Neutrons Canada

Written Submission for the Pre-Budget Consultations in Advance of the Upcoming 2025 Federal Budget

By: Neutrons Canada

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Recommendations

- **Recommendation 1:** That the Government of Canada allocate $95M over the 6-year period starting in 2025, and $25M per year ongoing starting in 2031, to the national neutron beam program to be managed by Neutrons Canada.

- **Recommendation 2:** That the Government of Canada include the national neutron beam program in the scope of the new funding framework for Major Research Facilities under Innovation, Science and Economic Development Canada.

Neutrons Canada

INVESTING IN CANADA'S NEUTRON BEAM RESEARCH INFRASTRUCTURE

GENERATING NEW KNOWLEDGE AND HIGH-IMPACT INNOVATIONS

Canadian research and innovation using major neutron beam facilities have produced social, environmental, and economic impacts worth ***at least triple*** Canada's investment.

IMPACT EXAMPLES

ACCELERATED UPTAKE OF ELECTRIC VEHICLES (EVs)

The present value of economic benefits to Canada, cumulative to 2030, attributable to research using neutrons is estimated at $1.6 billion, based on a conservative estimate that the research accelerated the development of EVs by just two years.

COMPUTER HARD DRIVES

Canada has realized at least $800 million in economic benefits attributable to neutrons from accelerated hard drive development.

CLEAN ENERGY PRODUCTION

Canada's nuclear power stations avoided losses of hundreds of millions of dollars and prevented gigatons of carbon dioxide emissions.

SUSTAINABLE FOOD

Daiya Foods, the top Canadian brand of plant-based cheese, launched new products in 2023 and 2024 resulting from a partnership with researchers who use neutron beams.

PUBLIC SAFETY

Canadians enjoy safety from improved, evidence-based regulations for airplanes, pipelines, and railroads.

TRAINING LEADERS IN INNOVATION

"Waterloo's Ontario Battery and Electrochemistry Research Centre is developing EV batteries to be more sustainable, safer, less expensive, and longer-lasting, and through this R&D, we are training entrepreneurial young researchers and R&D specialists who will be leaders in gigafactories being built in Canada by Volkswagen, Stellantis, Umicore and BASF. Neutrons are indispensable for analysis of many EV battery materials."
– Linda Nazar, Officer of the Order of Canada, and Tier 1 Canada Research Chair

Over 80% of students trained in research using neutron beams go on to careers in sectors where high-tech skills and innovation are most needed, including manufacturing, scientific and engineering services, and academia. 60% of undergraduates who use neutron beams earned graduate degrees, with two-thirds earning a doctorate. By comparison, only 16% of Canadian university graduates earn graduate degrees.

These impacts, and many others, are documented on our website with explanations of the calculations of return on investment based on studies[1]: https://neutrons.ca/canada-3x-investment/

Neutrons Canada

WORLD-LEADING CANADIAN NEUTRON BEAM RESEARCH ADDRESSING NATIONAL CHALLENGES

CLEAN ENERGY
Producing clean, reliable, and renewable energy and storing it for electric vehicles (EVs) and a green electricity grid.

NET-ZERO MANUFACTURING
Developing advanced manufacturing methods to reduce emissions and transition to EV production.

SAFETY AND SECURITY
Ensuring safety of airplanes, pipelines, and our inventory of used nuclear fuel, and extending service life of naval ships.

HEALTH AND FOOD SECURITY
Understanding health and disease, designing drugs and medical devices, and developing more sustainable foods.

QUANTUM INNOVATION
Understanding and designing materials for quantum computers and other quantum technologies.

Access to neutron beams for research is vital for materials innovation in the above areas.

What are neutron beams? Who uses them?

Neutrons are subatomic particles found inside the nucleus of every atom. Neutron beams are versatile and irreplaceable tools for materials research. They are one of several probes that engineers and scientists need to advance knowledge and improve materials. Neutron beams reveal nanometre-scale details about materials' molecular structures and motions that cannot be seen with other scientific tools. Neutron beams are among a set of complementary probes for materials research that are available only at Major Research Facilities, for example, the Canadian Light Source for x-rays and TRIUMF for muons.

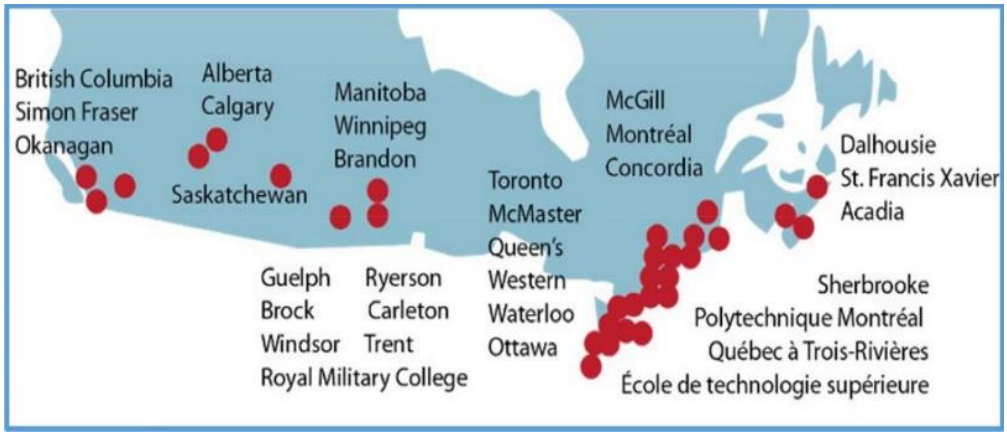

Figure 1. Over 5 years, about 800 engineers, scientists, and students from Canada and abroad, representing over 30 universities, used the now-closed Canadian Neutron Beam Centre.

Why does Canada need to invest now?

While other nations have invested about $10 billion in neutron beam research infrastructure since 2000, **Canada's primary neutron source at Chalk River closed in 2018**. Without neutron beam infrastructure,

Canada's scientific toolkit is incomplete. Since 2018, over 90% of Canadian neutron users have faced strong barriers against accessing alternate sources in other countries.[2] As a result, Canadian researchers now frequently avoid research questions for which neutron beams are needed. As experts exit the field, Canada's capability to apply them to advance our innovation agenda will decline. Failure to invest will compromise Canada's leadership in materials research with neutron beams and ultimately hamper Canada's long-term ability to innovate to meet our social, environmental, and economic challenges.

What is being done to rebuild?

Canada is just beginning to rebuild its neutron beam capabilities. Canadian universities are leading the way by developing a **national strategy**, **creating Neutrons Canada**, and **securing funding for projects valued at over $50M** that will (1) develop a modest neutron beam facility at the McMaster Nuclear Reactor and (2) establish 6-year partnerships with two major neutron sources in the United States.

Building on several years of consultations across Canada and internationally, the neutron beam community has laid out the next steps in the ***Canadian Neutron Long-Range Plan for 2025 to 2035*** (Neutron LRP). These steps comprise a comprehensive program that will enable Canadian students, scientists, and engineers to address scientific, social, environmental and economic challenges by providing access to versatile and irreplaceable materials research tools. The Neutron LRP outlines the activities of the proposed national neutron beam program, and corresponding investments, required for:

1. Facilitating Canadian participation in foreign neutron sources;
2. Building and operating domestic capabilities; and
3. Developing new neutron sources for the long term.

What investment is required to implement the national neutron beam program?

The top recommendation of the Neutron LRP is "that the Government of Canada allocate $95M over the 6-year period starting in 2025, and $25M per year ongoing starting in 2031, to the national neutron beam program to be managed by Neutrons Canada."

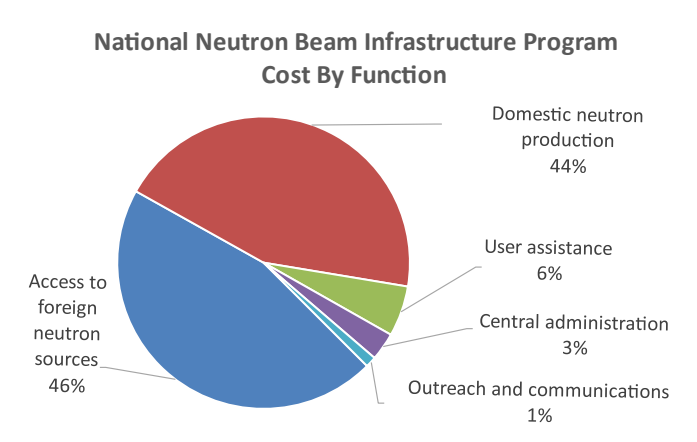

Figure 2. Breakdown of functions in the national program for research with neutron beams

($M)	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	Ongoing
Neutron Beam Program	3.0	11.7	16.8	19.6	22.7	21.2	25.0

How does this relate to the new funding framework for Major Research Facilities?

The expected scale and complexity of the national neutron beam program will match other facilities within Canada's portfolio of Major Research Facilities, such as the Canadian Light Source, SNOLAB, and Ocean Networks Canada. Major Research Facilities require special consideration in the federal budget because of their national scope and scale. The requested $25 million per year national neutron beam program will leverage access to billion-dollar neutron sources internationally and lay the foundation for a world-class domestic source in due course.

Thus, the Neutron LRP recommends that the national neutron beam program be included in the scope of the new decision-making framework for funding of Major Research Facilities recently approved by the Government of Canada. This new framework will be implemented by the Canada Foundation for Innovation and rolled out in phases over several years.

In the short-term, while the implementation is being rolled out, direct government investment of $95M from 2025 to 2030 is needed, as shown in the table above, through a contribution agreement with Neutrons Canada, thus enabling the ramp-up of Canada's neutron beam program. The ongoing $25 million per year beginning in 2031 for the neutron beam infrastructure program could then be included in the new funding framework for Major Research Facilities.

Has FINA endorsed funding for this program previously?

The House of Commons Finance Committee endorsed the recommendations of the Canadian Neutron Initiative to establish a national neutron beam program in its reports leading up to the 2018 and 2019 federal budgets.[3] In the interim, the Canadian Neutron Initiative focused on laying further groundwork for this national program by completing the national neutron strategy and creating Neutrons Canada. Neutrons Canada's members collaborated to secure research infrastructure funding for a McMaster University-led $50M project, described earlier. This project is a critical seed for the national neutron beam program. Neutrons Canada is now ready to begin implementing the program if funded in Budget 2025.

What is Neutrons Canada?

Neutrons Canada was founded in October 2022 as a not-for-profit corporation with 16 members: 15 universities across Canada and one industry member (Canadian Nuclear Laboratories). Neutrons Canada is led by an independent board of directors,[4] composed of experts in science policy, corporate governance, and research facility management who will oversee the requested funds and implementation of the national neutron beam program. Neutrons Canada's mission is to govern, manage, and represent Canada's infrastructure program for research and development with neutron beams. This program includes international partnerships to secure access to world-leading neutron laboratories, operation of Canada's domestic neutron beam facilities, and national initiatives for future neutron sources to address major social and economic challenges.

Conclusion

With a complete 21st-century scientific toolkit, Canadians can accelerate innovation in green manufacturing, clean and energy-efficient vehicles, clean energy production, and fighting diseases such as Alzheimer's and cancer. Canadians will also lay the foundations for breakthroughs in new materials,

such as biomaterials and quantum materials that will have a transformative influence on many technologies. It is with such innovations that the promise of enhanced quality of life for all Canadians can be achieved.

Endnotes

[1] For example: Walsh, A. C., Nienow, S., Merker, J. M. S., Decker, E. C., Strack, C. N., Salem, M. E., Martin, G., Shaw, B. (2024). *Assessment of the Retrospective and Prospective Economic Impacts of Investments in U.S. Neutron Research Sources and Facilities from 1960 to 2030*. RTI International Report Sponsored by the National Institutes of Standards and Technology. https://www.rti.org/publication/assessment-retrospective-prospective-economic-impacts-investments-u-neutron-research-sources-facilit

[2] Canadian Institute for Neutron Scattering. Survey of Canadian neutron beam users. January 2023.

[3] *Driving Inclusive Growth: Spurring Productivity and Competitiveness in Canada*. Report of the Standing Committee on Finance. December 2017. https://neutrons.ca/wp-content/uploads/2022/09/FINA_2017.pdf; *Cultivating Competitiveness: Helping Canadians Succeed*. Report of the Standing Committee on Finance. December 2018. https://neutrons.ca/wp-content/uploads/2022/09/FINA_2018.pdf

[4] Neutrons Canada Board of Directors: https://neutrons.ca/board-of-directors/