



**Canada's advanced network for research and innovation—
An essential component of a sustainable knowledge economy**

Pre-budget submission to the House of Commons Standing Committee on Finance

By CANARIE

August 12, 2011

Executive Summary

Science and technology investments that enable innovation are crucial for economic growth in knowledge-based economies. The Government of Canada recognizes the importance of innovation, including the commercialization of research, and has made it a priority. In 2010, the federal government invested approximately \$11B in science, technology and innovation (STI). CANARIE, Canada's Advanced Research and Innovation Network, is an important component of the digital infrastructure that underpins the Canadian STI ecosystem. It enables Canadian universities, colleges, federal and provincial labs and departments, "Big Science" facilities, Networks of Centres of Excellence, and private companies to conduct leading-edge research. This in turn positions Canada as a world-leading innovator and drives long-term economic and social well-being for all Canadians.

For Budget 2012, CANARIE would like to make the following recommendation:

1. Continued investment in CANARIE to increase the effectiveness of government R&D investments, and to help develop a sustainable knowledge economy.

Background

In today's knowledge economy, innovation has become critical to sustaining economic growth and productivity. Basic research and applied research are two of the main pillars of new knowledge creation and innovation that lead to economic growth and sustainable quality jobs. All leading OECD jurisdictions recognize the importance of innovation and have increased investments in science, technology and innovation (STI) related areas to develop the new industries of the 21st century. For example, the European Union has invested €50B through its 7th Framework Program (2007-2014) and has announced plans to increase the funding in the next framework program starting next in 2014.

The Canadian government has also increased its investments in science and technology, amounting to over \$11B annually. For example, in the last budget, the government announced creation of ten new Canada Excellence Research Chairs along with \$300M worth of other investments including investments in a New Media Fund, a new Brain Research Fund, the Perimeter Institute for Theoretical Physics, and NRC's Industrial Research Assistance Program (IRAP).

Digital Tools Enable Innovation

Government investments in digital tools and infrastructure increase the effectiveness of its investments in science and technology. Government support for CANARIE has significantly increased the effectiveness of investments the government makes in the Granting Councils (i.e. NSERC, SSHRC, CIHR) and CFI by enhancing research productivity, enabling access to advanced datasets and tools, and strengthening national and international collaborative efforts.

Using leading-edge technologies, CANARIE deploys and operates dedicated network infrastructure thousands of times faster than typical residential broadband connections. The CANARIE network is made up of 19,000 km of fibre-optic cable and connects over 1,100 facilities across Canada,

including 89 universities, 101 colleges, 125 provincial and federal labs/research parks and over 19 private sector labs. The network provides access to over one million users and in 2010 carried 28,000 terabytes of data, equivalent to twenty times the combined residential Internet traffic in Canada. It connects Canadian researchers and innovators to each other and to the rest of the world, permitting them to seamlessly connect with world-leading experts and participate in global scientific endeavours (e.g. ATLAS, Square Kilometre Array and International Cancer Genome Consortium among others).

The Government of Canada has been at the forefront internationally in terms of investing in digital infrastructure to support leading-edge research. As a result, Canadian researchers are able to conduct world-class research and be major contributors to global scientific efforts like the ATLAS project (which uses data from the Large Hadron Collider at CERN), outGRID (a global infrastructure for neuroscientists investigating brain disease) and HPDMNet (a project building high-capacity solutions to support immersive, interactive entertainment and other large-scale, data-intensive applications). To support leading-edge academic and industrial research, the Canadian Government created CANARIE in 1993.

Changing Needs of Researchers

The needs of the research and innovation community continue to evolve. In particular, very data-intensive research is becoming the norm. Traffic over the CANARIE network has increased 47% per year since 2006, and is expected to continue to grow by 50% per year. As more and more machines create more and more data, and as textual information is being digitized and used by humanities researchers and social scientists, mining and using these data to support innovation and discovery has become the way most cutting-edge research is conducted.

To support this kind of research, Canada needs a robust digital infrastructure that includes high-bandwidth networking, high performance computing, remotely installed sensors and collaborative software platforms. With digital infrastructure like CANARIE, scientists and researchers are able to push the boundaries of exploration and discovery in ways that were unthinkable just a few years ago. For example, using the CANARIE network, researchers are now collaboratively analyzing hundreds of 3-dimensional images of healthy and diseased brains to study neurological disorders; sifting through vast amounts of data to find the antimatter particle (the so-called “God” particle) which can fundamentally alter our understanding of the universe; and monitoring and analyzing environmental data from thousands of sensors on the ground, in the air, and under the sea. These are a tiny fraction of the thousands of research initiatives that are enabled by CANARIE.

Building Blocks of an Innovation-Driven Economy

According to the *State of the Nation* report released by the Science, Technology and Innovation Council (STIC), research and development may be the main components of a sustainable innovative economy but there are other essential elements that must be developed as well. STIC identified the following as essential components of an innovative knowledge economy: a strong talent pool, excellent research, private and public sector institutions that create value from research and development, strong

systematic mechanisms for knowledge transfer and application, and successful commercialization of innovation within the private sector.

In *State of the Nation*, the panel has also concluded that collaboration among innovation stakeholders is crucial to incent innovation and help transfer knowledge from “research labs to marketplace”. The ultimate benefits of innovation are only realized by greater wealth generation for society through translating new knowledge into new products and services sold in local and global markets.

CANARIE’s Role in a Sustainable Knowledge Economy

Since its creation in 1993, CANARIE, the only national high-bandwidth network dedicated to research and innovation, has been a leader in the deployment of new communication technologies such as the Internet, E-mail, Web, large-scale file sharing, and distributed computing. CANARIE received \$120M for the five-year period from 2007-2012 (the equivalent of \$24M per year) with the objective of: 1) delivering and managing the national backbone and 2) advancing network technology across Canada.

The value that is provided through a high-bandwidth network is more than just the number of connections. CANARIE helps implement the government’s research and innovation agenda. The latest innovation policy document from the federal government was released last May in the form of a consultation paper on the Digital Economy Strategy. The paper identified five priority areas that are essential to developing a sustainable digital economy. The chart below demonstrates how CANARIE complements government’s priorities:

Building a world-class digital infrastructure

- CANARIE’s core business, ultra-high-speed networking for advanced research, is a key component of national digital infrastructure
- CANARIE funds the development of world-leading software platforms (NEPs) to allow researchers to leverage the national network, giving them competitive advantage
- CANARIE is a key of provincial and territorial networks, addressing regional disparities

Encouraging businesses to adopt digital technologies

- CANARIE responded to the DES by creating a pilot service (DAIR) specifically designed to encourage ICT SMEs to adopt cloud-based digital technologies and to accelerate the commercialization of those technologies
- CANARIE funds the development of advanced technologies to reduce the carbon footprint of ICT equipment. These Green IT technologies leverage wind and sun energy and position Canada to be a commercial leader in this space

Developing a digitally skilled workforce

- CANARIE develops HQP directly through technology innovation programs and indirectly by providing a key component of digital infrastructure for research
- CANARIE is an innovation leader in Canada, spearheading new technologies like IPv6 and cloud computing

Growing successful Canadian companies

- CANARIE directly supports Canadian ICT SMEs through a pilot service (DAIR) designed to accelerate their time to market and reduce commercialization costs
- CANARIE indirectly supports commercialization of academic research by providing the required digital infrastructure

Creating made-in-Canada content across all platforms

- CANARIE facilitates collaboration and content creation that leverages the network and technology innovations

In its *State of the Nation* report, STIC panel points out that Canada continues to be one of the top countries to invest in research at universities and colleges. The report also acknowledges that Canada has developed a strong pool of talent, including high number of PhDs and other highly qualified personnel (HQP). However, the strong talent pool seems to be underemployed while the research funded at universities and colleges is not being commercialized at a rate that drives meaningful economic benefits.

To accelerate research commercialization, the STIC panel suggested that the government should incent increased collaboration among stakeholders in the innovation ecosystem, including academia and industry. CANARIE has already established relationships with all innovation ecosystem players in Canada, including universities, colleges, private sector companies, governments, and international partners. Therefore, CANARIE is in a strong position to continue to offer advanced infrastructure that would permit greater transfer of knowledge from academia to the private sector and increase the commercialization of research.

CANARIE Increases the Impact of Research Investments

The Government of Canada has increased its focus on the commercialization of research as a way to create sustainable, high-quality jobs. To better facilitate commercialization of research from universities, colleges and other research institutions, the government has created specialized virtual organizations such as the Centres of Excellence of Commercialization and Research (CECRs) and Business-Led Networks of Centres of Excellence (BL-NCEs). In the 2011 budget, the government announced increased investments in research through the Granting councils, funding for a Brain Research fund and a Digital Media fund, and creation of new Canada Excellence Research Chairs.

CANARIE is instrumental in providing advanced networking to all of the research funding recipients mentioned above. The leading-edge research conducted at premier Canadian research institutions requires vast amounts of data to be shared among sparsely located groups of researchers, which is not possible using a regular Internet connection. A typical Internet connection is designed to provide a large user base with limited bandwidth; however leading-edge research requires unlimited bandwidth to a smaller community of researchers and innovators. Enabling today's data-intensive research requires a dedicated high-bandwidth network like CANARIE. All leading OECD countries have publicly-funded, high-bandwidth research and education networks like CANARIE. These networks form part of the critical digital infrastructure required by research and innovation communities to engage in leading-edge, multidisciplinary, collaborative and data-intensive research and development.

Sustainable quality jobs of the future

Leading OECD jurisdictions, including the European Union and United States, have recognized that the jobs of the future will be created through knowledge-based industries that are still in nascent form (e.g. biotechnology, immersive media, new energy sources and technologies, etc). These future industries will require a new kind of support system, analogous to the roads and railways that built Canada in the 20th century:

- A highly skilled workforce, trained with leading-edge technologies
- Interconnected high-bandwidth networks, computing and storage facilities
- New software and tools to support large data sharing and collaboration
- Ability to effectively access, manipulate and analyze vast amounts of research data, wherever it may be
- Public access to research data

Clearly, a robust digital infrastructure is needed to ensure Canada can compete and thrive in the global digital arena.

Recommendations

CANARIE recommends that the Government of Canada continue to invest in the digital infrastructure required to support a sustainable knowledge-based economy in Canada.

1. Continue to invest in CANARIE to increase the effectiveness of government's R&D investments and support the development of a sustainable knowledge economy

According to the STIC report, collaboration among innovation stakeholders is the next big challenge that Canada needs to address in order to further incent innovation. CANARIE, along with other digital infrastructure players, is well positioned to provide the infrastructure required for collaboration. CANARIE helps increase the effectiveness of government R&D investments through increased research productivity and collaboration. The government should ensure that CANARIE is funded to keep our researchers and innovators at the leading-edge globally to develop new technologies that will ensure a sustainable knowledge economy and create quality jobs.