National Research Council Canada

2020–21

Departmental Plan

The Honourable Navdeep Bains, P.C., M.P.
Minister of Innovation, Science and Industry

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Table of contents

From the Minister

It is my pleasure to present the 2020–21 Departmental Plan for the National Research Council of Canada (NRC). We are working across the Innovation, Science and Economic Development Portfolio to enhance Canada's innovation performance, improve conditions for business investments, increase Canada's share of global trade and build a fair and efficient marketplace that promotes consumer choice and competition.

We will continue to work with provinces, territories, municipalities, Indigenous groups, industry, stakeholders and all Canadians to deliver an economic agenda that is growing an internationally competitive, knowledge-based economy while achieving our environmental goals.

The NRC is well positioned to support innovation ecosystems across the country, driving job creation, technology adoption, investment and firm scale-up through key partnerships with industry, academia and other government departments. By implementing the priorities set out in this Departmental Plan and its five-year strategic goals, and through continued excellence in science, research and innovation, I am confident the NRC will deliver solutions that address the great challenges Canada is facing. In particular, the NRC's continued support of key innovation initiatives such as the NRC Ideation Fund, Challenge Programs, Collaboration Centres, and Supercluster Support Programs will encourage sustainability and help to strengthen Canada's innovation economy.

Through these initiatives and more, we will continue to deliver our commitment to foster a dynamic and growing economy that creates jobs, opportunities and a better quality of life for all Canadians.

The Honourable Navdeep Bains
Minister of Innovation, Science and Industry
Mandate Letter[i]

From the President

Building on the extensive consultations undertaken through NRC Dialogue[ii] and the resulting "re-imagining" of the NRC, in 2019–20 we released our research-driven Five-Year Strategic Plan: *From Dialogue to Action, Excellence to Impact*. This plan sets out clear goals and actions that will enable the NRC to play a vital role in supporting creative, relevant and sustainable solutions to Canada's current and future economic, social and environmental challenges.

With this plan as our guide, the NRC will work in alignment with key government priorities to address the environmental, health and economic concerns confronting Canadians, and will find innovative solutions to unique challenges facing remote Canadian communities and Indigenous peoples. The NRC will support the Minister of Innovation, Science and Industry in driving mission-oriented research to address the great challenges of our age, including climate change, clean growth and a healthy society. Specifically, the NRC will support the Minister in delivering his mandate by continuing to: support Canada in transitioning to a low-carbon and sustainable economy; transform science into commercially successful innovation and opportunities for industries of tomorrow; and grow Canadian firms to scale. To deliver results in these areas, the NRC's priorities for 2020–21 will be driven by the following strategic areas of focus:

- **Enabling a more sustainable economy:** The NRC will support Canada's transition to a more sustainable economy through research on energy and the environment, natural resources, buildings and infrastructure, food, and transportation.
- **Supporting a healthier future:** With a strong reputation for global scientific leadership in biologics and vaccine development, medical devices and food production, the NRC will continue to advance research in health-related challenges such as an aging population, re-emergence of infectious diseases, and food security.
- **Innovating the everyday:** The NRC's significant expertise in digital technologies, artificial intelligence, robotics and automation, sensors and WIFI will help improve the everyday lives of Canadians, unlock new economic opportunities, and bring faster communication links to remote communities across the country.
- **Creating Canadian wealth through innovation:** Through active support for Canadian small and medium-sized enterprises (SMEs) provided by the National Research Council of Canada Industrial Research Assistance Program (NRC IRAP), the NRC will be a driver of economic growth, jobs, and opportunities for SMEs struggling to grow and thrive in their respective industries.

- **Understanding our world:** With more than 2,000 scientists, engineers and technicians contributing to scientific breakthroughs around the world, the NRC will utilise its knowledge and capabilities to help answer fundamental questions and enable technologies that will spur Canadian innovation in the future.
- **Building a workforce of the future:** The NRC will uphold excellence in research and innovation by placing an emphasis on people. To do so, we will call upon the newly developed Strategic Human Resources Plan, which focusses on talent development, transition and attraction, as well as employee diversity and wellness.

In 2020–21, the NRC will leverage its expertise and facilities as collaborative platforms in the innovation ecosystem where Canada's leading experts may convene to deliver breakthroughs and solutions in national priority areas. With our strategic areas of focus as our guide and through continued support to key innovation initiatives, including the NRC Ideation Fund,[iii] Challenge Programs,[iv] Collaboration Centres,[v] and Canada's innovation superclusters,[vi] the NRC is poised to help Canada address the global and national challenges that will reshape how our communities live, work and plan for the future.

Mr. Iain Stewart
President
National Research Council Canada
Mandate letter for Mr. Iain Stewart (September 6, 2018)[vii]

Plans at a glance

As Canada's largest federal performer of research and development (R&D), the National Research Council (NRC) plays an important role within the Canadian science, technology and innovation ecosystem. For more than a century, it has been working collaboratively to face critical, socioeconomic challenges and explore the possibilities they present, all the while focused on the well-being of Canadians.

In 2019–20, the NRC launched its Five-Year Strategic Plan to articulate how the organization will position itself to achieve its goals, objectives and intended results in alignment with Government of Canada priorities. With the aim of strengthening its impact in the innovation ecosystem, and maximizing research excellence over the longer term, the plan identifies strategic goals and envisioned outcomes for the next five years. These goals will be delivered through mission-oriented initiatives by NRC research centres and the innovation support provided by the National Research Council of Canada Industrial Research Assistance Program (NRC IRAP). The research centres and IRAP will be supported by corporate enabling strategies and a vision that sets ambitious, but attainable, goals for the future.

The areas of focus identified in the Five-Year Strategic Plan set the foundation for the NRC's 2020–21 planning highlights in its three departmental results: scientific and technological knowledge advances; innovative businesses grow; and evidence-based solutions inform decisions in government priority areas.

Scientific and technological knowledge advances

The NRC will work at the forefront of R&D, to advance knowledge and research excellence that targets a smarter, safer, healthier, and more prosperous society. Leveraging its research and technical expertise, the NRC will develop solutions to everyday challenges, dig deep into fundamental science, and support R&D that encourages sustainability and protects against threats to the environment. The NRC will work with leading-edge collaborators in government, academia and industry to explore new ideas and capabilities, such as next generation materials for low-carbon fuel production and next generation fast secure communications networks, through national and international partnerships, while maintaining a strong global presence and reputation. In support of this, the NRC will launch the third and fourth round of its New Beginnings initiative and the second round of its Small Teams initiative to support researcher-led, exploratory research and foster a collaborative work environment where creativity and research excellence are valued and recognized. The NRC will also continue to partner with academic institutions on Collaboration Centres to advance research based on the best possible expertise in Canada.

Innovative businesses grow

The NRC will work with businesses and academic institutions to develop and commercialize next generation disruptive technologies that will bring greater efficiency to Canadian homes,

workplaces and transportation networks. The NRC will continue to provide business innovation support and advice through NRC IRAP to support job creation, technology adoption, investment and scale-up. To accomplish this, NRC IRAP will continue to support small and medium-sized enterprises (SMEs) through funding for innovative and transformative R&D projects up to $10M, streamline its service delivery system, and increase its cooperation with other government innovation support programs. The expected results will be the acceleration of business growth through innovation, improved productivity, and the successful scale-up of high growth firms through strengthened support.

Evidence-based solutions inform decisions in Government priority areas

The NRC will join its resources with other government departments (OGDs), academia and industrial partners to strive for shared goals in government priority areas. The NRC will continue to support and implement key initiatives designed to deliver solutions to important national and global challenges and to position Canada for the economy of tomorrow. Specifically, the NRC will continue to advance its mission-driven Challenge Programs[iv] in Disruptive Technology Solutions for Cell and Gene Therapy; Artificial Intelligence Assisted Design; Novel Materials for Clean Fuels; and High-Throughput and Secure Networks; and, will explore new Challenge Programs, including Internet of Things: Quantum Sensors, Aging in Place, and The North. The NRC will also continue to support the Innovation Superclusters Initiative[viii] by aligning its research programs with the Digital Technology, Protein Industries, Advanced Manufacturing, Artificial Intelligence (AI)-Powered Supply Chains (SCALE.AI), and Ocean Superclusters.

Managing talent and resources effectively

As a companion to the Five-Year Strategic Plan, the NRC also launched its Strategic Human Resources (HR) Plan in 2019–20. The implementation of this plan, which includes targeted HR initiatives in support of three strategic priorities: Talent Development & Transition, Talent Attraction, and Talent Diversity & Wellness, will be a focus for the NRC in 2020–21.

In an effort to deliver corporate and business processes more efficiently, the NRC's research centres, IRAP, and corporate branches will focus on one process that they will improve to be more client-orientated and streamlined in 2020–21, such as project management and reporting. The NRC will also be completing its facility review to guide future investment planning for the organization.

For more information on the National Research Council's plans, priorities and planned results, see the "Core responsibility: planned results and resources, and key risks" section of this report.

Core Responsibility: planned results and resources, and key risks

This section contains detailed information on the department's planned results and resources for each of its core responsibilities. It also contains information on key risks related to achieving those results.

Science and Innovation

Description

Grow and enhance the prosperity of Canada through: undertaking, assisting and promoting innovation-driven research and development (R&D); advancing fundamental science and Canada's global research excellence; providing government, business and research communities with access to scientific and technological infrastructure, services and information; and supporting Canada's skilled workforce and capabilities in science and innovation.

The NRC has three departmental results for tracking and reporting against its core responsibility:

1. Scientific and technological knowledge advances;
2. Innovative businesses grow; and
3. Evidence-based solutions inform decisions in Government priority areas.

Planning highlights

The 2020–21 Departmental Plan is structured by the NRC's Core Responsibility of Science and Innovation, three Departmental Results (DR) and Five-Year Strategic Plan. To highlight the strategic areas in which 2020–21 plans will focus for results, the NRC's Five-Year Strategic Plan goals and strategies have been aligned to the three Departmental Results:

Strategic Focus	DR	Strategic Goal
Enabling A More Sustainable Economy	3	Contribute to a cleaner future by reducing Canada's reliance on fossil fuel
	1	Support R&D that encourages sustainability and protects against threats to our environment
Supporting a Healthier Future	3	Adopt and advance leading-edge health technologies to create a healthier future
	3	Develop innovative, affordable and sustainable approaches to food production
Innovating the Everyday	2	Achieve breakthroughs to bring greater efficiency to Canadian homes, workplaces and transportation networks
	1	Develop and deploy next-generation solutions to everyday challenges
Creating Canadian Wealth Through Innovation	2	Accelerate the start-up and commercialization of SMEs in Canada and help them to become the next generation of global multi-national enterprises (MNEs) who are ready to seize opportunities and expand their global reach
	2	Develop and commercialize leading-edge next generation disruptive technologies with universities and businesses
Understanding Our World	1	Dig deep into questions of fundamental science to spur Canadian innovation
	3	Fuel the next generation of fast and secure communication networks

Departmental Result 1: Scientific and technological knowledge advances

The NRC delivers research excellence by working with leading-edge collaborators and exploring new ideas and capabilities in areas of importance to Canadians.

The NRC's relationship with academia is an important collaborative platform for the organization. As a result, in 2020–21, the NRC will continue to partner with academic institutions on Collaboration Centres that bring together resources and expertise to advance knowledge in key areas of research.

Departmental Result Indicators

- Citation score;
- Peer-reviewed publications;
- Patents issued;
- Licence agreements; and
- Underrepresented groups in STEM.

In 2020-21, the NRC will invest facilities and personnel in established Collaboration Centres: Centre for Research and Applications in Fluidic Technologies; Collaboration Centre on Green Energy Materials; Karluk Collaboration Space; Canadian Institute for Cybersecurity-NRC Cybersecurity Collaboration Consortium; Joint Centre for Extreme Photonics; NRC-Waterloo Collaboration on Artificial Intelligence, Internet of Things, and Cybersecurity; and NRC-Fields Mathematical Sciences Collaboration Centre, and will work with universities to launch new centres in areas of strategic focus.

Enabling a more sustainable economy

Like the rest of the world, Canada faces the need to transition to a more sustainable economy to attempt to reverse the strains that modern life has placed on the environment. The NRC is well-positioned to support the shift to more sustainable living with research related to energy and environment, natural resources, buildings and infrastructure, food, and transportation.

In 2020–21, the NRC will seek to improve the resiliency of Canadian infrastructure to withstand the impacts of climate change; and, will work to develop alternative clean energy technologies to fuel Canada's way of life while reducing greenhouse gas emissions. Specifically,

- In partnership with federal, provincial and territorial governments, research organizations and asset owners, the NRC will explore the development and harmonization of national codes and standards that will enhance the resiliency of Canadian infrastructure and buildings. The NRC will collaborate with OGDs, research organizations and industry to develop innovative technologies for structural monitoring of infrastructure; and, will work with Indigenous communities on built environment issues.
- The NRC will contribute to enhancing the resiliency of Canadian coastal infrastructure and waterways. Using physical tanks and digital representations of coastal processes and infrastructure, the NRC will seek to develop a better understanding of harsh environments and support the development of a resilient, intelligent and connected coastal infrastructure.
- The NRC will develop next-generation materials for low-carbon fuel production and advanced electrochemical devices, as well as process technologies to support the

Canadian supply of clean energy materials, particularly for batteries. The NRC plans to develop and deploy new processes for producing and utilizing future fuels with reduced and zero-emission lifecycles, and will support Canadian industry in the development and commercialization of energy storage devices. The importance of these areas was validated in the 2018–19 Evaluation of the Energy, Mining and Environment Program.[ix]

- The NRC will seek to reduce the environmental footprint of the energy and mining sectors using innovative technologies. The NRC will develop advanced water characterization and treatment technologies for emerging contaminants, and will use life cycle assessment and techno-economic analysis capabilities to apply full cost accounting to energy and mining processes across all research centre activities in the sector.
- The NRC will seek to reduce the environmental footprint of the transportation and manufacturing sector through the development of new technologies. The NRC will develop multi-modal mobility systems focusing on fleet optimization, vehicle electrification, alternative fuels, battery recycling, active aerodynamics, and lightweighting solutions to reduce carbon fuel consumption. In addition, the NRC will develop new materials and manufacturing processes using Canadian biomass, biomass residues and waste.
- In collaboration with industry, academia and government regulators, the NRC is committed to developing, integrating and demonstrating technologies that will enable future sustainable air transportation. The NRC will investigate the digitization of aerospace manufacturing, leading to implementation of new technologies in robotized composite manufacturing for aerospace applications.

Innovating the everyday

Disruptive technologies, such as artificial intelligence (AI), automation sensors and robotics, are unlocking economic opportunities and changing the everyday lives of Canadians. With its significant expertise in digital and other technologies, the NRC is well-situated to design solutions that will innovate the way Canadians live and work in the future.

In 2020–21, the NRC will seek to advance efficiency-based innovations across industry sectors. Specifically,

- The NRC will contribute to solving mining sector challenges by developing breakthrough processes and digital innovation and analytics, such as wearable devices using advanced materials and additives. The NRC also plans to use bio-hydrometallurgical and bioremediation processes to reduce liabilities in mining operations; the importance of addressing environmental liabilities was recommended in the 2018–19 Evaluation of the Energy, Mining Environment Program.[ix]
- The NRC will reduce environmental impacts of freight transportation in Canada through advances in secure and intelligent monitoring, guidance, and modelling technologies.

- The NRC will lead the development of next generation marine transportation in Canada by reducing ship emissions, improving efficiencies, and mitigating the effects of ship underwater radiated noise. This will be achieved through the application of AI to the interpretation of vessel operational data and numerical prediction models.
- Issues concerning Canada's harsh marine environments will be addressed through the development of advanced digital prediction models. This will be accomplished by developing extensive expertise in AI for modelling and predicting ice and harsh environments, building comprehensive databases of environmental parameters, and developing the required hardware infrastructure and partnerships to enable large-scale numerical and AI projects and programs.
- The NRC will develop low-cost and highly accurate 3D imaging systems to contribute to the next generation of robotic manufacturing processes that support Canadians in their daily work.
- The NRC will contribute to the development of quantum-safe cryptography and associated algorithms to support the next generation of block chain applications.
- In collaboration with Indigenous communities, the NRC will develop innovative software to help preserve, promote and revitalize Indigenous languages and community knowledge. This includes AI and human-computer interaction tools for interactive teaching, translation, transcription, and everyday use.

Understanding our world

With over 2,000 scientists, engineers, and technicians contributing to science and engineering breakthroughs, the NRC brings deep and diverse expertise to bear on many of the fundamental questions and enabling technologies that will spur Canadian innovation in the future.

In 2020–21, the NRC will focus on knowledge breakthroughs that contribute to a better, safer and more prosperous future for Canada. Specifically,

- Funded by the U.S. National Radio Observatory and working with McMaster University, the NRC is leveraging Compute Canada resources to develop a cloud-based computing platform prototype that will take full advantage of scientific results from the Atacama Large Millimetre/sub-millimetre Array. Data archived by this facility offers tremendous discovery potential to university-based researchers. This project aims to develop and test a web-accessible interface, streamlined software tools and the computational resources needed to handle large, complex datasets, to demonstrate the feasibility of rolling out a fully-developed version to the wider astronomical community.
- Continued support of Canada's particle accelerator centre, TRIUMF[x] will be provided through a $58M contribution to support research in sub-atomic physics, including the development of new industry and community partnerships in pursuit of increased economic and societal benefits for Canada. In 2020–21, TRIUMF will work towards the

completion of the ARIEL facility, which will produce rare isotopes for science, business, and medicine.

- Through the Joint Centre for Extreme Photonics Collaboration Centre with the University of Ottawa, the NRC will contribute to the development of Vacuum-ultraviolet (VUV) combs that have potential applications in high resolution spectroscopy, photoelectron spectroscopy and future atomic clocks. The NRC will also work with university partners to develop quantum-enabled sensors for improvements in measurement, such as temperature sensors based on silicon photonics and single atom physics.
- The NRC will work with international partners to develop standardization for quantum technologies, which will lay the groundwork for future technology development.
- The NRC will continue working on the development of components for next generation secure communication systems, which will include light-matter interfaces, quantum computer memories and semiconductor sources.

Building a workforce of the future

Through the implementation of its Strategic HR Plan, the NRC will increase the diversity of its scientific and technological workforce and build a pipeline of future Science, Technology, Engineering, and Mathematics (STEM) talent.

The NRC will continue to build an ambassador network, develop materials to support outreach and use social media campaigns to raise awareness of NRC opportunities, particularly among underrepresented groups. The NRC will also implement engagement opportunities with high school students, continue to develop and deliver a graduate student program, refine its undergraduate student and Post-Doctoral Fellowship programs and engage strategically with world-class academic institutions that offer complementary capabilities.

Departmental Result 2: Innovative businesses grow

To support business innovation, the NRC will continue to accelerate the growth of small and medium-sized enterprises (SMEs) by providing them with a comprehensive suite of innovation services, advice and funding. Through this work, the NRC will help SMEs build innovative capabilities, scale up, and take their ideas to market.

Departmental Result Indicators
• Client satisfaction; • Revenue growth of NRC IRAP-engaged firms; • Job growth of NRC IRAP-engaged firms; and • Revenue from clients and collaborators.

Creating Canadian wealth through innovation

Canadian SMEs face an uphill battle to grow and thrive, and in some cases, survive. Through leveraging the facilities and expertise of its research centres and NRC IRAP funding and advisory services, the NRC has established itself as a partner for Canadian SMEs and a driver of economic growth, jobs, and opportunities in Canada.

NRC IRAP is committed to providing specialized advice, services and infrastructure to support the growth of innovative, high-potential Canadian businesses. NRC IRAP helps SMEs reach their potential and grow to scale through co-innovation projects, access to specialized professional services organizations and expert advisory services. In 2020–21, NRC IRAP will:

- Accelerate work with SMEs on high value/high impact R&D projects using $150M in additional, ongoing funding.
- Expand service offerings and partnerships with OGDs to support innovative SMEs in advancing their technologies through to commercialization. Continue to support Innovation, Science and Economic Development Canada on the delivery of the Innovative Solutions Canada (ISC) Challenge Stream program, Accelerated Growth Services, and a re-design and re-launch of the ISC Testing Stream, formerly the Build in Canada Innovation Program (BCIP).
- Continue its support to Employment and Social Development's Youth Employment and Skills Strategy (YESS), through the placement of graduates within SMEs. NRC IRAP is committed to delivering on YESS modernization to ensure young professionals face fewer barriers to join the workforce.

NRC IRAP’s long-standing model of combining advisory services and financial assistance to Canadian firms is recognized internationally as a best practice in fostering SME innovative capabilities. Building on past success, NRC IRAP will support Canadian SME expansion in global markets through a number of international initiatives:

- Continued implementation of the International Co-Innovation Action Programs (ICAP) to create a pipeline of SMEs with clear international co-innovation plans and help them effectively engage in bilateral and consortia projects. As part of this initiative, NRC IRAP plans to deliver regional ICAP training workshops.
- Delivery of the Canadian International Innovation Program (CIIP) will continue alongside Global Affairs Canada (GAC) and Trade Commissioner Services in India, South Korea, China and Brazil. In 2020–21, NRC IRAP will support CIIP program enhancements to increase program flexibility and impacts for Canadian SMEs.
- NRC IRAP will continue to support Canadian SME participation in international industrial R&D consortium projects with participants from more than 41 Eureka member economies. It will invest in selected “Eureka clusters”, increasing collaboration opportunities for Canadian SMEs and innovative foreign players.
- New Global Value Chain (GVC) pilot projects will be designed and delivered in 2020–21, which will establish a standardized GVC program model for Canadian SMEs in the coming years.
- NRC offices located in Tokyo and Munich will enable NRC IRAP to support Canadian SMEs in these priority markets. Last year, NRC IRAP organized a Partnership Development Activity (PDA) in each of these economies and will scale up PDAs in 2020–21 to reinforce positioning in the global market.

- Co-delivery of the CanExport Program with Global Affairs Canada will continue, offering a streamlined funding application process to SMEs, with referrals by Industrial Technology Advisors. CanExport expects an increase in funding applications and aims to support an estimated 1,500 SMEs in accessing international markets. The program will leverage the full benefits of its digital delivery platform to facilitate seamless program co-delivery and an end-to-end experience for clients.

In 2020–21, the NRC will continue to support the development and commercialization of new technologies through de-risked innovation, enabling industry partners to explore new ideas. Specifically,

- The Canadian Photonic Fabrication Centre offers foundry services to allow the significant Canadian photonics industry to take innovations from concept to market. The NRC will seek to expand these services from the fabrication of wafers to full solutions in collaboration with partners such as the Institut national d'optique, Centre de collaboration MiQro Innovation, Alberta Centre for Advanced Microsystems and Nanotechnology Products, and multinational companies with a significant presence in Canada.
- The NRC will continue to support the growth of Canadian SMEs that develop nano-enabled devices, and bio-products or technologies. The NRC will complete a preliminary assessment on the development of an open source, lower-cost, scanning electron microscope that could significantly reduce the barrier for businesses, researchers and others to access nano-scale precision imaging instrumentation.
- The NRC will also enhance its capabilities in nanomaterials synthesis through a project funded by the ISC Testing Stream and will continue to support the growth of SMEs through fiber technology licensing and collaboration.

In 2020–21, the NRC's Medical Devices Program will continue to de-risk early stage development of strategic technology platforms and transfer them to industry to accelerate product commercialization. For example, the NRC will undertake a three-year project with Marion Surgical to integrate NRC's generic bActive platform software into its pulmonary endarterectomy surgery simulator. A leading medtec company is expected to incorporate the same software and hardware know-how in its orthopaedic surgery simulation platform, building on the transfer of NRC's surgical simulator to the company which was recognized as a success in the 2019 evaluation of the Medical Devices Program[xi] of the program.

The NRC's Human Health Therapeutics Program will continue its work to de-risk development, testing and production of novel biologic medicines; launch a program to expand the Canadian biopharma pipeline of multi-functional antibody-based medicines to address needs in cancer and neurological diseases; and contribute to R&D initiatives and collaborations to foster bio-manufacturing in Canada.

Innovating the everyday

New frontiers in business are delivering more efficient homes, workplaces and transportation networks that improve Canadians' quality of life. With its innovative research and scientific knowledge and specialized facilities, the NRC supports industry clients and collaborators in bringing emerging technologies that benefit Canadians to market.

In 2020–21, the NRC will collaborate with SMEs to advance autonomous technologies, manufacturing processes and transportation systems. Specifically,

- The NRC will increase collaboration with SMEs to advance technologies for autonomous flight with the goal of delivering defined technology solutions and commercialization. NRC IRAP will provide leadership in supporting SMEs with advisory services, linkages, or financial contributions and the Aerospace Program will provide technical and advisory expertise and equal financial contributions.
- The NRC will develop new advanced manufacturing capabilities in robotics, various additive manufacturing technologies for mass customization, advanced composites for high volume applications and digital threading.
- The NRC will work towards improving safety and efficiency in rail transportation with world-leading technologies such as Instrumented Wheelsets,[xii] risk mapping and rail car and track health monitoring.
- The NRC will harness digital technologies to advance intelligent transportation systems targeting freight/personal mobility, multi-modal fleet optimization and cybersecurity.
- The NRC will lead the development of next generation marine transportation in Canada by developing technologies to facilitate autonomous shipping in Canada's harsh environments and ice-covered waters, and by participating in future regulatory frameworks.

Departmental Result 3: Evidence-based solutions inform decisions in Government priority areas

The NRC develops and supports targeted research and collaboration initiatives designed to advance knowledge and support business innovation in government priority areas.

Departmental Result Indicators
• Peer-reviewed publications co-authored with OGDs; • Revenue from collaborative work with OGDs.

Collaboration initiatives, such as the NRC Challenge Programs and the Innovation Superclusters Initiative, bring together the unique strengths of innovators from OGDs, academia and industry to foster transformative discoveries and technological breakthroughs that benefit Canadians.

In 2020–21, the NRC will continue to advance the four mission-oriented Challenge Programs established in 2018–19 as follows:

Challenge Program	2020–21 Planning Highlights
Disruptive Technology Solutions for Cell and Gene Therapy[xiii]	Accelerate the development of safe, affordable and accessible cell and gene therapies to treat cancer and rare genetic disorders of importance to Canada.
Novel Materials for Clean Fuels[xiv]	Develop and deploy clean energy technologies, including clean fuels and energy materials, in support of OGD's policy development for commercialization and integration of clean energy storage devices.
High-Throughput and Secure Networks[xv]	Develop innovative technologies to enable network operators and service providers to offer secure, affordable gigabit broadband services in rural and remote communities anywhere in Canada.
Artificial Intelligence for Assisted Design[xvi]	Advance research in multimedia analytics and technologies for Indigenous languages by leveraging current capabilities and developing new capabilities in data analytics, cybersecurity, and robotics.

During this period, the NRC will also initiate the development of the next set of Challenge Programs in the areas of Internet of Things: Quantum Sensors, Aging in Place, and The North.

In 2020–21, the NRC will continue to support Canada's five Innovation Superclusters: Digital Technology; Protein Industries; Advanced Manufacturing; Artificial Intelligence (AI)-Powered Supply Chains (SCALE.AI); and Ocean, by providing access to its research facilities, personnel and NRC IRAP project assessment services as needed. To sustain the impact of Superclusters, the NRC is establishing Supercluster Support Programs and has earmarked a reallocation of resources (staff, operations and facilities) to advance scientific research and technological platforms that align with the Superclusters focus areas.

The NRC has earmarked $24M annually in grants and contributions funding to support universities and SMEs collaborating with the NRC on Supercluster and Challenge Program research and development activities.

In 2020–21, the NRC will contribute to policy initiatives by supporting Supercluster Programs and providing leadership for research and development pillars in Supercluster Support Programs, through:

- The advancement of sustainable agriculture, food production practices, and renewable Canadian bio-resources in support of the Protein Industries Supercluster and Ocean Supercluster. The NRC will expand the capabilities offered through its core Algal Research and Plant Growth facilities to help address emerging government priorities.
- The provision of data analytic services to help SMEs integrate artificial intelligence and analytics solutions into their enterprises in support of the SCALE.AI Supercluster and Digital Technologies Supercluster.
- In support of the Next Generation Manufacturing Supercluster, the NRC will follow the Advanced Manufacturing Program roadmap and contribute to Canada's manufacturing sector with research to boost productivity and agility by reducing manufacturing costs in the factory, including those associated with design, supply, processing and assembly.

Areas of focus will include improved analytics, better machine and plant connectivity, increased automation, and more energy-efficient manufacturing facilities and operations. In addition, the NRC will develop novel formulations, processes, and methods for smart manufacturing, including metal and composite/polymer products manufacturing.

Supporting a healthier future

Canada continues to face global health-related pressures, including an aging population, the re-emergence of infectious diseases, and food security, as well as national health and well-being issues, such as health care in rural and remote areas and the unique needs of Indigenous communities. With a strong reputation for global scientific leadership in biologics and vaccine development, medical devices, and food production, the NRC is well-equipped to address these challenges and support a healthier future for Canadians.

In 2020–21, the NRC will work to advance health technologies, policies and standards. Specifically,

- The NRC is addressing the challenge of ensuring consumer safety in a legal cannabis market through the promotion of documentary standards for cannabis testing methods and the development of cannabis certified reference materials. These standards will ensure accuracy and consistency of testing results, assist licensed cannabis producers in achieving regulatory requirements, and ultimately promote confidence in regulated cannabis industries. The NRC is also helping ensure public safety by evaluating and validating roadside drug screening devices for Justice Canada.
- As the negative impacts of climate change continue to expand, anticipated warmer climates will result in an increased prevalence of pathogens and molds, and food contaminants; such as aflatoxins that thrive exclusively in warmer climates, which will inevitably materialize in Canada. These emerging food and environmental contaminants pose a significant measurement challenge as testing regimes are generally not in place. In anticipation of this, the NRC is taking a lead across government departments on detection and reference materials for blue/green algae-based microcystins, and is a leading provider of reference materials for toxic heavy metals.
- The NRC will support the Canadian Space Agency’s renewed mandate in health with microfluidic technologies for monitoring health in space. It will also work with Health Canada and the Communications Security Establishment on best practices for adoption of digital health technologies.
- The NRC will launch a Cognitive Care Network with the goal of delivering cutting-edge digital therapeutics prototypes focused on solutions to depression in working and northern populations, cognitive dysfunctions due to cannabis addiction and in schizophrenia, pediatric executive function, and cognitive decline in seniors.
- The NRC’s Human Health Therapeutics Program will continue to work collaboratively with the Public Health Agency of Canada and OGDs on Canadian vaccine development

efforts as part of the federal Vaccine Research Innovation and Development Working Group.
- R&D capabilities in nanobiomedicine will be leveraged by the NRC to advance the science of complex and poorly-understood biological mechanisms associated with disease at the nanoscale. The advancement of microscopy techniques and hardware/software will help to better characterize and accurately manipulate matter in increasingly complex nano- and atom-scale systems. The NRC will further collaborative efforts in R&D by continuing its Nanotechnology Initiative with the University of Alberta and will launch a call for joint project proposals in priority areas of nanotechnology. The NRC will also seek to establish new collaborations with leading Canadian and international institutions to further research in these areas.

Enabling a more sustainable economy

Changes in our environment are creating new challenges that have the potential to impact modern life in Canada. As a result, the NRC is working collaboratively with OGDs to face these challenges and transition Canada to a more sustainable economy. Specifically,

- The NRC will continue to provide secretariat support for the federal Genomics Research and Development Initiative (GRDI) and contribute to the two GRDI Shared Priority Projects: Antimicrobial Resistance, which aims to understand how food production contributes to antimicrobial resistance of human health and enable exploration of strategies for its reduction; and Metagenomics-Based Ecosystem Biomonitoring, which will characterize the complex microbial and invertebrate biodiversity of soil and freshwater through novel metagenomics approaches.
- The NRC will work to achieve carbon-neutral construction, and reduce waste during the course of construction. This will be accomplished through participation in a science hub on sustainability innovation with the federal government, and through the development of partnerships with leading organizations in construction sustainability.

Understanding our world

To ensure Canada’s long-term prosperity, the NRC will work with OGDs, academic and industry partners to drive innovation and push the limits of what is possible.

In 2020–21, the NRC will fuel the next generation of nanotechnology, measurement science, photonics and material engineering to develop leading innovations for a better, safer, more prosperous future for Canada. Specifically,

- Collaboration across the NRC’s programs provides an opportunity for the organization to offer multi-disciplinary projects and initiatives aimed at addressing critical gaps identified by OGDs. For example, the NRC will continue the development of sensing technologies to address the needs of OGDs in various sectors including defense, safety,

security and the environment. Notably, it is engaging OGDs in the development of printed sensors.
- The NRC will develop novel materials for adaptive and intelligent multi-functional objects using advanced manufacturing techniques such as 2D and 3D printing.
- The NRC will work with Government of Canada partners to develop a quantum science strategy for the federal government, including establishing an Assistant Deputy Minister-level Coordinating Committee on quantum science and technology.
- Building on its successful collaboration with Transport Canada (TC) on Remotely Piloted Aircraft Systems (RPAS) projects, the NRC will continue to collaborate with OGDs, academia and industry on research focused on remotely piloted aircraft. The RPAS collaboration with Transport Canada has strengthened Canada's foothold in the unmanned aerial vehicles industry and will help inform TC's regulatory framework for safe, yet affordable RPAS use.

Gender-based analysis plus (GBA+)

The NRC will continue to formalize its GBA+ framework, accountability and reporting mechanisms and build capacity and expand awareness across the organization, by integrating GBA+ into the NRC Equity, Diversity and Inclusion Strategy, annual operational plans, evaluations, and R&D programs. NRC IRAP will continue implementing a data collection strategy that takes into consideration the categories of GBA+ data regarding leadership representation of NRC IRAP clients, data governance for information collected, and development of internal processes and training. In addition, NRC IRAP will work to remove external barriers to growth for firms led by under-represented groups by providing targeted support through its Contribution to Organization funding mechanism. The types of support considered will be based on well-documented researched gaps such as access to capital, mentorship and other issues impacting entrepreneurs from under-represented groups.

United Nations' 2030 Agenda for Sustainable Development and the UN Sustainable Development Goals (SDGs)

The NRC is voluntarily developing its first three-year Departmental Sustainable Development Strategy (DSDS), which will be tabled in 2020–21. In alignment with the six goals identified in the Federal Sustainable Development Strategy:[xvii] greening government, effective action on climate change, clean growth, modern and resilient infrastructure, clean energy, and safe and healthy communities, the organization will identify UN Sustainable Development Goals (SDGs) that departmental actions contribute to, including:

- Greening government activities that support SDG 12.7:[xviii] *Promote public procurement practices that are sustainable, in accordance with national policies and priorities*.
- Construction sustainability, reduction of carbon emissions and increased resiliency of infrastructure to support SDG 9.1:[xix] *Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic*

development and human well-being, with a focus on affordable and equitable access for all.

- New processes and technologies in the production of clean energy materials, in support of SDG 7.A:[xx] *By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology.*

Further support to SDGs will be identified in the NRC's 2020-23 Departmental Sustainable Development Strategy.

Experimentation

Currently integrated in its operational planning process, the NRC continues to build capacity and expand awareness across its business units to ensure at least one experimental project is run each year in a research division, a corporate division and NRC IRAP. Below you will find the NRC's experimentation commitments for the 2020–21 fiscal year.

In 2020–21, the NRC will participate in the Treasury Board Secretariat's Experimentation Works (EW) Initiative, a government initiative to build public service capacity in experimentation skills and practice through unique learning by doing models. As part of the EW Initiative, NRC IRAP will use an experimentation approach to improve the diversity of ITA candidates recruited and hired. The new social media recruitment will include a test and compare element to increase the diversity (specifically women ITAs) in the first year and data will be compared with pre-study data.

Precise timing capability is at the very core of most national and international infrastructure. NRC's TimeLink™ Remote Clock relies on a high quality frequency standard that is continuously adjusted to maintain precise synchronization with UTC, and is more precise and secure than conventional GPS-based accurate timing that is prone to signal disruption. The NRC has engaged with Shared Services Canada (SSC) to provide SSC data centres, computer networks and SSC clients with access to official time utilizing NRC's TimeLink™. The NRC is collaborating with industrial and academic partners on developing TimeLink™ for Canadian Northern and remote regions under the NRC's High-throughput and Secure Networks Challenge Program. Also, the NRC is working with international partners in India where NRC's TimeLink™ could be adapted to disseminate their national time.

To support the creation of buildings and infrastructure that improve the well-being of Canadians, the NRC will establish living laboratories or large-scale pilot projects to validate new construction technologies. It will also conduct strategic research on the effects of environmental conditions on building occupant health and develop benchmarking methodologies for organizational productivity.

Collaborating with the Canadian Space Agency (CSA), the NRC IRAP BioMedical Sector team is developing a pilot program to support Canadian SMEs in the development of biomedical technologies in conjunction with terrestrial applications for deep space. CSA will support the pilot program by providing funding for feasibility studies and NRC IRAP will contribute up to $5M to support prototype development by SMEs.

In 2019–20, NRC IRAP established two pilot programs to help innovative firms improve their access to large-scale growth funding. A pilot program with the Business Development Bank of Canada was established in Ontario and a similar pilot program was established with National Bank to assist Quebec-based firms. In 2020–21, both pilot programs will be assessed to evaluate the effectiveness of the referral process and identify program improvement opportunities to support SME access to capital.

NRC IRAP's R&D Certificate Program will continue in 2020-21 to help more SMEs take advantage of the services offered by the NRC. As in previous years, NRC IRAP will monitor the performance of the Certificate program with the goal of ensuring continuous improvement of the client experience.

Key risks

The NRC is exposed to a range of political, economic, social, technological, legal and environmental factors that have the potential to impact its ability to achieve results in support of its Core Responsibility. Disruptive technologies, cybersecurity and privacy, aging populations, climate change and fluctuations in the Canadian economy are examples of factors that impact the NRC as an organization, the research it conducts and the businesses it supports.

In consideration of its risk context and operating environment, in 2020–21 the NRC will focus on corporate risks related to managing collaboration, financial stability, protection of information and assets, and emergency prevention and response.

The NRC has incorporated risk appetite into its corporate risk process. Accordingly, for 2020–21, key mitigation strategies will be focussed on reducing likelihood and consequence for the collaboration management and protection of information and assets risks. Existing controls were deemed sufficient for the financial stability and emergency prevention and response risks. In 2020–21, these risks will be monitored and no new mitigation strategies will be implemented.

Planned results for Science and Innovation

Departmental Result Indicators	Targets	Date to achieve target	2016–17 Actual results	2017–18 Actual results	2018–19 Actual results
Departmental Result 1: Scientific and technological knowledge advances					
Citation score of NRC-generated publications relative to the world average	1.50	March 31, 2021	1.53	1.45	1.51
Number of peer-reviewed publications generated by the NRC	1,000	March 31, 2021	1,086	982	1,030
Number of patents issued to the NRC	160	March 31, 2021	143	167	156
Number of licence agreements	40	March 31, 2021	40	46	31
Ratio of the NRC's workforce made up of underrepresented groups relative to Canadian average labour market availability in Science, Technology, Engineering, and Mathematics (STEM)[1]	1.0	March 31, 2021	0.99	0.98	1.02
Departmental Result 2: Innovative businesses grow					
Percentage of R&D clients who report positive benefits of working with the NRC	86%	March 31, 2021	81%	86%	90%
Percentage revenue growth of firms engaged with the NRC (IRAP-engaged firms)[2]	20%	March 31, 2021	26%	25%	27%
Percentage growth in Canada's science and technology related jobs through NRC supported firms (IRAP-engaged firms)[2]	10%	March 31, 2021	11%	13%	18%
Revenue earned from clients and collaborators	$76.4M	March 31, 2021	$82.5M	$87.0M	$79.7M
Departmental Result 3: Evidence-based solutions inform decisions in Government priority areas					
Revenue earned from other federal government departments	$77.6M	March 31, 2021	$74.9M	$82.4M	$93.1M
Number of NRC peer-reviewed publications co-authored with other federal government departments	60	March 31, 2021	69	60	55

Financial, human resources and performance information for the National Research Council's Program Inventory is available in the GC InfoBase.[xxi]

[1] The indicator is focused on the workforce representation of women through 2019–20. In 2017–18, the Canadian average labour market availability of women in NRC Science, Technology, Engineering, and Mathematics (STEM) jobs was 25.4%. Results are based on 2011 census data.
[2] Measured over a period of two calendar years and lagging by two years.

Planned budgetary financial resources for Science and Innovation

2020–21 budgetary spending (as indicated in Main Estimates)	2020–21 Planned spending	2021–22 Planned spending	2022–23 Planned spending
1,077,399,652	1,077,399,652	1,050,393,462	1,034,227,390

Financial, human resources and performance information for the National Research Council's Program Inventory is available in the GC InfoBase.[xxi]

Planned human resources for Science and Innovation

2020–21 Planned full-time equivalents	2021–22 Planned full-time equivalents	2022–23 Planned full-time equivalents
3,099.9	3,099.9	3,099.9

Financial, human resources and performance information for the National Research Council's Program Inventory is available in the GC InfoBase.[xxi]

Internal Services: planned results

Description

Internal Services are those groups of related activities and resources that the federal government considers to be services in support of Programs and/or required to meet corporate obligations of an organization. Internal Services refers to the activities and resources of the 10 distinct services that support Program delivery in the organization, regardless of the Internal Services delivery model in a department. These services are:

- Management and Oversight Services
- Communications Services
- Legal Services
- Human Resources Management Services
- Financial Management Services
- Information Management Services
- Information Technology Services
- Real Property Management Services
- Materiel Management Services
- Acquisition Management Services

Planning highlights

Launched in 2019–20, the Strategic HR Plan, a companion document to the NRC Five-Year Strategic Plan, positions the NRC with the workforce needed to achieve its strategic goals. In 2020–21, the NRC will continue to implement the strategies and initiatives of its five-year Strategic HR Plan, including:

- The Equity, Diversity and Inclusion (EDI) Strategy, which will provide tools for hiring managers and HR personnel to support hiring of employment equity groups, focus on building relationships with academic organizations that support diverse groups, enhance EDI through mandatory training, event promotion, and dialogue with targeted communities, develop focused strategies for recruitment of Indigenous peoples and persons with disabilities, and embed employment equity commitments in executive performance agreements.
- Implementation of a new organizational Wellness Strategy will begin with a focus on increasing awareness of wellness and mental health in the workplace, delivery of mental health training for employees and managers, and the continued establishment of roles and governance framework for the management of workplace wellness at the NRC.
- Execution of the new Leadership Development Framework, which includes: continuing the mandatory completion of role-based Canada School of the Public Service (CSPS) leadership development programs for those appointed to leadership roles; continuing work with CSPS in the implementation of a new leadership program for STEM professionals; creating an updated process for identifying and supporting high-potential

employees; training and resource recommendations for supervisors to address key challenges; and establishing of a mentoring approach at the NRC.

The NRC's values and ethics policy framework, guidelines and tools will be further developed in 2020–21 to support employees and managers in areas including, Conflict of Interest, Research and Scientific Integrity, Harassment and Violence Prevention, and Conflict Resolution. Building on the researcher-based President's Research Excellence Advisory Committee, the NRC will implement an Early Career Research Network to provide frank advice on research issues.

The NRC is committed to playing a leadership role in scientific and technical research. This requires access to the necessary infrastructure, tools, and information technology platforms, as well as information and data management that allow the NRC's researchers, ITAs and business groups to deliver on the NRC's mandate and meet established objectives in an agile manner. To accomplish this, the NRC is undertaking a number of connected initiatives, most notably:

- Modernizing research IT platforms by leveraging cloud services, implementing NRC-run specialized research environments and re-investing in high-performance computing clusters.
- Establishing data management services, repositories and best practices that enable effective long-term access and re-use of high-value information holdings as part of an NRC-wide (and GC-wide) data strategy.
- A multi-year strategy to embrace new approaches to environments, and partnerships to co-invest in IT infrastructure. This strategy will also focus on managing both open and secure science to enable collaboration, while protecting valuable information.

In 2020–21, the NRC will further develop its business management services, including:

- An updated framework for managing intellectual property (IP) aligned with the government-wide strategy and taking into account increasing complexity of IP arrangements in collaborative research agreements.
- New approaches to client relationship management with an increased emphasis on strategic account management and IP commercialization, providing dedicated business development resources for high volume routine technical service contracts, and a focus on reducing turnaround times for development of contracts.

The NRC will progress in developing its strategy to revitalize its buildings and real estate and will remain engaged with OGDs, the private sector and academia in realizing the vision of the Federal Science and Technology Infrastructure Initiative. This includes a leadership role in developing the science and research vision and active engagement with partners. This ongoing priority will complement the internal review, rationalization and streamlining of facilities at the NRC. By simultaneously assessing and planning for renewal of NRC buildings and real-estate through a three-year external review of facilities, the NRC will improve workspace and achieve reductions in waste, energy consumption and green-house gas emissions.

Work to complete NRC Dialogue action items will continue in 2020–21, with a focus on high priority projects: simplification of processes (including procurement, contracting in, onboarding of new employees, and project management and timecoding of staff). In particular, a special project team has been tasked with bringing the simplification of processes to completion by the end of the fiscal year.

Planned budgetary financial resources for Internal Services

2020–21 budgetary spending (as indicated in Main Estimates)	2020–21 Planned spending	2021–22 Planned spending	2022–23 Planned spending
139,856,365	139,856,365	145,292,573	145,734,419

Planned human resources for Internal Services

2020–21 Planned full-time equivalents	2021–22 Planned full-time equivalents	2022–23 Planned full-time equivalents
928.0	928.0	928.0

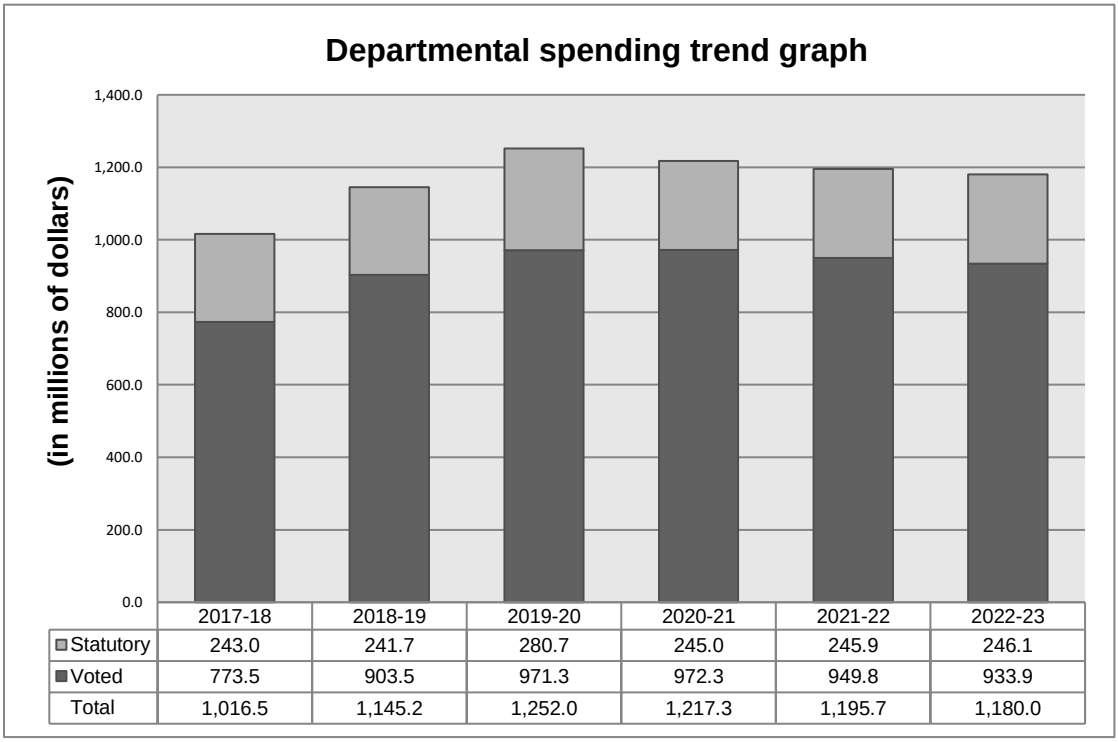
Spending and human resources

This section provides an overview of the department's planned spending and human resources for the next three consecutive fiscal years, and compares planned spending for the upcoming year with the current and previous years' actual spending.

Planned spending

Departmental spending 2017–18 to 2022–23

The following graph presents planned (voted and statutory) spending over time.



	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
Statutory	243.0	241.7	280.7	245.0	245.9	246.1
Voted	773.5	903.5	971.3	972.3	949.8	933.9
Total	1,016.5	1,145.2	1,252.0	1,217.3	1,195.7	1,180.0

The increase of $106.8M of the 2019–20 forecast spending ($1,252.0) in comparison to authorities used in 2018–19 ($1,145.2M) is mainly attributable to $47.7M for the NRC Industrial Research Assistance Program to support business research and development for projects as well a planned increase of $37.4M in statutory revenue spending primarily due to expenditures associated with investments in real property, information technology, and scientific equipment. The remaining variance is mostly associated with cost increases related with collective bargaining ratification.

NRC's total planned spending of $1,217.3M in 2020–21, $1,195.7M in 2021–22 and $1,180.0M in 2022–23 varies as a result of sunsetting projects, programs or funding decisions. In all future years, NRC's total planned spending is less than its current fiscal year forecast of $1,252.0. This decrease results entirely from temporary funding and statutory revenue spending. NRC's permanent funding envelope, in comparison to the current fiscal year, is stable.

The following table summarizes the main permanent and temporary year-over year funding variances between total planned spending for each fiscal year.

(in millions of dollars)			
Items[3]	**2020–21**	**2021–22**	**2022–23**
Total Planned Spending	**1,217.3**	**1,195.7**	**1,180.0**
Variance over prior year	(34.7)[4]	(21.6)	(15.7)
Permanent Funding Variance			
TRIUMF	3.5	0.1	1.1
Collective Bargaining	(1.4)	6.1	1.4
Total Permanent Funding Variance	**2.1**	**6.2**	**2.5**
Temporary Funding Variance			
Statutory Revenue Spending	(37.4)	-	-
2018–19 Operating Budget Carry-Forward	(14.8)	-	-
Sunsetting of Youth Employment and Skills Strategy funding	(10.0)	-	-
NRC IRAP – 2018–19 Reprofile	(5.6)	-	-
Capital Funding – Free Access to Building Codes	(0.8)	(0.8)	-
Project funding variances for Canada's participation in the Thirty Meter Telescope	30.5	(6.0)	(13.6)
CSTIP – 2018–19 Reprofile	5.6		(5.6)
Sunsetting of the 2014 and 2016 Federal Infrastructure Initiatives	0.2	(25.1)	
Total Temporary Funding Variance	**(32.3)**	**(31.9)**	**(19.2)**

[3] Zero indicates there is no variance.

[4] 2019–20 Total forecast spending is $1,252.0M.

Budgetary planning summary for core responsibilities and Internal Services (dollars)

The following table shows actual, forecast and planned spending for each of the National Research Council's core responsibilities and to Internal Services for the years relevant to the current planning year.

Core responsibilities and Internal Services	2017–18 expenditures	2018–19 expenditures	2019–20 forecast spending	2020–21 budgetary spending (as indicated in Main Estimates)	2020–21 planned spending	2021–22 planned spending	2022–23 planned spending
Science and Innovation	787,453,668	992,172,039	1,090,789,384	1,077,399,652	1,077,399,652	1,050,393,462	1,034,227,390
Internal Services	229,069,769	153,031,813	161,226,847	139,856,365	139,856,365	145,292,573	145,734,419
Total	**1,016,523,437**	**1,145,203,852**	**1,252,016,231**	**1,217,256,017**	**1,217,256,017**	**1,195,686,035**	**1,179,961,809**

Expenses related to National Science Library, Research Information Technology Platforms and Special Purpose Real Property were not reallocated to the Science and Innovation Core Responsibility for 2017–18 because the reporting structure was not in place to allow NRC to report on the Departmental Results Framework and Program Inventory of record for 2020–21.

Planned human resources

The following table shows actual, forecast and planned full-time equivalents (FTEs) for each core responsibility in the National Research Council's departmental results framework and to Internal Services for the years relevant to the current planning year.

Human resources planning summary for core responsibilities and Internal Services

Core responsibilities and Internal Services	2017–18 actual full-time equivalents	2018–19 actual full-time equivalents	2019–20 forecast full-time equivalents	2020–21 planned full-time equivalents	2021–22 planned full-time equivalents	2022–23 planned full-time equivalents
Science and Innovation	2,997.3	3,062.6	3,099.9	3,099.9	3,099.9	3,099.9
Internal Services	981.9	887.6	928.0	928.0	928.0	928.0
Total	**3,979.2**	**3,950.2**	**4,027.9**	**4,027.9**	**4,027.9**	**4,027.9**

FTEs related to National Science Library, Research Information Technology Platforms and Special Purpose Real Property were not reallocated to the Science and Innovation Core Responsibility for 2017–18 because the reporting structure was not in place to allow NRC to report on the Departmental Results Framework and Program Inventory of record for 2020–21.

The NRC's total planned FTEs of 4,027.9 in 2020–21 will remain mostly stable through 2022–23. The planned FTEs for 2020–21 increased by 77.7 when compared to 2018–19 actuals. This increase is mainly attributable to supporting Federal Budget 2018 funding, including the increase of $150 million for the NRC's Industrial Research Assistance Program, and supporting additional youth employment opportunities within the NRC.

Estimates by vote

Information on the National Research Council's organizational appropriations is available in the 2020–21 Main Estimates.[xxii]

Condensed Future-Oriented Statement of Operations

The condensed future-oriented statement of operations provides an overview of the National Research Council's operations for 2019–20 to 2020–21.

The amounts for forecast and planned results in this statement of operations were prepared on an accrual basis. The amounts for forecast and planned spending presented in other sections of the Departmental Plan were prepared on an expenditure basis. Amounts may therefore differ.

A more detailed future-oriented statement of operations and associated notes, including a reconciliation of the net cost of operations to the requested authorities, are available on the National Research Council's website.[xxiii]

Consolidated Condensed Future-Oriented Statement of Operations for the year ending March 31, 2021 (dollars)

Financial information	2019–20 forecast results	2020–21 planned results	Difference (2020–21 planned results minus 2019–20 forecast results)
Total expenses	1,241,801,000	1,218,520,000	(23,281,000)
Total revenues	200,274,000	193,676,000	(6,598,000)
Net cost of operations before government funding and transfers	1,041,527,000	1,024,844,000	(16,683,000)

The NRC's 2020–21 planned expenses and revenues are based on the Annual Reference Level Update (ARLU). They include NRC's portion of the expenses accounts of the Canada-France-Hawaii Telescope Corporation (CFHT) ($1.6M) and TMT International Observatory LLC (TIO) ($4.1M). Planned revenues are composed of research services ($67.2M), technical services ($93.6M), intellectual property, royalties and fees ($6.4M), sale of goods and information products ($3.1M), rentals ($9.1M) and other ($2.6M). Also included is $11.7M of accrued adjustments mainly from the consolidation of the revenue accounts of CFHT ($1.7M) and TIO ($7.4M) with NRC operations.

Corporate Information

Organizational profile

Appropriate minister:

The Honourable Navdeep Bains, P.C., M.P., Minister of Innovation, Science and Industry

Institutional head: Mr. Iain Stewart, President

Ministerial portfolio: Innovation, Science and Economic Development

Enabling instrument: *National Research Council Act*,[xxiv] R.S.C. 1985, c. N-15

Year of incorporation / commencement: 1916

Other: The NRC is a departmental corporation of the Government of Canada, reporting to Parliament through the Minister of Innovation, Science and Industry. The NRC works in partnership with members of the Innovation, Science and Economic Development Portfolio to leverage complementary resources to promote science and research and integrated innovation, to exploit synergies in key areas of science and technology, to promote the growth of small and medium-sized enterprises and to contribute to Canadian economic growth. The NRC's Council provides independent strategic advice to the NRC President and it reviews organizational performance. The President provides leadership and strategic management and is responsible for the achievement of the NRC's long-range goals and plans in alignment with government priorities as reflected in his mandate letter. Each of the NRC's Vice-Presidents is responsible for a number of areas composed of programs and research initiatives, centres, the NRC Industrial Research Assistance Program, and/or a corporate branch. Vice-Presidents and NRC managers are responsible for executing plans and priorities to ensure successful achievement of objectives.

Raison d'être, mandate and role: who we are and what we do

"Raison d'être, mandate and role: who we are and what we do" is available on the National Research Council's website.[xxiii]

For more information on the department's organizational mandate letter commitments, see the "Minister's mandate letter"[i].

Operating context

Information on the operating context is available on the National Research Council's website.[xxiii]

Reporting Framework

The National Research Council's approved Departmental Results Framework and Program Inventory for 2020–21 are as follows.

Departmental Results Framework			Internal Services
	Core Responsibility: Science and Innovation		
	Departmental Result: Scientific and technological knowledge advances	I1. Citation score of NRC-generated publications relative to the world average	
		I2. Number of peer-reviewed publications generated by the NRC	
		I3. Number of patents issued to the NRC	
		I4. Number of licence agreements	
		I5. Ratio of the NRC's workforce made up of underrepresented groups relative to Canadian average labour market availability in Science, Technology, Engineering and Mathematics (STEM)	
	Departmental Result: Innovative businesses grow	I6. Percentage of R&D clients who report positive benefits of working with the NRC	
		I7. Percentage revenue growth of firms engaged with the NRC (IRAP-engaged firms)	
		I8. Percentage growth in Canada's science and technology related jobs through NRC supported firms (IRAP-engaged firms)	
		I9. Revenue earned from clients and collaborators	
	Departmental Result: Evidence-based solutions inform decisions in Government priority areas	I10. Revenue earned from other federal government departments	
		I11. Number of NRC peer-reviewed publications co-authored with other federal government departments	
Program Inventory	Advanced Electronics and Photonics		
	Aerospace		
	Aquatic and Crop Resource Development		
	Automotive and Surface Transportation		
	Business Management Support (Enabling)		
	Collaborative Science, Technology and Innovation Program		
	Construction		
	Design & Fabrication Services (Enabling)		
	Digital Technologies		
	Energy, Mining and Environment		
	Genomics Research & Development Initiative		
	Herzberg Astronomy & Astrophysics		
	Human Health Therapeutics		
	Industrial Research Assistance Program		
	International Affiliations		
	Metrology		
	Medical Devices		
	Nanotechnology		
	National Science Library		
	Ocean, Coastal and River Engineering		
	Security and Disruptive Technologies		
	Special Purpose Real Property (Enabling)		
	Research Information Technology Platforms (Enabling)		
	TRIUMF		

Changes to the approved reporting framework since 2019–20

In 2019-20, the NRC made minor amendments to its DRF indicators:

- The indicator for intellectual assets was unbundled into three indicators: publications, patents, and licence agreements to allow for greater emphasis of key NRC results.
- Some indicator names were changed to be more concise and more clearly communicate what the indicator is trying to measure.
- The indicator for co-authored publications with OGDs was added to provide better insight into NRC's contributions in government priority areas.

Structure		2020–21	2019–20	Change	Reason for change
CORE RESPONSIBILITY		Science and Innovation	Science and Innovation	No change	Not applicable
	PROGRAM	Advanced Electronics and Photonics	Advanced Electronics and Photonics	No change	Not applicable
	PROGRAM	Aerospace	Aerospace	No change	Not applicable
	PROGRAM	Aquatic and Crop Resource Development	Aquatic and Crop Resource Development	No change	Not applicable
	PROGRAM	Automotive and Surface Transportation	Automotive and Surface Transportation	No change	Not applicable
	PROGRAM	Business Management Support (Enabling)	Business Management Support (Enabling)	No change	Not applicable
	PROGRAM	Collaborative Science, Technology and Innovation Program	Collaborative Science, Technology and Innovation Program	No change	Not applicable
	PROGRAM	Construction	Construction	No change	Not applicable
	PROGRAM	Design & Fabrication Services (Enabling)	Design & Fabrication Services (Enabling)	No change	Not applicable
	PROGRAM	Digital Technologies	Digital Technologies	No change	Not applicable
	PROGRAM	Energy, Mining and Environment	Energy, Mining and Environment	No change	Not applicable
	PROGRAM	Genomics Research & Development Initiative Shared Priority Projects	Not applicable	New program	Note 1
	PROGRAM	Herzberg Astronomy & Astrophysics	Herzberg Astronomy & Astrophysics	No change	Not applicable
	PROGRAM	Human Health Therapeutics	Human Health Therapeutics	No change	Not applicable
	PROGRAM	Industrial Research Assistance Program	Industrial Research Assistance Program	No change	Not applicable
	PROGRAM	International Affiliations	International Affiliations	No change	Not applicable
	PROGRAM	Metrology	Metrology	No change	Not applicable

	PROGRAM	Medical Devices	Medical Devices	No change	Not applicable
	PROGRAM	Nanotechnology	Nanotechnology	No change	Not applicable
	PROGRAM	National Science Library	National Science Library	No change	Not applicable
	PROGRAM	Ocean, Coastal and River Engineering	Ocean, Coastal and River Engineering	No change	Not applicable
	PROGRAM	Security and Disruptive Technologies	Security and Disruptive Technologies	No change	Not applicable
	PROGRAM	Special Purpose Real Property (Enabling)	Special Purpose Real Property (Enabling)	No change	Not applicable
	PROGRAM	Research Information Technology Platforms (Enabling)	Research Information Technology Platforms (Enabling)	No change	Not applicable
	PROGRAM	TRIUMF	TRIUMF	No change	Not applicable

Note 1	Program added to Program Inventory in 2020–21. GRDI was previously reported on as a federal horizontal initiative. In 2019–20, the NRC was charged with continuing to report, on behalf of all participating departments and agencies, on GRDI Shared Priority Projects only, as requested by TBS.

Supporting information on the program inventory

Supporting information on planned expenditures, human resources, and results related to the National Research Council's Program Inventory is available in the GC InfoBase.[xxi]

Supplementary information tables

The following supplementary information tables are available on the NRC's website:[xxiii]

- Details on transfer payment programs
- Gender-based analysis plus

Federal tax expenditures

The National Research Council's Departmental Plan does not include information on tax expenditures that relate to its planned results for 2020–21.

Tax expenditures are the responsibility of the Minister of Finance, and the Department of Finance Canada publishes cost estimates and projections for government-wide tax expenditures each year in the Report on Federal Tax Expenditures.[xxv] This report provides detailed information on tax expenditures, including objectives, historical background and references to related federal spending programs, as well as evaluations, research papers and gender-based analysis. The tax measures presented in this report are solely the responsibility of the Minister of Finance.

Organizational contact information

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Appendix: definitions

appropriation (crédit)

Any authority of Parliament to pay money out of the Consolidated Revenue Fund.

budgetary expenditures (dépenses budgétaires)

Operating and capital expenditures; transfer payments to other levels of government, organizations or individuals; and payments to Crown corporations.

core responsibility (responsabilité essentielle)

An enduring function or role performed by a department. The intentions of the department with respect to a core responsibility are reflected in one or more related departmental results that the department seeks to contribute to or influence.

Departmental Plan (plan ministériel)

A report on the plans and expected performance of a department over a 3-year period. Departmental Plans are tabled in Parliament each spring.

departmental priority (priorité ministérielle)

A plan or project that a department has chosen to focus and report on during the planning period. Departmental priorities represent the things that are most important or what must be done first to support the achievement of the desired departmental results.

departmental result (résultat ministériel)

A consequence or outcome that a department seeks to achieve. A departmental result is often outside departments' immediate control, but it should be influenced by program-level outcomes.

departmental result indicator (indicateur de résultat ministériel)

A factor or variable that provides a valid and reliable means to measure or describe progress on a departmental result.

departmental results framework (cadre ministériel des résultats)

A framework that consists of the department's core responsibilities, departmental results and departmental result indicators.

Departmental Results Report (rapport sur les résultats ministériels)

A report on a department's actual accomplishments against the plans, priorities and expected results set out in the corresponding Departmental Plan.

experimentation (expérimentation)

The conducting of activities that seek to first explore, then test and compare, the effects and impacts of policies and interventions in order to inform evidence-based decision-making, and improve outcomes for Canadians, by learning what works and what doesn't. Experimentation is related to, but distinct form innovation (the trying of new things), because it involves a rigorous comparison of results. For example, using a new website to communicate with Canadians can be an innovation; systematically testing the new website against existing outreach tools or an old website to see which one leads to more engagement, is experimentation.

full-time equivalent (équivalent temps plein)

A measure of the extent to which an employee represents a full person-year charge against a departmental budget. Full-time equivalents are calculated as a ratio of assigned hours of work to scheduled hours of work. Scheduled hours of work are set out in collective agreements.

gender-based analysis plus (GBA+) (analyse comparative entre les sexes plus [ACS+])

An analytical process used to assess how diverse groups of women, men and gender-diverse people experience policies, programs and services based on multiple factors including race, ethnicity, religion, age, and mental or physical disability.

government-wide priorities (priorités pangouvernementales)

For the purpose of the 2020–21 Departmental Plan, government-wide priorities refers to those high-level themes outlining the government's agenda in the 2015 Speech from the Throne, namely: Growth for the Middle Class; Open and Transparent Government; A Clean Environment and a Strong Economy; Diversity is Canada's Strength; and Security and Opportunity.

horizontal initiative (initiative horizontale)

An initiative in which two or more federal organizations are given funding to pursue a shared outcome, often linked to a government priority.

non-budgetary expenditures (dépenses non budgétaires)

Net outlays and receipts related to loans, investments and advances, which change the composition of the financial assets of the Government of Canada.

performance (rendement)

What an organization did with its resources to achieve its results, how well those results compare to what the organization intended to achieve, and how well lessons learned have been identified.

performance indicator (indicateur de rendement)

A qualitative or quantitative means of measuring an output or outcome, with the intention of gauging the performance of an organization, program, policy or initiative respecting expected results.

performance reporting (production de rapports sur le rendement)
The process of communicating evidence-based performance information. Performance reporting supports decision-making, accountability and transparency.

plan (plan)
The articulation of strategic choices, which provides information on how an organization intends to achieve its priorities and associated results. Generally a plan will explain the logic behind the strategies chosen and tend to focus on actions that lead up to the expected result.

planned spending (dépenses prévues)
For Departmental Plans and Departmental Results Reports, planned spending refers to those amounts presented in the Main Estimates.

A department is expected to be aware of the authorities that it has sought and received. The determination of planned spending is a departmental responsibility, and departments must be able to defend the expenditure and accrual numbers presented in their Departmental Plans and Departmental Results Reports.

program (programme)
Individual or groups of services, activities or combinations thereof that are managed together within the department and focus on a specific set of outputs, outcomes or service levels.

program inventory (répertoire des programmes)
Identifies all of the department's programs and describes how resources are organized to contribute to the department's core responsibilities and results.

result (résultat)
An external consequence attributed, in part, to an organization, policy, program or initiative. Results are not within the control of a single organization, policy, program or initiative; instead they are within the area of the organization's influence.

statutory expenditures (dépenses législatives)
Expenditures that Parliament has approved through legislation other than appropriation acts. The legislation sets out the purpose of the expenditures and the terms and conditions under which they may be made.

strategic outcome (résultat stratégique)
A long-term and enduring benefit to Canadians that is linked to the organization's mandate, vision and core functions.

target (cible)

A measurable performance or success level that an organization, program or initiative plans to achieve within a specified time period. Targets can be either quantitative or qualitative.

voted expenditures (dépenses votées)

Expenditures that Parliament approves annually through an Appropriation Act. The vote wording becomes the governing conditions under which these expenditures may be made.

Endnotes

i. Minister of Innovation, Science and Industry Mandate Letter, https://pm.gc.ca/en/mandate-letters/minister-innovation-science-and-industry-mandate-letter
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iii. NRC Ideation Fund, https://nrc.canada.ca/en/research-development/research-collaboration/programs/ideation-fund-where-breakthroughs-begin
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v. Collaboration Centres, https://nrc.canada.ca/en/research-development/research-collaboration/collaboration-centres
vi. Supporting Canada's innovation superclusters, https://nrc.canada.ca/en/research-development/research-collaboration/programs/supporting-canadas-innovation-superclusters
vii. NRC President's Mandate Letter, https://nrc.canada.ca/en/corporate/about-nrc/mandate-letter-mr-iain-stewart-september-6-2018
viii. Innovation Superclusters Initiative, https://www.ic.gc.ca/eic/site/093.nsf/eng/home
ix. 2019–20 Evaluation of the Energy, Mining and Environment Program, https://nrc.canada.ca/en/corporate/planning-reporting/evaluation-nrcs-energy-mining-environment-research-centre
x. TRIUMF, https://www.triumf.ca/
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xiii. Disruptive Technology Solutions for Cell and Gene Therapy Challenge Program, https://nrc.canada.ca/en/research-development/research-collaboration/programs/disruptive-technology-solutions-cell-gene-therapy-challenge-program
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xvi. Artificial Intelligence for Assisted Design Challenge Program, https://nrc.canada.ca/en/research-development/research-collaboration/programs/artificial-intelligence-design-challenge-program
xvii. Federal Sustainable Development Strategy, https://www.fsds-sfdd.ca/index.html#/en/goals/
xviii. Sustainable Development Goal 12.7, https://www.un.org/sustainabledevelopment/sustainable-consumption-production/
xix. Sustainable Development Goal 9.1, https://www.un.org/sustainabledevelopment/infrastructure-industrialization/
xx. Sustainable Development Goal 7.A, https://www.un.org/sustainabledevelopment/energy/
xxi. GC InfoBase, https://www.tbs-sct.gc.ca/ems-sgd/edb-bdd/index-eng.html#start
xxii. 2020–21 Main Estimates, https://www.canada.ca/en/treasury-board-secretariat/services/planned-government-spending/government-expenditure-plan-main-estimates.html
xxiii. National Research Council's website, https://nrc.canada.ca/en/corporate/planning-reporting/financial-performance-reporting
xxiv. *National Research Council Act*, https://laws-lois.justice.gc.ca/eng/acts/N-15/
xxv. Report on Federal Tax Expenditures, http://www.fin.gc.ca/purl/taxexp-eng.asp