

**Written Submission for the Pre-Budget
Consultations in Advance of the 2023
Federal Budget**

**By: Canadian Association of Physicists
(CAP)**

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Recommendations

- **Recommendation 1:** That the Government review the financial status of HQP (Highly Qualified Personnel) trainees, addressing whether that status has eroded over decades to the point of impacting economic growth, and the wellness and future opportunities of those trainees. This review should inform additional Government investment in funding for HQP training.
- **Recommendation 2:** That the Government provide, as per the Naylor Report¹ recommendation, annual ongoing 10% increases to each of the Tri-Council budgets until research funding is commensurate with other G7 countries.
- **Recommendation 3:** That the Government take steps to identify all major research facilities that should be repaired/restored/ upgraded and provide adequate funding to address these needs.
- **Recommendation 4:** That the Government implement the Naylor report recommendation to increase the budgets for the existing Canada Foundation for Innovation (CFI) Infrastructure Operating Fund (IOF), Major Scientific Initiatives (MSI) fund, and the NSERC Research Tools and Instruments (RTI) grants. Further, competitions for the CFI MSI should be held more frequently, ideally once every two years, but at least once every three years.
- **Recommendation 5:** That the Government manage its investments in Big Science (as defined in the Naylor report¹) in a more coordinated manner with funding from conception and approval through implementation and operations and invest the additional funding required for their renewal.

¹ <http://www.sciencereview.ca/eic/site/059.nsf/eng/home>

Introduction:

We are pleased to have the opportunity to make expert recommendations to the House of Commons Standing Committee on Finance as it develops its economic strategy for 2023 (and beyond). We are hereby providing the Committee with a written submission with five recommendations that our organization asserts are important for the growth and diversification of the Canadian economy and the wellbeing of Canadians.

Who We Are: The CAP, with 1800 members, is Canada's national association for physicists working in industry, academia and government across all sub disciplines of physics. The CAP strives to unleash the full potential of physics and physicists for the benefit of Canada and the world. The CAP is recognized and respected for its science and technology expertise, including an in-depth understanding of their economic and societal impacts. The CAP has testified at House of Commons Committees, including the Standing Committee on Industry, Science and Technology for a study on the "State of Disruptive Technologies" on June 9, 2015.

Canadian physicists look forward to working with the Standing Committee on Finance to enhance economic growth on the heels of the COVID-19 pandemic, through judicious infusions of funding for scientific research, technology development, and training.

Our recommendations will have important positive impacts on the employment of highly qualified personnel (HQP) and will generate economic impacts from research and development advances.

Recommendation 1 – The Financial Status of HQP

The Government of Canada places an appropriately high value on training of HQP, recognizing them as drivers of innovation and essential for the Canadian economy of tomorrow. Physics HQP are critical for the many sectors of the economy including new quantum technologies, data science, medical technologies, energy and renewables, defense technologies, and more, all of which are essential for Canada.

Fundamentally, investing in our intellectual infrastructure means training our best and brightest whose work will result in cutting edge technologies that will be required to solve some of the world's most critical challenges. These HQP who are trained at the frontier of knowledge and driven to solve new problems, will in turn facilitate new technologies to support economic growth, helping Canada and Canadian businesses tackle the future challenges, including those posed by unanticipated crises such as pandemics.

Financial support for undergraduate and graduate students, and postdoctoral fellows has eroded significantly over decades. Consider the NSERC USRA (Undergraduate Summer Research Award) program. In the 1980s, these four-month awards enabled an undergraduate student to pay an entire year's expenses, including living away from home and tuition, with relatively little or no debt. Today, they barely cover the cost of tuition. As a second example,

graduate scholarships have not increased in the last decade despite greatly increased enrollments. Consequently, and as a result of other increased factors, costs (e.g., tuition, rent, and food) have vastly outpaced increases in student and postdoctoral fellow funding; many of our trainees are in difficult circumstances.

Overall, this situation is placing obvious pressure on our ability to attract and retain graduate students and postdoctoral fellows who are able to obtain significantly higher stipends on US and European scholarships and fellowships. We need to ensure that Canada is a competitive and prosperous nation in the 21st century; a country where Canadians can thrive to their full potential.

Given the Government's focus on trainees, and their inarguable value to our society, it is time for a comprehensive assessment of their circumstances to develop recommendations for improving the situation and the overall societal outcomes of our training programs. Possible actions could include restoring the buying power of stipends at all levels which would necessitate significant increases in Tri-Council funding, Government investment in low-cost student housing, and means-tested tuition relief.

Recommendation 2 – Research Funding

In agreement with the Canadian Council of Research (CCR), the CAP asserts that the competitiveness of Canada's economy critically depends on investment in both discovery-driven fundamental research and key technologies, and in the training of HQP for both.

Fundamental research is critical for Canada to make the novel discoveries that lead to the development of technologies that are transformative, the so-called "disruptive technologies" which will ensure the global competitiveness of our economy and secure prosperity and safety of current and coming generations of Canadians. There are many examples of fundamental physics discoveries resulting in innovative technologies, economic impacts and impacts on individuals. For example, Canada's Nobel Laureate, Donna Strickland, discovered chirped pulse amplification which resulted in short pulse lasers used in applications ranging from improved eye surgeries to manufacturing of glass for cell phone screens.

In June 2016, the Government of Canada announced the appointment of a review panel on Federal Support for Fundamental Science. Headed by David Naylor of the University of Toronto, the Panel included university and funding agency administrators, industry leaders, and Canada's most recent Nobel Laureate at that time, physicist Art McDonald of Queen's University. The Panel's mandate was to undertake "a review of the federal system of supports for extramural research."

The Panel's report (the Naylor Report), released in April 2017, documents Canada's declining support of fundamental research, defines the real needs in this area, and outlines a concrete path forward to meet that need. To date, through Budgets 2018, 2019, and 2021, the Government has acted on some of the report's recommendations. However, over the past 15 years, Canada's research funding as a percentage of GDP has declined from 2% to 1.6% while

that of virtually all other major nations grew. This deficiency was clearly recognized as an important priority in the 2021 report of the Standing Committee on Finance (SCF) where Recommendation 125 is that the federal investment in R&D be brought to 2% of GDP by 2026.

More must be done to support the research community efforts to advance Canada's global competitiveness and prosperity. Canadian researchers, including our HQP trainees, are at the forefront of important discoveries, and their findings and expertise are crucial to ensure the competitiveness of the Canadian economy in numerous key technologies from materials science and information technology to life sciences and the discovery and development of drugs and vaccines that have proven essential for not just our health, but also for the economy.

We strongly recommend that the Government of Canada, as per the recommendation in the Naylor Report, implement annual ongoing 10% increases to each of the Tri-Council budgets until research funding is commensurate with other G7 countries.

We make this statement in parallel with many other Canadian organizations, including the Partnership Group for Science and Engineering (PAGSE), the Canadian Consortium for Research (CCR), and the Association of Canadian Early Career Health Researchers (ACECHR). Further, this recommendation is perfectly aligned with recommendation 125 of the SCF.

Recommendations 3 & 4 - Research Facilities and Equipment

Without equipment renewal and access to state-of-the-art facilities, much novel research and development is impossible. Particularly devastating to the research landscape are instances where a national facility has reached its useful lifetime and there is no mechanism for replacement and/or upgrade to ensure continued vibrant Canadian research. Loss of research facilities could lead to a loss of research capacity in areas in which Canada was once a world leader. **The Government is therefore urged to take steps to identify all major research facilities that should be repaired/restored/ upgraded and provide adequate funding to address these needs.**

There are facilities that have not been maintained in a state of scientific readiness. Many of these demonstrated their scientific worth by being the result of successful proposals to highly competitive infrastructure programs such as CFI. However, the CFI-IOF is insufficient and facilities suffer from chronic underfunding for operations and maintenance. NSERC RTI grants provide crucial support to replace aging research equipment and fund new, state-of-the-art equipment for Canadian researchers. Currently the need for funding outstrips the RTI budget, with significant impact on the available equipment, the quality of the research, and the training of HQP.

The Naylor panel found that "the current level of CFI's Infrastructure Operating Fund (IOF) is insufficient to cover more than a small fraction of the ongoing costs of research infrastructure at institutions throughout Canada. This leads to ineffective use of smaller-scale equipment and means that researchers sometimes spend inordinate amounts of time trying to secure funding."

Additional funding should be provided to the CFI to meet the special operating needs of individual researchers through small capital awards.

The CFI-MSI fund received an increase for its last round, however that enabled only six new, relatively small, programs to be identified as National Facilities. The MSI program should be increased further (subject to any evolution of Big Science as addressed in Recommendation 5), and the time between 'onramp' opportunities should be decreased from six years to three or even two years.

We recommend that the Government implement the Naylor report recommendation to increase the budgets for the existing CFI-IOF and -MSI funds, and the NSERC RTI grants by a total of \$30M per year. As well, the CFI should decrease the time between successive CFI-MSI competitions.

Recommendation 5 – Big Science

The idea of Big Science is appealing on many fronts. The strategic initiative that developed the Sudbury Neutrino Observatory (SNO) and ultimately led to a Nobel Prize in Physics for Canada unfolded over decades. It involved the development of a major observatory deep underground, and the development of a research program that continues to inspire and utilize research excellence from across Canada.

A Big Science initiative often, but not always, involves a big facility, but should be understood as a program with a vision to accomplish something important and bold. There is obviously a will for this in Canada as evidenced by the ocean networks, Canadian Light Source, SNOLab, TRIUMF, Canadian contributions to space missions, and more. These initiatives can materialize as institutes such as the Arthur B. McDonald Canadian Astroparticle Physics Research Institute. The recognized value inherent in Big Science is reflected in funding programs such as the Canada First Excellence Research Fund (CFREF), Canada Excellence Research Chairs, Canada 150 research chairs, and superclusters.

The Naylor Report specifically pointed out the need for coordination in executing Big Science initiatives. Consistent with their finding, **we recommend that the Government manage its investments in Big Science (as defined in the Naylor report) in a more coordinated manner from conception and approval through implementation and operations and, when appropriate, invest the additional funding required for their renewal.**

Conclusion

The recommendations outlined herein will result in a strong science culture leading directly to novel disruptive technologies. These will allow Canadian researchers to assist Canadian businesses to be more competitive and enhance the wellbeing of Canadians.