implement this agenda.



## Building on Our Strengths

Canada stands out among countries with an enviable record of fiscal discipline, price stability, open product markets, and flexible labour markets. We have the eighth-largest economy and the seventh-highest standard of living in the world. And we stand on the best economic footing of any of the Group of Seven (G-7) economies, with the strongest job-creation record over the past decade and the lowest debt-to-gross-domestic-product (GDP) ratio.

We have built a strong research base. Canadian researchers are at the forefront of important scientific developments in many fields of inquiry, ranking first in the G-7 in the number of publications produced on a per-capita basis.

And we have built a skilled workforce. Canada has the highest proportion of post-secondary graduates in our workforce among G-7 countries, and our students show great potential. Canadian students perform exceptionally well, ranking near the top of the Organisation for Economic Co-operation and Development (OECD) in reading, science, and mathematics test results.

## Facing Our Challenges

Despite these achievements, we face very real economic and environmental challenges that require a new level of effort and success. Canada's productivity gap relative to our largest trading partner, the United States, is widening. For Canadians to continue to enjoy a high quality of life and standard of living, we must improve our productivity and competitiveness through innovation. At the same time, our economic activity must be sustainable over the long term. Clean air, land, and water are fundamental priorities.

These challenges require a new approach—a new strategy that builds on our strong economic fundamentals, takes advantage of the research capacity that we have built, and more effectively uses science and technology to develop practical applications to address our challenges.



## A New Approach

Our S&T Strategy for a more competitive and sustainable economy is built on the following convictions.

**Canada needs a strong private-sector commitment to S&T.** Firms large and small are bringing innovations into our lives, whether in the form of new technologies to address environmental problems, new products to make our homes, schools, and businesses more comfortable and energy efficient, or new therapies to improve the health and well-being of Canadians. Organizations at the forefront of scientific development and technological achievement create high-quality, knowledge-intensive jobs with high wages. They make our economy more competitive and productive, giving us the means to achieve an even higher standard of living and better quality of life. The private sector in Canada needs to do more of what it alone can do, which is to turn knowledge into the products, services, and production technologies that will improve our wealth, wellness, and well-being.

At a time when Canada's overall productivity gains are below those of other trading nations with whom we compete, the need to encourage greater private-sector S&T investment is a national priority.

**Canada must continue to strengthen its knowledge base.** S&T capacity is more widely distributed around the world today, with countries such as China and India moving increasingly into higher segments of the value chain based on their cost advantages and considerable number of highly qualified personnel. To succeed in an increasingly competitive global arena, Canadians must be at the leading edge of important developments that generate health, environmental, societal, and economic benefits. Now that we have built a strong research foundation, we must strive for excellence in Canadian science and technology.

World-class research excellence is Canada's standard.



**Canada must be a magnet for talent.** Our aging population, combined with opportunities for Canadians to work anywhere in the world, challenge us to put in place the right conditions to attract, retain, and develop the talent and ingenuity Canada needs. Having built a skilled and inclusive workforce, the challenge now is to achieve the right skill mix and put it to use. Canada has fewer highly qualified S&T students and workers than many other OECD countries, in large part due to weak demand for these skills by the private sector. Canadian businesses and other organizations need to make better use of the skills, talent, and knowledge of our graduates. This, in turn, will generate more interest among young people in pursuing S&T studies and careers, encouraging a virtuous circle of talent generation and mobilization.

Talented, skilled, creative people are the most critical element of a successful national economy over the long term.

*Mobilizing Science and Technology to Canada's Advantage* is focused on encouraging a more competitive and sustainable Canadian economy with the help of science and technology. This new, focused Strategy recognizes that the most important role of the Government of Canada is to ensure a competitive marketplace and create an investment climate that encourages the private sector to compete against the world on the basis of their innovative products, services, and technologies. Canada must maximize the freedom of scientists to investigate and of entrepreneurs to innovate.

This Strategy also lays out a framework that will guide intelligent and strategic investments of public funds. Building on our strong foundation, we need to be more strategic, more efficient, more effective, and more accountable for delivering results that make a difference in people's lives.





## Fostering S&T Advantages

The Government of Canada will foster three distinct Canadian S&T advantages: an Entrepreneurial Advantage, a Knowledge Advantage, and a People Advantage:

- Canada must translate knowledge into commercial applications that generate wealth for Canadians and support the quality of life we all want in order to create an **Entrepreneurial Advantage**.
- Canadians must be positioned at the leading edge of the important developments that generate health, environmental, societal, and economic benefits in order to create a **Knowledge Advantage**.
- Canada must be a magnet for the highly skilled people we need to thrive in the modern global economy with the best-educated, most-skilled, and most flexible workforce in the world in order to create a **People Advantage**.

These advantages will be supported by the federal policy commitments outlined in this S&T Strategy, described in detail in Chapters 3 to 6. The Strategy and its policy commitments will be guided by four core principles:

**Promoting World-Class Excellence.** The Government of Canada will ensure that its policies and programs inspire and assist Canadians to perform at world-class levels of scientific and technological excellence. The government will foster an environment of healthy competition to ensure that funding supports the best ideas.

**Focusing on Priorities.** The Government of Canada will continue to play an important role in supporting basic research across a broad spectrum of science. To enhance our success, we will also be more focused and strategic—targeting more basic and applied research in areas of strength and opportunity.

**Encouraging Partnerships.** The Government of Canada will support S&T collaborations involving the business, academic, and public sectors, at home and abroad. Partnerships are essential to lever Canadian efforts into world-class successes and to accelerate the pace of discovery and commercialization in Canada. Through partnerships, the unique capabilities, interests, and resources of various and varied stakeholders can be brought together to deliver better outcomes.

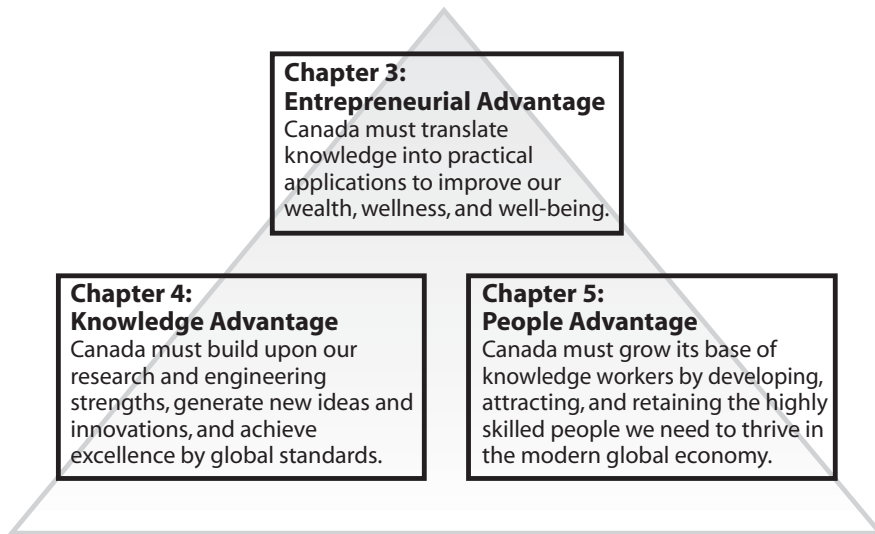


**Enhancing Accountability.** The Government of Canada will implement stronger governance and reporting practices to deliver and demonstrate results. Accountability is important because it puts the responsibility on those who are supported by public funds to demonstrate to taxpayers that results are being achieved.

### **The Science and Technology Framework**

**Vision:** We will build a sustainable national competitive advantage based on science and technology and the skilled workers whose aspirations, ambitions, and talents bring innovations to life.

To achieve this vision, we will create three S&T Advantages for Canada:



Government actions will be guided by four core principles:

- Promoting world-class excellence
- Focusing on priorities
- Encouraging partnerships
- Enhancing accountability



## Federal Policy Commitments

**To create an Entrepreneurial Advantage:** Canada's federal government will foster a competitive and dynamic business environment that encourages S&T investments. We will distinguish Canada by establishing the lowest tax rate on new business investment in the G-7. Through strong and clear environmental laws and regulations that work with market forces, we will also create the conditions for businesses and people to respond to environmental challenges with entrepreneurial innovation.

The private sector will identify and lead new research networks that address their priorities under the Networks of Centres of Excellence Program. In addition, the government will support large-scale research and commercialization centres in areas where Canadians have the potential to achieve world-class excellence, in partnership with other levels of government and the private sector.

The government will increase the impact of its business R&D assistance programs. We will align the programs and activities of existing federal organizations to increase commercialization outcomes, and invite the provinces and territories to work with us in this regard.

**To create a Knowledge Advantage:** Canada's federal government will focus strategically on research in areas that are in the national interest from a social and economic perspective. We will focus more of our energies and resources in the areas identified below.

- Environmental science and technologies.
- Natural resources and energy.
- Health and related life sciences and technologies.
- Information and communications technologies.

We will periodically review research priorities to ensure that we are achieving world-class leadership in these fields and providing opportunities for Canadians. Basic and applied science across all disciplines, including natural sciences and engineering, social sciences and humanities, and health sciences, will be mobilized to support these priorities.



We will maintain our G-7 leadership in public R&D performance by making new investments in R&D; ensuring that higher-education institutions have the leading-edge research equipment and facilities required to compete with the best in the world; and supporting domestic and international research and networks in areas of strategic importance to Canada.

We will enhance value for money, accountability, and the responsiveness of Canada's three granting councils by strengthening their governance and consolidating, integrating, and aligning their programs that support academic research.

The federal government undertakes R&D and related scientific activity to uphold regulatory, public policy, and operational mandates in important areas such as health care, food safety, and environmental protection. We will focus our activities in areas where government is best able to deliver results, and consider alternative management arrangements for non-regulatory federal laboratories. Our objective is to increase the impact of federal investments, lever university and private-sector strengths, create better learning opportunities for students, and foster research excellence.

**To create a People Advantage:** Canada's federal government will continue to reduce personal income tax to ensure Canada attracts and retains the highly skilled workers necessary to foster innovation and growth. We will enhance the immigration and temporary foreign workers systems so that they provide Canadian firms with improved access to people with the skills our modern economy needs. We will work with provinces and territories to foster excellence in, and improved access to, post-secondary education. We will increase opportunities for all to participate in the workforce by modernizing labour market programming and reducing barriers to labour mobility and credentials recognition.

The government will help students demonstrate their value by sponsoring hands-on research internships and, through scholarships, help increase the supply of the highly qualified and globally connected S&T graduates that businesses need to succeed in today's economy.

We will also seek to increase the number of Canadians pursuing education and careers in S&T by bringing Canadians involved in science promotion together to coordinate our efforts and increase our impact.



## A Modern Approach to S&T Management

Canada must be connected to the global supply of ideas, talent, and technologies. We will explore opportunities to strengthen these ties.

A more streamlined external advisory system, with a broad and clear mandate, is required to strengthen the voice of external science advice and help the government address complex S&T issues. In order to achieve these objectives, the federal government will consolidate the roles and responsibilities of the Advisory Council on Science and Technology, the Council of Science and Technology Advisors, and the Canadian Biotechnology Advisory Committee into a single new council. The new Science, Technology and Innovation Council will provide policy advice to the government on S&T and innovation issues and benchmark Canada's S&T performance against international standards of excellence.

Establishing competitive environments, measuring success, and holding people and organizations more accountable for the results they achieve with taxpayers' dollars are more important than ever. Canada's federal government will increase its accountability to Canadians by improving the way that we measure and report the results of federal S&T expenditures.

## The Path Forward

*Mobilizing Science and Technology to Canada's Advantage* sets out a new and focused approach to mobilize science and technology to our long-term economic and social advantage. It takes into account where we have come from and where we need to go, the changing landscape within which S&T takes place, and international developments. It positions Canada to succeed by addressing our challenges and building on our science and technology strengths. Above all, it recognizes the important role that the private sector and others play in Canada.

The Government of Canada will do its part, and create a climate of innovation and discovery in our nation.

- For the business community, we will focus on what government does best; providing an enabling environment that promotes private investment in R&D, advanced technologies, and skilled workers.



- For the higher-education community, we will sustain our world-leading commitment to basic and applied research in all domains, while focusing that collective effort more effectively on priorities that matter to Canadians. We will sustain our commitment to train the next generation of researchers and innovators upon whom Canada's future success depends.
- For Canadians overall, we will hold ourselves accountable for delivering results. Canada's federal government understands the far-reaching implications of science and technology discoveries and applications, and the endless educational and professional opportunities they provide for Canadians. The main reason for enhancing Canada's S&T capability is to improve the lives of ordinary Canadians, their families, and communities. This is our ultimate aim, and it is how Canadians will judge the success of this S&T Strategy.

This Strategy benefited from the advice of many individuals and organizations this past year, including the Advisory Council on Science and Technology, the Council of Canadian Academies, the Council of Science and Technology Advisors, the National Science Advisor, the Expert Panel on Commercialization, the Telecommunications Policy Review Panel, and the Association of Universities and Colleges of Canada. The work of the Conference Board of Canada, the Canadian Council of Chief Executives, the OECD, and others has also been an important source of information and ideas. Provincial and territorial governments shared their views in a comprehensive discussion paper and subsequent dialogue with the federal government. Leaders active at the forefront of S&T developments in Canada also gave of their time, participating in regional roundtables and a forum in Edmonton to share their views on how to make Canada a stronger country through science and technology.

The federal government is thankful to those who have taken the time to share their valuable insights and helpful suggestions, and looks forward to implementing this Strategy in collaboration with other orders of government and Canada's S&T leaders over the coming years. Together, we will build a sustainable national competitive advantage based on science and technology and the skilled workers whose aspirations, ambitions, and talents bring innovations to life.

*Chapter*



IMPROVING  
CANADIANS'  
LIVES AND  
OPPORTUNITIES  
THROUGH  
SCIENCE AND  
TECHNOLOGY







In November 2006, Canada's federal government released *Advantage Canada*, an economic plan to make Canada a world leader for current and future generations. *Advantage Canada* is based on the premise that Canada already has tremendous strengths—including the drive and ingenuity of our people, the relative strength of our fiscal position, and our strong research base. It also recognizes that Canada can and must do more to turn our ideas into innovations that provide solutions to environment, health, and other important challenges, and to improve our economic competitiveness.

This Strategy—*Mobilizing Science and Technology to Canada's Advantage*—is the government's plan to achieve these goals.<sup>1</sup> It sets out a comprehensive, multi-year science and technology agenda. The S&T initiatives announced in the Budget Plan 2007 demonstrate the government's commitment to take early action to implement this agenda.

We will build a sustainable national competitive advantage based on science and technology and the skilled workers whose aspirations, ambitions, and talents bring innovations to life.

This S&T Strategy recognizes that the most important role of the Government of Canada is to ensure a free and competitive marketplace, and foster an investment climate that encourages the private sector to compete against the world on the basis of their innovative products, services, and technologies. The government also has a role in supporting research and development (R&D), which is the basis for new discoveries that lead to improved lives, better jobs, and new business opportunities.<sup>2</sup>

To achieve world excellence in science and technology, Canadians must promote and defend two complementary and indivisible freedoms: the freedom of scientists to investigate and the freedom of entrepreneurs to innovate and market their products to the world.

This strategic framework for S&T will guide the Government of Canada in how it approaches investments in S&T intended to increase our competitiveness, improve the quality of our environment, reduce greenhouse gas emissions, improve the health of Canadians, promote the sustainable growth of our energy sector, and ensure national security.

This S&T Strategy complements and builds on recent federal initiatives that support science and technology advances, including environmental innovation, to make the lives of Canadians better.



**Canada's federal government is encouraging environmental innovation by:**

Creating clear and effective policy frameworks for the environment, including the Regulatory Framework for Air Emissions to reduce air pollution and greenhouse gas emissions, and the Comprehensive Chemicals Management Plan to manage potentially dangerous substances and reduce mercury and toxic substances.

Creating the EcoENERGY Technology Initiative to reduce air pollutants and gas emissions from conventional energy sources and increase Canada's supply of clean energy, including through the development of alternative, sustainable energy technologies.

Supporting collaborative research initiatives to improve the recovery of energy from traditional sources and develop alternative forms of energy. Budget 2007 provides \$15 million to the Canada School of Sustainable Energy to advance collaborative academic research in these areas.

Creating the Canada EcoTrust for Clean Air and Climate Change to support projects in the provinces and territories that reduce greenhouse gas emissions and air pollution. The Government of the Province of Quebec has identified potential projects for the trust, including new technology development for the trucking sector; renewable energy sources in rural regions; cellulosic ethanol; geothermal heat pumps; technological research and innovation for the reduction and sequestration of greenhouse gases; biogas from landfill sites; and waste treatment and energy recovery from biomass. The government will invest over \$1.5 billion in the trust.

Science and technology is not an end unto itself. It is a means by which we can pursue sustainable development. Our ability to do so depends on Canadians pushing the frontiers of knowledge and applying their skills to turn knowledge into new and important innovations. To succeed, we must be excellent, focused, connected, and accountable. These are the principles upon which this Strategy stands.



## 1.1 The Benefits of Science and Technology for Society

Canada has a long and proud history of research excellence and scientific success. From the discovery of insulin, to the design of Research in Motion's BlackBerry, Canadian innovations are making important differences in people's lives and changing the world for the better.

Scientific discoveries and new technologies are providing solutions to many of the issues most important to Canadians. They are giving us the knowledge and the means to improve the quality of our environment, protect endangered species, improve our health, enhance public safety and security, and manage our natural resources. S&T comes into play in virtually all aspects of our lives, helping us to solve problems and create opportunities.

Science and technology plays a key role in protecting Canada's environment, and environmental S&T is an important source of long-term economic strength for Canada. A healthier and cleaner environment enriches the quality of life in Canada, which attracts and retains the highly skilled and mobile people we need to succeed in the global economy. Responsible development of our natural resources ensures future jobs and wealth creation across the country. Energy efficiency and environmentally sustainable business practices are increasingly important competitive advantages for our businesses. Canada has the potential to be a leader in the rapidly emerging business of environmental technology.

Through a series of strategic new initiatives, the Government of Canada is encouraging a cleaner, renewable energy supply, encouraging greater energy efficiency in Canadian homes, buildings, businesses, and transportation, and increasing Canada's capacity to respond to the challenge of a changing climate.

Science and technology is also a driving force behind successful health outcomes for Canadians. Health research is tackling big issues for all Canadians—finding cures or treatments for cancer, heart disease, HIV/AIDS, and a vast range of other acute and chronic diseases; developing vaccines; and understanding how to limit the spread of diseases and potential pandemics. New drugs, medical devices, nutraceuticals, and functional foods are the result of research that improves the health of Canadians and generates wealth to support our economy.

**Canada's Food Guide** is based on extensive research and analysis of research from around the world on the nutritional value of foods, the needs of the human body, and the eating habits of Canadians.



Government research in these fields allows regulators to keep pace with these developments, ensuring that products are safe and that they are made available to those in need as soon as possible.

Science and technology also enables the government to address public safety, security, and defence challenges, and mitigate risks to Canadians. S&T leads to the development of new technologies that properly equip first-responders in emergencies with the necessary tools and knowledge to do their jobs effectively. As new threats and risks emerge, whether from terrorists, natural disasters, or human-caused accidents, first-responders must be equipped to respond quickly and effectively, while ensuring their own safety and the safety of those they are trying to help. S&T is also instrumental in modeling and predicting natural disasters, such as earthquakes, tsunamis, floods, landslides, and forest fires, and helping us prepare for and respond to these events.

Enabling technologies, including information and communications technologies (ICTs), nanotechnologies, and biotechnologies underpin many of the most transformative advances in science and technology. ICTs have brought about fundamental reforms in such areas as commerce, education, and health care. They have put large new computing resources in the hands of people and are enabling and accelerating advances in other areas. Biotechnology is having profound impacts in health, agriculture, and the environment with the emergence of new drug therapies, higher and more nutritious crop yields, and new approaches to pollution prevention and remediation. Nanotechnologies, involving scientific discovery at the nano-scale, are expected to revolutionize how we work and live, with the potential to resolve a number of energy and environmental challenges.

Improvements in our quality of life and standard of living will depend on our increasing success in bringing scientific and technological innovations to life. Some of the key benefits that Canada can achieve through a more comprehensive, strategic approach to science and technology include the following:

- **Encouraging a better overall quality of life.** Making Canada an incubator for research and development and scientific discovery improves our quality of life by helping to attract and retain highly skilled people who add value to our communities in many ways—from volunteering individual time and skills to investing in major philanthropic initiatives.



- **Encouraging high-quality, well-paying knowledge economy jobs.** Organizations at the forefront of scientific development and technological achievement are more competitive. They create high-quality, knowledge-intensive jobs with high wages. They also create a demand for sophisticated professional and other support services from local businesses. Science and technology helps firms participate in the high-value segments of global value chains. This is where we need Canadian firms to succeed in order to sustain a high standard of living for Canadians.
- **Helping to improve our world through scientific discovery.** S&T allows Canadians to bring to the world new ideas, technologies, products, designs, and services that address global issues and challenges such as poverty, urbanization, international security, and global warming. It also provides social innovation in management, marketing, and global awareness.
- **Having a stronger voice on the world stage.** Canadian leadership in science and technology allows us to have a stronger, more respected voice on the world stage on many issues of global concern, and of concern to Canadians.

## 1.2 Science and Technology as a Source of National Competitive Advantage

Science and technology—and the innovations that it creates—is especially important for Canada at this point of our history. That's because we need to do more to increase our productivity.

Canada is not as productive as our most important trading partner and the world's benchmark economy, the United States, and the productivity gap is widening.

Scientific and technological innovations enable modern economies to improve their competitiveness and productivity, giving us the means to achieve an even higher standard of living and better quality of life.

"Canada's productivity growth between 1947 and 1973 exceeded that of the United States, and Canada's level of productivity relative to the United States peaked at 91.4 per cent in 1984. Since then Canada has steadily fallen further behind the United States, especially in the post-2000 period. In 2004 Canada's level of labour productivity relative to that of the United States was 73.7 per cent, a level not observed since the 1950s."

*"Lessons for Canada from the International Productivity Experience," Andrew Sharpe (Centre for the Study of Living Standards, Research Report 2006-02, 2006, p. 5.)*



Recently, the Chief Economist of the OECD, Jean-Philippe Côtis, stated:

“Canada often stands out as one of the best in the class.” With fiscal discipline, price stability, open product markets, and flexible labour markets, “Canada has put itself in the privileged situation where it has mainly to look forward to new challenges. And it is certainly well placed to meet them. However, this should not lead to complacency.”<sup>3</sup>

At a time when Canada's overall productivity gains are below those of other trading nations with whom we compete, the need to encourage greater private-sector S&T investment is a national priority.

Canada's private sector leads the way, turning knowledge into wealth and fostering meaningful opportunities for Canadians to make important contributions to our economy and society. To succeed, businesses need people who can push the frontiers of knowledge and apply their skills and talent to turn their good ideas into practical applications that improve our lives.

Critical success factors for building economic competitiveness through S&T include:

- Private-sector S&T leadership.
- Canadians pushing the frontiers of knowledge.
- A skilled and talented workforce.

## **Private-Sector S&T Leadership**

The economic evidence linking private-sector research and innovation to economic growth is compelling: the OECD has estimated that every percentage point increase in business R&D as a proportion of GDP leads to a 12-per-cent increase in income per person in the long run.<sup>4</sup> This correlation was described by Dr. Tom Brzustowski, former President of the Natural Sciences and Engineering Research Council (NSERC) and now RBC Professor of Commercialization of Innovations at the University of Ottawa's School of Management, when he said:



“Prosperity requires wealth creation, and wealth creation is the business of business. Wealth is created where value is added; the more value is added, the more wealth is created. In the knowledge-based economy, value is added when knowledge is embedded in new or improved products (goods or services), and that is done through R&D.”<sup>5</sup>

Businesses in Canada need to do more to improve their productivity. Canada's private-sector R&D investment as a proportion of GDP is below levels in Japan, the United States, Germany, and France. Similarly, the number of patents produced in Canada is low compared with many other OECD countries. Canadian firms also invest less in new machinery and equipment, which embody the latest innovations, than do many of their competitors. Since these investments are a key productivity driver, it is crucial that the private sector increase its investments in S&T and advanced technologies.

#### **Commercialization Performance Indicators**

Fifty-four per cent of R&D in Canada is performed by business, well below the OECD average of 68 per cent.

Canada ranks 14th in the OECD: business expenditures on R&D as a percentage of GDP.

Canada ranks 16th in the OECD: high-quality patents per million population.

Canada ranks 19th in the OECD: investment in machinery and equipment as a percentage of GDP.

*Source: OECD 2005, 2006*

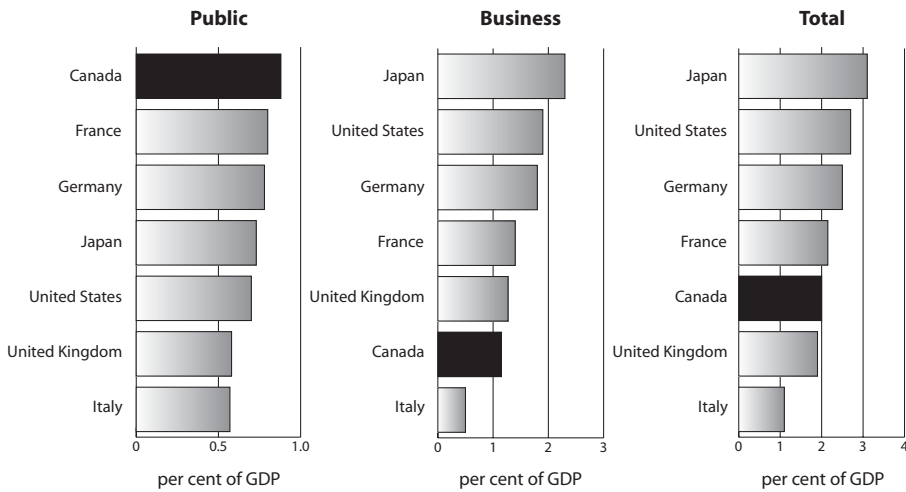
There is considerable consensus among economists, governments, think tanks, and industry that Canada can do more to turn S&T advances into sources of competitive advantage.<sup>6</sup>



### Canadian business investment in R&D lags behind international competitors

More than \$27 billion in R&D was performed in Canada in 2005, 54 per cent of which was performed by the private sector.<sup>7</sup> The scale of R&D effort by the Canadian private sector is far less than its international private-sector competitors in many advanced economies. Firms performed 68 per cent of the total R&D undertaken in OECD countries and have clearly established themselves as front-runners in the United States, where they account for 70 per cent of all R&D performed there. Canada is also a middle-of-the-pack performer when it comes to business expenditures in R&D relative to GDP, ranking 14th in the OECD and 6th in the G-7 in 2004.<sup>8</sup> R&D is highly concentrated in Canada. Fewer than 300 Canadian firms can be termed R&D leaders—investing more than \$3 million each year in R&D.<sup>9</sup> Ten of these firms account for 24 per cent of all R&D performed by the private sector.<sup>10</sup> Only one Canadian firm was in the top 100 corporate R&D performers in the world, putting Canada at the bottom of the G-7.<sup>11</sup>

#### Canada's Lagging R&D Intensity Is Concentrated in the Business Sector: R&D Expenditures as a Percentage of GDP (2003)



Note: Public expenditures includes R&D performed by government and higher education.  
Source: *Advantage Canada: Building a Strong Economy for Canadians*, Finance Canada, November 2006.





### **Canadian business investment in machinery and equipment lags behind international competitors**

Canadian firms also invest less than their counterparts in other countries in advanced machinery and equipment, ranking last among G-7 countries. New machinery and equipment investment embodies the latest ideas and technologies and is an important way to acquire domestic and foreign technology. Since 2002, the ratio of capital depletion in the Canadian manufacturing sector has been persistently under 0.5—the rate of new investment that is considered sufficient to replace the value of capital used up.<sup>12</sup> Low levels of investment by Canadian firms in information and communications technologies (ICT) compared with the United States are of particular concern, given that two thirds of Canadian productivity gains from 1990 to 2000 were from industries that use ICTs intensively.<sup>13</sup> As reported by the Telecommunications Policy Review Panel, the ratio of ICT investment to GDP for Canada's business sector was only 66 per cent of U.S. levels in 2004, down from 75 per cent in 1987. Canada's shortfall relative to the U.S. in total machinery and equipment investment as a share of GDP is largely explained by the ICT investment shortfall.<sup>14</sup>

There are structural and historic reasons for Canada's relative weakness in private-sector investment in R&D and advanced technologies. Some of the more commonly cited factors include:

- **Industrial composition.** Canada has research-intensive industries, but they account for a smaller share of Canada's economy than in the United States.
- **Smaller businesses.** Canada has a greater number of smaller firms relative to our competitors such as the United States. Smaller firms often have more difficulty financing and managing R&D and adopting new technology.
- **Regulatory and marketplace framework policies.** Canada's competitive intensity and marketplace framework policies (such as business taxation, intellectual property, and regulatory regimes) could be more conducive to private-sector investment in R&D and commercialization.
- **Access to funding and venture capital.** Canadian venture capital tends to be invested in a large number of smaller firms at early stages of development, rather than focused on building global leaders. Also, returns on venture capital investment in Canada have been relatively low, making it more difficult to attract the kind of long-term investment provided by pension funds and other institutional investors.



The federal government has asked the Council of Canadian Academies to work with the private sector and academic experts to deepen our understanding of the S&T investment constraints and opportunities facing Canadian firms. This will help the government better support an increased commitment to S&T by Canada's private sector.

### **Council of Canadian Academies**

The Council of Canadian Academies provides expert assessments of the state of science on important domestic and international issues. It brings together, under one umbrella, the RSC: The Academies of Arts, Humanities and Sciences of Canada; the Canadian Academy of Engineering; and the Canadian Academy of Health Sciences. These assessments contribute to informed public discussion and decision-making.

## **Canada Pushing the Frontiers of Knowledge**

Generating innovations that improve our wealth, wellness, and well-being does not depend solely on the private sector. It requires a national capacity to generate knowledge and a talented workforce to put it to use—two areas where Canadians have built up considerable strengths.

Canadian researchers are at the forefront of important scientific developments as measured by publications and citations. We can all take pride in the success of Canada's scientists and researchers, who are contributing 4.8 per cent of the OECD's research publications even though Canada has only 2.8 per cent of the OECD's population.

Recent work by the Council of Canadian Academies has determined that most Canadian S&T is operating at or near international levels of excellence, and that Canadians are leaders in a broad range of fields important to our long-term success.<sup>15</sup> A review of S&T projects supported by the Canada Foundation for Innovation has identified Canadian strengths in areas such as information and communications technologies, genomics, proteomics, bioinformatics, advanced materials, energy, and the environment.



Government-led science has also delivered for Canada, authoring one third to one half of all Canadian publications in domains such as agriculture and food science, oceanography, meteorology, and the environment. Government science has developed world-class technologies, such as the Canadarm, and scientific expertise in areas such as new vaccines and hydrogen fuel cells that benefit Canadians and the world.

#### **Research Performance Indicators**

Canada ranks 2nd in the OECD: higher-education R&D/GDP.

Canada ranks 6th in the OECD: publications per capita.

Canada ranks 5th in the OECD: quality of publications.

*Source: OECD 2006, Observatoire des sciences et technologies 2007*

Canada's strong position in pushing the frontiers of science was not a given. A decade ago, we were worried about our capacity to gain competitive advantage from knowledge. Many talented Canadians were deciding to apply their skills in countries that offered more research support and world-class research facilities. These countries were attracting our top researchers with irresistible opportunities to be the ones to make important new discoveries in their fields.

Canada now has a strong research base, and the government is committed to maintaining Canada's current G-7 leadership in public research. Today's research environment at Canadian universities is attracting leading researchers from around the world, and welcoming Canadians who had been studying or working abroad back home.<sup>16</sup> We have many more researchers and stronger research institutions. We have built a strong foundation for future success.

Clearly, challenges remain and we need to sustain our efforts while focusing on excellence. Other countries are increasing their commitment to succeed through investments in knowledge. Canada must build on its strong research foundation and turn it into a source of competitive advantage.



Canadian researchers and institutions must strive to be among the world's top performers, build clusters of world-leading research excellence and strength, and translate more research into commercial outcomes.<sup>17</sup>

World-class research excellence is Canada's standard.

## A Skilled and Talented Workforce

Talented, skilled, creative people are critical to building and sustaining a successful national economy over the long term.

Canada has a highly skilled workforce by international standards. Among G-7 countries, we have the highest proportion of post-secondary graduates in our workforce. The number of degrees awarded in Canadian universities is up considerably, particularly in fields that support S&T and its commercialization—including architecture, engineering, mathematics, computer and information sciences, and business and management.

### Talent Performance Indicators

Canada ranks 1st in the OECD: share of population with tertiary education.

Canada ranks 20th in the OECD: natural science and engineering degrees as a share of total degrees.

Canada ranks 18th in the OECD: share of young Canadians with PhDs.

Canada ranks 17th in the OECD: number of people in S&T occupations as a share of total employment.

*Source: OECD 2004, 2005, 2006*

Canada's New Government understands the importance of education and skills to our personal and national well-being. Federal and provincial governments have increased their support for learning institutions, helped make post-secondary education more affordable for young Canadians, provided Canadians already in the workforce with more and better training opportunities, and have attracted more immigrants to live and work in Canada. We have built an inclusive and skilled workforce.



Canadian students have the proven capacity to pursue higher-level S&T studies. The Programme for International Student Assessment tests 15-year-olds in reading, science, and mathematics. Canadian students, on average, have performed well, often ranking near the top of the OECD in all three categories.

Too few of our students, however, choose to pursue advanced S&T degrees. Compared to the OECD average, we have fewer natural science and engineering degree students within our total student population and fewer PhD-holders among young Canadians.

To increasingly draw knowledge from within research institutions and create innovations for the marketplace, Canada also needs more people with both science and business skills.

"What used to be done purely within the company, exclusively in an R&D department, in secret and kept confidential, is now being done in interdisciplinary project teams across different departments, in an 'open innovation' model that involves universities, start-up firms and customers. There is a trend towards higher specialty products with shorter life times and towards higher technology-intensive products. These changes are creating a need for more people with S&T background, but also different types of people. Multidisciplinary teams require solid content and good collaboration skill."

*Ellen de Brabander, Deputy Chief Technology Officer, DSM, Netherlands, OECD Global Science Forum Conference, 2005.*

Canada's private sector does not provide strong enough incentives for students to strive for advanced S&T and business management skills. Canadian firms across most industries hire fewer university graduates as a percentage of their total workforce than do their counterparts in the United States, particularly fewer PhD graduates. Canadian firms also tend to pay graduates less compared to firms in the United States. These factors may explain why there are fewer people working in S&T occupations in our labour market than in the United States and most OECD countries.



Some attribute this weak demand for advanced degrees to the management skills of Canadian corporate leaders. Canadian managers are less likely to have a university education than U.S. managers, and are about half as likely to have a university business degree. American financial professionals are twice as likely to have an advanced university degree as their Canadian counterparts. Others attribute the weak demand to an over-reliance on cost reduction, rather than innovation, as the main competitiveness strategy among Canadian firms.

Canadian businesses and other organizations need to recognize, reward, and make better use of the skills, talent, and knowledge of our current graduates. This, in turn, will help foster greater interest among Canada's young people to pursue S&T and related studies and careers, fostering a virtuous circle of talent generation and mobilization.

### 1.3 The Changing Context

The business environment is different from that of even 20 years ago. Production processes are becoming increasingly segmented internationally. Until recently, R&D was one of the least-internationalized segments of value chains. Today, firms are increasingly establishing R&D facilities in many locations around the world.<sup>18</sup> To sustain high-paying jobs, Canadian firms will need to move into higher-value segments of international production chains. This will require greater private-sector investment in the latest scientific and technological developments and in skilled personnel.

Talent is also far more mobile than it used to be. Our aging population, combined with opportunities for Canadians to work anywhere in the world, challenge us to put in place the right conditions to attract, retain, and develop the talent and ingenuity Canada needs.

S&T capacity is more widely distributed around the world today, with countries such as China and India moving increasingly into this segment of the value chain based on their cost advantages and considerable number of highly qualified personnel. To succeed in an ever-more competitive global arena, Canada must have researchers, research facilities, research equipment, talent, and firms that are nothing short of excellent by world standards. Canada has built a strong research and talent foundation. Now we must take it to a new level by making strategic choices and focusing our resources where we can achieve the most benefit.



S&T developments are increasingly costly and complex, taking place at the interface of disciplines and coming on-stream more rapidly than ever before. To be at the leading edge, and stay there, domestic and international S&T collaborations have become essential. And as we increasingly focus our efforts domestically, we need to tap resources beyond our borders to benefit from the many discoveries that originate outside Canada.

## **The Evolving Nature of National Competitiveness Strategies**

Countries around the world are recognizing and responding to the changing environment for S&T as part of a new generation of competitiveness strategies. Canada's new approach takes into account this changing context.

Many OECD countries have adopted competitiveness strategies that seek to mobilize S&T for national advantage. These strategies are focused on:<sup>19</sup>

- **Increasing the application and commercialization of research.** Countries are strengthening their business environments to encourage greater investment and innovation. In addition to strengthening marketplace framework policies, governments continue to reorient their support to foster business innovation through direct means (grants, loans) or indirectly (tax incentives for R&D and early-stage capital funds). Austria, Finland, Germany, and the Netherlands have gone further, streamlining and consolidating their innovation support programs to make them simpler for industry to use. Others are focused on improving knowledge transfer from universities to firms, including by standardizing intellectual property arrangements so that companies can better access and commercialize publicly funded research.
- **Establishing strategic research priorities.** Many nations, including the United States, Australia, Finland, New Zealand, Korea, Italy, Iceland, and the United Kingdom, identify research priorities in areas where they can compete on the basis of world-class excellence. These strategic research priorities are grounded in the particular opportunities and challenges facing each country and often also emphasize key technology areas. Priority-setting processes typically involve defining societal goals and delivering them through competitive processes to ensure the best ideas get rewarded. Priority setting, at this level, avoids a return to past practices of “picking winners” at a project or company level, and also avoids exposing governments to market risks that are better borne by the private sector.



- **Supporting S&T collaborations and partnerships.** Countries are increasingly fostering collaboration among firms, and between firms and public research bodies. Countries are also putting more emphasis on international collaborations by, for example, sharing major research infrastructure and research projects to address global challenges.
- **Securing a talented workforce.** Countries around the world are recognizing the importance of having a workforce with S&T skills and experience. Many have taken action to improve science literacy in their society and the quality of science teaching at all levels of education. Many countries are attracting more women and minorities into S&T fields. Increasingly, countries are also supporting the international mobility of students and young researchers, seeking to attract top talent from around the world and connect domestic talent to global networks.
- **Improving accountability for achieving results.** Many countries have implemented governance reforms for public research organizations to increase their impact, efficiency, and responsiveness to societal needs. These include giving universities and other public research organizations more autonomy, alongside stronger evaluation and performance measurement requirements.

Many countries around the world understand the importance of S&T to their future prosperity and quality of life. They are creating the conditions to attract investment and talented workers, investing strategically in research, and reaching out to form strategic alliances that provide competitive advantage. Canada can do no less.

Canada's Strategy will mobilize science and technology to make this country one of the world's innovation leaders. It builds on past efforts, including the 1996 policy on Science and Technology for the New Century, which put in place a sound macro-economic environment and built a solid research platform. It also respects the role and contribution of each of the key S&T players in Canada.





## 1.4 Respecting the Roles and Responsibilities of Canada's Key Players

There are three main categories of R&D investors and performers in Canada:

- Businesses.
- Institutions of higher education (universities and colleges).
- Governments (federal, provincial, territorial, and local).

### The Private Sector: Turning Knowledge into Opportunity

The for-profit private sector plays the central role of translating knowledge into goods, services, and technologies for domestic and global markets.

Firms invest in R&D to generate new products, services, and process improvements. And it is the private sector that builds the innovative and

competitive companies that win on the world stage. Their ability to bring innovations to market requires foresight, risk-taking, and creativity in the adoption and use of advanced technologies.

The private sector performed \$14.7 billion of R&D in 2005 and employed about 127,000 R&D personnel (2004).

*Source: Statistics Canada 2006, 2007*

The non-profit sector is an important supporter of the R&D performed in universities in Canada. This includes organizations such as the Killam Trust and health charities such as the Heart and Stroke Foundation and the Canadian Cancer Society. The non-profit sector invested close to \$800 million in R&D in 2005, with the financial backing of individual, corporate, and government donors.

### The Higher-Education Sector: Building on Canada's R&D Strengths

The research conducted in our universities and teaching hospitals educates students in advanced fields of knowledge. Some will become the researchers of tomorrow. Others will follow a range of practical pursuits in all sectors of the economy. Higher-education research is also a key source of ideas and invention.

The higher-education sector performed \$9.9 billion of R&D in 2005 with 54,700 R&D personnel (2004).

*Source: Statistics Canada 2006, 2007*



More than 80 Canadian universities develop research and innovation talent and perform research. Scientists, clinical investigators, and other researchers are involved in health research at teaching hospitals and research institutes of regional health authorities. In addition, many of Canada's 150 community colleges and polytechnics located in over 1,000 communities across the country work with local business organizations to develop and adopt new scientific developments and technologies. In all cases, their greatest contribution lies in their important contribution toward training students in essential S&T skills.

## **Provincial, Territorial, and Local Governments: Building Regional Competitive Advantage**

Provincial and territorial governments play a significant role in the national S&T system. They perform research, support universities, fund university and private-sector research, influence the business environment through marketplace framework policies and tax incentives, and support regional innovation networks.

In 2004, Ontario and Quebec were the largest provincial R&D investors, with expenditures of \$489 million and \$436 million, respectively, followed by Alberta (\$325 million). Together, these three provinces accounted for almost 90 per cent of total provincial R&D expenditures. In 2005, provincial and territorial governments contributed \$1.1 billion toward higher-education research, in addition to their support for higher-education operating costs.

Municipalities are also increasingly involved in supporting local S&T capacity, recognizing the need to position their communities at the forefront of science and technology developments to compete successfully.

## **The Government of Canada: Fostering the Conditions for S&T Excellence**

To create economic opportunity and to protect and safeguard Canadians, the federal government:

- Encourages private-sector S&T investment.
- Funds university and college R&D.
- Undertakes science and technology work.
- Fosters national and international partnerships.



### Federal S&T Expenditures, 2005-06

In-house	\$5.0 billion
Higher education	\$2.7 billion
Businesses	\$1.0 billion
Others	\$0.6 billion
<b>TOTAL</b>	<b>\$9.3 billion</b>

Source: Statistics Canada 2007

## Encouraging Private-Sector S&T Investment

The most important role of the Government of Canada is to ensure a competitive marketplace and create an investment climate that encourages the private sector to compete against the world on the basis of their innovative products, services, and technologies. *Advantage Canada* affirmed the government's commitment to get the fundamentals right. We are building an economic climate that attracts and encourages investment and innovation through low and stable inflation rates and by fostering a competitive tax environment and forward-looking regulatory regime, reducing the government debt burden, cutting red tape, attracting foreign investment, and enhancing internal trade and labour mobility.

Other important instruments, including intellectual property policies and tax policies, encourage private-sector investment in R&D and advanced technologies. Notable among them is the Scientific Research and Experimental Development (SR&ED) tax incentive program. It is the single largest federal program supporting business R&D in Canada, providing over \$3 billion in tax assistance to Canadian businesses in 2006. In addition, the charitable donations tax credit supports the leadership and vision of Canada's charities that mobilize the direct support of Canadians for the areas of research that are most important to them.

While the direct-support programs of the federal government can play a strategic role, they supplement the broader government roles of ensuring appropriate business and regulatory frameworks, and supporting the Canadian higher-education R&D system that provides the highly skilled workers that business needs.

The Government of Canada provided \$1 billion in direct support for private-sector S&T in 2005.



### **Why governments support private-sector S&T**

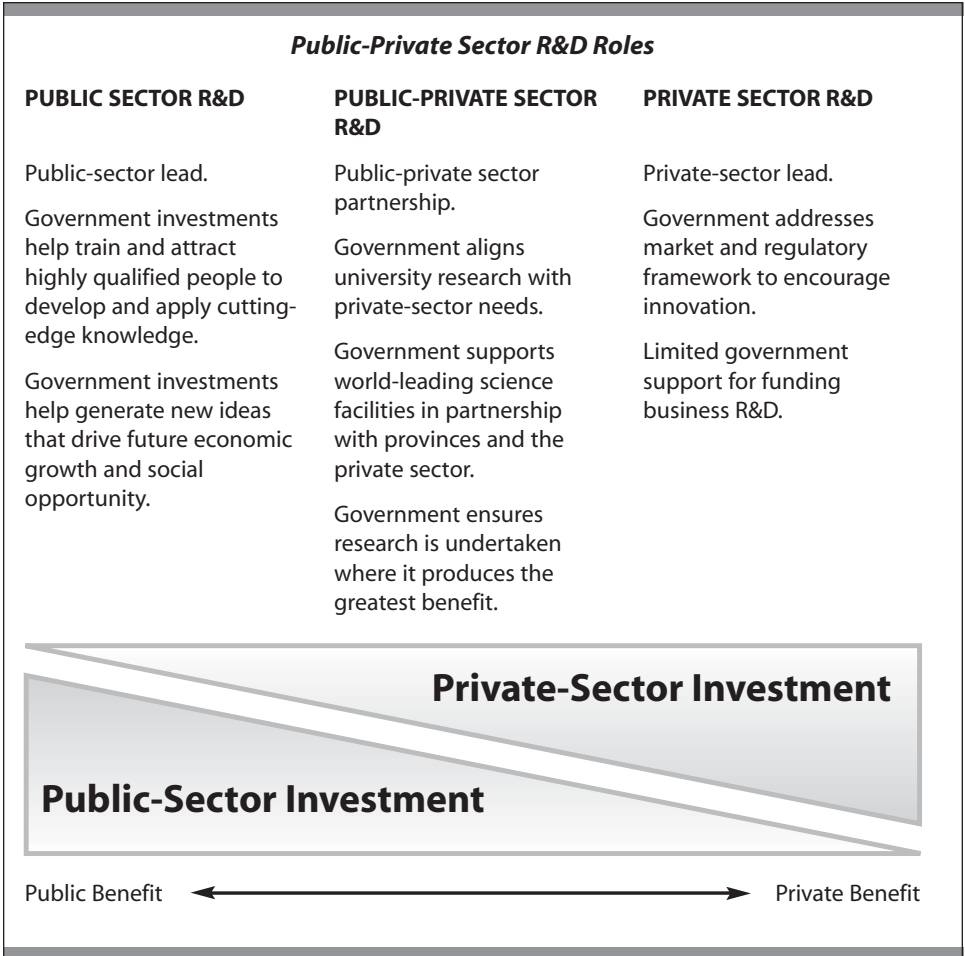
The benefits to society from private investments in S&T often exceed the benefits to the investing company. Even though a company may pay the full cost of developing a new approach, it can't keep the full benefit of the resulting innovation to itself. Other companies soon copy or adopt the idea, resulting in the spread of a good idea to the wider benefit of the economy and society.

The spill-over benefits from private S&T include:

- Developing new product and process innovations that bring improved productivity performance across the entire economy and strengthen the ability of many Canadian firms to compete internationally.
- Developing and commercializing such socially desirable goods and services as clean production technologies, energy-efficient innovations, and new medical discoveries in priority fields of public health.
- Increasing the collective knowledge base and skill sets of employees.
- Creating high-quality and well-paying jobs across entire industries.

Public S&T funding encourages firms to make investments they might otherwise not. The result is wider benefits to our economy and society.

As the following figure illustrates, the greater the benefits from research that accrue to the individual firm, the smaller is the role for public support. Research takes place along a continuum of activity, with an intermediate zone where public and private-sector research interests and activities intersect. As this type of research generates both public and private gains, there is a role for government in supporting it when there is a clear private-sector commitment as well.



**Funding Higher-Education Research in Canada**

Firms do not have a strong incentive to fund basic research on their own, given such factors as the long timeframes involved, the wide availability of the knowledge created, and the uncertainty over its commercial outcomes. In some cases, the benefits to society far exceed the required investment, but if the firm cannot appropriate sufficient returns, it will choose not to make those investments. Public support for basic research is justified by the fact that the benefits to society are significant.<sup>20</sup> Without government support, many discoveries that have generated important economic and social benefits would never have materialized.

The Government of Canada funded \$2.7 billion of university R&D and related scientific activities in 2005.



The federal government supports researchers and students, funds the direct and indirect costs of their research, and gives them access to world-class research infrastructure and networks. Government support for university research and research training is provided predominantly through the Natural Sciences and Engineering Research Council of Canada (NSERC), the Social Sciences and Humanities Research Council of Canada (SSHRC), the Canadian Institutes of Health Research (CIHR), and support provided to third-party organizations such as the Canada Foundation for Innovation (CFI), Genome Canada, the Canadian Institute for Advanced Research (CIAR), the Canadian Health Services Research Foundation (CHSRF), the Canadian Foundation for Climate and Atmospheric Sciences (CFCAS), and the Pierre Elliot Trudeau Foundation.

### Undertaking Science and Technology Work within Government

There is a great deal of science and technology work in the national interest that is conducted by the federal government itself. Federal R&D and related activities, including long-term monitoring to observe, understand, and predict trends, helps the government respond to infectious disease outbreaks, prepare for potential natural disasters, protect water supplies, manage fisheries, respond to environmental emergencies, and support public safety, security, and defence.

More than 30 departments and agencies performed over \$2.2 billion of R&D and \$2.7 billion of related scientific activity in 2005.

Science-based government departments and agencies support our economy and society through effective, up-to-date, and efficient regulations essential to the responsible introduction and ongoing monitoring of new products, services, and technologies, such as pharmaceuticals, medical devices, and food products.

Federal departments and agencies also undertake S&T in support of economic development objectives. The National Research Council of Canada is the federal government's primary provider of research and

**Largest R&D performers among federal science-based departments and agencies**

- National Research Council Canada
- Natural Resources Canada
- Agriculture and Agri-Food Canada
- Defence Research and Development Canada
- Environment Canada
- Atomic Energy of Canada Limited
- Canadian Space Agency
- Fisheries and Oceans Canada
- Industry Canada
- Health Canada



research facilities. It pursues cutting-edge R&D that helps support the growth of Canadian industry and uncovers solutions to national challenges in health, climate change, the environment, clean energy, and other fields. Its Industrial Research Assistance Program plays a large role in supporting the diffusion of S&T to small and medium-sized firms across the country. Agriculture and Agri-Food Canada, the Canadian Space Agency, the Communications Research Centre, Natural Resources Canada, and others invest substantial resources in S&T to support economic development.

As the approach to science becomes more multidisciplinary and S&T capacity more widely distributed, the government is increasingly drawing on research expertise in universities and business across Canada and internationally. Science-based departments and agencies are already engaged in and actively pursuing new collaborative opportunities, including situating federal research activity in new shared-space locations, developing shared management approaches with universities, and making greater use of academic and private-sector research providers.

The Shirleys Bay campus of the Communications Research Centre, in Ottawa, houses related federal government departments and agencies and, since 1994, has incubated 42 private-sector companies. The Canadian Science Centre for Human and Animal Health in Winnipeg houses the National Microbiology Laboratory, Level 4, and is the first facility in the world to accommodate both human and animal health facilities at the highest level of biocontainment under one roof. Environment Canada's National Wildlife Research Centre is located on the campus of Carleton University in Ottawa, providing collaborative opportunities for researchers that are critical to wildlife conservation in Canada.

### **Fostering National and International Networks and Scientific Partnerships**

The Government of Canada plays an important role facilitating domestic and international partnerships among researchers, industries, and others to improve the speed with which advanced knowledge can be generated, tapped, and applied to solve problems and create opportunities.



Research collaboration between the government, private, and academic sectors takes many forms. These include informal communication between individual researchers, formal sharing of facilities, joint research projects, and joint support for institutions undertaking research that has both public and private benefits. As there are considerable benefits to obtain, and insufficient economic incentives for the private sector alone to pursue them, there is a role for government to support collaborations. Collaborations of this type only work when there is a sincere commitment by all parties that is matched by an allocation of resources to the joint effort.

### **Networks of Centres of Excellence Program**

In 2004–05, the Networks of Centres of Excellence Program managed 21 R&D networks involving the private sector, academic, and federal and provincial departments and agencies. About 830 companies participated in the program. They contributed \$28.5 million in cash and kind toward the \$149-million total cost of the R&D undertaken by the networks. Other non-government partners, including hospitals, research institutes, and not-for-profit organizations, contributed \$12 million.

*Mobilizing Excellence, Network of Centres of Excellence Annual Report 2004/05. [www.nce.gc.ca](http://www.nce.gc.ca)*

## **1.5 From the S&T Context to the S&T Framework**

This S&T Strategy provides a framework to guide government policy and program decision-making, and contributes to the implementation of specific measures that build upon *Advantage Canada*. The Strategy:

- Sets out a new and more focused approach to mobilize science and technology to our long-term economic and social advantage.
- Positions Canada to succeed by addressing our challenges and building on our science and technology strengths.
- Recognizes the important role that the private sector and others play in Canada.
- Seeks to put in place the conditions for our collective success.



*Chapter*

**2**



A FRAMEWORK  
TO MOBILIZE  
SCIENCE AND  
TECHNOLOGY TO  
CANADA'S  
ADVANTAGE





## 2.1 Fostering Three Science and Technology Advantages

The S&T Strategy of Canada's federal government aims to build a sustainable national economic advantage and a higher quality of life by developing three distinct advantages: an Entrepreneurial Advantage, a Knowledge Advantage, and a People Advantage. These advantages will enable researchers, innovators, and businesses to improve Canada's productivity performance and make a meaningful difference in the lives of Canadians.

### **Entrepreneurial Advantage**

Canada must do more to translate knowledge into commercial applications.

To create an Entrepreneurial Advantage, the Government of Canada will:

- Foster a competitive and dynamic business environment that encourages S&T investments.
- Pursue public-private research and commercialization partnerships.
- Increase the impact of federal business R&D assistance programs.

### **Knowledge Advantage**

Canadians must be positioned at the leading edge of the important developments that generate health, environmental, societal, and economic benefits.

To create a Knowledge Advantage, the Government of Canada will:

- Focus strategically on research in the national interest from a social and economic perspective.
- Maintain our G-7 leadership in public R&D performance.
- Enhance value for money, accountability, and the responsiveness of Canada's three granting councils.
- Explore new approaches to federally performed S&T.



## People Advantage

Canada must be a magnet for the highly skilled people we need to thrive in the modern global economy with the best-educated, most-skilled, and most flexible workforce in the world.

To create a People Advantage, the Government of Canada will:

- Enhance opportunities for S&T graduates.
- Increase the supply of highly qualified and globally connected S&T graduates that businesses need to succeed in today's economy.
- Get Canadians excited about science and technology.

## 2.2 A Principles-Based Approach

The Government of Canada's actions will be guided by four core principles:

### Promoting World-Class Excellence

The Government of Canada will ensure that its policies and programs inspire and assist Canadians to perform at world-class levels of scientific and technological excellence. In today's fiercely competitive global economy, merely being good is not good enough. The government will create an environment of healthy competition to ensure that funding supports the best ideas.

### Focusing on Priorities

Canada is well-positioned to rise to the challenge of new global competitors. We already have 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. We will do so by strategically targeting funding in areas of opportunity that build on national strengths.

### Fostering Partnerships

Partnerships involving the business, academic, and public sectors at home and abroad are essential to lever Canadian efforts into world-class successes and to accelerate the pace of discovery and commercialization in Canada. The cost, complexity, and pace of scientific achievement today—along with the complementary skill sets that exist in the industrial, university, and public sectors—demand the creation of smart partnerships. Through partnerships, the unique capabilities, interests, and resources of various and



varied stakeholders can be brought together to deliver better outcomes. The Government of Canada will support S&T collaborations. It will also align roles and responsibilities within the federal public sector, and with other orders of government and the private sector, to generate greater social and economic opportunities from the public investment in S&T.

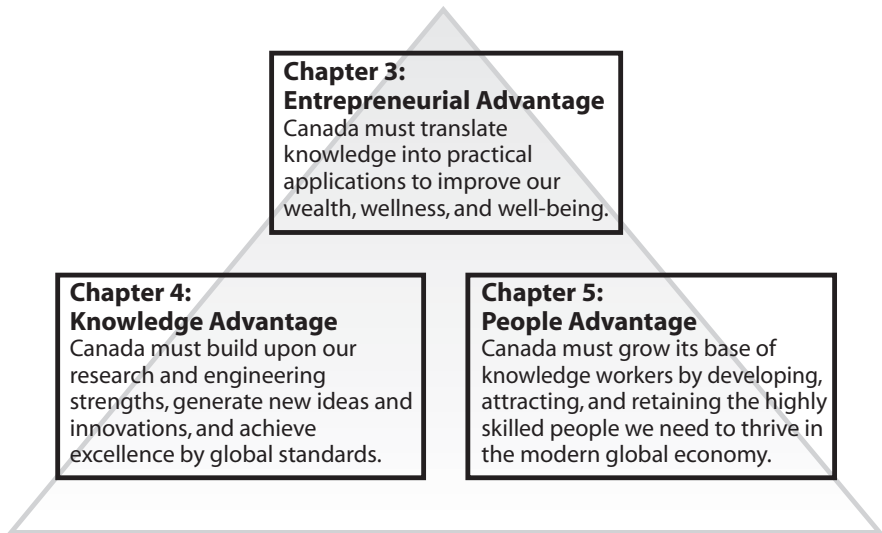
## Enhancing Accountability

The strategic importance of S&T to our nation merits rigorous and disciplined accountability mechanisms to ensure value for money. Stronger governance and reporting practices will help to deliver and demonstrate results that make a difference in people's lives. Accountability is important because it puts the responsibility on those who are supported by public funds to demonstrate to taxpayers that results are being achieved.

### The Science and Technology Framework

**Vision:** We will build a sustainable national competitive advantage based on science and technology and the skilled workers whose aspirations, ambitions, and talents bring innovations to life.

To achieve this vision, we will create three S&T Advantages for Canada:



Government actions will be guided by four core principles:

- Promoting world-class excellence
- Focusing on priorities
- Encouraging partnerships
- Enhancing accountability



The following three chapters examine each of the S&T advantages. They look at the current contribution of the Government of Canada, and propose new directions to ensure that federal support going forward is effective, efficient, and responsive to the realities of the 21st century. The Annex to this document contains a summary of the policy commitments contained in this Strategy. These commitments build on a strong base of existing federal support.

### Highlights of Select Federal Investment in Science and Technology, 2006–2007

#### Entrepreneurial Advantage

The federal government supports:

- Business R&D through the Scientific Research and Experimental Development tax credit (SR&ED): over \$3 billion
- University, business, and government collaborative research through the Networks of Centres of Excellence Program: \$82.4 million
- Business investments in R&D through Technology Partnerships Canada and the Industrial Research Assistance Program (IRAP): \$637 million

#### Knowledge Advantage

The federal government supports:

- Research through the granting councils: \$1.3 billion
- Indirect costs of research: \$300 million
- Research infrastructure through the Canada Foundation for Innovation: \$400 million
- Genome Canada: \$120 million
- Federal intramural R&D: \$2.2 billion
- CANARIE's high-speed research network: \$24 million

#### People Advantage

The federal government supports:

- nearly 2,000 university researchers through the Canada Research Chairs program: \$247 million
- Canada's best students in their pursuit of advanced studies through Canada Graduate Scholarships: \$105 million
- Additional scholarships, fellowships, Chairs, and awards for researchers through the Granting Councils: \$437 million

*Chapter*

3

# ENTREPRENEURIAL ADVANTAGE —

**Making Canada a World Leader  
through Science and Technology**







The federal government supports productivity growth through S&T by putting in place the conditions that encourage private-sector investment. By encouraging entrepreneurs to innovate and market their products to the world, the government can maximize the benefits from its investment in skills and research.

With this in mind, the Government of Canada will:

- Foster a competitive and dynamic business environment.
- Pursue public-private research and commercialization partnerships.
- Increase the impact of federal business R&D assistance programs.

### **3.1 Fostering a Competitive and Dynamic Business Environment**

Governments establish marketplace framework policies—the basic rules under which businesses, consumers, and others conduct their activities in the marketplace. Marketplace framework policies influence private-sector decisions to invest, trade, and innovate. They play a vital role in encouraging firms to strive to be environmental innovators. Key marketplace framework policies that touch on S&T include competition, trade, investment, intellectual property, taxation, regulation, and capital markets.

Innovation usually takes place when there is vigorous competition among firms. Competition drives firms to become more efficient, invest in new technologies, and introduce new products and services. A highly competitive national economy also helps our companies to be more successful when competing in global markets. In the broadest sense, the challenge is to encourage competition by letting market forces play out, while ensuring that individual firms with market power are deterred from taking action that undermines competition. Canada's federal government will work to ensure that its competition laws are encouraging a more innovative economy.

Openness to international trade and investment brings expertise and innovation to Canada, increases competition to bring out the best in firms, and gives Canadian firms opportunities to reap the rewards from their investments in innovation in world markets. Canadian trade agreements, S&T agreements, and tax treaties have dramatically increased our openness to trade, and the movement of new ideas, products, and technologies benefiting Canadians. However, recent difficulties in concluding the Doha round of multilateral trade negotiations have led many countries to pursue bilateral or regional negotiations to capture the benefits of freer trade.



To ensure that Canadian businesses can fully participate in global market opportunities, the government will develop a new approach to international trade policy through a comprehensive Global Commerce Strategy that will enhance linkages with existing and emerging markets through regional and bilateral trade and investment agreements.

Foreign direct investment in Canada provides firms with capital to innovate and brings with it new technologies, new ways of doing business, and healthy competition. When Canadians invest abroad, they integrate into global supply chains, seize opportunities, and improve their competitiveness. Canadians are investing more abroad, but Canada has been attracting a declining share of global direct investment. This is limiting opportunities for Canadians. We need to ensure that our approach to foreign direct investment is modern and in line with best practices around the world.

A modern intellectual property regime is critical for researchers and creators, whose ability to commercialize the fruit of their labour is directly linked to the protection provided by patent and copyright laws. Canada therefore needs to maintain intellectual property protection that is competitive with its trading partners in order to attract both venture capital and intellectual capital.

Canada is committed to maintaining a balanced patent regime that provides appropriate incentives for innovation while respecting Canadians' values and ensuring that they have access to the latest scientific information and technologies. Similarly, Canada is committed to ensuring that its copyright framework provides the legal protection necessary to give copyright-based industries the confidence to invest in and roll out new business models that make full use of leading-edge technologies, while promoting the use of these technologies by researchers to gain access to the knowledge and information needed for innovation and competitiveness.

High business taxes are harmful because they reduce the returns from investment, thereby reducing the amount of business investment that takes place in Canada. With increasingly mobile capital, Canada must build an internationally competitive corporate tax system that will attract and retain business investment. The tax relief measures in Budget 2006 and the Tax Fairness Plan will reduce the general corporate income tax rate from 21 per cent to 18.5 per cent by 2011; eliminate the corporation surtax for all corporations in 2008; and has eliminated the federal capital tax. Budget 2007 will further enhance competitiveness by increasing capital cost allowance rates for manufacturing buildings and other assets to better reflect useful life. As a result of these tax reductions, Canada will have a meaningful marginal effective tax rate advantage over the United States, and will move to the third-lowest tax rate on new business investment in the G-7 by 2011.<sup>21</sup>



In recent years, OECD countries have been reducing their level of direct support for industrial R&D, and using more indirect incentives, such as tax credits. Canada's SR&ED tax incentive program is one of the most advantageous systems in the industrialized world for promoting business investment in R&D, providing over \$3 billion in tax assistance to innovative Canadian businesses in 2006. It is the single largest federal program supporting business R&D in Canada, and it will continue to play a leading role in fostering a competitive and dynamic business environment in Canada. The SR&ED tax incentives are supplemented by similar measures in most provinces. The government continually monitors the effectiveness of SR&ED tax incentives.

Regulation and S&T are fundamentally interconnected. Science and technology inform the development and management of federal regulations in areas such as health and safety and environmental protection, ensuring that requirements imposed by government continue to be technically feasible and economically sound. Good regulatory practice means managing risks and opportunities.

The experience in Canada and other OECD countries in recent years confirms that regulation, done right, encourages innovation by setting standards for industry to meet in upgrading products and processes. For instance, when strong, clear environmental laws and regulations work with market forces, governments create incentives and conditions in which businesses and people protect our natural environment and respond to environmental challenges with entrepreneurial innovation. Strong environmental protection laws preserve our natural heritage, attract "new economy" firms and entrepreneurs, and incubate world-leading environmental protection industries.

Canada's new Chemicals Management Plan is part of the government's comprehensive environmental agenda. This \$300-million initiative will make Canada a world leader in assessing and regulating chemicals that are used in thousands of industrial and consumer products. It will improve our environment and protect the health and safety of Canadians through scientific risk assessments of legacy chemicals.

At the same time, it is essential to ensure that effective regulatory approaches are in place to tackle the increasingly important intellectual property, information-sharing, and confidentiality issues that are part and parcel of life in the 21st century. The challenge is to ensure that Canada's regulatory framework supports the delivery of S&T benefits to Canadians.

There are opportunities to increase cooperation and coordination on S&T-related regulatory issues among federal, provincial, and territorial governments, and with our continental neighbours and trade partners.



Consequently, we must promote better international regulatory cooperation as it relates to S&T. Through the Security and Prosperity Partnership, for example, the Government of Canada is already working with the United States and Mexico to encourage the compatibility of regulations and reduce redundant testing and certification requirements in the S&T area. We must also continue to improve the cost-effectiveness of regulatory processes affecting S&T, strengthen performance and accountability measures, and develop and implement regulations in a more timely way.

Work is under way by Health Canada to move beyond international standardization in the regulation of health products to include international work sharing in order to take advantage of international expertise, sustain the high standard of safety and efficacy assessments, and continue to improve product review times.

The biotechnology landscape is rapidly becoming more complex and global: science has produced a second wave of biotechnology products with diverse regulatory, social, and ethical implications, and international competition to commercialize these products is much more intense. At the same time, governments worldwide are investing heavily in nanotechnology, the challenges and opportunities of which are yet to be fully realized. Both of these areas of innovation will need to be supported by strong science and effective regulation to protect human health and the environment while supporting Canadian competitiveness.

Canada's financial institutions and capital markets have a role to play in ensuring that innovative businesses have access to appropriate financing to enable them to reach their potential. One avenue for businesses to finance growth is through venture capital. Keeping Canada's financial institutions and markets innovative and competitive, with a flexible regulatory framework founded on sound principles, will ensure that they continue to meet the needs of our growing economy. Regular reviews of financial institution statutes will contribute to encouraging this environment, as will reduced barriers to international capital flows. For example, Budget 2007 announced significant developments that will facilitate access by Canadian entrepreneurs to venture capital from the United States. Most notably, agreement in principle has been reached on changes to the Canada-U.S. tax treaty, including treaty recognition of limited liability companies and the elimination of source-country withholding tax on interest. Another important change is the removal of non-resident tax clearing requirements ("section 116 certificates") for shares that are listed on any stock exchange in any OECD country with which Canada has a tax treaty. These measures address longstanding concerns of the venture capital sector.



## Policy Commitments

Canada's federal government will create a business environment that is conducive to greater private-sector innovation by:

- Ensuring competition policies provide competitive marketplaces. As announced in Budget 2007, the government will task an expert, independent panel to undertake a comprehensive review of Canada's competition policies.
- Encouraging foreign direct investment in Canada.
- Establishing the lowest tax rate on new business investment in the G-7. Budget 2007 proposes measures to allow Canada to become one of the most investment-friendly countries in the G-7 by providing assistance to the manufacturing sector to invest in machinery and equipment, aligning capital cost allowances with useful life, and providing a financial incentive to the provinces to facilitate the elimination of provincial capital taxes.
- Identifying opportunities to improve the Scientific Research and Experimental Development (SR&ED) program, including its administration, to further encourage R&D within the business sector in Canada.
- Putting in place an effective, forward-looking, and responsive regulatory environment that promotes a competitive marketplace and protects the health and safety of Canadians and the environment. As part of this effort, federal regulatory departments and agencies will develop a plan to ensure biotechnology, nanotechnology, and ICT products, services, and technologies are regulated responsibly and in a timely manner, drawing on international best practices and benchmarks. As announced in Budget 2007, the government will invest \$9 million over two years to make Canada a best-in-class regulator by ensuring that efficiency and effectiveness are key considerations in the development and implementation of regulations through a new Cabinet directive on streamlining regulation.
- Fostering a leading-edge financial system.
- Considering new or different approaches to stimulate the supply of venture capital in Canada, including working to attract institutional investments in Canadian funds. Budget 2007 announced agreement in principle on the major elements of an updated Canada-U.S. Tax Treaty, including addressing tax barriers to improve access to U.S. venture capital by Canadian entrepreneurs.



## 3.2 Pursuing Public-Private Research and Commercialization Partnerships

Partnerships of researchers and entrepreneurs are important because they bring research strengths to bear on market-driven challenges and opportunities. There is a role for public support for such partnerships because the benefits they provide spread across the economy. The federal government already supports research collaborations between researchers in the public and private sectors. For example:

- The Networks of Centres of Excellence program brings university and industry researchers together, under the leadership of the university, to advance S&T developments with practical applications. To date, centres have spun off 117 companies and contributed to the development of more than 6,000 highly qualified professionals, including researchers, post-doctoral fellows, graduate students, and technicians.<sup>22</sup> There are opportunities to generate even greater commercial outcomes from this program by creating new networks that are proposed and led by the private sector.
- The Natural Sciences and Engineering Research Council's College and Community Innovation Pilot Program is enabling community colleges to help Canadian businesses address practical technology-based challenges and opportunities. It is also exposing college students to business work environments. There are opportunities to further enable colleges to support innovation in communities across the country.
- Global leadership in research and commercialization requires large-scale facilities operating at world-class levels of excellence. Such facilities produce outstanding research and market innovations, help attract leading researchers to Canada, provide unique training opportunities for young Canadians, and contribute to the growth of innovative industries and firms. They also provide opportunities to lever international resources.

The Perimeter Institute for Theoretical Physics in Waterloo, Ontario, is an example of a world-renowned research institute. Since its creation in 1999, the Perimeter Institute has become a leader for Canadian research in the emerging field of quantum physics and a model for science education and outreach. The Medical and Related Sciences Discovery District (MaRS) in Toronto is a good example of a major commercialization facility. It brings together, in the same building, leading health researchers, investors, businesses, and legal, banking, and other commercialization services in a creative and collaborative environment.



**Budget 2007 announced support for Canadian research and commercialization centres capable of global leadership:**

Perimeter Institute for Theoretical Physics at the University of Waterloo.

Brain Research Centre at the University of British Columbia.

Canada School of Sustainable Energy at the University of Alberta, the University of Calgary, and the University of Lethbridge.

Li Ka Shing Knowledge Institute at St. Michael's Hospital, affiliated with the University of Toronto.

Heart and Stroke Foundation Centre for Stroke Recovery, affiliated with the University of Toronto and the University of Ottawa.

Montreal Neurological Institute at McGill University.

National Optics Institute in Québec City.

Life Science Research Institute in Halifax, affiliated with Dalhousie University.

The benefits from large world-class facilities are highest when there is close collaboration between research institutes, governments, and the private sector to reflect joint priorities, combine strengths and expertise, and share resources. Canada needs a more effective and efficient way to identify research and commercialization opportunities where we have the potential to be world-class and to bring together the partners and resources required to achieve world-leading excellence.

- Efforts to support the transfer of technology from Canadian universities to the private sector are resulting in spin-off companies, technology licensing agreements, and patent filings. More can be done to encourage technology transfer at both ends of that process. A review will be launched to uncover factors that might be inhibiting S&T collaboration between industry and the higher-education sector (universities and colleges). This review will include an assessment of whether a new approach to intellectual property management of university research is warranted. In the meantime, the government will pilot new approaches to university and government laboratory technology transfer; greater involvement by the private sector in the design of these new approaches is needed.

The granting councils support knowledge transfer and the commercialization of university research through a number of initiatives, including CIHR's Proof of Principle Program, NSERC's Idea to Innovation Program, and SSHRC's Knowledge Impact in Society Program.



## Policy Commitments

Canada's federal government will strengthen public-private research and commercialization partnerships by:

- Introducing new business-led research networks under the Networks of Centres of Excellence (NCE) Program in order to bring together government, private, and academic experts from around the world to support applied research in environment, energy, ICT, and health priorities, through a competitive, national process. As announced in Budget 2007, the government will provide \$11 million in 2008-09 to accelerate the creation of new business-led NCE networks.
- Establishing a new Centres of Excellence in Commercialization and Research program. In partnership with other levels of government and the private sector, federal support will help Canada to achieve a critical mass of capacity in strategic areas of scientific opportunity and competitive advantage. As announced in Budget 2007, the government will provide \$350 million over three years to support eight large-scale centres of research and commercialization in priority areas where Canada has the potential to be a global leader (see page 57) and to fund other centres that operate at international standards of excellence, as determined through international peer-reviewed competitions.
- Developing new approaches to transfer knowledge and technologies from universities, research hospitals, and government laboratories to the private sector.
- Encouraging collaboration between community colleges and local firms to support the development, adaption, and adoption of new technologies. As announced in Budget 2007, the government will provide \$48 million over five years to make the College and Community Innovation pilot a permanent program and support more college-industry partnerships.
- Creating a new tri-council private-sector advisory board for the granting councils to provide advice on the implementation of business-driven Networks of Centres of Excellence, Centres of Excellence in Commercialization and Research, and the college initiatives.





### 3.3 Increasing the Impact of Federal Business R&D Assistance Programs

Federal and provincial departments and agencies deliver a range of programs to increase private-sector innovation. These initiatives provide loans, grants, contracts, and repayable contributions to firms using a variety of mechanisms, including government programs, arm's-length foundations, and international organizations.

For instance, the National Research Council of Canada's Industrial Research Assistance Program (IRAP) helps Canadian small and medium-sized businesses access, develop, exploit, and apply technologies to create new products, services, and industrial processes. IRAP's field force of 260 advisors gives firms access to a unique national network of highly specialized technical and business experts in more than 100 communities across Canada. The Business Development Bank of Canada plays an important role in stimulating the supply of venture capital available to emerging technology companies. It provides early-stage venture capital through direct investments in firms and by helping to capitalize funds managed by venture capital partners. Sustainable Development Technologies Canada supports the development of environmental technologies and their introduction into the marketplace.

Greater cooperation and alignment among federal programs, and between federal and provincial programs, could generate efficiencies and increase the effectiveness of these efforts. Alignment is particularly important for emerging technologies, such as biotechnology developments, given their long development times and high development costs.

Early opportunities to improve outcomes from particularly large federal programs with national reach, including the Business Development Bank of Canada, the Natural Sciences and Engineering Research Council, and the National Research Council of Canada, warrant priority attention. The Government of Canada will also continue to engage the provinces in discussions designed to align programs and improve outcomes.

In addition to improving alignment and partnerships in business R&D support, the Government of Canada will continuously improve the impact and effectiveness of individual programs. The Strategic Aerospace and Defence Initiative is an example of this, representing a new approach to supporting R&D excellence and partnerships in Canada's aerospace, defence, security, and space industries. It replaces the former Technology Partnerships Canada.



## Policy Commitments

Canada's federal government will improve the impact and efficiency of federal R&D business assistance by:

- Replacing Technology Partnerships Canada with a new program, the Strategic Aerospace and Defence Initiative. This program will support excellence in aerospace and defence R&D.
  - Aligning the programs and activities of existing organizations to increase commercialization outcomes. In the first instance, the National Research Council of Canada, the Natural Sciences and Engineering Research Council of Canada, and the Business Development Bank of Canada will implement a plan to work more effectively together to support the commercialization of research in Canada. This exercise could be broadened to include other departments and agencies over time.
  - Working with the provinces and territories to improve commercialization outcomes.
-

*Chapter*

**4**



# KNOWLEDGE ADVANTAGE –

**A 21st-Century Research Plan**





Consistent with the directions set out in *Advantage Canada*, the Government of Canada will help to make our country more productive and competitive by positioning Canadian researchers at the leading edge of the important developments that generate health, environmental, societal, and economic benefits. We will do this by:

- Focusing strategically on research in the national interest from a social and economic perspective.
- Maintaining our G-7 leadership in public R&D performance.
- Enhancing value for money, accountability, and the responsiveness of Canada's three granting councils.
- Exploring new approaches to federally performed S&T.

## 4.1 Focusing Strategically on Research in the National Interest

The federal government will continue to play an important role in supporting basic research. University research generates tremendous benefits that are not predictable at the outset. It is important for society and for Canada's private sector that universities continue to explore lines of enquiry that will seed longer-term social and economic opportunities.

While basic research is a necessary foundation for advancing knowledge and innovation, Canada must increasingly harness science and technology to meet our social and economic needs. By setting research priorities, the government will focus funding, build partnerships, and lever Canada's public research base to address social and economic challenges and maximize our competitive advantage.

The Council of Canadian Academies has identified Canadian S&T strengths and opportunities in areas where Canada can leverage our research strengths to achieve economic and social advantage. These include:<sup>23</sup>

- Environmental science and technologies.
- Natural resources and energy.
- Health and related life sciences and technologies.
- Information and communications technologies.



The granting councils and the National Research Council of Canada, in collaboration with other federal funding partners that support higher-education research, such as the Canada Foundation for Innovation, will work together to build a critical mass of expertise in these priority areas. They will support multidisciplinary research that brings together expertise from diverse fields, including natural sciences and engineering, social sciences and humanities, and health sciences. The councils will report annually on their collective progress.

This will build on and complement other federal initiatives that support important S&T advances in these priority areas.

The Minister of Industry will periodically renew research priorities, in consultation with other federal government departments and provincial departments responsible for innovation. To inform this process, the government has asked the Council of Canadian Academies to undertake periodic assessments of Canada's S&T strengths, weaknesses, and opportunities.

#### **EcoENERGY Technology Initiative**

The federal government will invest \$230 million over four years to support the research, development, and demonstration of clean-energy technologies. The EcoENERGY Technology Initiative will accelerate the development of new clean energy technologies in the areas of carbon dioxide sequestration, clean coal, clean oil sands production, and renewable energy, helping Canada to become a *clean* energy superpower.



### **Policy Commitments**

Canada's federal government will target resources that support world-class research excellence in areas of social, environmental, and economic opportunities for Canada by:

- Directing resources to priority areas where Canada can build global research and commercial leadership: environmental science and technologies, natural resources and energy, health and related life sciences and technologies, and information and communications technologies. Federal funding agencies will coordinate their efforts to support research priorities and report on progress. As announced in Budget 2007, the government will provide \$85 million per year in new resources to the granting councils for priority research, \$30 million to the Rick Hansen Foundation to keep Canada at the leading edge of spinal cord research, \$500 million over seven years to Sustainable Development Technology Canada to help Canada become a world leader in developing and commercializing next-generation renewable fuels, and \$100 million to Genome Canada to position Canada as a world leader in genomics and proteomics research.



## 4.2 Maintaining Our G-7 Leadership in Public Research and Development Performance

Canadian governments and higher-education institutions performed more than \$12 billion of R&D in 2005, representing 0.9 per cent of Canada's GDP. The Government of Canada's contribution was significant, with a \$4.7 billion investment in higher-education R&D and in its own (intramural) R&D. These investments helped put Canada in a leadership position, ranking first among G-7 countries.

### Public R&D performance of G-7 countries as a share of GDP

Canada	0.90 per cent (2005)
France	0.78 per cent (2005)
Germany	0.76 per cent (2005)
Japan	0.73 per cent (2004)
United States	0.69 per cent (2004)
United Kingdom	0.58 per cent (2004)
Italy	0.56 per cent (2004)

Source: OECD 2006

In addition to its own research activities, the federal government provides significant support for research activities in the higher-education sector, including universities, colleges, and research hospitals. Federal support targets all aspects of the post-secondary research enterprise, including:

- Direct research support provided through the federal granting councils.
- Support for the indirect costs associated with federally sponsored research through the **Indirect Costs of Research Program**.
- Funding to attract and retain leading scientists and future research leaders, including through the **Canada Research Chairs Program**, which supports 2,000 research chairs in universities across the country.
- Support for leading-edge research infrastructure, including through the **Canada Foundation for Innovation**, a not-for-profit corporation that funds research equipment and facilities at universities, colleges and research hospitals, and through **CANARIE**, a not-for-profit corporation that manages an ultra-high-speed research network linking universities, research centres, government research laboratories, and schools to each other and with international peer networks.
- Support for global networks of top researchers and students, including through the **Canadian Institute for Advanced Research (CIAR)**, a not-for-profit organization that enables Canadians to participate in and lead groundbreaking research on the international stage.

This comprehensive approach ensures that all aspects of our post-secondary research environment are globally competitive, enabling Canada to generate the new discoveries and the highly skilled graduates we will need to succeed in the knowledge-based economy.



## Policy Commitments

Canada's federal government will maintain Canada's G-7 leadership in public-sector R&D performance by:

- Making new investments in R&D, including through the granting councils, in areas where Canada has the potential to be a world leader. Budget 2007 announced increased support for targeted research in priority areas (see page 64).
- Ensuring that higher-education institutions have the leading-edge research equipment and facilities required to compete with the best in the world. As announced in Budget 2007, the government will provide \$510 million to the Canada Foundation for Innovation to support state-of-the-art higher-education research infrastructure in another major competition before 2010, and \$120 million to CANARIE to maintain and further develop its research broadband network.
- Supporting leading-edge domestic and international research and networks in areas of strategic importance to Canada. As announced in Budget 2007, the government will provide \$10 million over two years to the Canadian Institute for Advanced Research to strengthen academic global research networks.
- Encouraging a supportive higher-education research environment, including through ongoing support to the Indirect Cost of Research program. As announced in Budget 2007, the government will provide an additional \$15 million per year to the Indirect Cost of Research program to help post-secondary institutions support the additional research activities enabled by the new resources provided to the granting councils for priority research.

## 4.3 Enhancing Value for Money, Accountability, and the Responsiveness of Canada's Three Granting Councils

In keeping with the 2006 Budget commitment, the government completed a review of the accountability and value for money of the granting councils' activities. The International Review Panel of the Canadian Institutes for Health Research and an examination of the Natural Sciences and Engineering Research Council and Social Sciences and Humanities Research Council identified opportunities to strengthen outcomes and improve accountability to Canadians.





The granting councils are taking steps to improve governance arrangements. For instance, through recent initiatives such as quarterly reporting on activity and results, the Natural Sciences and Engineering Research Council is working to strengthen reporting to government. By enhancing the role of the external Vice-President of its council, the Social Sciences and Humanities Research Council is increasing its openness to the views of the community and oversight of the President and staff.

The granting councils will continue to improve their responsiveness and accountability to the government, research community, and wider public. Currently, the President of each granting council also serves as its Chair. These roles should be separated, in keeping with good governance practices. In addition, the councils' membership should be drawn from users of research and non-academic research communities to ensure that investment decisions reflect a broader view of Canada's economic and national needs and opportunities.

The government can improve value for money by developing a more comprehensive approach in its management of the overall envelope of support for higher-education R&D. This includes ensuring the right balance in funding for researchers, direct and indirect costs of the research they perform, research infrastructure, and research networks.

The granting councils should continue to improve client service to the research community. As more and more research questions cross disciplinary boundaries, it is important to ensure an efficient grant application system that recognizes and addresses this fact. Access to a suite of well-integrated and aligned programs across the granting councils will reduce the administrative burden on researchers, allowing them more time to focus on their research.

The selection of world-class research initiatives requires a competitive process that is informed by international developments. There are currently differences among Canada's three granting councils in the extent to which they rely on international experts to select world-class projects for funding, the competitiveness of their grant review processes, and the form and level of support provided. These differences call for careful consideration to identify best practices and ensure public funding supports international levels of research excellence.



## Policy Commitments

Canada's federal government will enhance accountability and value for money from the granting councils by:

- Improving governance measures, including by separating the functions of the Chair and President of the granting councils. As the government fills vacancies on the councils' governing bodies, it will seek out more business and community representation to ensure that the composition of granting council governing bodies reflects Canada's broad economic and national interests.
- Adopting a more integrated approach to support academic research and improve client service. Funding agencies will develop a plan to consolidate, integrate, and align programs.
- Ensuring that grant application procedures are competitive and promote international excellence. As part of their plan to improve program coordination and integration, the granting councils will jointly review their research application procedures and funding allocation processes to identify best practices, in consultation with university and research stakeholders, and make appropriate changes.

## 4.4 Exploring New Approaches to Federally Performed Science and Technology

The federal government invested \$5 billion in 2005 on its own S&T initiatives. This included over \$2.2 billion for government R&D, and \$2.7 billion for related scientific activities (data collection, testing and standards development, feasibility studies, and education support such as scholarships). These investments allow the government to uphold regulatory, public policy, and operational mandates in important areas such as health care, food safety, and environmental protection.

### **Federal Science at Work for Canada**

Discoveries and innovations from the National Research Council of Canada include roadside emissions testing devices, green energy solutions (from ocean tides, biomass conversion, gas turbines, and wind and fuel cell technologies), "greener" plastics, next-generation electric hybrid technologies, ecosystem surveillance technologies, and environmental monitoring standards.



In some instances, science is best performed by federal departments and agencies. For example, some aspects of science activities supporting the regulation of products and technologies may need to reside within government for reasons of public trust. Yet in other instances, federal science can benefit from partnerships with others.

To fulfill their mandate and serve Canadians, federal science-based departments and agencies must be in a position to set and implement policy on a wide variety of issues. This means having the right assets and highly trained personnel, and using the latest scientific methods in support of decision-making.

Sound science is the foundation on which the government manages the diverse range of human activities in our waters, including fishing, aquaculture, transportation, and oil and gas exploration. Because these decisions can affect people's lives in a variety of ways—from the livelihood of Canadians in coastal communities to the protection of the environment for current and future generations—decisions must be based on the highest-quality science available. In turn, this requires cutting-edge technology in the hands of top-notch researchers, long-term monitoring, data management, and the ability to interpret and transform new knowledge into sound science advice.

Looking forward, a number of federal science organizations are challenged by an aging infrastructure and workforce, and will need to explore new approaches to ensure that they are adequately resourced, effectively managed, and squarely focused on delivering results. At the same time, how the federal government invests in S&T in order to fulfill its regulatory, public policy, and operational mandates must take into account the fundamental changes that have taken place in Canada's S&T system and the context in which the government operates.



The Council of Science and Technology Advisors recently examined the changing environment affecting the federal government's S&T effort. S&T capacity is now widely distributed across the innovation system, with competence in key areas frequently residing in academia and industry. Recognizing this, federal departments and agencies have developed a wide range of domestic and international partnerships to bring together the knowledge and talent necessary to address today's increasingly complex and interdisciplinary policy and regulatory issues, and stimulate innovation in the economy.

We must aggressively break down the barriers that stand in the way of more strategic S&T collaborations among federal departments and agencies and between the federal S&T community and universities, industry, and the non-profit sector. Collaboration on S&T issues is sometimes impeded by legislative, policy, regulatory, financial, infrastructure, human resource, and cultural factors. Differences in intellectual property policies and management arrangements, for instance, may present particular obstacles for collaboration between federal science-based departments and agencies and universities and colleges. The challenge now is to develop effective, results-based strategies and approaches for overcoming these barriers. The Assistant Deputy Ministers Committee on S&T is the whole-of-government coordinating committee for science-based departments and agencies and is the appropriate venue to continue efforts aimed at strengthening S&T collaborations.

At the same time, we must continue to explore and develop innovative new models for S&T collaboration between federal departments and agencies and other sectors. As set out in *Advantage Canada*, the government has committed to consider transferring the management of some non-regulatory federal laboratories to universities in order to lever university and private-sector strengths, create better learning opportunities for students, and foster research excellence.



### **Federal S&T Partnership Initiatives**

The National Institute for Nanotechnology—a National Research Council of Canada, University of Alberta, and Government of Alberta partnership—combines the strengths of a federal laboratory and a university to position Canada at the forefront of nano-scale discoveries that are expected to generate significant benefits in such areas as health and the environment.

Through the Chemical, Biological, Radiological/Nuclear Research Technology Initiative, Defence Research and Development Canada is leading a network of federal, industrial and academic laboratories to increase Canada's knowledge and preparedness to respond to security threats.

The Canadian Space Agency's space missions are based on collaboration with industry partners and university-based principal investigators. For example, the main structure and instrumentation of SCISAT, the Canadian satellite studying the ozone layer, were developed by the private sector. The science program is led by a team of experts from universities across Canada, as well as the U.S., Belgium, France, Japan, and Sweden. This S&T Strategy will guide a strategic review of the Canadian Space Program, including its contribution to international space exploration initiatives.

The National Research Council of Canada's Technology Clusters Initiative is encouraging research partnerships between federal, provincial, and municipal governments, industry, and the higher-education sector. This initiative is accelerating the commercialization of new technologies produced by small and medium-sized firms. It is also building regional S&T capacity in key sectors and industries across Canada, including ocean technologies (St. John's, Newfoundland and Labrador), aluminum technologies (Saguenay-Lac-St-Jean, Quebec) and fuel cells and hydrogen technologies (Vancouver, British Columbia).



## Policy Commitments

Canada's federal government will protect the public interest and increase the impact of federal S&T investments by:

- Focusing the government's own S&T activities where the federal government is best able to deliver benefits to Canadians, and ensuring that federal departments and agencies have access to the S&T capacity required to fulfill their important policy and regulatory mandates in areas such as health, environment, and safety. Budget 2007 announced \$39 million over two years for Department of Fisheries and Oceans science research programs to strengthen fisheries management and resource conservation, and \$10 million to Public Safety Canada to expand the activities of the Canadian Police Research Centre which supports S&T in policing and public safety.
- Launching an independent expert panel to report to the President of the Treasury Board on options for transferring non-regulatory federal laboratories to universities or the private sector, and identify up to five laboratories that could be early candidates for transfer. As announced in Budget 2007, the government will relocate Natural Resource Canada's CANMET Materials Technology Laboratory to new state-of-the-art facilities at the McMaster Innovation Park in Hamilton, Ontario.
- Enhancing collaboration within the federal S&T community and developing improved approaches for fostering research, talent, knowledge transfer, and commercialization among science-based departments and agencies, universities and colleges, and the private sector. As part of this effort, the government will review its own intellectual property policies to ensure they do not impede S&T collaboration and technology transfer, and strengthen collaboration among science-based departments and agencies through the revitalization of the Assistant Deputy Ministers Committee on S&T.

*Chapter*

5



# PEOPLE ADVANTAGE —

**Growing Canada's Base  
of Knowledge Workers**







Talented, skilled, creative people are the most critical element of a successful national economy. It is through the talent of Canadians in their capacity as researchers, scientists, teachers, managers, and investors that we bring innovations to life. Our environment must give them the freedom and the motivation to investigate and innovate.

Canadians' S&T achievements have been and will continue to be important, making our families and communities better places within which to live, work, and learn.

"... if Canada and the United States are going to continue to be the source of the pioneering breakthroughs that are the foundation for economic prosperity, both countries must take a long, hard look at what they are doing—and not doing—to make sure that their companies have access to the brightest, smartest and the most creative thinkers in the world."

Bill Gates, "At Risk: innovation," *The Globe and Mail*, February 8, 2007, p. A17.

The Government of Canada understands the far-reaching implications of science and technology discoveries and applications, and the endless possibilities they provide: more educational and professional opportunities, more prosperous living for individuals and families, and healthier communities.

The following policies and initiatives, outlined in *Advantage Canada*, will help Canada keep its best and brightest, attract talent from around the world, and enhance the quality of our existing workforce by:

- Making personal income taxes more competitive.
- Working with the provinces and territories to modernize labour market programming.
- Aligning immigration policies to our needs.
- Ensuring immigrants are able to contribute to their full potential.
- Attracting more foreign students and making it easier for them to stay in Canada.
- Increasing labour market flexibility and efficiency, and reducing barriers to mobility.
- Modernizing supports to learners and making post-secondary education more accessible.



Compared with other countries with which we are competing for jobs, talent, and investment, Canada's personal tax rates remain high. The measures introduced by the government—through Budget 2006, the Tax Fairness Plan, and Budget 2007—will provide almost \$38 billion in tax relief for individuals over 2006-07 to 2008-09. In addition to reducing the overall tax burden, a number of these measures will also support greater labour market participation (e.g., the Canada Employment Credit, the Working Income Tax Benefit, and allowing phased retirement for older, more experienced workers). *Advantage Canada* committed the government to continue to reduce personal income taxes to attract and retain highly skilled workers, increase the incentives for Canadians to succeed here in Canada, encourage all workers to invest in education and training, and encourage firms that employ highly skilled workers to invest in Canada.

#### **Learning more about Canada's scientists**

Canada's museums and science centres across the country celebrate our scientists, thinkers, and innovators (<http://www.canadiansciencecentres.ca/main.htm>). The Canadian Science and Engineering Hall of Fame of the Canada Science and Technology Museum honours individuals whose outstanding scientific or technological achievements have had long-term implications for Canadians (<http://www.sciencetech.technomuses.ca>). Online exhibits such as "The Gee in Genome!" at the Canadian Museum of Nature (<http://nature.ca/genome>) provide windows into the activities of our leading researchers.

In certain regions of the country, the economy is growing so quickly that employers are having difficulty finding enough workers to meet needs in key occupations. At the same time, skilled workers are dwindling in key occupations, particularly the skilled trades, as many are approaching retirement and there are not enough younger skilled workers to take their places. Increasing the labour market participation of under-represented Canadians, better aligning immigration policies to our labour market needs and initiatives such as the modernization of labour market programs will help increase labour supply. Skilled individuals from around the world have the knowledge and experience to complement Canada's homegrown talents.



Improved labour market information and foreign credential recognition, and reduced barriers to mobility, will enhance labour market efficiency. Providing good labour market information will help workers locate suitable jobs and employers find the people they need. Reducing barriers to labour mobility and improving credential recognition will help employers in need of skilled labour find the skills and workers they need more quickly and effectively. It will also improve the job matching process.

Post-secondary institutions are critical in providing Canadians with the knowledge and skills they need to succeed in the labour market. Colleges and universities have an important role to play in responding to the changing skills requirements of the labour market and supporting the needs of youth and adult learners. As we build a sustainable national competitive advantage for Canada based on S&T, it will be important to invest in the education and skills development of Canadians at all levels of higher education and throughout their lives. The federal government will work in partnership with provincial and territorial governments, who have responsibility for education.

To support these efforts, the Government of Canada is committed to:

- Enhancing opportunities for S&T graduates.
- Increasing the supply of highly qualified and globally connected S&T graduates that businesses and other organizations need to succeed in today's economy.
- Getting Canadians excited about science and technology.

## 5.1 Enhancing Opportunities for Science and Technology Graduates

To compete and win through new technologies and innovative solutions, Canadian businesses need to invest in S&T and hire more talented science and technology graduates. The policy directions laid out in Chapter 3 will help to increase the private sector's demand for S&T workers.

To complement marketplace framework policy initiatives, the federal government can create additional opportunities for skilled graduates by linking them with businesses that can make use of their talents. The government can do so by supporting internship programs that expose students to research opportunities and careers in the private sector. These programs also stimulate business interest in S&T by demonstrating the benefits from hiring highly qualified people.



For example, the Mathematics of Information Technology and Complex Systems (MITACS) Network of Centres of Excellence enables graduate students and post-doctoral candidates to participate in applied research projects with businesses. This initiative aligns student research interests with business needs and creates a new receptor capacity in business for the results of mathematics research. Other internship initiatives supported by the federal government include NSERC's Industrial R&D Fellowships, which place graduates in firms to conduct research, and the Intellectual Property Mobilization Program, which trains next-generation technology transfer experts.

These programs have been successful in increasing private-sector investment in research and researchers, and providing valuable training to our students in business settings. *Advantage Canada* identifies the need to expose more students to private-sector research challenges through internships and targeted collaborative research.

## **5.2 Increasing the Supply of Highly Qualified and Globally Connected Science and Technology Graduates**

To succeed in a global economy that is increasingly driven by knowledge and innovation, Canada will need to increase the participation of Canadians and immigrants in the workforce, and improve the skills and knowledge of Canadians through quality education and skills development. This includes increasing the number of highly qualified graduates in our labour force.

More individuals with graduate degrees in sciences and engineering will be needed to replace retiring workers, and meet stronger demand for S&T skills from the private sector, universities, colleges, and governments. To meet this challenge, the government will work not only to increase the number of workers with advanced education, but also to ensure that they possess the necessary skills and experience to make a difference in a changing world.



In this regard, the Government of Canada supports scholarship programs to encourage Canadians to pursue advanced education and conduct research, both here and abroad, and to attract top students from around the world. The granting councils, for example, provide internationally competitive financial support to the best Canadian graduate students through Canada Graduate Scholarships. These scholarships are provided to the top 2,000 masters and 2,000 doctoral students each year. The granting councils also manage other scholarship programs, including those that support international research and training collaborations.

Scholarships that encourage Canadian students to study abroad have experienced limited uptake possibly because they do not fully offset the added costs associated with foreign study. Scholarships targeted at foreign students are helping Canada to attract more top foreign talent, but we continue to have a smaller share of the world's international student market than other countries like Australia, the United Kingdom, and the United States with similar immigration policies.<sup>24</sup> There are opportunities to strengthen Canada's scholarship initiatives and, consistent with the policy commitment in *Advantage Canada*, market Canada as a destination of choice for international students.

As a nation, we need to ensure that our scholarships in key areas such as natural, social, and health sciences, engineering, and humanities are internationally competitive. This will help to achieve our goals of training and attracting the world-class students and graduates that Canada's research community and economy need.

In addition to supporting scholarship programs, the Government of Canada will make labour market information more accessible and better tailored to the needs of students. Labour market information represents an important trigger for career decisions by students, including the decision to pursue post-secondary education.



## 5.3 Getting Canadians Excited About Science and Technology

Many industrialized countries invest in science literacy to encourage young people to become interested in studying science. These programs can play an important role in stimulating a culture of science, technology, and entrepreneurship.

Canada has a number of S&T promotional activities offered through federal and provincial governments, the private sector, and not-for-profit organizations, including museums, science centres, educational institutions, societies, and foundations. At the federal level, 14 departments and agencies sponsor over 70 science promotion initiatives, at a total cost of about \$24 million per year.<sup>25</sup>

For example, the Prime Minister's Awards for Teaching Excellence and for Excellence in Early Childhood Education, originally created to recognize science and mathematics teachers in elementary and secondary schools, has since been expanded to include teachers in all disciplines and early childhood educators who develop skills for the knowledge-based economy. The program has honoured over 1,100 teachers and about 100 educators. The Youth Outreach Program of the Canadian Institutes of Health Research provides students with the skills, knowledge, and motivation they need to seek a career in health research. By engaging young people early in lecture series, workshops, demonstrations, competitions and lab mentoring, the program increases their interest in exploring career opportunities in this field.

Many science-promotion initiatives in Canada are small in scale and lack a forum to combine their efforts in order to increase their impact. The government will bring these players together to shape a shared vision, and coordinate and focus our respective efforts. The goal of this initiative is to increase the number of people pursuing education and meaningful careers in S&T in Canada.



## Policy Commitments

Canada's federal government will create opportunities for Canadians to acquire skills and use knowledge to create advantages for themselves and the nation by:

- Continuing to reduce personal income tax and make the tax system fairer to ensure that Canada attracts and retains the highly skilled workers necessary to foster innovation and growth. Measures introduced to date by the government through Budget 2006, the Tax Fairness Plan, and Budget 2007 will provide nearly \$38 billion in tax relief for individuals over three years. Budget 2007 also delivers on the Tax Back Guarantee—the government's commitment to use the interest savings from national debt reduction to reduce personal income taxes.
- Modernizing labour market programming, working with the provinces to remove barriers to labour mobility, and improving foreign credential recognition and the Temporary Foreign Worker systems to make it easier for employers to get the skills they need to remain competitive. Budget 2007 takes decisive action, with a new labour market training architecture and initiatives to better align the immigration program with the needs of the labour market.
- Improving the quality of education for Canadians by: providing stable and predictable funding to provinces and territories for post-secondary education; working with them to develop shared objectives and enhance public accountability; modernizing Canada's system of student financial assistance; and marketing Canada's post-secondary education system to attract the best foreign students. As announced in Budget 2007, the government will increase the Canada Social Transfer by \$800 million per year beginning in 2008-09 (growing at 3 percent per year thereafter) for provinces and territories to strengthen the quality and competitiveness of the Canadian post-secondary education system, launch a review of the Canada Student Loans Program, and provide \$2 million over two years to promote Canada internationally as a destination of choice for post-secondary students.
- Increasing support for research internships to expose more students to the private sector; encourage more firms to hire S&T graduates; and increase the number of graduates with both research and business skills and know-how. As announced in Budget 2007, the government will support up to 1,000 interns per year when fully operational, under a new Industrial R&D Internship program modelled after the MITACS program.
- Increasing support for scholarships, including in science and engineering, to encourage more youth to pursue advanced degrees in Canada; support outstanding Canadian graduate students who wish to study overseas; and attract outstanding graduate students and post-doctoral fellows to Canada. As announced in Budget 2007, the government will invest \$35 million over two years, and \$27 million per year thereafter, to expand the Canada Graduate Scholarships. When the new scholarships are fully in place, the councils will support an additional 1,000 students per year.
- Fostering a culture that values and rewards ingenuity and entrepreneurship. The government will develop an action plan that will include increasing the number of people pursuing education and careers in S&T, in consultation with other levels of government, universities, colleges, the private sector, and not-for-profit stakeholders.





*Chapter*

6



# MAKING CANADA A WORLD LEADER

**for Current and Future Generations**





## 6.1 Building a Better Tomorrow through Strategic Partnerships Today

In keeping with one of our core principles—partnerships—the Government of Canada recognizes the importance of working in partnership with provincial and territorial governments to make Canada a better and more prosperous nation.

In June 2006, the provinces and territories presented the Government of Canada with a discussion paper to facilitate a dialogue on S&T issues. There is a shared understanding among all levels of government that S&T is important to the future of our nation and our regions. There is a shared assessment of the key issues and challenges. And there is a shared commitment to work more closely together to position Canada to succeed.

The ideas outlined in this S&T Strategy have benefited from this dialogue with the provinces. The federal government looks forward to implementing this Strategy in collaboration with provincial and territorial governments, and building synergy between federal, provincial, and territorial activities and policies.

It is no longer enough for countries to support S&T only from a national perspective. Canada must be connected to the global supply of ideas, talent, and technologies—as a contributor and in order to adopt and adapt important innovations for the benefit of Canada. The federal government encourages international S&T collaboration through support for multinational collaborative research projects, international S&T missions, outreach activities undertaken by Canadian S&T Councilors and Trade Commissioners, and bilateral S&T agreements with France, Germany, Japan, the European Union, India, and China.

### **Canada-California Strategic Partnership Initiative**

Canada and the State of California have embarked on a strategic partnership to achieve world-class research strength in areas such as cancer stem cell research, infectious diseases, sustainable energy, and ICT/Broadband. Strategic international and inter-sectoral collaboration among governments, researchers, industry, and investors is pointing the way toward new approaches to positioning Canada as a global R&D and innovation leader.



As the Canada-California Strategic Partnership Initiative is demonstrating, there are meaningful opportunities to further strengthen Canada's connection to the global supply of ideas, talent, and technology. Canada needs to do more to encourage international collaboration in order to access the tremendous knowledge being generated elsewhere and lever the enormous potential of such initiatives as the European Union scientific framework program. Canada would also benefit from stronger efforts to attract leading researchers from around the world to contribute to Canadian research priorities.



### **Policy Commitments**

Canada's federal government will make Canada a world leader through stronger domestic and international partnerships by:

- Working with provincial and territorial governments to ensure that our respective policies, programs, and activities together provide the right conditions for S&T advances here in Canada.
- Strengthening Canada's ties to the global supply of ideas, talent, and technology. The government will assess Canada's S&T presence on the international scene and explore options to further improve Canada's ability to contribute to and benefit from international S&T developments, including through the Global Commerce Strategy.

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## **6.2 A Modern Approach to Science and Technology Advice to Government**

In the 1990s, the Advisory Council on Science and Technology was established to advise government on how to create a more innovative economy, the Council of Science and Technology Advisors was established to advise government on how to strengthen the federal science enterprise, and the Canadian Biotechnology Advisory Committee was established to provide government with advice on important policy issues associated with biotechnology. The Government of Canada is grateful to the Canadians who have participated in the work of these advisory bodies. The contribution of senior representatives from the business, academic, and other research communities has made an important contribution to S&T in Canada.



A decade ago, there were many national and uniquely federal issues that warranted the attention of separate bodies. Today the value of this distinction is less clear. A new approach is required. Most S&T issues need to be considered in the context of a system of innovation that considers private, academic, and government interests, and that situates our national interests in an international context. A single external committee would be able to provide more integrated advice, with a stronger voice.

We also need to broaden the mandate of external advisors. Their role in providing advice on S&T policy issues is important and must continue. In addition, arm's-length, independent, and credible advisors can help to mobilize Canadians around an ongoing effort to become one of the world's innovation leaders. This requires a regular assessment of how we benchmark against other countries, and a public forum from which to challenge Canadians and their governments to respond.

The new advisory body will engage businesses, universities, colleges, and governments in a dialogue on important S&T issues referred to it by the government and share its findings broadly. It will include representatives from federal science advisory councils, universities, colleges, and particularly the private sector, given the tremendous importance of private-sector S&T investment to our nation.

The federal government will strengthen its ability to obtain not only policy advice but also assessments of the state of the science underpinning key public policy issues. The Council of Canadian Academies provides in-depth, independent, expert assessments for Canadians of what is known on topics of interest. The Government of Canada has referred questions on gas hydrates, groundwater, and nanotechnology to the Council, and is requesting the Council to now also examine the factors influencing relatively low investment by Canadian businesses in R&D and advanced technologies. In addition, the Council will provide reference letters on shorter-term or unexpected and pressing issues. On behalf of the Minister of Health, the Council is now preparing a reference letter on the transmission of seasonal and pandemic influenza.



## Policy Commitments

Canada's federal government will revitalize external S&T advisory bodies by:

- Consolidating the roles and responsibilities of the Advisory Council on Science and Technology, the Council of Science and Technology Advisors, and the Canadian Biotechnology Advisory Committee into a new Science, Technology and Innovation Council, reporting to the Minister of Industry. The new Council will provide the government with policy advice on S&T issues and produce regular State-of-the-Nation reports that benchmark Canada's S&T performance against international standards of excellence.

## 6.3 Greater Sophistication in Measuring the Impacts of Our Science and Technology Investments

Canada needs a stronger emphasis on achieving, measuring, and demonstrating results to Canadians.

The Government of Canada invested over \$9 billion to support and advance Canada's S&T capacity in 2005. These expenditures supported researchers, universities, research laboratories, and innovative firms in their quest for new knowledge, products, processes, and services. To ensure that these investments are effective in improving Canada's S&T capacity and contributing to our economic and social objectives, it is important to measure the full impact of these initiatives and communicate this back to Canadians. That's why the federal government will increase its effort to develop the indicators and measures that will be used to assess the impacts of government S&T investments.



## Policy Commitments

Canada's federal government will increase its accountability to Canadians by:

- Improving its ability to measure and report on the impact of S&T expenditures. The government will improve its understanding of Canadian S&T developments and the impact of federally performed S&T, and will work with the OECD and other countries to develop metrics that will enable comparisons against international benchmarks of success.



## 6.4 A Better Life for Canadians, Our Families, and Our Communities

Canada's federal government understands the far-reaching implications of science and technology discoveries and applications, and the endless possibilities they provide. Our goal is to seek better lives for individual Canadians and their families: safer streets, better medicines and health care, higher educations that lead to better jobs, and better futures for our children. Science and technology is the way to achieve these important goals.

We understand that science and technology, for example, is crucial to finding solutions to the complex environmental challenges we are facing. Environmental technology will provide us with the knowledge and tools we need to help protect our environment, and to ensure that future generations have clean air, water, land, and energy.

The Government of Canada will do its part, and create a climate of innovation and discovery in our nation.

- For the business community, we will focus on what government does best; providing an enabling environment that promotes private investment in R&D, advanced technologies, and skilled workers.
- For the higher-education community, we will sustain our world-leading commitment to basic and applied research in all domains, while focusing that collective effort more effectively around societal goals that matter to Canadians. We will sustain our commitment to training the next generation of researchers and innovators, upon whom Canada's future success depends.
- For Canadians, we will hold ourselves more accountable for delivering results that make a difference in their lives.



*Mobilizing Science and Technology to Canada's Advantage* sets out a new and more focused approach to mobilize science and technology to our long-term economic and social advantage. It takes into account where we have come from and where we need to go, the changing landscape within which S&T takes place, and international developments. It positions Canada to succeed by addressing our challenges and building on our science and technology strengths. Above all, it recognizes the important role that the private sector and others play in Canada.

The federal government looks forward to implementing this Strategy in collaboration with other levels of government and Canada's S&T leaders over the coming years. Budget 2007 announced funding for a considerable number of initiatives in this Strategy and positions us well to take early action in this regard. Together, we will build a sustainable national competitive advantage based on science and technology and the skilled workers whose aspirations, ambitions, and talents bring innovations to life.

Budget 2007 invests significant new resources in science and technology, totaling \$1.9 billion.

- \$350 million over three years to support leading Centres of Excellence in Commercialization and Research that position Canada for global leadership in priority research areas.
- \$11 million in 2008-09 to create research networks proposed and led by the private sector.
- \$3 million in 2008-09 and \$45 million over the next four years to support partnerships between colleges and industry.
- \$4.5 million over two years to establish a new Industrial R&D Internship Program.
- \$170 million over the next two years in additional funding for the granting councils for research targeted toward key priorities; \$85 million per year thereafter.
- \$30 million over the next two years in additional funding for the indirect costs of federally sponsored research at universities and research hospitals; \$15 million per year thereafter.
- \$510 million to the Canada Foundation for Innovation (CFI) to support the modernization of research infrastructure at Canadian universities, hospitals, and non-profit research organizations.
- \$100 million in 2006-07 to Genome Canada to extend promising research projects and sustain funding for regional genome centres.

*Continued on page 91*





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- \$500 million over seven years to Sustainable Development Technology Canada to invest with the private sector in establishing large-scale facilities for the production of next-generation renewable fuels.
- \$120 million in 2006-07 to CANARIE Inc. to manage and improve Canada's research broadband network over the next five years.
- \$35 million over two years and \$27 million per year thereafter to support an additional 1,000 graduate students through the Canada Graduate Scholarship program.
- \$39 million over the next two years to the Department of Fisheries and Oceans to invest in fisheries science and research.
- \$30 million to The Rick Hansen Man in Motion Foundation, to help Canadians living with spinal cord injuries.
- \$10 million over the next two years to the Canadian Institute for Advanced Research (CIAR) to help Canadian researchers participate in groundbreaking research on the international stage.
- \$10 million over two years for the Canadian Police Research Centre to support science and technology in policing and public safety.
- \$6 million in 2008-09 toward relocating Natural Resources Canada's CANMET Materials Technology Laboratory to the McMaster Innovation Park in Hamilton, Ontario.
- \$2 million over two years for a new international education marketing campaign to promote Canada as a destination of choice for post-secondary students.

The Government also committed to:

- identify opportunities over the coming year to improve the SR&ED program to further encourage research and development within the Canadian business sector; and
- launch an independent expert panel that will consider options for transferring the management of non-regulatory federal laboratories to universities or the private sector.





*A n n e x*

# SUMMARY OF POLICY COMMITMENTS

## **Entrepreneurial Advantage**

**Canada's federal government will create a business environment that is conducive to greater private-sector innovation by:**

- Ensuring competition policies provide competitive marketplaces. As announced in Budget 2007, the government will task an expert, independent panel to undertake a comprehensive review of Canada's competition policies.
- Encouraging foreign direct investment in Canada.
- Establishing the lowest tax rate on new business investment in the G-7. Budget 2007 proposes measures to allow Canada to become one of the most investment-friendly countries in the G-7 by providing assistance to the manufacturing sector to invest in machinery and equipment, aligning capital cost allowances with useful life, and providing a financial incentive to the provinces to facilitate the elimination of provincial capital taxes.
- Identifying opportunities to improve the Scientific Research and Experimental Development (SR&ED) program, including its administration, to further encourage R&D within the business sector in Canada.



- Putting in place an effective, forward-looking, and responsive regulatory environment that promotes a competitive marketplace and protects the health and safety of Canadians and the environment. As part of this effort, federal regulatory departments and agencies will develop a plan to ensure biotechnology, nanotechnology, and ICT products, services, and technologies are regulated responsibly and in a timely manner, drawing on international best practices and benchmarks. As announced in Budget 2007, the government will invest \$9 million over two years to make Canada a best-in-class regulator by ensuring that efficiency and effectiveness are key considerations in the development and implementation of regulations through a new Cabinet directive on streamlining regulation.
- Fostering a leading-edge financial system.
- Considering new or different approaches to stimulate the supply of venture capital in Canada, including working to attract institutional investments in Canadian funds. Budget 2007 announced agreement in principle on the major elements of an updated Canada-U.S. Tax Treaty, including addressing tax barriers to improve access to U.S. venture capital by Canadian entrepreneurs.

**Canada's federal government will strengthen public-private research and commercialization partnerships by:**

- Introducing new business-led research networks under the Networks of Centres of Excellence (NCE) Program in order to bring together government, private, and academic experts from around the world to support applied research in environment, energy, ICT, and health priorities, through a competitive, national process. As announced in Budget 2007, the government will provide \$11 million in 2008-09 to accelerate the creation of new business-led NCE networks.
- Establishing a new Centres of Excellence in Commercialization and Research program. In partnership with other levels of government and the private sector, federal support will help Canada to achieve a critical mass of capacity in strategic areas of scientific opportunity and competitive advantage. As announced in Budget 2007, the government will provide \$350 million over three years to support eight large-scale centres of research and commercialization in priority areas where Canada has the potential to be a global leader (see page 57) and to fund other centres that operate at international standards of excellence, as determined through international peer-reviewed competitions.
- Developing new approaches to transfer knowledge and technologies from universities, research hospitals, and government laboratories to the private sector.



- Encouraging collaboration between community colleges and local firms to support the development, adaptation, and adoption of new technologies. As announced in Budget 2007, the government will provide \$48 million over five years to make the College and Community Innovation pilot a permanent program and support more college-industry partnerships.
- Creating a new tri-council private-sector advisory board for the granting councils to provide advice on the implementation of business-driven Networks of Centres of Excellence, Centres of Excellence in Commercialization and Research, and the college initiatives.

### **Canada's federal government will improve the impact and efficiency of federal R&D business assistance by:**

- Replacing Technology Partnerships Canada with a new program, the Strategic Aerospace and Defence Initiative. This program will support excellence in aerospace and defence R&D.
- Aligning the programs and activities of existing organizations to increase commercialization outcomes. In the first instance, the National Research Council of Canada, the Natural Sciences and Engineering Research Council of Canada, and the Business Development Bank of Canada will implement a plan to work more effectively together to support the commercialization of research in Canada. This exercise could be broadened to include other departments and agencies over time.
- Working with the provinces to improve commercialization outcomes.

### **Knowledge Advantage**

#### **Canada's federal government will target resources that support world-class research excellence in areas of social, environmental, and economic opportunities for Canada by:**

- Directing resources to priority areas where Canada can build global research and commercial leadership: environmental science and technologies, natural resources and energy, health and related life sciences and technologies, and information and communications technologies. Federal funding agencies will coordinate their efforts to support research priorities and report on progress. As announced in Budget 2007, the government will provide \$85 million per year in new resources to the granting councils for priority research, \$30 million to the Rick Hansen Foundation to keep Canada at the leading edge of spinal cord research, \$500 million over seven years to Sustainable Development Technology Canada to help Canada become a world leader in developing and commercializing next-generation renewable fuels, and \$100 million to Genome Canada to position Canada as a world leader in genomics and proteomics research.



### **Canada's federal government will maintain Canada's G-7 leadership in public-sector R&D performance by:**

- Making new investments in R&D, including through the granting councils, in areas where Canada has the potential to be a world leader. Budget 2007 announced increased support for targeted research in priority areas (see page 64).
- Ensuring that higher-education institutions have the leading-edge research equipment and facilities required to compete with the best in the world. As announced in Budget 2007, the government will provide \$510 million to the Canada Foundation for Innovation to support state-of-the-art higher-education research infrastructure in another major competition before 2010, and \$120 million to CANARIE to maintain and further develop its research broadband network.
- Supporting leading-edge domestic and international research and networks in areas of strategic importance to Canada. As announced in Budget 2007, the government will provide \$10 million over two years to the Canadian Institute for Advanced Research to strengthen academic global research networks.
- Encouraging a supportive higher-education research environment, including through ongoing support to the Indirect Cost of Research program. As announced in Budget 2007, the government will provide an additional \$15 million per year to the Indirect Cost of Research program to help post-secondary institutions support the additional research activities enabled by the new resources provided to the granting councils for priority research.

### **Canada's federal government will enhance accountability and value for money from the granting councils by:**

- Improving governance measures, including by separating the functions of the Chair and President of the granting councils. As the government fills vacancies on the councils' governing bodies, it will seek out more business and community representation to ensure that the composition of granting council governing bodies reflects Canada's broad economic and national interests.
- Adopting a more integrated approach to support academic research and improve client service. Funding agencies will develop a plan to consolidate, integrate, and align programs.



- Ensuring that grant application procedures are competitive and promote international excellence. As part of their plan to improve program coordination and integration, the granting councils will jointly review their research application procedures and funding allocation processes to identify best practices, in consultation with university and research stakeholders, and make appropriate changes.

**Canada's federal government will protect the public interest and increase the impact of federal S&T investments by:**

- Focusing the government's own S&T activities where the federal government is best able to deliver benefits to Canadians, and ensuring that federal departments and agencies have access to the S&T capacity required to fulfill their important policy and regulatory mandates in areas such as health, environment, and safety. Budget 2007 announced \$39 million over two years for Department of Fisheries and Oceans science research programs to strengthen fisheries management and resource conservation, and \$10 million to Public Safety Canada to expand the activities of the Canadian Police Research Centre which supports S&T in policing and public safety.
- Launching an independent expert panel to report to the President of the Treasury Board on options for transferring non-regulatory federal laboratories to universities or the private sector, and identify up to five laboratories that could be early candidates for transfer. As announced in Budget 2007, the government will relocate Natural Resource Canada's CANMET Materials Technology Laboratory to new state-of-the-art facilities at the McMaster Innovation Park in Hamilton, Ontario.
- Enhancing collaboration within the federal S&T community and developing improved approaches for fostering research, talent, knowledge transfer, and commercialization among science-based departments and agencies, universities and colleges, and the private sector. As part of this effort, the government will review its own intellectual property policies to ensure they do not impede S&T collaboration and technology transfer, and strengthen collaboration among science-based departments and agencies through the revitalization of the Assistant Deputy Ministers Committee on S&T.



## People Advantage

### **Canada's federal government will create opportunities for Canadians to acquire skills and use knowledge to create advantages for themselves and the nation by:**

- Continuing to reduce personal income tax and make the tax system fairer to ensure that Canada attracts and retains the highly skilled workers necessary to foster innovation and growth. Measures introduced to date by the government through Budget 2006, the Tax Fairness Plan, and Budget 2007 will provide nearly \$38 billion in tax relief for individuals over three years. Budget 2007 also delivers on the Tax Back Guarantee—the government's commitment to use the interest savings from national debt reduction to reduce personal income taxes.
- Modernizing labour market programming, working with the provinces to remove barriers to labour mobility, and improving foreign credential recognition and the Temporary Foreign Worker systems to make it easier for employers to get the skills they need to remain competitive. Budget 2007 takes decisive action, with a new labour market training architecture and initiatives to better align the immigration program with the needs of the labour market.
- Improving the quality of education for Canadians by: providing stable and predictable funding to provinces and territories for post-secondary education; working with them to develop shared objectives and enhance public accountability; modernizing Canada's system of student financial assistance; and marketing Canada's post-secondary education system to attract the best foreign students. As announced in Budget 2007, the government will increase the Canada Social Transfer by \$800 million per year beginning in 2008-09 (growing at 3 percent per year thereafter) for provinces and territories to strengthen the quality and competitiveness of the Canadian post-secondary education system, launch a review of the Canada Student Loans Program, and provide \$2 million over two years to promote Canada internationally as a destination of choice for post-secondary students.
- Increasing support for research internships to expose more students to the private sector; encourage more firms to hire S&T graduates; and increase the number of graduates with both research and business skills and know-how. As announced in Budget 2007, the government will support up to 1,000 interns per year when fully operational, under a new Industrial R&D Internship program modelled after the MITACS program.





- Increasing support for scholarships, including in science and engineering, to encourage more youth to pursue advanced degrees in Canada; support outstanding Canadian graduate students who wish to study overseas; and attract outstanding graduate students and post-doctoral fellows to Canada. As announced in Budget 2007, the government will invest \$35 million over two years, and \$27 million per year thereafter, to expand the Canada Graduate Scholarships. When the new scholarships are fully in place, the councils will support an additional 1,000 students per year.
- Fostering a culture that values and rewards ingenuity and entrepreneurship. The government will develop an action plan that will include increasing the number of people pursuing education and careers in S&T, in consultation with other levels of government, universities, colleges, the private sector, and not-for-profit stakeholders.

## **A Modern Approach to S&T Management**

**Canada's federal government will make Canada a world leader though stronger domestic and international partnerships by:**

- Working with provincial and territorial governments to ensure that our respective policies, programs, and activities together provide the right conditions for S&T advances here in Canada.
- Strengthening Canada's ties to the global supply of ideas, talent, and technology. The government will assess Canada's S&T presence on the international scene and explore options to further improve Canada's ability to contribute to and benefit from international S&T developments, including through the Global Commerce Strategy.

**Canada's federal government will revitalize external S&T advisory bodies by:**

- Consolidating the roles and responsibilities of the Advisory Council on Science and Technology, the Council of Science and Technology Advisors, and the Canadian Biotechnology Advisory Committee into a new Science, Technology and Innovation Council, reporting to the Minister of Industry. The new Council will provide the government with policy advice on S&T issues and produce regular State-of-the-Nation reports that benchmark Canada's S&T performance against international standards of excellence.



**Canada's federal government will increase its accountability to Canadians by:**

- Improving its ability to measure and report on the impact of S&T expenditures. The government will improve its understanding of Canadian S&T developments and the impact of federally performed S&T, and will work with the OECD and other countries to develop metrics that will enable comparisons against international benchmarks of success.



# NOTES

- 1 Consistent with the work of the Council of Canadian Academies, this Strategy defines science and technology “as a *joint* entity, [rather] than as two separate endeavors, hence the symbol “S&T.” It encompasses the traditional disciplines in the natural sciences — the study of nature; the social sciences, humanities and health sciences — the study of human beings; and engineering — the creation and study of artifacts and systems. Our conception of S&T includes, but does not specify, the myriad connections from science to technology and vice versa. It encompasses a very broad concept of technology — the predictable and reproducible application of knowledge in everyday life, in the form of goods, services, organizations, methods and tools.” Council of Canadian Academies, *The State of Science & Technology in Canada* (2006) p. 29. ([www.scienceadvice.ca/study.html](http://www.scienceadvice.ca/study.html))
- 2 Research and Development (R&D): refers to the creative work undertaken on a systematic basis to increase the stock of scientific and technical knowledge and use this knowledge in new applications. It includes experimental development (work done to achieve technological advancement to create or improve new materials, devices, products or processes); applied research (work done to advance scientific knowledge with a specific practical application in view); and basic research (work done to advance scientific knowledge without a practical application in view).
- 3 Jean-Philippe Cotis, “Benchmarking Canada’s Economic Performance”, *International Productivity Monitor*, Number 13 (Fall 2006), p. 3–5.
- 4 OECD, *The Sources of Economic Growth in OECD Countries* (2003).
- 5 Brzustowski, T. “Innovation in Canada: Learning from the Top 100 R&D Spenders” *Optimum Online*. Vol. 36, Issue 4, December 2006.
- 6 Some documents that illustrate this consensus include People and Excellence: The Heart of Successful Commercialization, The Expert Panel on Commercialization, 2006; Reinventing Innovation and Commercialization Policy in Ontario, The Institute for Competitiveness and Prosperity, Working Paper #6, 2004; Striving for Excellence, Canadian Manufacturers and Exporters, 2003; Investing in Innovation, Conference Board of Canada, 2001; and Risk and Reward: Creating a Canadian Culture of Innovation, Business Council on National Issues, 2000.
- 7 Statistics Canada, *Estimates of Canadian Research and Development Expenditure (GERD)*, Cat. No. 88F0006XIE2006009 (September 2006).



- 8 OECD, *Main Science and Technology Indicators 2006/2* (December 2006).
- 9 Statistics Canada, special tabulations for Canada Economic Development, Quebec Regions, 2006.
- 10 Statistics Canada, *Estimates of Canadian Research and Development Expenditure (GERD)*, Cat. No. 88F0006XIE2006009 (September 2006).
- 11 U.K. Department of Trade and Industry, *2006 R&D Scoreboard* (2006).
- 12 Statistics Canada, *The Daily* (November 23, 2005).
- 13 OECD, *ICT and Economic Growth: Evidence from OECD Countries, Industries and Firms*, 2003.
- 14 Industry Canada, Telecommunications Policy Review Panel Final Report (Ottawa: 2006), Chapter 7, p. 12.
- 15 Council of Canadian Academies, *The State of Science & Technology in Canada*, 2006. ([www.scienceadvice.ca/study.html](http://www.scienceadvice.ca/study.html)).
- 16 Thirty-one per cent of the 1,755 Canada Research Chairs that have been created to date were offered to leading researchers from around the world, including 244 Canadians who decided to return to Canada to make their contribution here.
- 17 Only four Canadian universities rank among the top 100 in the world; none ranks among the top 20. *Shanghai Jiao Tong University Index 2006*. [http://ed.sjtu.edu.cn/rank/2006/ARWU2006\\_Top100.htm](http://ed.sjtu.edu.cn/rank/2006/ARWU2006_Top100.htm)
- 18 OECD, *Science, Technology and Industry Outlook*, 2006.
- 19 OECD, *Science, Technology and Industry Outlook*, 2006, pp. 50-51. ([http://www.oecd.org/document/62/0,2340,en\\_2649\\_34273\\_37675902\\_1\\_1\\_1\\_1,00.html](http://www.oecd.org/document/62/0,2340,en_2649_34273_37675902_1_1_1_1,00.html))
- 20 Dominique Guellec and Bruno van Pottelsberghe de la Potterie (2001) estimate that public R&D generates 30 per cent greater spillover benefits across the economy, compared with the more limited (but still important) spillover benefits from private-sector research.
- 21 The marginal effective tax rate is an indicator of the tax burden on new investment. It includes not only the statutory tax rate, but also deductions and credits associated with purchasing capital goods and other taxes paid by corporations. It measures the extra return on an investment required to pay corporate-level taxes, expressed as a percentage of the total return on the investment.
- 22 NCE website: [www.nce.gc.ca/chair\\_e.htm](http://www.nce.gc.ca/chair_e.htm)



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- 23 Council of Canadian Academies, *The State of Science and Technology in Canada*, 2006. ([www.scienceadvice.ca/study.html](http://www.scienceadvice.ca/study.html))
  - 24 Canada attracts 5 per cent of OECD international post-secondary students studying abroad, behind Australia (6 per cent), France (9 per cent), Germany (10 per cent), U.K. (11 per cent), and the U.S. (22 per cent). OECD, *Education at a Glance 2006*.
  - 25 Jeffrey Crelinsten, Impact Group, *The Federal Government's Role in Promoting a "Knowledge Culture"* (September 14, 2006.)

