CANADA FOUNDATION FOR INNOVATION

Investing for impact:

An analysis of the outcomes and achievements of Canada's national research facilities supported through the Canada Foundation for Innovation's Major Science Initiatives Fund

November 2025

INNOVATION
Canada Foundation for Innovation
Fondation canadienne pour l'innovation

About the Canada Foundation for Innovation

With a bold, future-looking mandate, the CFI equips researchers to be global leaders in their fields and to respond to emerging challenges. Our investments in state-of-the-art tools, instruments and facilities at universities, colleges, research hospitals and non-profit research institutions underpin both curiosity- and mission-driven research that cuts across disciplines and bridges all sectors. The research infrastructure we fund mobilizes knowledge, spurs innovation and commercialization, and empowers the talented minds of a new generation.

The Canada Foundation for Innovation respectfully acknowledges that its head office is located on the traditional, unceded territory of the Anishinaabe Algonquin People.

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Executive summary

The Canada Foundation for Innovation (CFI) invested significantly through the Major Science Initiatives Fund (MSIF) to support operating and maintenance needs of 16 national research facilities from 2017 to 2023. These facilities have been pivotal in advancing science and innovation, and in tackling societal issues. This summary provides an overview of the investments made by the CFI and highlights the outcomes and achievements of national research facilities in Canada for the funding period.

The objectives of the 2017 competition were to:

- Secure and strengthen national research facilities for world-class research
- Enable optimal operation and full exploitation of scientific capabilities
- Promote best practices in governance and management.

Over a six-year period, the CFI contributed $535 million through the MSIF to support the operational and maintenance needs of 16 national research facilities. This investment was matched by $645 million from partners, resulting in a total investment of $1.2 billion. In addition, since 1997, the CFI has invested nearly $800 million in capital to build the capacity of those facilities.

From 2017 to 2023, the 16 facilities employed over 1,000 skilled personnel annually, with a focus on scientific and technical roles. The facilities provided training and development opportunities to ensure optimal operations, and user satisfaction remained high, ranging from 89 to 92 percent over the reporting period. Although the majority of users were from academia, engagement grew across a diversity of sectors, with the total number of users increasing by 64 percent, from 36,979 to 60,616 during the six years. The facilities reported significant research outputs, with total annual outputs increasing from 9,131 to over 12,212 over six years. This included peer-reviewed publications and conference contributions, demonstrating the facilities' vital role in advancing scientific knowledge.

The facilities also contributed socioeconomic benefits, including health improvements through COVID-19 research initiatives and economic growth via technology transfers and collaborations with industry.

Moreover, the facilities refined their governance and management structures, creating new committees and roles. They also evolved good practices in equity, diversity and inclusion and increased collaborations with Indigenous communities. This is in part because the CFI promotes responsible stewardship by encouraging national facilities to adopt best practices in governance and management.

The CFI's investments through the 2017 MSIF competition enabled significant advancements in research capabilities, fostering innovation and addressing societal challenges. The collaborative efforts and effective governance practices of the facilities led to substantial contributions to the Canadian research landscape and broader societal benefits.

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Introduction

What is the purpose of this report?

The Canada Foundation for Innovation's (CFI) Major Science Initiatives Fund (MSIF) provides support for the ongoing operating and maintenance (O&M) needs of national research facilities. The purpose of this report is to demonstrate the outcomes and achievements of the facilities funded through the 2017 Major Science Initiatives Fund competition. Visit the CFI's website to find out more about the history of the MSIF.

Through the 2017 competition, 17 national research facilities received funding between 2017 and 2023. This report covers 16 of those facilities (listed in Table 1 and shown in Figure 1), and excludes Compute Canada, which was funded for the first four years before transitioning to the Digital Research Alliance of Canada in 2021.

Over a six-year period, the CFI invested $535 million through the MSIF to support the O&M needs of these national research facilities. This investment was matched by $645 million from partners, resulting in a total investment of $1.2 billion. In addition, since 1997, CFI has invested nearly $800 million in capital to build the capacity of those facilities. Considering the 40-60 funding model of the CFI, this represents a total investment of more than $2 billion in research infrastructure.

The information provided in this report is based on the final performance reports that facilities were required to submit after the end of the funding period, summarizing their progress and key achievements during the period of funding.

Facilities funded in the 2017 competition

- André E. Lalonde Accelerator Mass Spectrometry Facility (AEL-AMS)
- Canada's National Design Network (CNDN)
- Canada's national platform for genome sequencing & analysis (CGEn)
- Canadian Cancer Trials Group Operations and Statistics Centre (CCTG)
- Canadian Centre for Electron Microscopy (CCEM)
- Canadian Light Source (CLS)
- Canadian Research Data Centre Network (CRDCN)
- CCGS *Amundsen*
- Érudit (now funded as Coalition Publica)
- International Vaccine Centre (InterVac, now known as the Vaccine and Infectious Disease Organization (VIDO))
- Ocean Networks Canada (ONC)
- Ocean Tracking Network (OTN)
- SNOLAB
- SuperDARN Canada
- The Centre for Phenogenomics (TCP)
- The Metabolomics Innovation Centre (TMIC)

What were the objectives of the 2017 competition?

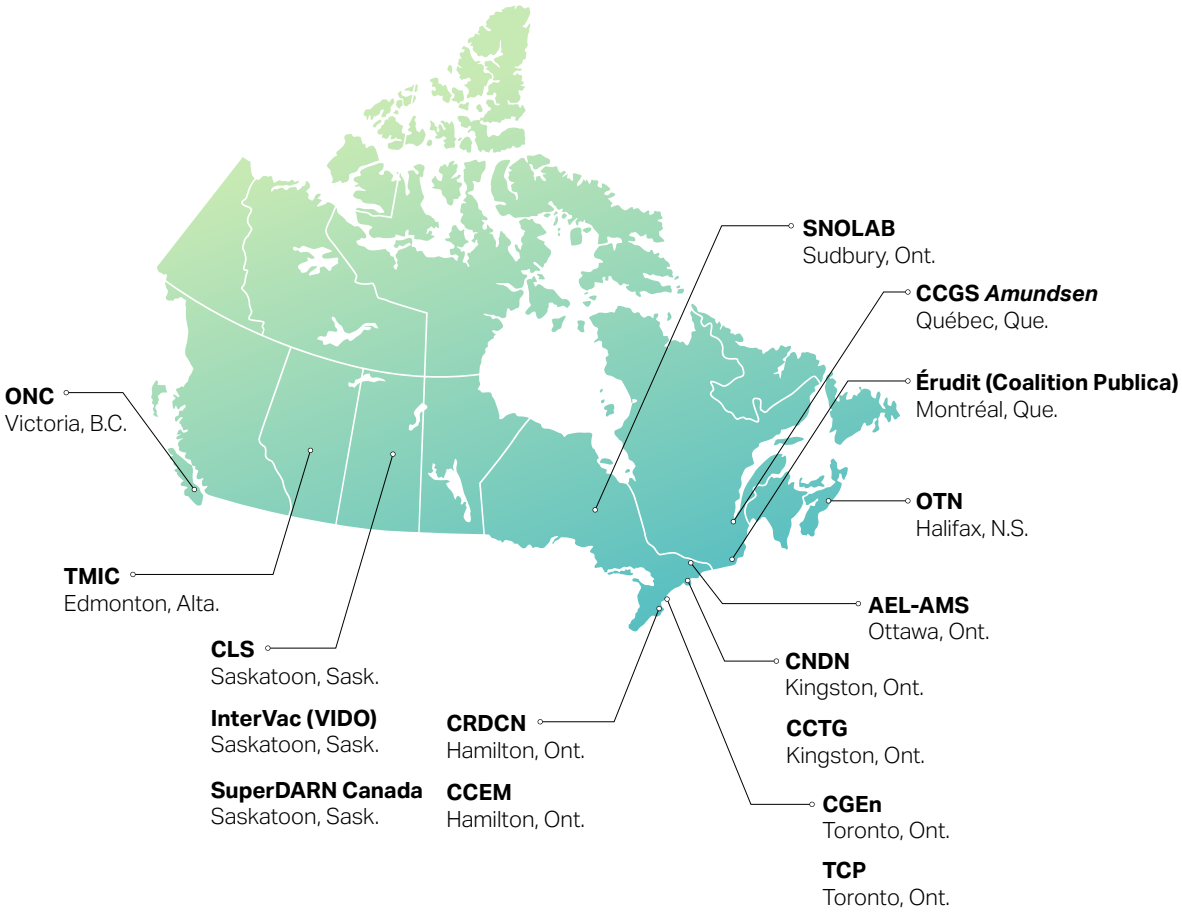
Support provided through the MSIF during the 2017 to 2023 funding cycle was intended to:

- Secure and strengthen state-of-the-art national research facilities that enable Canadian researchers to undertake world-class research and technology development that leads to social, health, economic, or environmental benefits to Canadians
- Enable funded facilities to operate at an optimal level and to have their scientific and technical capabilities fully exploited
- Promote the adoption of best practices in governance and management, including long-term strategic and operational planning in keeping with the scale and complexity of the facility.

How was a national research facility defined?

According to the call for proposals for the 2017 Major Science Initiatives Fund competition, a national research facility was defined as: "one that addresses the needs of a community of Canadian researchers representing a critical mass of users distributed across the country by providing shared access to substantial and advanced specialized equipment, services, resources, and scientific and technical personnel. The facility supports leading-edge research and technology development, and promotes the mobilization of knowledge and transfer of technology to society. A national research facility requires resource commitments well beyond the capacity of any one institution. A national research facility, whether single-sited, distributed or virtual, is specifically identified or recognized as serving pan-Canadian needs and its governance and management structures reflect this mandate."

Figure 1: Location of national research facilities across Canada*



*Locations show the central point for each facility.

What types of facilities received funding through the 2017 competition?

The facilities that received funding were highly diverse. Some, such as CLS and SNOLAB, are single-sited, whereas others, such as CRDCN and CGEn, are distributed across multiple locations, and Coalition Publica is entirely virtual.

The size of the six-year O&M budget varied considerably between facilities, with support from the CFI ranging from $1.9 million to over $135.2 million (see Table 1). Each facility also had a unique partner funding profile.

The facilities offered access to research capabilities to the users from a wide range of research fields from social sciences and humanities to health and natural sciences such as ocean and environmental sciences, physics, genomics and proteomics, and material science.

The facilities also varied in their stages of operational maturity and governance practices. As a result, both the number and the nature of their outputs and outcomes varied. For this report, an effort was made to capture the overall achievements and progress of the 16 facilities taken as a whole, while also highlighting each facility's strengths and unique contributions with examples.

Optimizing operations and maintenance to maximize the capacity of facilities

The CFI made major contributions to operations and maintenance

The CFI invested $535.4 million in multiyear funding toward the O&M needs of the 16 facilities between April 1, 2017 and March 31, 2023. This funding initially covered up to 40 percent of eligible O&M costs and the remaining 60 percent was provided by other funding partners. The CFI's contribution increased from 40 to 60 percent in 2018 for seven facilities (see Table 1) to alleviate budgetary pressures related to challenges in securing partner funding for facilities that are considered major in scale, and which have substantive operation budgets. This increase ensured their long-term sustainability.

Table 1: CFI funding received by national research facilities (from the highest amount invested through the MSIF to the lowest)

Research facility	**Funding through the MSIF[1]** (2017 to 2023)	**Funding for research infrastructure from other CFI funding programs[2]** (1999 to 2023)
CLS [3]	$135,209,690	$130,673,256
ONC[3]	$83,572,784	$60,247,176
SNOLAB[3]	$75,046,268	$82,664,951
CGEn	$42,850,500	$140,514,403
CCGS *Amundsen*[3]	$37,812,132	$42,620,171
InterVac (VIDO)[3]	$37,492,988	$85,240,744
CNDN[3]	$30,626,000	$59,627,472
OTN[3]	$27,071,734	$41,988,514
TCP	$20,317,928	$58,144,221
CCTG	$12,500,000	$5,644,134
CRDCN	$8,079,263	$12,089,191
TMIC	$7,513,737	$4,879,269
CCEM	$5,791,000	$34,639,329
Érudit (Coalition Publica)	$5,688,118	$8,284,984
AEL-AMS	$3,929,004	$12,262,698
SuperDARN Canada	$1,885,813	$19,979,228
Total CFI contributions	**$535,386,959**	**$799,499,741**

1 Total amount over six years including funding increases after midterm reviews.

2 Since its inception, the CFI has also contributed approximately $800 million in capital investments to these facilities.

3 The CFI's contribution increased in 2018 from 40 to 60 percent of total eligible O&M costs.

CFI funding went toward a variety of operating and maintenance costs

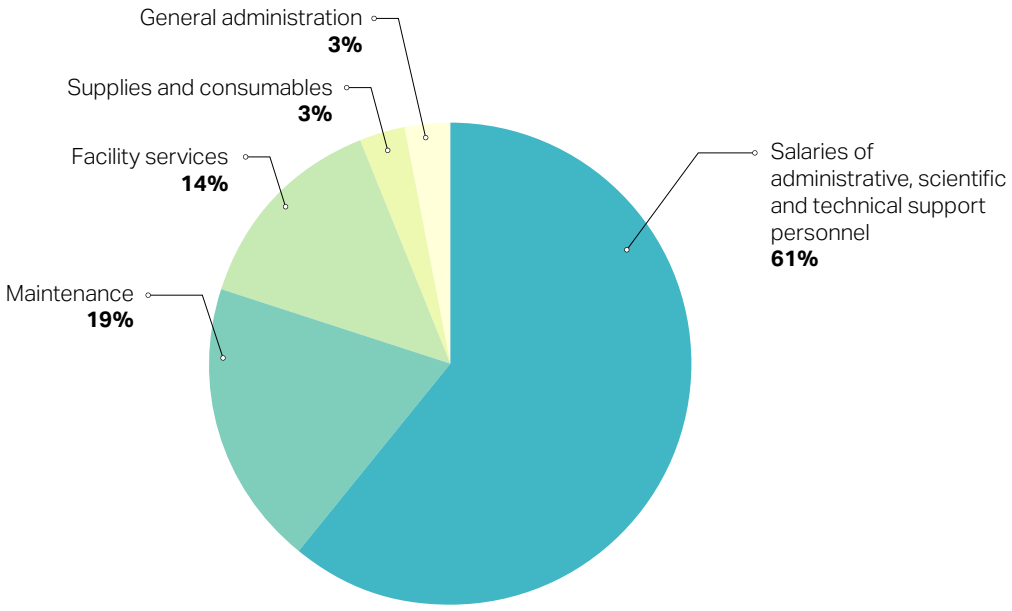
O&M costs eligible for funding from the MSIF included:

- Salaries of administrative, scientific and technical personnel
- Extended warranties/service contracts
- Replacement parts and minor upgrades
- Services that directly support the facility
- Supplies and consumables
- Communications and outreach activities
- Administrative costs (excluding personnel)
- Training and professional development.

In 2018, the CFI expanded eligible costs to include: technology development and information technology development and support to enhance the services a facility can offer. Most facilities reported that the eligibility of these costs has enabled them to improve their services.

The largest of the facilities' total expenditures over the six years, accounting for more than half, went toward supporting skilled professionals dedicated to the operation of the infrastructure, including administrative, scientific and technical personnel (see Figure 2). The distribution of these expenditures highlights the facilities' commitment to enhancing and sustaining cutting-edge research environments and maximizing their capacity.

Figure 2: Total combined expenditures across 16 facilities over six years



The CFI also provided funds for research infrastructure

In addition to supporting the ongoing O&M costs of research facilities, the CFI also provided funding for research infrastructure.

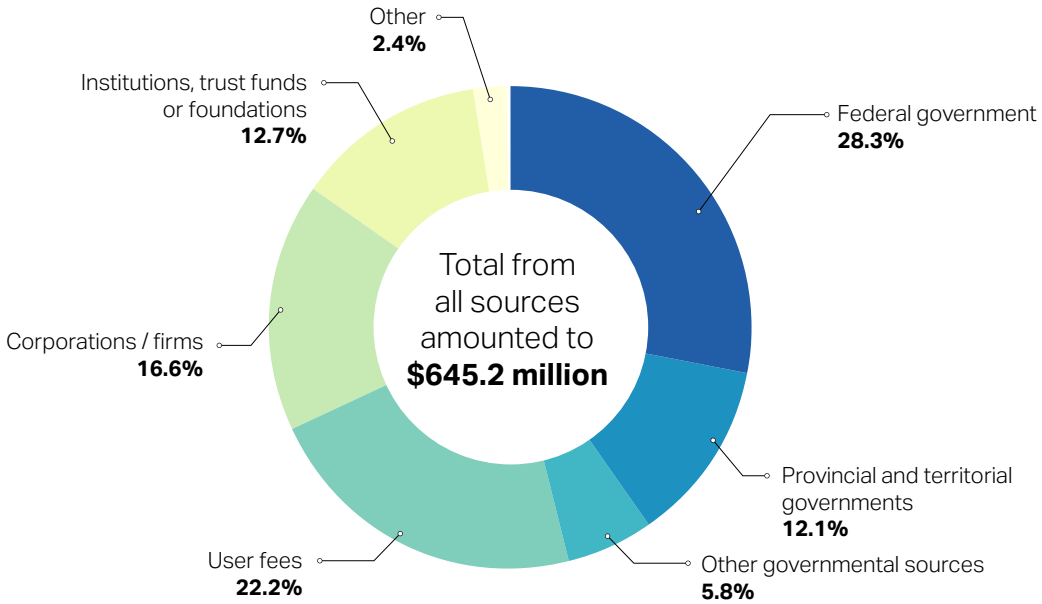
Since its inception, the CFI has contributed approximately $800 million in capital investments to enhance the research infrastructure of the 16 facilities, mainly through the John R. Evans Leaders Fund (JELF), the Innovation Fund and the International Joint Venture Fund (see Table 1). This represents a total investment of more than $2 billion in research infrastructure once the CFI's funding model is taken into account.

A diversity of partners also contributed

Numerous Canadian and international contributors from across sectors provided essential support for the significant costs of operating and maintaining these important research facilities (see Figure 3). Between 2017 and 2023, $645.2 million in partner funding was obtained by the 16 facilities. Those contributions consisted of $512.9 million in cash and $132.3 million in-kind, with cash accounting for approximately 80 percent.

Nearly half of the partner contributions ($298 million) were from government (federal, provincial, territorial and other government sources). Of that, $182 million (28.3 percent of the total) was from federal government departments and agencies such as Fisheries and Oceans Canada, Statistics Canada, and the federal research funding agencies (Canadian Institutes of Health Research, Natural Sciences and Engineering Research Council of Canada, Social Sciences and Humanities Research Council). Another $78 million (12.1 percent) of the government sources came from the provinces and territories. The majority of other government contributions, amounting to $38 million (5.8 percent), are from international institutions, including cash contributions from the United States' National Institutes of Health (specifically for CCTG) and in-kind contributions from foreign governments (mostly the United States) and their departments (specifically for OTN and CCGS *Amundsen*).

Figure 3: Total partner contributions from all sources



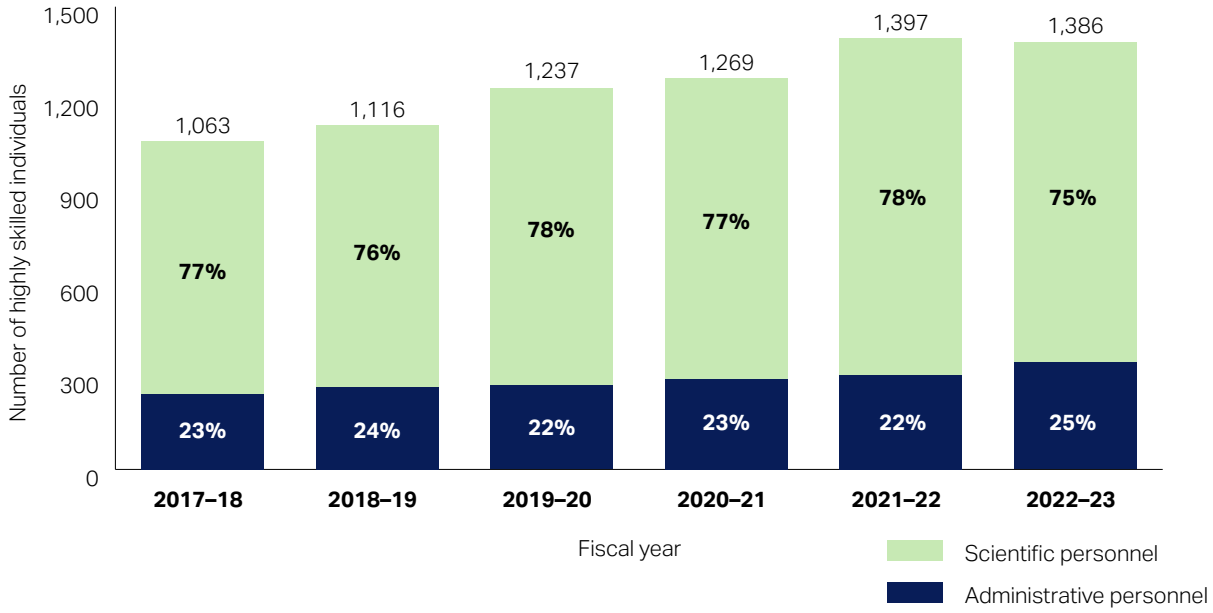
Among the other major funding sources, user fees generated over the funding period by nine of the 16 facilities accounted for $143 million (22 percent), followed by private-sector corporations (e.g., scientific equipment suppliers), which contributed $106.8 million (17 percent), and the facilities' host and collaborating institutions, which contributed $81.8 million (13 percent).

The capacity of facilities was enhanced by leveraging expertise and ensuring optimal use

The 16 facilities employed more than 1,000 highly qualified people annually, reaching nearly 1,400 by the sixth year (see Figure 4). Over three-quarters of those positions were occupied by scientific and technical personnel. These individuals possess expertise in facility-specific research procedures and in the operation and maintenance of specialized equipment (e.g., accelerator mass spectrometry, marine geomatics, cybersecurity, clinical research, beamline technologies, information architecture, vaccines, etc.). They train the next generation of scientists and provide comprehensive support to facility users.

Throughout the funding period, facilities enhanced their personnel capacity, performance, and skill sets through training programs, workshops, and conferences, ensuring staff were well equipped to meet user needs and maintain optimal operations.

Figure 4: Annual total number of highly qualified individuals employed by facilities



Facilities were required to quantify their usage levels relative to optimal capacity by measuring relevant data specific to each facility. This could include the percentage of time the facility is used versus its availability, excluding required maintenance periods. This metric varied significantly across facilities depending on the specific capability of each piece of equipment or instrument as well as O&M processes tailored to each facility.

The annual trend of optimal use level varied across facilities, with some experiencing decreases during the COVID-19 pandemic in fiscal year 2020–21, and others reporting stable levels of use throughout the six years. However, in years five and six, the facilities that saw reductions during the COVID-19 pandemic returned to or exceeded their original levels of use.

Collaborating broadly to promote and deliver world-class research

The 16 facilities supported through the MSIF between 2017 and 2023 reported wide networks of collaborators and partners worldwide, including from Europe, Japan, Australia, Brazil and the United States. Those collaborations spanned across sectors including academia, governments, industry and non-profit organizations.

This collaborative approach allowed the facilities to:

- Promote their scientific and technical capabilities nationally and internationally
- Reach out to potential users across sectors
- Catalyze research and technology development
- Transfer knowledge and technology to ultimate users including policy-makers and industry.

Collaborations were also leveraged by the research facilities to share best practices with like-facilities in Canada and abroad. Eleven of the facilities reported collaborations with other national research facilities in which they shared good practices in areas of common interest such as data management. The facilities evolved into a community that allowed them to identify new collaborative opportunities and benefit from each other's services and instrumentation. Academic collaborations supported student exchanges, workshops and facility tours which enriched the training of highly qualified personnel.

Examples of collaborations reported by facilities

Collaborations with Canadian and international government research organizations: SuperDARN collaborated with the Department of National Defence's science and technology organization, Defence Research and Development Canada, and the US Naval Research Laboratory to demonstrate how the ionosphere interfered with their ability to track research objectives in the High Arctic. This collaboration led to a proof-of-concept study showing that high-frequency radars are a viable option to replace the North American Aerospace Defence Command's (NORAD) North Warning System, and it also contributed to a number of advancements in the readiness of polar technology in Canada.

Collaborations between Canadian and international research facilities: A collaboration between SNOLAB and the Arthur B. McDonald Canadian Astroparticle Physics Research Institute has significantly strengthened Canada's particle astrophysics community, resulting in a two-thirds increase in the number of experimental particle astrophysicists. This partnership also fostered multidisciplinary collaboration, as researchers joined forces to address challenges in next-generation detector design and background radiation mitigation. SNOLAB's international engagement with peer underground laboratories in countries such as France and the United Kingdom facilitated valuable exchanges on best practices for facility operations and management, helping to maintain SNOLAB's global visibility and leadership in the field.

Collaborations with industry: AEL-AMS collaborates with companies to enhance the technology employed in accelerator mass spectrometry (AMS), a method for detecting minute quantities of rare isotopes, such as carbon-14. It partners with companies in the Netherlands, Switzerland and Finland to enhance the precision of this technology, particularly for analyzing tiny samples. In one recent project, AEL-AMS collaborated with a Finnish company to improve the testing for biofuels and biocarbon products using carbon-14. This helps companies demonstrate that their products are derived from renewable sources, not fossil fuels. These improvements enable businesses to meet government regulations and quality standards more easily. By sharing expertise and developing new testing methods, AEL-AMS supports innovation in industries such as energy, environment and health.

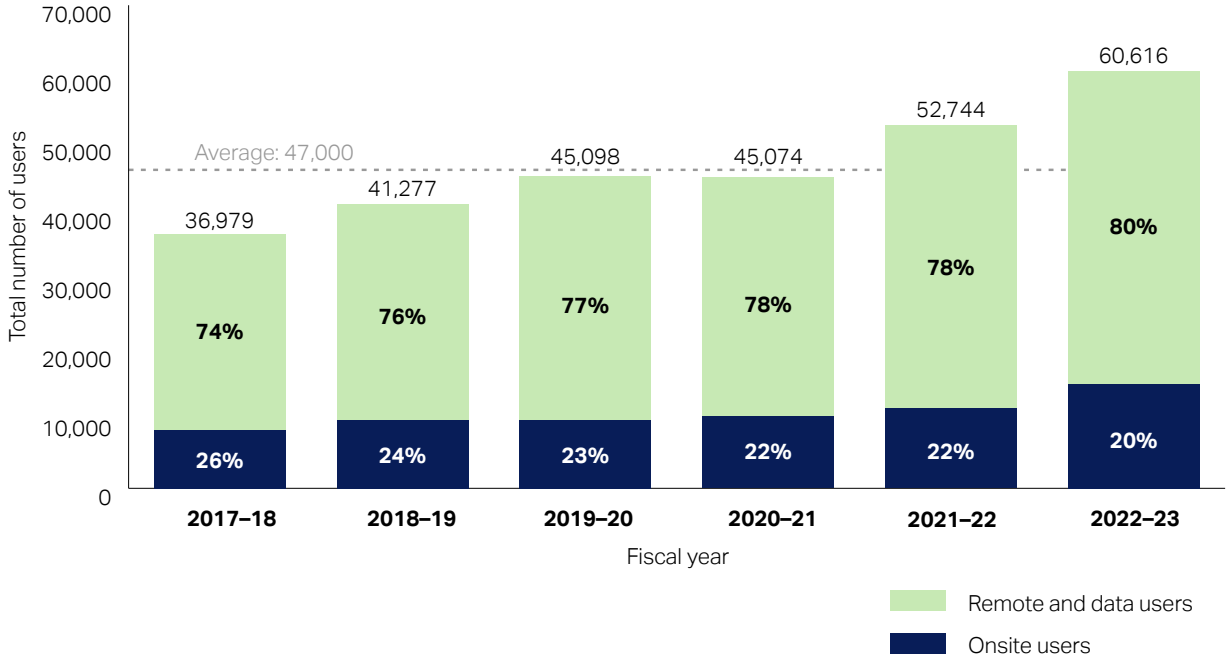
Collaborations within the community of national research facilities: Collaborations between facilities offered mutual benefit by enabling access to specialized technologies and services unique to each. VIDO scientists collaborated with the CLS to deliver ways to combat the COVID-19 pandemic. This collaboration included research on decontamination and reuse of respiratory masks, and studying the long-term impact of COVID-19 infection. OTN collaborated with ONC by deploying their ocean wildlife tracking instruments on ONC infrastructure, as well as by sharing data management practices and standards.

Enabling access to a diversity of users

Facility users increased

The overall number of users of all 16 facilities increased by 64 percent, from 36,979 to 60,616, between years one and six (see Figure 5). Users can be onsite or can access the facility or its electronic data archives remotely. Data and remote users accounted for much of the increase, rising from 27,358 to 48,737 over six years.

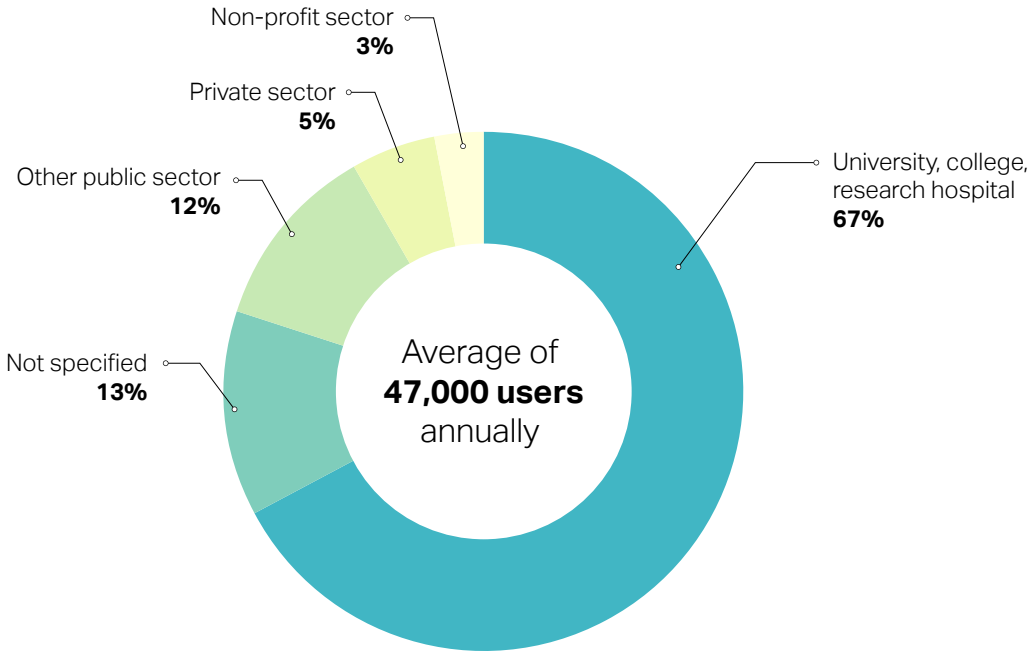
Figure 5: Number of facility users per type annually



Facilities attracted users across multiple sectors from Canada and abroad

Facility users came from multiple sectors (see Figure 6), and from almost every province and territory, as well as from other countries (see Figure 7). The highest proportion (67 percent) of users was from the academic sector and included university researchers, students and postdoctoral trainees. The facilities also attracted users from the public (12 percent), private (5 percent) and non-profit (3 percent) sectors.

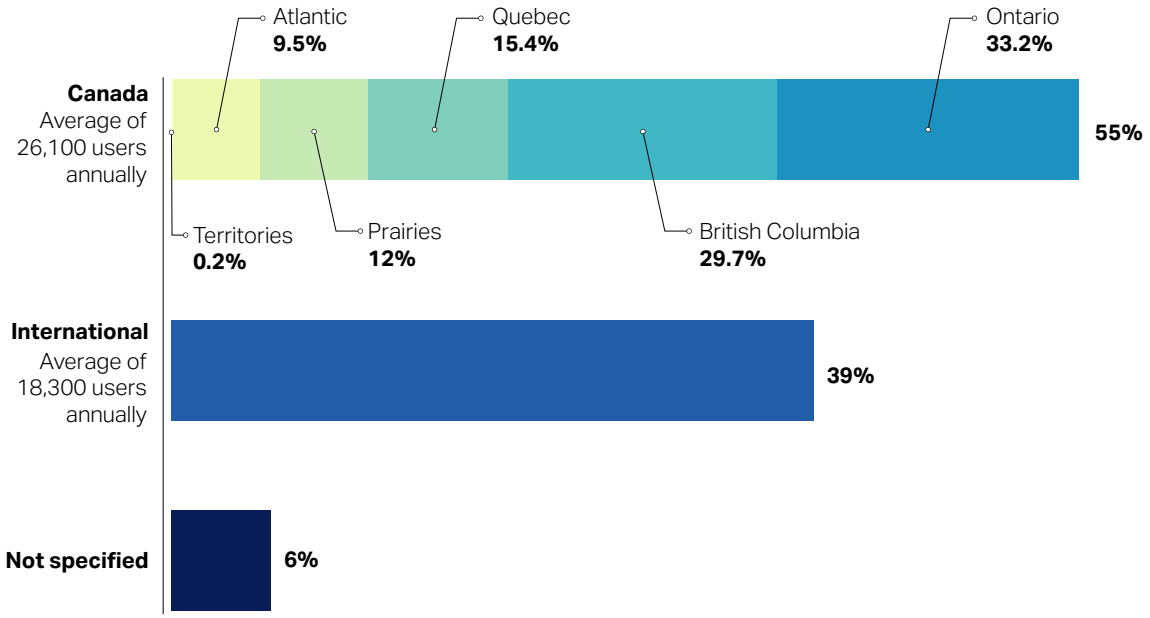
Figure 6: Users by sector



More than half of users come from Canada (Figure 7). Ontario, British Columbia and Quebec together accounted for approximately 80 percent of users in each of the six years. The distribution of users is generally proportional to the distribution of postsecondary institutions and researchers across provinces and territories.

The total number of international users increased from approximately 13,000 to over 23,900 over six years in line with the overall user growth. The annual average proportion of international users was 39 percent (Figure 7), remaining consistent throughout the funding period. This number temporarily dropped to 34 percent during the COVID-19 pandemic. The involvement of international users varied significantly across facilities. Some had very few, while six facilities (CCTG, ONC, OTN, SNOLAB, SuperDARN, TMIC) reported that over half of their users were international. Of the 18,300 international users reported, nearly half (8,600) were from the United States, while the rest (9,700) were from other countries.

Figure 7: Users by geographic location



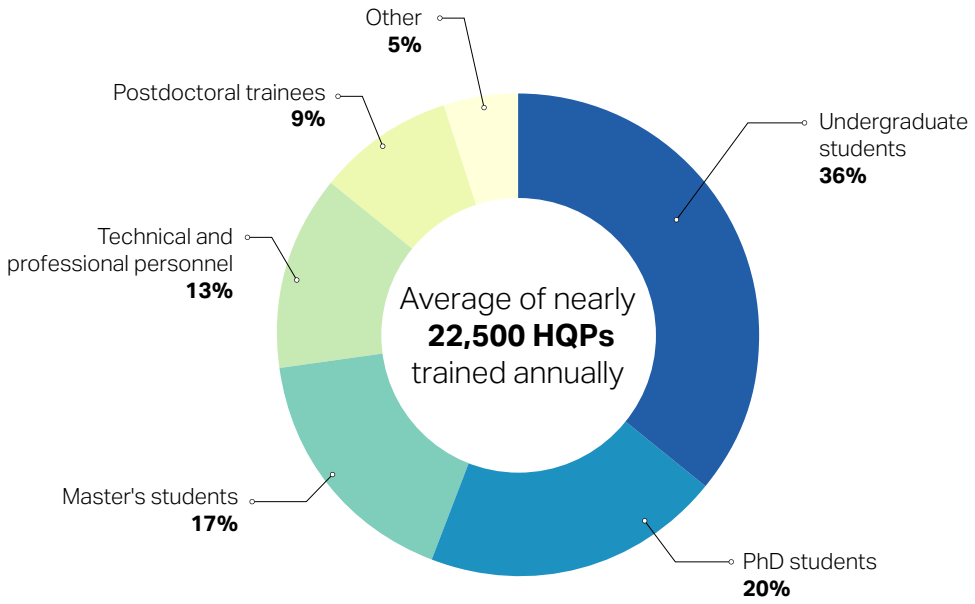
User satisfaction

All facilities monitor user satisfaction levels through surveys to uphold high service standards and identify potential issues. Most facilities indicated that they routinely monitored user feedback to better understand user needs and enhance the overall user experience. This included aspects such as cost, turnaround times and data usability. Several facilities (e.g., CNDN, AEL-AMS, CLS) followed up with users by phone or email to understand reported issues and mitigate them. Over the six reporting years, the user satisfaction level across all 16 facilities remained consistently high, ranging from 89 percent to 92 percent.

Providing training and skills development for highly qualified personnel

Facilities fostered a dynamic and supportive training environment for students and postdoctoral trainees

Figure 8: Percentage of HQP by type across all facilities



On average, the total number of highly qualified personnel (HQP) trained annually across all facilities was 22,474. The total number and proportion of HQP by type remained stable over six years. More than one-third of HQP were undergraduate students, followed by PhD and master's students (see Figure 8). This demonstrates the facilities' strong commitment to research and skills development from the early postsecondary education stages. The facilities' specialized infrastructure and personnel provide unique training opportunities that may not be available elsewhere in Canada or abroad. These opportunities include research, technology development, specialized practices unique to each funded facility, as well as participation in conferences, summer schools, clinics and workshops to further HQP skills.

Examples of training reported by facilities

Training in infectious disease research and biomanufacturing: VIDO offers a variety of training programs aimed at developing HQP in infectious disease research, animal trials, containment levels 2 and 3 and biomanufacturing techniques. In addition to the state-of-the-art research environment, these programs benefit from the unique complementarity of the Vaccine Development Center, a Containment Level 3 vaccine manufacturing facility compliant in Good Manufacturing Practice (GMP) that houses specialized scientific equipment. In total, VIDO trained over 300 HQP during the 2017–23 period adding to the talent base in Canada and internationally. VIDO also delivers a high containment operations and maintenance workshop and provides training in quality control and regulatory policy for GMP and security for new employees and postdoctoral trainees.

Training in conducting clinical trials: CCTG offers a variety of unique training opportunities designed to enhance the skills and knowledge of new investigators and allied health professionals. The New Investigator Cancer Trials Practicum is known as the only training of its type in Canada, providing practical clinical trial experience over a year. Furthermore, the biennial three-day New Investigator Clinical Trials Course covers essentials of clinical trial conduct, and the annual New Investigator Workshop, held at CCTG's annual spring meeting, offers additional learning opportunities. CCTG also provides one- and two-year fellowships for MD and postgraduate students, as well as supervision for master's, PhD and postdoctoral students from Queen's University.

Training aboard an Arctic ocean research vessel: Eighty percent of the users onboard the CCGS *Amundsen* are HQP. The vessel's unique training environment enables HQP to gain experience in the safe operation of the latest oceanographic instruments under extreme Arctic conditions. Many HQP collect data for their thesis projects using sophisticated sampling devices. Additionally, life onboard helps them develop soft skills such as interactions with colleagues, problem-solving and work management.

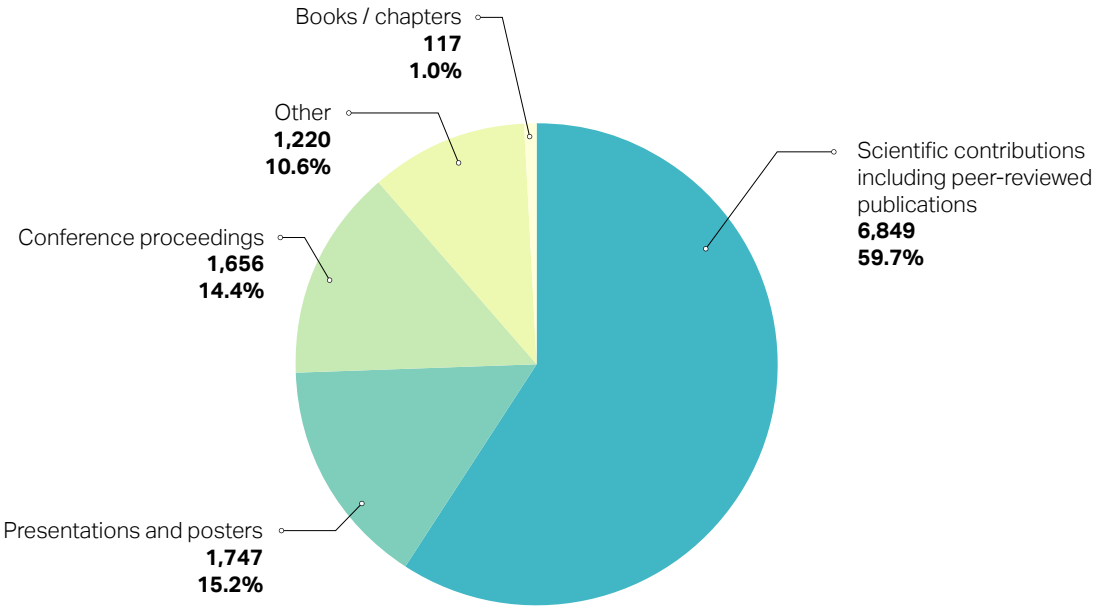
Enabling world-class research and technology development

Facilities were hubs for advancing and sharing knowledge

Total annual research outputs across 15 facilities (excluding Coalition Publica[4]) increased from 9,131 in year one to over 12,000 in year six, averaging 11,589 annually. This growth was primarily driven by scientific contributions which include peer-reviewed publications in journals, magazines or newsletters. There was an increase in the number of publications between years four and five (from 7,149 to 9,722) during the COVID-19 pandemic. In contrast, the number of the rest of research outputs remained relatively constant over six years.

Knowledge transfer extended beyond traditional publications, with facility staff and users actively contributing to the academic community by participating on average in over 1,600 conference proceedings as well as 1,700 presentations and posters. Although books and book chapters represented a smaller proportion of outputs (one percent), on average the 117 contributions per year in this category add to the overall volume of knowledge disseminated during the funding period.

Figure 9: Research outputs



4 Coalition Publica, a digital platform providing open-access scholarly and cultural publications, reported the number of citations of the publications on its platform, instead of the standard key performance indicators for research outputs. Over six years, the annual number of citations per article published on Coalition Publica increased from 2,000 in year one to nearly 18,000 in year six.

Examples of outputs reported by facilities

Informing public policy: CRDCN, a national research infrastructure for over 2,500 researchers in the quantitative social and health sciences in Canada, provides secure access to detailed and anonymized Statistics Canada data to researchers at 45 universities across Canada. CRDCN researchers advance knowledge on a wide range of subjects including population health, education and social development, income and employment, and immigration and settlement. Research findings contribute to evidence-informed decision making in federal and provincial and territorial government programs, and CRDCN supports wider policies in the research ecosystem, including advancements in Open Science.

Providing access to important research data resources: TMIC is internationally recognized for the quantity, availability and quality of its data resources, including bioinformatic tools and databases, often cited in global metabolomics research, with over 50 percent of all metabolomics manuscripts referencing at least one TMIC resource. This demonstrates that TMIC has enabled numerous research projects and publications spanning assay validation, various diseases, health and nutrition, agriculture, and more, contributing to advancements in metabolomics and related fields.

Advancing autism research: CGEn leads the MSSNG project (pronounced "missing") for autism spectrum and related neurodevelopmental disorders. This ambitious collaboration which includes Autism Speaks and Google aims to sequence the genomes of more than 10,000 individuals from families with autism worldwide. It has produced the world's largest autism whole-genome dataset and has enabled research that has revealed 134 autism-linked genes. MSSNG's goal is to provide the best resources to enable the identification of many subtypes of autism, which may lead to better diagnostics, as well as personalized and more accurate interventions.

Enabling access to and visibility of Canadian research: Coalition Publica provides access to nearly 350 scholarly and cultural journals, with open access to 98 percent of articles. In doing so, it enhances dissemination of the research output of approximately 3,500 Canadian and 2,800 international researchers each year. Publications on the platform are accessed by more than five million users worldwide annually. By promoting French-language publishing, Coalition Publica strengthens Canada's bilingual research ecosystem. It preserves and provides access to one of the largest textual data repositories, particularly in French, from major documentary institutions such as Bibliothèque et Archives nationales du Québec and Library and Archives Canada. These texts represent a unique linguistic resource for both text mining and machine learning analysis.

Facilities catalyzed technology transfers and socioeconomic benefits

Over the funding period, the 16 facilities catalyzed scientific and industrial innovation. Their technology transfer activities resulted in patents, licences and spin-offs. Nine facilities reported on average 260 patents annually for discoveries with commercial value, on topics such as radio systems and methods, electronics, imaging, materials, computational and machine learning models, manufacturing processes, and methods for diagnosing and treating illnesses. Over 80 percent of these patents were reported by a single facility and its users, CNDN.

Nine facilities reported 122 licences annually on average. For example, VIDO developed new animal vaccines including one for the porcine epidemic diarrhea virus, which was approved by the Canadian Food Inspection Agency for emergency use in outbreaks in pigs in Manitoba. They also collaborated with the Kenya Agricultural and Livestock Research Organization and International Livestock Research Institute to develop a vaccine for contagious bovine pleuropneumonia to use for controlling the disease in cattle. This vaccine won the Best Veterinary Vaccine at the 12th World Vaccine Congress in Washington D.C. in 2019.

Facilities also worked with companies to co-develop new methods and technologies, test new products, and provide technical services, equipment and expertise. The facilities worked with a wide range of industry partners, in areas such as lasers, medical technologies, semiconductors, pharmaceuticals, energy, communications/networking, fisheries and mining. Eleven facilities reported 331 technical reports annually on average, which were provided to companies to support commercial goals.

The annual average of those same five facilities was 47 spin-offs, which stimulated economic growth and created job opportunities.

Examples of technology transfers reported by facilities

Translating research into economic advancement: By providing access to advanced microsystems technologies, CAD tools and fabrication services, CNDN facilitated the creation of innovative designs and prototypes. Its support led to over 1,100 patents being applied for and/or issued, 200 technologies licensed, and 75 spin-off companies created since 2017. The facility's multidisciplinary approach and collaboration with industry partners ensured that researchers could effectively translate their research into marketable products and technologies, driving significant economic and technological advancements.

Contributing to commercial success: TMIC's expertise in metabolomics research and technology development has enabled a spin-off company, OMx Health Analytics, to streamline their operations, reducing costs for users and making metabolomics more accessible. OMx Health Analytics has significantly contributed to the commercial operations of the DrugBank database, a comprehensive online database that combines detailed drug, chemical, pharmacological and molecular biology information and includes drug targets and interactions. OMx has created more than 30 high-tech positions and secured a $9 million funding round in 2022, substantially bolstering Alberta's economic landscape.

Examples of socioeconomic benefits reported by facilities

COVID-19 pandemic responses: Several facilities contributed to Canada's pandemic response.

- CGEn implemented Canada's COVID-19 whole genome sequencing initiative (HostSeq) and generated whole genome sequences matched with clinical data for more than 10,000 Canadians affected by COVID-19. These data helped understand variable disease outcomes, identify new biomarkers for risk prediction, and create a national platform and genomics-related network to prepare for future biological crises.
- CLS was one of the first synchrotron facilities in the world to acquire data on the proteins making up the SARS-CoV-2 virus. They used their beamlines to: help visualize the molecular structures of key proteins in the virus, understand how potential therapeutics and vaccines combat COVID-19, analyze ways to improve personal protective equipment, and study the long-term effects of the virus.
- VIDO accomplished several firsts in Canada, including isolating SARS-CoV-2 and developing animal models to test new medicines. The facility significantly contributed to more than 200 groups worldwide, from various sectors, in developing more than 400 potential vaccines and treatments for COVID-19. VIDO's expertise, experimental data and technical reports led to publications, policy decisions and the approval of new medicines. Six technologies progressed to human clinical trials, with one ultimately used to vaccinate people globally. VIDO was also awarded a major grant from the Coalition for Epidemic Preparedness Innovations — the first for a Canadian organization developing broad COVID-19 vaccines. An economic study found that a decade of VIDO's work contributed over half a billion dollars to Canada's economy and created 2,375 full-time equivalent jobs.

Cancer treatment: CCTG led a trial that validated the safety of a particular surgical approach for women with cervical cancer, while another trial demonstrated how a novel combination of immunotherapy and chemotherapy enhanced outcomes for patients with metastatic pleural mesothelioma. These results represent new treatment options for patients and are expected to change practice in Canada and globally. Canadian patients have early access to innovative treatments as volunteers on CCTG trials.

Agri-tech and protecting livestock production: VIDO is uniquely positioned to rapidly research and develop novel animal health technologies to mitigate the ongoing risk to the Canadian livestock sector of production-limiting infectious diseases. During the 2017 and 2018 swine coronavirus outbreaks in Manitoba, twenty thousand doses of a vaccine developed and produced at VIDO were used to protect livestock. In addition, the VIDO team created protocols to minimize the spread of the disease, publishing a sanitization method for transport trailers that was later implemented.

VIDO is also preparing Canada for foreign animal diseases, such as African Swine Fever (ASF), that threaten North America. An ASF outbreak in Canada would abruptly shut down international markets and jeopardize the two-thirds of Canadian pork that is exported — a negative impact recently estimated at $15 billion annually. With backing from livestock producers, VIDO became the first non-governmental organization in Canada authorized to work with the ASF virus, enhancing research and the industry's response capabilities to reduce the likelihood of this foreign animal disease reaching Canada.

Saving healthcare costs: CCTG collaborated with private partners to establish indications for multiple novel drugs and diagnostic tests. The facility also generated valuable economic insight by conducting various cost analyses using data from Canadian cancer trials to provide actionable evidence to inform public healthcare policy. New drugs and diagnostics provided to patients on trials also led to millions of dollars of healthcare costs saved.

Protecting lives and infrastructure against earthquakes: ONC works with operators of major infrastructure in British Columbia on the integration of its real-time Earthquake Information Messaging System (EIMS) to help save lives and protect infrastructure. Operators can sign up for ONC's automated messages that detail earthquake shaking arrival times, location, intensity and magnitude. This information can be used to activate safety measures before ground shaking arrives, thus reducing earthquake risks to the public. Live data from ONC's land-and-seafloor seismic sensor network is also available for integration into the Canadian Earthquake Early Warning system.

Improving the resilience of coastal communities to natural hazards: ONC inundation modelling makes coastal communities more resilient to natural hazards like tsunamis, storm surges and sea-level rise due to climate change. ONC integrates seafloor bathymetry and coastal topography data to create high resolution digital elevation models (DEM). These DEMs are used by ocean, tsunami and storm surge modellers to forecast coastal inundation including the expected speed, direction, height, inundation extents and arrival times. ONC and partners consult Indigenous community members to learn from Knowledge Holders and to understand residents' tsunami and flood risk priorities and vulnerabilities that inform emergency plans, evacuation routes and risk reduction initiatives. Models have been completed for several regions and First Nations communities along British Columbia's coast, demonstrating how Traditional Indigenous Knowledge and ocean science together can better prepare the Pacific west coast for big earthquakes and climate induced storm surge events.

Population health and safety: AEL-AMS employs specialized equipment to detect trace radionuclides, including those from nuclear facilities. The facility evaluated the level of soil contamination at the Chalk River Canadian Nuclear Laboratory during redevelopment planning to ensure the safety of local residents and staff at the nuclear lab. They also monitored tritium levels downstream in Ottawa's water supply and confirmed that municipal water was safe and in compliance with regulations. AEL-AMS also supported Canada's international commitments by collaborating with the International Atomic Energy Agency to monitor radionuclides in water from Japan's Fukushima site, contributing to national seafood safety and environmental risk assessments, and highlighting the lab's role in global health and safety.

Contributing to environmental management: The scientific activities conducted aboard the CCGS *Amundsen* have significantly informed policy-makers about the state of Arctic ecosystems, wildlife and resources. The facility's unprecedented access to the Canadian Arctic seas has directly contributed to the development of both Canadian and international policies on fisheries, environmental protection, and natural resource management. This includes the establishment of marine protected areas in the Canadian Arctic and subarctic regions, such as the Tallurutiup Imanga National Marine Conservation Area.

Protecting critically endangered whales: OTN's glider-based program has been crucial in protecting the critically endangered right whale, which migrates between the southern U.S. and Canada. Thanks to this effort, there has been only a single reported death of a right whale in the Gulf of St. Lawrence in the six-year period between 2019 and spring 2025, following the deaths of 19 whales in just two years between 2017 and 2019 due to ship strikes and fishing gear entanglement. This success has also ensured Canada's compliance with the U.S.'s environmental standards, maintaining the trade relationship between both countries.

Promoting best practices in governance and management

The success of research facilities is underpinned by effective governance and management structures and practices. The CFI promotes responsible stewardship by encouraging national research facilities to adopt best practices in governance and operations. To support the facilities in developing and implementing best practices in these areas, the CFI provides tools and resources for practices spanning data management, communicating achievements and impacts, risk management, and developing strategic plans. The CFI also convenes an annual MSIF workshop to enable research facilities to share good practices and develop new ones for emerging or evolving needs (e.g., cybersecurity).

Facilities advanced their practices in governance and management

All facilities refined their governance structure by implementing new, more formalized or stronger models and processes. Key improvements during the 2017 to 2023 funding cycle included creating advisory, budget, finance, strategy, and/or partnership committees (e.g., AEL-AMS, Coalition Publica, CRDCN, ONC). In these facilities, newly created committees served to support and guide facilities with their strategic planning and goals. Several facilities also increased the diversity of their board membership, including across sectors, internationally, and from Indigenous communities.

Changes to management structures of the 16 facilities ranged from none or very minor changes to major restructuring of their management models and processes. Among the changes to management were the creation of new management committees and diverse administrative, science and technology, and leadership positions (e.g., a chief operating officer). Six of the facilities (CNDN, Coalition Publica, CRDCN, OTN, SNOLAB and TCP) reported major organizational restructuring, mostly in response to growth of their teams and to improve their oversight and management.

Facilities evolved good practices in equity, diversity and inclusion

All research facilities continued to evolve their equity, diversity and inclusion (EDI) practices and actions in multiple ways. Among the good practices were the creation and refinement of EDI statements and strategies and the establishment of EDI working groups or advisors. New programs for outreach, education, and Indigenous community engagement were created, including new education/outreach hires.

Several facilities (e.g., AEL-AMS, CNDN, ONC, VIDO) also embedded EDI principles in hiring processes and in the composition of boards of directors, management teams and advisory committees (e.g., by undertaking the Government of Canada's 50 – 30 Challenge for leadership positions, or by setting goals to attain gender parity and significant representation of underrepresented groups on boards and in senior management positions). Several facilities started tracking the progress of their EDI actions through user and facility staff surveys to monitor and demonstrate progress (e.g., the participation of women in science, technology, engineering and mathematics (STEM) in leadership positions).

Accessibility to physical, virtual and data resources were further developed and improved by various means including providing open access to data and increasing accessibility to physical facilities.

Advancement of good practices in Indigenous engagement

Research partnerships and collaborations with Indigenous communities have increased and deepened during the funding period. For example, ONC co-developed a coastal hazard assessment framework that utilized a Two-Eyed Seeing approach, interweaving Indigenous Knowledge with its tsunami and flood hazard modelling services, the results of which support emergency planning for coastal communities. CCGS *Amundsen* hired Indigenous trainees and experts aboard the vessel as field scientists and assistants and engaged Inuit Knowledge Holders as part of its objective to combine marine science and Inuit Qaujimajatuqangit (Inuit Traditional Knowledge) to support studies that balance scientific approaches.

Conclusion

CFI investments in national research facilities through the 2017 MSIF competition enabled significant progress in advancing scientific knowledge, fostering innovation and addressing societal challenges through collaborative efforts and effective governance practices.

The CFI investment of $535 million, supplemented by $645 million from various partners, has built upon nearly $800 million in capital funding provided by the CFI over the last 25 years, typically accompanied by partner contributions representing approximately 60 percent of total project costs.

This cumulative investment has allowed these facilities to operate optimally, attract users, train and employ highly skilled personnel, and produce substantial research outputs.

The numerous examples reported by these facilities also demonstrate their contributions to socioeconomic benefits, including health improvements, economic growth, and policy influence.

Building on over a decade of experience supporting national research facilities, and lessons learned from the 2017–23 and previous MSIF funding periods, the CFI continues to evolve its support and oversight practices of these facilities. The CFI's close and collaborative support of national research facilities will enable them to continue to benefit Canadians and enhance their international reputation and impacts.