A Pre-Budget Submission to the

HOUSE OF COMMONS STANDING COMMITTEE on FINANCE

Executive Summary

The Canadian Association of Physicists offers the following recommendations to create jobs and increase productivity by increasing the competitiveness of Canadian businesses, providing opportunities for highly trained Canadians to pursue innovative careers, and positioning Canada to lead in the development and implementation of disruptive (transformative) technologies:

Recommendation 1: Expand the NSERC Discovery Grant program at a rate of $15M per year until it reaches a level equivalent to its 2002 level adjusted for inflation and growth in GDP and population, because this program provides a critical foundation for Canadian innovation capacity. [Supports "Productivity", and "Jobs"]

Recommendation 2: That funding of merit-based NSERC Postgraduate and Postdoctoral Fellowship programs be increased by $86 million per year,[1] phased in over 3 years, to a level that can support at least 2500 Postgraduate Scholarships and 300 Postdoctoral Fellowship awards per year to keep pace with the growth of industrial and academic needs for new highly qualified personnel. [Supports "Jobs" and "Productivity"]

Recommendation 3: That current gaps in medium scale infrastructure funding be addressed by two measures: 1) that the CFI MSI fund be renewed and expanded by at least $50M for the next five-year cycle beginning in 2016 to allow for the funding of the operating costs of a larger number of facilities; and 2) that an additional $10M per year be given to NSERC to expand its RTI program to cover equipment up to $1.5M through an annual competition. [Supports "Infrastructure" and "Productivity"]

Background:

The Canadian Association of Physicists (CAP), with 1700 members, is Canada's national association for physicists working in industry, academia and government. The CAP strives to unleash the full potential of physics and physicists for the benefit of Canada. The CAP is recognized and respected for its science and technology expertise, and has testified at House of Commons Committees, including most recently, the Standing Committee on Industry, Science and Technology for a study on the "State of Disruptive Technologies" on June 9, 2015.

[1] For example, 170 more post-doctoral fellowships at $45,000 per year for 3 years, and 1000 more postgraduate scholarships at an average of $21,000 per year for 3 years.

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Canada's international competitiveness and capacity for sustained innovation depend on balanced support of research, including discovery-driven fundamental research. Fundamental research is critical to be competitive in identifying and developing technologies that are transformative, that is, so-called "disruptive technologies."

The CAP's recommendations identify means of support for research that will have positive impacts in three of the Committee's key themes, namely: productivity, infrastructure, and jobs.

Recommendation 1:

One of the most important determinants of knowledge transfer from universities to businesses is the quality and breadth of the research that is pursued in academic settings where highly qualified people are trained before entering the private sector. While market-driven research can address specific issues for industries in the shorter term, it is the fundamental research, characterized by longer timelines and unexpected discoveries, that can generate and incubate unexpected technologies that will become transformative solutions to today's problems and incubate whole new industries of the future.

The core federal program that enables Canada's leadership in fundamental research is NSERC's Discovery Grants program. The 2014 Federal Budget provided an increase of $15 million per year to NSERC, which it is using mainly for the Discovery Grants program. The CAP strongly supports this initiative because it is a good start toward mitigating the ongoing erosion of this program's capacity to meet the demands of the increasing numbers of excellent researchers that are supported by it.

> ***Recommendation 1: Expand the NSERC Discovery Grant program at a rate of $15M per year until it reaches a level equivalent to its 2002 level adjusted for inflation and growth in GDP and population, because this program provides a critical foundation for Canadian innovation capacity.*** *[Supports "Productivity", and "Jobs"]*

Recommendation 2:

One of the most important elements of Canada's innovation landscape is the transfer of knowledge and skills from academic research environments to the private and government sectors via the flow of highly qualified people (HQP) into non-academic careers. A sense of the impact of HQP on the economy can be seen in a recent Stats Can report[2] that found that of doctoral graduates in 2005 trained in computer, mathematics and physical sciences, almost half were employed in non-academic careers. Similar trends were found in a study by the American Institute of Physics of doctoral graduates in physics in 2009 and

[2] Statistics Canada. *Expectations and Labour Market Outcomes of Doctoral Graduates from Canadian Universities.* www.statcan.gc.ca/pub/81-595-m/81-595-m2011089-eng.pdf

2010. These results reflect the value that the quantitative and analytical skills can bring to activities well outside a student's academic discipline.

HQP impact the economy by stimulating and creating employment for others through innovations that create new spin-off companies or increase competitiveness, as confirmed by the OECD: "An economy's ability to encourage research affects its capacity to create new knowledge and stimulate innovation. Increasing specialization and rapid growth in scientific production have made research professionals with advanced research degrees the cornerstone of modern science and innovation systems worldwide."[3] Yet Canada, with 8.2 doctorate holders per thousand population, trails countries like Switzerland (25), Germany (14), the United States (13.5), Great Britain (12.4), and Israel (9.7).[4]

In Canada, NSERC programs support the training of a large proportion of HQP in science.[5] NSERC Postgraduate Scholarships and Postdoctoral Fellowships are the cornerstone programs that attract our brightest young people into a research career. However, the numbers of awards are dropping, rather than keeping pace with the growth of industrial and academic needs for these HQP. For example, comparing between 2010 and 2014, there was a drop from 2520 to 1510 post-graduate awards offered and a decline from 286 to 130 post-doctoral awards offered. The number of post-doctoral awards is slipping far below Canada's HQP needs: in academia alone, approximately 400 full-time university professors were appointed in engineering, math, and science in 2010-2011.[6]

Direct support for HQP in the form of long term merit based scholarships and fellowships must be given a high priority, and that we must close the gap in training HQP between ourselves and our OECD competitors. These HQP will be Canada's scientific and engineering leaders in the future, and increasing the number of merit-based awards above 2010 levels will help keep a sufficient number of the best and brightest Canadian trainees in Canada.

> ***Recommendation 2: That funding of merit-based NSERC Postgraduate and Postdoctoral Fellowship programs be increased by $86 million per year,[7] phased in over 3 years, to a level that***

[3] The Organization of Economic Co-operation and Development (OECD) Science, Technology, and Industry Scoreboard 2013. dx.doi.org/10.1787/sti_scoreboard-2013-en.

[4] *OECD/UNESCO Institute for Statistics/Eurostat data collection on Careers of Doctorate Holders 2010*. Cited by reference in footnote 2.

[5] The training of HQP in science is supported by programs that fund trainees directly (the NSERC Undergraduate Student Research Award [USRA] program, a number of postgraduate scholarship [NSERC PGS, Alexander Graham Bell Canada Graduate Scholarships, Vanier Canada Graduate Scholarships] programs and postdoctoral fellowship [NSERC Postdoctoral and Banting Postdoctoral] programs), and programs in which there is a training component (the NSERC Discovery Grant Program and the NSERC CREATE Program, and MiTACS).

[6] 2012-2013 Canadian Association of University Teacher's Almanac.

[7] For example, 170 more post-doctoral fellowships at $45,000 per year for 3 years, and 1000 more postgraduate scholarships at an average of $21,000 per year for 3 years.

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can support at least 2500 Postgraduate Scholarships and 300 Postdoctoral Fellowship awards per year to keep pace with the growth of industrial and academic needs for new highly qualified personnel. *[Supports "Jobs" and "Productivity"]*

Recommendation 3:

A key to attract and retain the best research talent is the development of and access to globally competitive research infrastructure. Universities can then ensure that students are trained on the most advanced systems. These students will be the first to discover new ways of doing things, giving them competitive advantages they can bring to their careers.

On a small scale, individual researchers must be able to renew or acquire equipment in an excellence-based peer-reviewed competition, as exemplified by the NSERC Research Tools and Infrastructure (RTI) program. NSERC has indicated that it will maintain the RTI program for equipment below $150,000. On larger scales, communities of researchers must be able to find funds to operate shared facilities, exemplified by the Canada Foundation for Innovation (CFI) funds. As the CFI typically funds infrastructure costing over $1.5M, there is a gap in the available programs for equipment or infrastructure in the range of $150,000 to $1.5M, which should be met by expanding the NSERC RTI program into this range and holding competitions annually on a competitive peer reviewed basis. These awards should include a partial contribution towards the operating costs of the facilities for the first five years of operation.

CAP applauds the recent expansion of the CFI Major Science Initiatives (MSI) fund. Originally created for national scale facilities representing over $50M in capital, it began funding 40% of operating costs for medium scale facilities through its competition in 2014. CAP also applauds the $1.33B planned investment in research infrastructure via the CFI proposed in the 2015 budget. Whether by allocating some of these funds, or injecting new funds, the MSI fund should be renewed and expanded because the limited funds in the 2014 competition resulted in only a small fraction of the facilities in need being funded. The expanded MSI fund should also cover a greater portion of the total operating costs of facilities where appropriate, because operations of research facilities that have long term research goals are generally not suitable for industrial support.

Recommendation 3: That current gaps in medium scale infrastructure funding be addressed by two measures: 1) that the CFI MSI fund be renewed and expanded by at least $50M for the next five-year cycle beginning in 2016 to allow for the funding a larger number of facilities; and 2) that an additional $10M per year be given to NSERC to expand its RTI program to cover equipment up to $1.5M through an annual competition. *[Supports "Infrastructure" , "Jobs" and "Productivity"]*

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