2022–23 Departmental Results Report

Canadian Space Agency

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Minister of Innovation, Science and Industry

Canadian Space
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From the Minister

It is our pleasure to present the 2022–23 Departmental Results Report for the Canadian Space Agency (CSA).

Over the past year, the Innovation, Science and Economic Development Canada (ISED) Portfolio worked closely with other government departments and agencies following the pandemic to build a more resilient, sustainable and inclusive economy that benefits all Canadians.

In 2022–23, CSA continued to advance work on the next generation space robotic system, Canadarm3[i], our contribution to the Lunar Gateway. [ii] Thanks to the longstanding collaboration with the National Aeronautics and Space Administration (NASA), we are going back to the Moon and Canada is at the center of this exciting journey. In March 2023, funding was announced to extend Canada's

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participation in the International Space Station[iii] (ISS) Program through 2030, fund Canadian science activities on the Lunar Gateway, and to build a lunar utility rover – all important steps towards securing a Canadian presence on the lunar surface.

Canada's leadership as a space-faring nation benefits Canadians by providing new opportunities and improving their everyday lives. The CSA is actively working with the space industry, academia and the scientific community to support innovative and sustainable solutions that address healthcare challenges and food accessibility across Canada and in space.

The CSA also continued to work with other government departments to monitor our environment and adapt to the effects of climate change. In 2023, the RADARSAT Constellation[iv] Mission (RCM) captured its one millionth image of the Earth. Data provided by the RCM is used by five federal departments and support 23 operational services to Canadians in areas such as maritime surveillance, disaster management and ecosystem monitoring.

Throughout 2022–23, the CSA continued to stimulate the growth of the space sector through the Lunar Exploration Accelerator Program[v] (LEAP), which aims to encourage Canadian companies to develop cutting-edge scientific instruments and technologies. The CSA also launched a new wave of investments through the Space Technology Development Program[vi] (STDP), intended to reduce technological unknowns of future space missions and stimulate industrial innovation.

We invite you to read this report to learn more about the many achievements for Canada in Space in 2022–23 and how the ISED Portfolio is working together with Canadians of all

backgrounds and in all regions—urban and rural—to position Canada as a leader in the global economy.

The Honourable François-Philippe Champagne, P.C., M.P.
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Minister of Innovation, Science and Industry Mandate Letter[vii]

Results at a glance

Throughout 2022–23, the CSA's focus remained on the implementation of the Canadian Space Strategy: Exploration, Imagination, Innovation.[viii] This strategy aims to create the right conditions for the growth of the Canadian space sector; guarantee that Canada's space scientists are offered a rich environment in which to pursue science excellence; fully realize the benefits of space for Canadians; and ultimately help strengthen Canada's place in space. The CSA's priorities for 2022–23 sought to ensure that Canada's investments in space contributed to tackling challenges here on Earth.

Priority 1—Propelling space exploration through the Lunar Program

In 2022–23, the CSA continued to facilitate space exploration through the LEAP[v] by providing opportunities in research, development and space innovation. An exciting LEAP opportunity is the micro-rover that will explore the lunar south pole. The CSA has been working with international partners to send humans beyond low Earth orbit, to distant destinations like the Moon and Mars. This will be achieved with the Lunar Gateway[ii], a space station in lunar orbit that will serve as a stepping stone for deep-space exploration.

In return for its commitment to contribute Canadarm3[i] to the Lunar Gateway, Canada secured the opportunity to send the first Canadian astronaut to orbit the Moon. Jeremy Hansen, a CSA astronaut, has been selected to take part in the Artemis II[ix] mission. The ongoing work on the ISS[iii] and the preparation work on the future Lunar Gateway is helping scientists to prepare for what lies ahead: deep space exploration.

Priority 2—Adapting to climate change with space-based data

Space-based data is an indispensable tool on which government departments, industry, and academia rely for monitoring vulnerabilities, assessing natural disasters, and engineering cutting-edge solutions to withstand today's environmental challenges, and those to come. This year, RADARSAT Constellation Mission[iv] (RCM) has proven again to be a strategic asset for Canada, supporting the management of natural disasters and emergencies across the globe by responding to 95% of the activations of the International Charter on Space and Major Disasters[x] and enabling numerous services to Canadians on an ongoing basis with valuable imagery. Moreover, in line with the Strategy for Satellite Earth Observation (SEO) and the Federal Sustainable Development Strategy (FSDS), the CSA has been working closely with partners to support the whole satellite Earth Observation value chain which will enable the Government of Canada to provide reliable services to Canadians, improving their day-to-day lives. To this end, the CSA: advanced on the WildFireSat[xi] mission, a Canadian satellite system equipped with infrared technology to monitor wildfires from space; confirmed Canada's High-altitude Aerosols, Water vapour and Clouds (HAWC) commitment in the NASA Atmospheric Observing System (AOS) mission focussed on aerosol and cloud processes that drive extreme weather and climate change; and, celebrated the successful launch of the NASA SWOT mission with a critical enabling Canadian technology on-board, which surveys 90% of the world's water, will provide fine details of the oceans' surface topography and how bodies of water change over time. Overall, CSA satellite data has been used by several governmental departments to benefit Canadians and respond to the effects of

climate change. These practices allow the CSA to work with partners to monitor and protect Canada's ecosystems, thereby contributing to the United Nation's Sustainable Development Goal (SDG) 17[xii]: strengthening partnerships to promote global action on sustainable development.

Priority 3—Leveraging deep-space health and food innovations

Remote regions and the deep space have something in common: they are not easily accessible and essential services are limited. The Deep Space Healthcare Challenge[xiii] is exploring the concept of remote healthcare in space and here on Earth whereas the Deep Space Food Challenge[xiv] is trying to tackle issues related to food security. Leveraging innovative technologies with minimal resources will be the cornerstone of the challenges. The two competitions are ongoing and will be concluded in spring 2024.

Priority 4 — Building a resilient economy

Canada is well positioned to strengthen the competitiveness and foster firm growth of the Canadian space sector. In 2022–23, the CSA has continued to fund brilliant ideas via the Space Technology Development Program[vi] (STDP). Contracts and contributions awarded to Canadian organizations for the development of technologies through STDP are supporting future needs of the Canadian Space Program and stimulate industrial innovation. In November 2022, the CSA selected a Canadian company to build the Canadian lunar rover that will land on the Moon by 2027 in search of water ice. This was achieved through LEAP[v] and developed as part of the Canadian Space Strategy to create the right conditions for the growth of the space sector. The CSA has also supported the next generation of experts by cultivating interest in STEM through youth activities and by providing access to training and career development opportunities to postsecondary students.

The CSA has also provided funding to industry and universities through the smartEarth[xv] and Research Opportunities in Space Science (ROSS) initiatives focused on the use of space data to advance science and applications, in particular for understanding and managing climate risks. Through the "Bridging the Information Gap through Space-based Analysis" initiative, which ended in 2022, the CSA funded Canadian companies who developed an Earth Observation (EO) monitoring system for environmental management of ports in terms of environmental protection and sustainable development. This project contributed to Canada's innovation agenda by building capacity to exploit the tremendous potential of Earth observation technologies and by creating highly skilled jobs to address current environmental challenges related to economic development in industrial port areas.

For more information on CSA's plans, priorities and results achieved, see the "Results: what we achieved" section of this report.

Results: what we achieved

Core responsibility

Canada in Space

Description

The CSA coordinates the space policies and programs of the Government of Canada; ensures that other government departments and agencies have access to space data, information, and services to deliver on their mandates; plans, directs and manages projects relating to scientific or industrial space research and the development of space science and technology; promotes the transfer and diffusion of space technology to and throughout the Canadian industry; and encourages the commercial exploitation of space capabilities, technology, facilities and systems. The CSA also aims to build Canada's capacity and engage the next generation of space scientists and engineers and provides opportunities to inspire young people to develop the required skills and to pursue studies and careers in science, technology, engineering, and math (STEM).

Result 1: Canada remains a leading spacefaring nation

The year 2022–23 marked a definitive step towards establishing a permanent presence on the Moon. The Lunar Gateway,[ii] led by NASA, represents a crucial advancement in humanity's quest to travel beyond the Moon and onwards to Mars. This space station in lunar orbit will be a rendezvous location for space exploration on the surface of the Moon. Canada's contribution, Canadarm3,[i] is essential to lunar missions: with its highly autonomous robotic system, it will use cutting-edge software to perform tasks around the Moon without human intervention. In 2022–23, Canada advanced the Canadarm3 design to ensure it meets the technical requirements for the Lunar Gateway station. Another benefit to participation in Gateway is access to deep-space science. In May 2022, the CSA also launched the Gateway Science and Technology Utilization initiative for the development of concept studies in preparation of the use of the Lunar Gateway Station. Proposals were evaluated and five concept studies contracts were issued in 2023–24.

In the meantime, the robotic arm Canadarm2 and the handy robot Dextre[xvi] continued to operate on the ISS,[iii] for a combined total of approximately 1,210 active hours. Canadarm2 was used for inspection, capture and berthing of visiting vehicles, as well as for inspections and surveys on the ISS itself. Dextre played an integral role in station maintenance and scientific research. Finally, Canadarm2 was used to support a total of six spacewalks.

As part of Canada's participation in the Lunar Gateway, Canada secured an astronaut flight into deep space on the Artemis II[ix] mission, making Canada the first international partner to fly around the Moon, taking humans to their furthest distance yet from Earth. Inspiring Canadians and nourishing national pride, the Artemis II mission will be the culmination of decades-long international collaboration with NASA. Built on the success of the Artemis I[xvii] flight test, this 10-day mission onboard the Orion spacecraft[xviii] will further solidify Canada's presence in space and its international position in the space domain. Since this is the first

Artemis flight with a crew, the astronauts will play a critical part in validating the concept of operations for future Artemis missions, participating in some test and development activities as well as the formal standalone training and simulations with the flight control team. Canada, as a responsible space nation, is a signatory of the Artemis Accords—a political commitment to conduct deep space exploration safely, sustainably and with full transparency.

Throughout 2022–23, the CSA continued activities with planetary exploration on Mars. The Alpha Particle X-Ray Spectrometer[xix] (APXS) instrument has been operating successfully for the past 10 years on the NASA-led Mars Science Laboratory[xx] (MSL) mission. The Curiosity[xxi] rover, and more specifically the APXS, has been essential in investigating the past and present habitability at the Gale Crater[xxii] landing site by analyzing samples of the Martian surface. Through the CSA's continued support of APXS, in the last 355 Martian days (365 Earth days), it has investigated 146 scientific targets of interest and has been powered on for 13 days and 20 hours. NASA's MSL mission was extended to March 2026 which resulted in the CSA also extending the contract for APXS science operations to cover MSL Extended Mission 4 and ensure the continuation of APXS's excellent science.

In 2022–23, the CSA incentivized the private sector to develop new products and services for commercial markets in space exploration through the Lunar Surface Exploration Initiative (LSEI). In May 2022, seven contracts for concept studies were awarded to Canadian companies targeting a wide variety of technical areas to determine a suite of potential Canadian contributions to human spaceflight and lunar surface exploration. LSEI's activities ensure that Canada remains a leader in future space exploration ventures with an eye to harnessing space to solve problems on Earth through cross-sectoral collaborations.

In support of Canada's Strategy for Satellite Earth Observation[xxiii] (SEO), the CSA has further enhanced its collaboration and consultation with the national and international Earth observation community. Most notably, the CSA's National Earth Observation (EO) Forum in 2022, with more than 200 participants, engaged wide range of stakeholders and identified three common themes deserving of increased support: fostering collaboration, retaining and developing talent, and improving data access. Forums like these are essential to the CSA's ability to work with domestic and international partners.

Another significant advancement towards the objectives of this strategy is the development of the first Satellite Earth Observation (SEO) Roadmap, a living-document intended to summarize ongoing activities, ensuring a coordinated alignment of Canada's space priorities while also identifying options for future investments with Environment and Climate Change Canada[xxiv] (ECCC) and Natural Resources Canada[xxv] (NRCan).

Satellites are not only helpful in monitoring natural disasters in Canada but may also support response to natural disasters worldwide. The CSA is a founding member of the International Charter on Space and Major Disasters[x] and has continued to support its activities in 2022–23. With the RCM[iv] being one of the most responsive satellite systems in the virtual constellation of the International Charter Space and Major Disasters, the CSA was able to respond to 95% of requests for assistance by delivering critical data to disaster management authorities in less

than four hours after receiving a call for help. These contributions enable the CSA to contribute to SDG 13: take action on climate change and its impacts.

Since its launch in 2001, the CSA has continuously supported Canada's Optical Spectograph and InfraRed Imaging System[xxvi] (OSIRIS), an instrument onboard the Swedish Odin[xxvii] satellite, whose datasets advance Earth system science, our understanding of ozone recovery and the Earth's radiative energy budget,[xxviii] and are key to Canada's contributions to the UN Montreal Protocol[xxix] on monitoring and safeguarding the ozone layer. In 2022–23, the OSIRIS team published an updated aerosol dataset, as well as the merged SAGE II—OSIRIS—SAGE III/ISS ozone dataset. The open access datasets have been used by over 850 researchers in over 25 countries, resulting in 32 scientific discoveries. Similarly, SCISAT[xxx] open datasets have been studied by over 650 users around the world used to better understand atmospheric chemistry, which is directly related to climate change.

Solar storms and erratic space weather can be damaging to our technology and infrastructure here on Earth. With that in mind, the CSA continued to support the scientific analysis of data acquired by instruments that observe the region of near-Earth space comprised of the thermosphere, ionosphere, and magnetosphere. In August 2022, an Announcement of Opportunity (AO) for a geospace observatory[xxxi] was issued and two major projects were selected: the SuperDARN,[xxxii] a global network of scientific radars that monitors conditions in the near-Earth environment and the Space Environment Canada (SEC), a Canada-wide network composed of over 100 ground-based instruments used for remote sensing of a broad range of ionospheric properties and phenomena.

Furthermore, 13 grants awarded to academia led to advancements in predictive models of the ionospheric and thermospheric space environment and allowed scientists to study the effects of space weather on radio wave propagation and communications over Canada. These analyses benefited Government of Canada departments like NRCan,[xxv] which operates the Canadian Space Weather Forecast Centre.[xxxiii]

Operations of the Near-Earth Object Surveillance Satellite[xxxiv] (NEOSSat) are ongoing. The space telescope detects and tracks asteroids, comets, satellites and space debris, contributing to the international effort to catalogue near-Earth asteroids and comets. The CSA also supported five projects through the NEOSSat Science Guest Observation (GO) Program.[xxxv]

Throughout 2022–23, the CSA maintained its space situational awareness services in order to contribute to the sustainability of operations of the space environment. To this end, the CSA continued to operate its space debris Conjunction Risk Assessment and Mitigation System (CRAMS), delivering advanced analyses and collision avoidance strategies for close approaches with 123 Canadian and international satellites.

In 2022–23, CSA further advanced the development of Quantum Encryption and Science Satellite[xxxvi] (QEYSSat) space and ground segments, preparing for the fabrication and testing phases of the project.

The James Webb Space Telescope[xxxvii] (JWST, also known as Webb), a joint mission with NASA and the European Space Agency (ESA) was fully commissioned in 2022, .In return for Canada's contributions, Canadians scientists have started research on a wide range of

astronomical topics, such as extrasolar planets, the evolution and formation of galaxies, galaxy clusters, supermassive black holes, and the life cycle of stars. These projects enable more than 50 Canadian astronomers (i.e., co-investigators, principal investigators, and graduate/undergraduate students) with 26 active JWST grants, to contribute to the four main scientific objectives of the JWST mission. With the Canadian instrument Near-Infrared Imager and Slitless Spectrograph[xxxviii] (NIRISS) used on the JWST, astronomers are now able to capture infrared light, invisible to the human eye. This is helping scientists in determining if distant planets could be habitable based on whether they have certain molecules like water, carbon dioxide, methane and oxygen in their atmospheres.

The OSIRIS-REx[xxxix] mission is on its way back to Earth carrying a precious sample from asteroid Bennu and is set to land in Utah, USA, in September 2023. Due to its contribution of the OSIRIS-REx Laser Altimeter[xl] (OLA) to the mission, Canada will host 4% of the total sample returned to Earth. In 2022–23, the CSA prepared laboratories for the sample's arrival in Canada, as early as 2024. Through the distribution and study of this sample, this facility will enable a greater understanding of the solar system's history and the origin of life.

One of CSA's objectives for 2022–23 was to involve young Canadians in space-related activities and introduce them to potential space-STEM career paths. In 2022–23, the CSA opened its first Space Brain Hack Challenge,[xli] encouraging youth in grades 6–12 to innovate and invent solutions to support astronauts' mental health on Lunar Gateway and Moon-related missions.

In autumn 2022, over 6,985 students across the country in grades 6–8 (aged 11–13) entered the Lunar Rover Research Challenge,[xlii] a competition centred on planning a rover mission to seek ice deposits on a mock lunar landscape. The winners of the first edition of the Challenge earned the opportunity to command a rover prototype and execute their own mission in a simulated lunar environment. This project is a nod to the Canadian rover that will explore the lunar south pole by 2027 in search of water ice.

The CSA also supported non-profit educational institutions such as the London Regional Children's Museum, which received funding to engage local secondary school students to design and install a hands-on exhibit component to showcase robotics to younger visitors. So far, the project has involved 72 students in grades 9–12 and has produced robust designs for interactive versions of RADARSAT, Dextre, Canadarm and Canadarm2 to add to the Museum's space gallery. The same year, 40 grade 9 students began to create hands-on STEM

programming for 400 children aged 4–9 about space technology, lunar missions, technology, and robotics.

Space exhibits at the London Regional Children's Museum

High school students showcasing miniature versions of RADARSAT, Dextre, Canadarm and Canadarm2 at the London Regional Children's Museum.

In 2022–23, the CSA continued to implement the Canadian CubeSat Project[xliii] (CCP), which engages students from post-secondary institutions to explore space through science by designing and building their own miniature satellites. In the second half of 2022–23, six CubeSats were integrated at the CSA and launched to the ISS.[iii] Two were deployed into low Earth orbit while the remaining four were to be deployed at a later date. Despite some technical challenges, most teams are now operating their CubeSats and conducting science according to the objectives of their missions. The CubeSats Initiative in Canada for STEM[xliv] (CUBICS), which is the follow-up to CCP, was launched in September 2022.

Small but mighty

A CubeSat is a square-shaped miniature satellite (10 cm × 10 cm × 10 cm—roughly the size of a Rubik's cube). CubeSats are used for a number of things but mainly to test new instruments, take measurements and conduct experiments from space. They are custom built to the specific requirements of their mission but must have the three following components:
1. An antenna and radio communication system, which sends and receives information to and from Earth.
2. A power source, like a solar panel or simply a battery.
3. A computer, which executes instructions to ensure proper functioning of the satellite.

Created in 2012 through a collaboration with France's space centre, the Centre national d'études spatiales (CNES), the CSA's stratospheric balloon program STRATOS[xlv] was renewed for an additional 10 years in September 2022. The agreement guarantees Canadian academia, industry and other government agencies access to stratospheric balloon platforms for conducting science and technology demonstrations. In August 2022, four zero-pressure balloons[xlvi] carrying six Canadian payloads were launched[xlvii] from the Timmins stratospheric balloon base[xlviii] to test new technologies, conduct science experiments and take measurements.

Through the Flights and Fieldwork for the Advancement of Science and Technology[xlix] (FAST) initiative, the CSA awards several grants every two years to support

the research projects of Canadian universities and post-secondary institutions. These research projects contribute to the development of new scientific knowledge and space technologies, while making it possible for students to acquire hands-on experience in space-like missions. More than 65 projects were launched, 17 of which were completed this year.

Initiatives like the CCP, STRATOS and FAST not only provide students with hands-on experience in space-STEM fields, but they also promote skills development, enhance employability, and enrich academic programs.

Result 2: Space information and technologies improve the lives of Canadians

In October 2022, Canada announced that the CSA will take part in the Atmosphere Observing System[l] (AOS) mission led by NASA. Canada's contribution to the AOS is the High-altitude Aerosols, Water vapour and Clouds[li] mission (HAWC), consisting of two Canadian instruments on a Canadian satellite and a third on a NASA satellite. These instruments will provide critical data to support extreme weather prediction, climate modelling, and monitoring of disasters, such as volcanic eruptions, wildfires and extreme precipitation. In 2022–23, Canada supported NASA's successful AOS mission concept review. In collaboration with academia, the CSA continued building the framework for the HAWC mission science and application development, as well as the preparatory work with industry. The data produced by HAWC and AOS will be fully open and accessible to the general public.

In 2022–23, the CSA operated and ensured the performance of the RCM[iv] in order to meet the growing needs of the Government of Canada users. In March 2023, RCM reached its one millionth image milestone, an exploit achieved in less than four years from its launch. In comparison, it took 12 years for RADARSAT-1 to reach this accomplishment.

The newly developed RADARSAT Service Desk[lii] is a centralized hub that provides useful information relating to past, present, and future RADARSAT missions to the user community. It was deployed in December 2022 for Government of Canada users and upgraded in February 2023 for public users. All categories of users can now apply to become a vetted user and access almost all of the archived RCM data.

The Earth Observation Service Continuity[liii] (EOSC) initiative seeks to investigate and articulate cost-effective solutions ensuring synthetic aperture radar (SAR) imagery service continuity through a balanced portfolio of commercial data sourcing, international partnerships, and maximizing the use of free and open public domain imagery, as well as sovereign capabilities to address the ever-growing needs of Canadians. To support the investigation of solutions, the CSA, supported by key departments, has engaged industry through four concept studies, established the foundations for ongoing and future partnerships with international space agencies, and coordinated numerous comprehensive analyses, all of these activities aim to determine the best way to ensure SAR service continuity post-RCM. Additionally, more than 10 advanced research and development (R&D) projects totalling

$10M were awarded to the Canadian space sector. These projects are aimed at enabling the strategic capabilities of the next generation of Canadian satellite.

In line with the Open Government Directive, in 2022–23, the CSA repatriated over 32,000 raw and processed RADARSAT-1 data segments from international stations and delivered them to the Canadian Centre for Mapping and Earth Observation[liv] (CCMEO) in order to make them accessible to users.

In April 2022, the Government of Canada's Federal Budget announced funding for a Canadian operational wildfire monitoring system. The CSA has worked closely with the Canadian Forest Service[lv] (CFS) to support the development of the WildFireSat[xi] mission, a wildfire monitoring system that will use satellites equipped with innovative infrared technology to monitor active wildfires from space. The joint team, which includes the CSA, NRCan[xxv] and ECCC,[xxiv] has been working in partnership with three contractors to optimize the requirements and explore innovative procurement strategies to produce and disseminate wildfire monitoring products for forest fire management, smoke forecasting and carbon emission monitoring and reporting. This Canadian initiative will enhance Canada's ability to manage wildfires in the country. It aims to monitor all active wildfires in Canada from space on a daily basis. WildFireSat will reduce wildfire losses through more precise wildfire monitoring, improving our ability to make informed decisions about defending communities and avoiding unnecessary evacuations. It will allow us to better protect our resources, infrastructure, and environment by providing better situational awareness, particularly near inhabited areas. It will help reduce health problems associated with smoke and air pollution.

Monitoring our forests

Forest fire risk monitoring technology produced by Canadian company AUG[lvi] uses RCM[iv] data to predict forest fire risk in Canada. RCM data has the potential to play a significant role in forest fire danger forecasting by complementing the current practice of using only meteorological information from a limited number of weather stations, and it can address some of the limitations of optical data. AUG's cutting-edge technology offers remarkable improvements in accuracy, coverage, and special/temporal resolutions. Moreover, it provides invaluable Fire Weather Index estimation and Geographical Information System prediction maps, crucial for fire danger forecasting.

In December 2022, the Surface Water and Ocean Topography[lvii] (SWOT) hydrological science satellite, led by NASA and the Centre National des Études Spatiales (CNES) was successfully launched. SWOT ensures that wide coverage from space will provide precise measurements of surface water levels. The CSA contributed a key component to the satellite: a set of extended interaction klystrons (EIKs). This device will amplify NASA's main radar instrument's signal in order to measure the fine details of the oceans' surface topography and how bodies of water change over time.

> ## Monitoring our rivers, lake and oceans
> Canada has the longest coastline and the largest number of lakes in the world. The SWOT satellite mission ensures wide coverage from space and will soon provide scientists with precise measurements of surface water levels and ocean currents. This means that we will better understand the dynamics of oceans, rivers and lakes, which are important factors for freshwater management and for climate change assessment.
>
> (*Image credit: CNES/David Ducros*)

In addition, in 2022–23, CSA renewed the Memoranda of Understanding (MOU) with Fisheries and Oceans Canada[lviii] (DFO) and ECCC[xxiv] to support SWOT data modelling and instrument deployment, including a major data collection campaign in the St. Lawrence estuary planned for 2023–24. This collaboration with Government departments will be essential for assessing SWOT science data over Canadian waters and future data uses by the Canadian Government. The CSA continues to support four Canadian universities for data analyses as SWOT data becomes available.

The DFO's Dark Vessel Detection program leverages satellite technology, including Canada's RCM to detect otherwise undetectable "Dark" vessels. The platform provides near real-time tracking information to fisheries authorities, which assists them in combatting illegal, unreported, and unregulated fishing activities and in protecting ocean ecosystems. This service highlights Canada's global ocean leadership. Furthermore, this capability supports the UN SDG 14[lix]: conserve and sustainably use the oceans, seas, and marine resources for sustainable development.

In line with the objective of reducing health risks for astronauts during missions, the CSA conducted several experiments and studies on board the ISS. In March 2023, the Vection[lx] study was successfully completed. Data collection, both on the ISS[iii] and on the ground continued as planned throughout the year for Vascular Aging,[lxi] Wayfinding[lxii] and SANSORI. Moreover, two new experiments, CARDIOBREATH[lxiii] and Space Health,[lxiv] which both use the Bio-Monitor system, recruited their first astronaut subjects and executed on-orbit data collection. These studies have the potential to improve health outcomes for Canadians by advancing expertise, technologies, and applications that may improve healthcare on Earth.

Through Health and Life Sciences AO, the CSA established 19 grant agreements with a range of small to large universities across Canada. These studies will advance knowledge of ways to protect astronauts from the health risks of spaceflight.

A bedrest study[lxv] was completed allowing the testing of a novel exercise protocol for astronauts as a countermeasure to mitigate the effects of an extended duration mission in microgravity. A

request for proposal (RFP) was issued, and a contractor was selected to test the protocol with astronauts on the ISS.

Health Beyond aims to collaboratively identify and develop innovative and sustainable medical solutions as part of evolving the healthcare delivery model currently used in low-Earth orbit for deep space. The flagship element of this initiative is the Connected Care Medical Module[lxvi] (C²M²), a modular integrated healthcare solution that can operate in both connected and remote environments Following a competitive process, five Canadian companies were selected to build prototypes of the C²M². Each company will produce their own versions of a C²M². The CSA is also building relationships with healthcare authorities in Northern and remote communities to define the best approach for demonstrations of healthcare solutions in a remote environment. The unique, isolated, and extreme environment of space provides research opportunities to find innovative solutions to healthcare challenges shared by astronauts and people living in remote communities.

In 2022–23, the CSA along with its partners, the Privy Council Office[lxvii] (PCO) and Impact Canada, continued running the Deep Space Healthcare Challenge.[xiii] This challenge seeks to create new detection and diagnostic technologies that will help support front-line workers in remote communities in Canada and crews on deep-space missions. Given that remote communities and deep space astronauts face many of the same challenges when it comes to accessing healthcare, advisors from Indigenous Services Canada and the First Nation Health Authority have been involved in the challenge to help innovators understand the needs of Indigenous peoples in remote communities. In April 2023, five teams, including an Indigenous-led organization, were announced as finalists.

The Deep Space Food Challenge[xiv] seeks to develop food production technologies and systems that can tackle the challenge of food security in rural and harsh environments as well as in deep space. This challenge will build knowledge and create capacity for sustainable agriculture, which is aligned with SDG 2[lxviii]: support a healthier and more sustainable food system. Phase 2 of the challenge was completed in April 2023 and four finalists have advanced to Phase 3.

In 2022–23, there were 101 operational services based on space data offered to Canadians; these services contributed to a plethora of benefits on Earth. For instance, a majority of operational services contributed to the improvement of the protection of natural and built environments, natural resources management, and decision-making and policy development.

Space technologies developed with CSA support can sometimes find applications outside of their initial intended use which, in turn, generates economic benefits and improves the lives of Canadians. For 2022–23, the CSA can report that 41 space technologies and applications were adapted for use on Earth or reuse in space. The majority of reported reuses had an application on earth, while around 25% of reuses found an application in space. The reuses were principally in the environment, telecommunications, aerospace, and healthcare sectors. For example, a wearable physiological monitoring platform was adapted and reused in Northern communities to

monitor health conditions and train police officers on interpreting physiological signs of medical conditions.

Result 3: Canada's investments in space benefit the Canadian economy

In 2022–23, the CSA launched another wave of investments through the STDP[vi] funding initiative. These investments support the development of Canadian industrial capabilities in space technologies to expand the commercial potential of Canadian space companies and reduce technological unknowns. In 2022–23, 29 Canadian companies received funding for 30 R&D projects and three technology demonstrations in space projects for a total investment of $23M. Furthermore, 34 projects funded in previous years were completed in 2022–23 which enabled Canadian space companies to increase their readiness level and commercial potential.

The LEAP[v] aims to provide opportunities for Canadian scientists and to foster innovative ideas in the lunar context. The scientific and technological advancements stemming from LEAP are expected to generate tangible benefits for the Canadian economy. In November 2022, a Canadian company was selected to build the Canadian lunar rover and develop the Canadian payloads. The lunar rover will be designed to survive the lunar night and to gather scientific data. This data will then be used to help find water ice, a key component needed for the future of human space exploration. It will also allow scientists to better understand the lunar geology and environment.

Support for firm growth and Canadian innovators that wish to go into business, grow their companies, and bring their innovations to markets has been upheld through the Innovative Solutions Canada[lxix] (ISC) program. In 2022–23, the CSA funded two contracts for the development of prototypes resulting from its first ISC challenge: Artificial Intelligence and Big Data Analytics for Advanced Autonomous Space Systems. Canadian companies will develop software to improve maritime risk awareness and improve systems that optimize the operations and usage of EO satellites.

In 2022–23, the CSA launched three other ISC challenges focused on technologies related to space robotics. The first two, Proximity Sensor System for Space Robotics and Visual AI for Space Robotics Obstacle Detection, were launched in August 2022. The third challenge, "AI for Space Robotics Auto-Diagnostics and Early Failure Prediction", was opened in September 2022. The technology advancements produced by these challenges will improve the autonomy of future space robotic systems and could also be applied to other Canadian industries, such as underground mining.

The CSA, through the smartEarth[xv] funding activity, has supported the downstream space sector so that it can build its expertise to take advantage of all the opportunities offered through space. The improved accessibility and availability of space data combined with advances in analysis technologies, such as artificial intelligence, machine learning, deep learning, and high-performance computing, creates more opportunities for the development of cutting-edge

solutions to address current and future challenges on Earth. The smartWhales initiative is one example. Led by the CSA in collaboration with Fisheries and Oceans Canada and Transport Canada, it is a space-based solution to detect and monitor the presence of North Atlantic right whales and predict the movement in Canadian waters.

Through the "Bridging the Information Gap through Space-based Analysis"[lxx] AO, which ended in 2022, the CSA has funded 17 Canadian companies to create revolutionary new applications using EO data. These applications promote scientific excellence, economic growth and, job creation and will contribute to prosperity in Canada.

The 21 projects financed through the "Canadian Downstream Space Sector Delivering on Canada's Better Future"[lxxi] AO remain ongoing. This funding stimulates capacity development in the Canadian downstream industry to develop innovative solutions for answering national sustainable development challenges and address complex global transformations, such as technological revolutions, climate change, and environmental degradation.

In November 2022, Canada and European Space Agency (ESA) member states announced new investments during the ESA's Ministerial Council meeting. The Canadian investments, totalling $60M, in selected ESA optional programs will allow the Canadian space sector to participate in world-class missions and activities in Earth observation, satellite communications, navigation, space exploration, space situational awareness, space safety, and general technology development.

The CSA's David Florida Laboratory[lxxii] (DFL) celebrated its 50th year as Canada's world-class assembly, integration and testing centre for spacecraft and flight hardware. In 2022–23, DFL conducted 36 unique tests for various businesses and research institutions in the Canadian space sector. Environmental qualification facility improvements were undertaken to further support Canada's contributions to international partnerships such as the Lunar Gateway and ISS, as well as upcoming CSA projects and commercial satellite programs.

Gender-based Analysis Plus (GBA Plus)

The Science, Technology and Expertise Development in Academia (STEDiA) initiative supported Canadian post-secondary institutions that offer hands-on experiences in space-like missions to post-secondary students and early-career professionals. This initiative also provided direct support to post-secondary students for careers and professional development opportunities, including space conferences and training. All activities included measures to promote access and participation among students and early-career professionals from all over the country, including women, Indigenous peoples, persons with disabilities and visible minorities.

The CSA contracted an Inuit-owned social enterprise to train local technicians and enable Inuit-led operations and research success for the Naurvik project ("the growing place" in Inuktitut). The Naurvik project is a renewable energy plant production facility in Gjoa Haven, Nunavut. These efforts will enable a culturally responsive understanding of food

production and food security challenges in Canada's North, and in harsh and isolated locations. The CSA also participated in the Indigenous Mapping Workshop,[lxxiii] an annual event aimed to support Indigenous peoples in accessing tools, technology and satellite-based EO knowledge required to map their lands.

In 2022–23, the CSA continued to implement the action plan set out in the Evaluation of the implementation of GBA Plus at the CSA. In particular, the CSA collaborated with Statistics Canada to obtain more disaggregated data on those employed by the space sector. This new information was analyzed and compiled with the disaggregated data already collected through various internal data collections. A disaggregated database was created to centralize the information and increase its visibility. Accessible disaggregated data will increase its utilization within the decision-making process and in turn, increase equity, diversity and inclusion in the space sector. In parallel, the CSA began revising its GBA Plus policy along with its implementation tools, and GBA Plus elements were included in both the Departmental Results Framework and the Performance Information Profiles.

On another front, through the GBA Plus Community of Practise, the CSA has worked to increase awareness of the GBA Plus intersectional design and provide concrete tips and examples on how the space sector can better serve diverse groups of people in Canada. Finally, in 2022–23, intermediate level GBA Plus training was delivered to GBA Plus Sector Advisors.

UN 2030 Agenda for Sustainable Development and the UN SDG

In 2022–23, the CSA activities contributed to a wide range of SDGs. This was done primarily through targeted initiatives, such as the Deep Space Food Challenge (SDG 2[lxviii]), the Deep Space Healthcare Challenge (SDG 3[lxxiv]), and outreach initiatives like the CCP and CUBICS that provide students with hand-on experience in space-STEM sectors (SDG 4[lxxv]).

The CSA also provided EO data to our partners who, in turn, are using it to monitor and track environmental conditions to inform decision-making and policy in environmental areas (SDG 17[xii]). In 2022–23, the CSA initiated the drafting process of its first Departmental Sustainable Development Strategy, which will further outline the CSA's commitment and plans for the SDGs.

Innovation

In 2022–23, the Service and Experimentation Management team continued to implement the "Ideas to Action to Innovation (I^2A)" initiative. I2A Space recruited new ambassadors, allowing sharing of diverse experiences, and continued to test new ideas from employees. As part of the implementation of hybrid work, the CSA has also

developed several tools to facilitate the transition period. These include the introduction of a chatbot to answer the most frequently asked questions on the future of work.

Key risks

The success of CSA depends on its people. In 2022–23, the CSA has put in place strategies to reduce the negative impact of increased workload on employees. For instance, the CSA used the flexibility given to recruitment including talent management plan and renewed the staffing service agreement with Public Services and Procurement Canada (PSPC) in order to improve the hiring process. Furthermore, to continue innovating, the CSA has implemented the Strategy on Service and Digital and its pillars are now part of Information Management/Information Technologies (IM/IT) sector's communications. The CSA also led a whole-of-government space-based EO Forum in 2022 to define strategic investments and flexible programming.

Results achieved

The following table shows, for Canada in space, the results achieved, the performance indicators, the targets and target dates for 2022–23, and the actual results for the three most recent fiscal years for which actual results are available.

Departmental results	Performance indicators	Target	Date to achieve target	2020–21 actual results	2021–22 actual results	2022–23 actual results
Canada remains a leading space-faring nation	Ranking of Canadian government civil space budget as a share of GDP among OECD and BRIC nations	27	March 31, 2023	23 (2019)	27 (2020)	22 (2021)
	Canada's rank among Organization for Economic Co-operation and Development nations on the citation score	13	March 31, 2023	17 (2019)	15 (2020)	20[1] (2021)

[1] There has been a 24% increase in space-related publications in recent years, putting Canada in 8th place among OECD countries in terms of the number of publications. Since those publications are recent, it will take a few years for them to accumulate citations and, in turn, impact Canada's citation score.

	of space-related publications					
Space information and technologies improve the lives of Canadians	Number of Canadian space technologies adapted for use on Earth or reuse in space	25	March 31, 2023	23 (2019)	25 (2020)	41[2] (2021)
	Number of services offered to Canadians dependent on space data	120	March 31, 2023	111 (2020)	101 (2021)	101[3] (2022)
Canada's investments in space benefit the Canadian economy	Value of GDP of the Canadian space sector	$2.3B	March 31, 2023	$2.5B (2019)	$2.7B (2020)	$2.8B[4] (2021)
	Number of employees in the Canadian space sector	9,000	March 31, 2023	10,541 (2019)	10,868 (2020)	11,629[5] (2021)

Financial, human resources and performance information for CSA's program inventory is available in GC InfoBase.[lxxvi]

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[2] The increase in reuses is the result of an increase of 27% in the private sector participation rate in the data collection.

[3] Data quality assurance processes resulted in adaptations to the methodology and the removal of some services from the CSA's inventory. Furthermore, the 15 services listed as "in development" were not included.

[4] The decline in 2020 was smaller than expected and partially mitigated by government support programs (Canada Emergency Wage Subsidy) put in place during the COVID-19 pandemic. Both of these reasons explain why GDP is higher than initially anticipated.

[5] In 2021, the Canadian space sector workforce was primarily made up of people who identified as male (71%). Those who identified as female represented 29%, while 0.1% of the workforce identified as other. In 2021, 67% of the Canadian space sector workforce had a least a bachelor's degree.

Budgetary financial resources (dollars)

The following table shows, for Canada in Space, budgetary spending for 2022–23, as well as actual spending for that year.

2022–23 Main Estimates	2022–23 planned spending	2022–23 total authorities available for use	2022–23 actual spending (authorities used)	2022–23 difference (actual spending minus planned spending)
329,883,029	329,883,029	547,046,144	425,072,047	95,189,018

The positive variance of $95.2 million is mainly due to the space exploration initiative Canadarm3.

Financial, human resources and performance information for CSA's program inventory is available in GC InfoBase.^{lxxvi}

Human resources (full-time equivalents)

The following table shows, in full-time equivalents, human resources the department needed to fulfill this core responsibility for 2022–23.

2022–23 planned full-time equivalents	2022–23 actual full-time equivalents	2022–23 difference (actual full-time equivalents minus planned full-time equivalents)
415.6	459.5	43.9

The positive variance of 43.9 FTEs is mainly due to the hiring of additional staff to support space exploration initiatives, mainly Canadarm3.

Financial, human resources and performance information for CSA's program inventory is available in GC InfoBase.^{lxxvi}

Internal services

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 an organization's corporate obligations. Internal services refer to the activities and resources of the 10 distinct service

categories that support program delivery in the organization, regardless of a department's the internal services delivery model. The 10 service categories are:

- acquisition management services
- communication services
- financial management services
- human resources management services
- information management services
- information technology services
- legal services
- material management services
- management and oversight services
- real property management services

In 2022–23, the CSA strengthened the Investments Governance and Management Framework (IGMF), improving internal processes such as the Report to Comptroller General and projects led by Public Services and Procurement Canada (PSPC).

Tools for project managers were developed, such as an online integrated consultation tool, centralized investment management sheets, best practices, work instructions and improved templates for project documents. Furthermore, the Organizational Project Management Capacity Assessment (OPMCA) and the Project Complexity and Risk Assessment (PCRA) were initiated.

The OPMCA review, which considers active projects between April 2019 and March 2022, was nearing completion in March 2023.

In 2022–23, the CSA continued the implementation of the Safety and Mission Assurance (S&MA) Practise. In total, nine project risk assessments were completed. The CSA has developed a Project-Specific Safety Review-Meeting Plan for human-rated projects such as the Lunar Gateway. This defines the independent board, project team and contractor personnel roles and responsibilities as well as deliverables. The CSA also developed a preliminary Mishap Response and Contingency Plan with the primary purpose of satisfying the Lunar Gateway safety requirements.

In 2022–23, most of the approved activities in the Departmental Security Plan (DSP) were completed and a few were nearing completion, continuing to strengthen the CSA's security posture, aligned with best practices and risk assessments. The CSA has already identified and prioritized the security risks for the next three-year cycle, and a new DSP should be ready for approval in the first months of the 2023-24 fiscal year.

Implementation of the 2021–24 Workforce Management Strategic Plan has continued with a focus on equity, diversity and inclusion. The CSA supported the objective of attracting and retaining talented people and building a diverse and inclusive workforce by co-creating a three-year strategy on departmental recruitment. To foster learning, leadership and the development of

future talent and skill, the CSA implemented a mentoring and sponsorship program and developed an integrated leadership framework.

The CSA has also developed a 2023–26 Strategy on Mental Health and created the Mental Health and Wellness Ambassador Community, a network responsible of increasing awareness and reducing stigma around mental health. Furthermore, a Mental Health and Wellness Champion was appointed to promote a respectful and healthy workplace.

Innovation continued being a priority in 2022–23. A team dedicated to collective staffing has been set up, and new resources have been added to innovate and simplify recruitment practices. A new electronic tool for tracking staffing activities is in use; improvements will be proposed on an ongoing basis, and the integration of classification activities is planned. Lastly, a new organization data portal which presents workforce demographics and specific personnel data to supervisors was launched.

The CSA deployed its planned activities for 2022–23 as part of its property asset maintenance strategy. Capital investment in end-of-life assets took place at both the DFL and the John H. Chapman Space Centre. The majority of assets condition reporting was completed for all sites and once finalized, it will provide short-, medium-, and long-term investment forecasting. The pilot project with NRCan for building optimization is complete and significant progress was made to determining the best path for carbon neutrality.

In the context of Digital Transformation, the CSA made the shift to the Microsoft 365 environment in 2022–23. Through a human-centric approach, the IM/IT sector phased the migration in bundles that would make sense for the users. In January 2023, IM/IT launched its Digital Transformation newsletter. This newsletter informs CSA employees of what is happening in the digital world and also transmits and repeats the pillars of our digital transformation strategy to anchor them within the organization. IM/IT also updated its cloud workload migration strategy.

2022–23 was a major year in terms of continuing the modernization of tools and infrastructure. In collaboration with the various CSA sectors, IM/IT worked on automating processes and generating efficiencies in CSA's operations. Additional efforts were made to bring more data to decision makers in the form of dashboards. Significant work was done to upgrade aging Wi-Fi to the more modern and high-performing GC Wi-Fi. To better accommodate hybrid work, several components of the network architecture had to be updated to allow an increase in bandwidth, providing more than eight times the throughput available at the beginning of the pandemic in 2020. Another significant effort was made to update the conference rooms and streamline the connection process to hybrid meetings from within the CSA. This work will continue in 2023–24 to ensure that all rooms with significant seating capacity can support hybrid meetings.

In addition, the CSA expanded its cybersecurity function in 2023–24 with governance and an approach that further integrates corporate and programmatic activities as well as its space missions, its supply chain and the other space agencies. In particular, the CSA updated its

Cybersecurity Management Framework and developed its CSA Cybersecurity Event Management Plan (CSEMP) in accordance with Canada's central agencies.

Contracts awarded to Indigenous businesses

The CSA is a Phase 2 organization and is aiming to achieve the minimum 5% target by the end of 2023-24. To that effect, Procurement Strategy for Indigenous Business[lxxvii] (PSIB) has been developed, aimed at developing the capacity of Indigenous businesses in the space and R&D sectors.

The CSA Procurement and Contract Administration (PCA) team completed an annual Procurement Strategy for Indigenous Businesses including the use of conditional or voluntary set asides to increase contract awards to Indigenous businesses and Indigenous Participation Plans (IPPs) to grow industry capacity.

To facilitate this plan, updated procurement practices have been implemented internally and include a new process to determine Indigenous capacity and pursue set asides whenever industry availability is identified, and additional stream of data has been collected for more comprehensive reporting and trend analysis in the future.

Furthermore, IPPs were required in all R&D or space project contracts that were enabled through the development of templates for bid evaluation criteria pertaining to IPPs.

Procurement officers received training throughout the year on related activities such as identifying Comprehensive Land Claims Areas and searching the Indigenous Business Directory. They also took part in Canada School of Public Service (CSPS) course offerings.

In addition to these internal changes, the CSA PCA team has committed to sending representatives to Indigenous Services Canada's Reverse Job Fair for Indigenous Businesses in September 2023 and continues to network through CSA's Indigenous Community of Practice to inform and help sectors adopt new practices.

Procurement also added socio-economic benefits, including Indigenous procurement as a priority within its internal governance. The Contracts Review Committee will challenge procurement plans or evaluation criteria that are unduly restrictive as part of their approval process to ensure disadvantaged groups are not facing unnecessary challenges or propose approaches that increase Indigenous participation when suitable. An updated Procurement Framework has also been drafted to reflect socio-economic considerations in procurement and is pending approval.

In 2022–23, CSA awarded 4.87% of contracts to Indigenous suppliers with a total value of $2,265,516. An additional 3% of contracts worth $1,419,941 included clauses or bid evaluation criteria that encouraged Indigenous participation although it did not result in a contract awarded to an Indigenous business[6]. Going forward, the CSA will continue its efforts to support Indigenous business and entrepreneurs.

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[6] These totals are calculated based on the reporting guidance provided by Indigenous Services Canada and exclude all contracts that fall within the Deputy Head approved exemptions.

Budgetary financial resources (dollars)

The following table shows, for internal services, budgetary spending for 2022–23, as well as spending for that year.

2022–23 Main Estimates	2022–23 planned spending	2022–23 total authorities available for use	2022–23 actual spending (authorities used)	2022–23 difference (actual spending minus planned spending)
58,395,350	58,395,350	68,385,097	73,163,448	14,768,098

The positive variance of $14.8 million is mainly due to activities aimed at the modernization and optimization of internal services, the updating of the network infrastructure and the hiring of additional resources to support programs.

Human resources (full-time equivalents)

The following table shows, in full-time equivalents, the human resources the department needed to carry out its internal services for 2022–23.

2022–23 planned full-time equivalents	2022–23 actual full-time equivalents	2022–23 difference (actual full-time equivalents minus planned full-time equivalents)
408.4	373.9	(34.5)

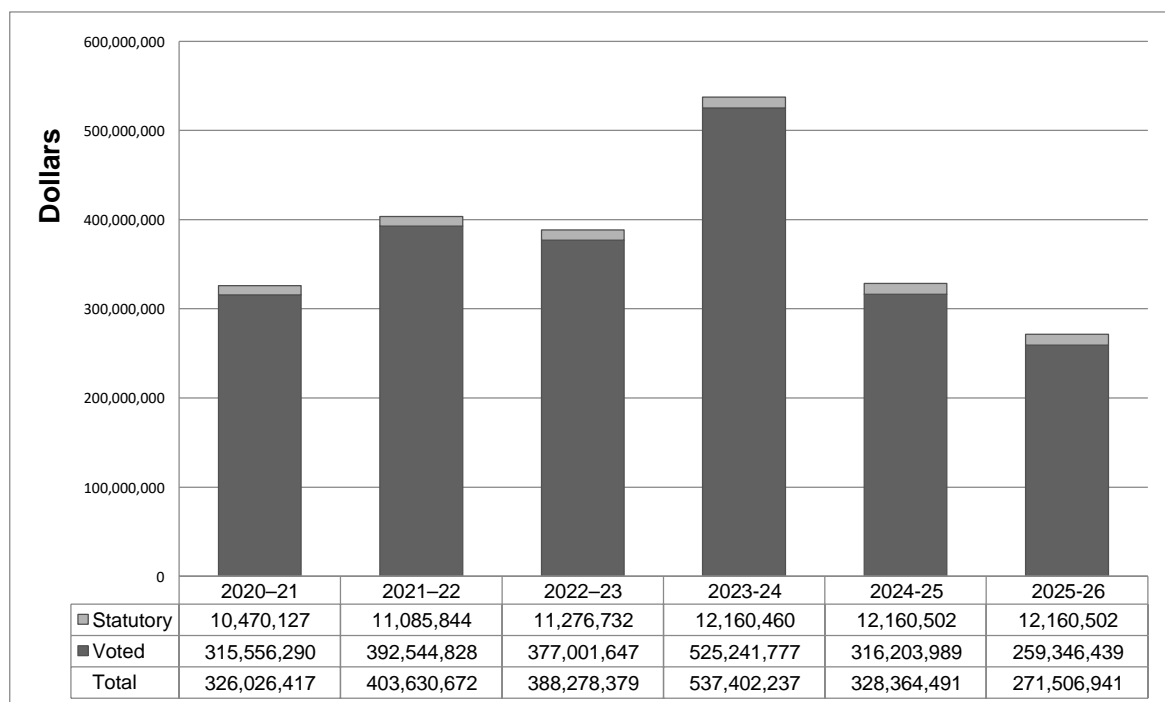The negative variance of 34.5 FTE is mainly due to delays in the creation and staffing of positions and the departure of employees who could not be replaced during the year, particularly in the Information Technology Directorate. The same trends are expected in the short-term future due to ongoing issues surrounding staffing due to labour shortages in various streams of employment across the federal government.

Spending and human resources

Spending

Spending 2020–21 to 2025–26

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

	2020–21	2021–22	2022–23	2023-24	2024-25	2025-26
☐Statutory	10,470,127	11,085,844	11,276,732	12,160,460	12,160,502	12,160,502
☐Voted	315,556,290	392,544,828	377,001,647	525,241,777	316,203,989	259,346,439
Total	326,026,417	403,630,672	388,278,379	537,402,237	328,364,491	271,506,941

Spending variances are primarily attributable to specific funds allocated to the following initiatives in which funding exceeded the CSA's ongoing resource allocations.

- As indicated in the Budget 2015 and 2016 announcements, additional funding of $30M over four years starting in 2016–17 was authorized to maintain Canada's participation in the ESA's Advanced Research in Telecommunications Systems (ARTES) Program.

- In accordance with the Budget 2015 announcements, and with $379 million in new funds earmarked in the Budget 2016, additional funding of $318 million over eight years beginning in 2017–18 has thus far been authorized to support activities on board the ISS and to fulfill Common Systems Operations Costs related to the extension of Canada's participation in the ISS until 2024, in accordance with international treaty obligations.

- Additional funding of $25.1M spread over six years starting in 2018–19 for the QEYSSat project.

- Budget 2019 included, additional funding of $150M over five years starting in 2019–20 to carry out activities under the LEAP.

- In accordance with 2019 announcements, committing $1.9 billion over 24 years for the Canadarm3 as a Canadian contribution to the NASA-led Lunar Gateway Program, additional funding of $27.4M spread over four years starting 2020–21 to undertake the first definition phase of Canadarm3 project and, STEM activities and additional funding of $335.3M for fiscal years 2022–23 and 2023–24 to undertake the second definition phase of the Canadarm3 project.

The cumulative effect of reallocating unused funds to subsequent years as a result of the sound management of high-risk projects, including increased technological risks, long-term development cycles, and work schedule uncertainties, had an impact on the CSA's spending trend in recent years.

Budgetary performance summary for core responsibilities and internal services (dollars)

The "Budgetary performance summary for core responsibilities and internal services" table presents the budgetary financial resources allocated for the CSA's core responsibilities and for internal services.

Core responsibilities and internal services	2022–23 Main Estimates	2022–23 planned spending	2023–24 planned spending	2024–25 planned spending	2022–23 total authorities available for use	2020–21 actual spending (authorities used)	2021–22 actual spending (authorities used)	2022–23 actual spending (authorities used)
Canada in Space	329,883,029	329,883,029	476,342,693	265,605,491	547,046,144	271,954,249	307,943,051	425,072,047
Subtotal	**329,883,029**	**329,883,029**	**476,342,693**	**265,605,491**	**547,046,144**	**271,954,249**	**307,943,051**	**425,072,047**
Internal services	58,395,350	58,395,350	61,059,544	62,759,000	68,385,097	58,455,404	60,165,098	73,163,448
Total	**388,278,379**	**388,278,379**	**537,402,237**	**328,364,491**	**615,431,241**	**330,409,653**	**368,108,149**	**498,235,495**

The planned spending variances in 2022–23 to 2024–25 are mainly attributable to investments in the Canada's participation in the ISS until 2024, which includes MSR, investments in LEAP, as well as the smart robotic system Canadarm3, which is the Canadian contribution to the NASA-led Lunar Gateway Program, announced in Budget 2019. It is important to note that the CSA's project and mission funding profile varies from year to year, depending on the status of each mission, which has an impact on planned spending and actual spending (expenditures).

The decrease in planned budgetary spending from 2023–24 to 2024–25 is mainly attributable to the ramping down of the current phase in the Canadarm 3 project as well as the end of additional funding for the participation in the International Space Station (ISS).

The CSA lapsed $115.3 million in 2022–23 of which 96% ($111.2M) was mainly related to capital project funding envelopes (including the risk budget) that are rolled over year to year until the project is closed. This is an inherent part of projects within the Canadian Space Program, and for 2022–23, 99.55% of lapsed funds are reprofiled to future years.

The variances in actual spending from 2020–21 to 2022–23 are aligned with allocations for flagship initiatives including Canadarm3. Procurement difficulties and delays in awarding contracts during the Covid-19 pandemic have subsided.

Human resources

The "Human resources summary for core responsibilities and internal services" table presents the full-time equivalents (FTEs) allocated to each of CSA's core responsibilities and to internal services.

Human resources summary for core responsibilities and internal services

Core responsibilities and internal services	2020–21 actual full-time equivalents	2021–22 actual full-time equivalents	2022–23 planned full-time equivalents	2022–23 actual full-time equivalents	2023–24 planned full-time equivalents	2024–25 planned full-time equivalents
Canada in Space	391.2	434.1	415.6	459.5	466.1	453.0
Subtotal	**391.2**	**434.1**	**415.6**	**459.5**	**466.1**	**453.0**
Internal services	317.5	332.1	408.4	373.9	362.2	363.7
Total	**708.7**	**766.2**	**824.0**	**833.4**	**828.3**	**816.7**

The variance in the number of FTEs since 2020–21 is mainly attributable to the additional resources required to fill certain gaps and priorities, including:

- additional scientific and technical staff to support the activities of the ISS until 2024;

- additional changes as a result of the Canadarm3 mission, which includes new obligations such as those stemming from the new Policy on Service and Digital;

- increased investments to recruit the next generation of public servants, which includes the student programs; and

- new departmental requirements for internal services, such as managing Phoenix, setting up a data expertise centre, results-based accountability, and policy resets.

For fiscal year 2022–23, the 9.4 positive variance between planned and actual full-time equivalents is mainly due to the hiring of additional staff to support space exploration initiatives, mainly Canadarm3 project.

Expenditures by vote

For information on CSA's organizational voted and statutory expenditures, consult the Public Accounts of Canada.lxxviii

Government of Canada spending and activities

Information on the alignment of CSA's spending with Government of Canada's spending and activities is available in GC InfoBase.lxxvi

Financial statements and financial statements highlights

Financial statements

CSA's financial statements (unaudited) for the year ended March 31, 2023, are available on the department's website.lxxix

Financial statement highlights

Condensed Statement of Operations (unaudited) for the year ended March 31, 2023 (dollars)

Financial information	2022–23 planned results	2022–23 actual results	2021–22 actual results	Difference (2022–23 actual results minus 2022–23 planned results)	Difference (2022–23 actual results minus 2021–22 actual results)
Total expenses	559,813,153	544,050,316	552,320,738	(15,762,837)	(8,270,422)
Total revenues	650,926	28,657	172,518	(622,269)	(143,861)
Net cost of operations before government funding and transfers	559,162,227	544,021,659	552,148,220	(15,140,568)	(8,126,561)

Note 1. The CSA is financed by the Government of Canada through parliamentary authorities. Financial reporting of authorities provided to the CSA does not parallel financial reporting, according to generally accepted accounting principles since authorities are primarily based on cash flow requirements. Consequently, items recognized in the Condensed Statement of Operations are not necessarily the same as those reported under authorities from Parliament.

Total planned expenses for 2022–23 were $559.8M, a variance of $15.8M (2.8%) when compared to actual results of $544.0M. The variance between planned and actual expenses is mainly explained by the following:

- Amortization expenses of assets under construction, planned to be capitalized to capital assets in 2022–23, being lower than projected ($-8.5 M) as well as the extension of the remaining useful life of the International Space Station's assets ($-22.9 M).
- Salaries and employee benefits expenses, being higher than projected ($+13.4 M).

Total planned revenues for 2022-23 were $650.9K, a variance of $622.3K compared to actual results of $28.6K. The variance is due to planned gain on disposal of Crown assets that have not materialized.

In 2022–23, total expenses were $544.0M, a decrease of $8.3M (1.5%) when compared with the previous year's total expenses of $552.3M. This decrease is mainly due to the following:

- Decreased amortization expenses mainly related to the extension of the remaining useful life of the International Space Station's assets ($-8.4 M).
- Decreased expenses in Professional and Special Services mainly related to Canadarm3 ($-13.3 M).
- Increased expenses in Salaries and employee benefits ($9.2M).

The CSA's total revenues were $0.03M in 2022–23 ($0.17M in 2021–22), which represents the re-spendable portion of overall revenues of $1.3M. The majority of these revenues are reported under the sale of goods and services provided by the DFL, i.e., sale of goods and services to private business or other Government of Canada departments, and location and use of public property.

The 2022–23 planned results information is provided in the CSA's Future-Oriented Statement of Operations and Notes 2022–23.[lxxx]

Condensed Statement of Financial Position (unaudited) as of March 31, 2023 (dollars)

Financial information	2022–23	2021–22	Difference (2022–23 minus 2021–22)
Total net liabilities	188,342,171	114,091,936	74,250,235
Total net financial assets	178,503,620	103,074,847	75,428,773
Departmental net debt	9,838,551	11,017,089	(1,178,538)
Total non-financial assets	1,325,194,597	1,364,221,915	(39,027,318)
Departmental net financial position	1,315,356,046	1,353,204,826	(37,848,780)

Total net liabilities of $188.3M consist mainly of accounts payable and accrued liabilities. These represent goods and services received at year-end but that have not yet been paid by

the CSA. The $74.2M (65.1%) variance from 2021–22 to 2022–23 is normal as payment schedules may vary from one year to another, especially those related to space programs.

Total assets were $1,503.7 M at the end of 2022–23 ($178.5M in net financial assets and $1,325.2 M in non-financial assets), an increase of $36.4M mainly attributable to the increase in the "Due from the Consolidated Revenue Fund (CRF)", which represents the net amount of cash that the Agency is entitled to draw from the CRF without further authorities to discharge its liabilities.

Non-financial assets are mainly composed of space-related assets ($1.12B over $1.32B or 84.8%).

The 2022–23 planned results information is provided in CSA's Future-Oriented Statement of Operations and Notes 2022–23.[lxxx]

Corporate information

Organizational profile

Appropriate minister: The Honourable François-Philippe Champagne, P.C., M.P.

Institutional head: Lisa Campbell, President

Ministerial portfolio: Innovation, Science and Economic Development

Enabling instrument: Canadian Space Agency Act, S.C. 1990, c. 13[lxxxi]

Year of incorporation/commencement: Established in March 1989

Other: The CSA was established in 1989. The Agency's headquarters are located at the John H. Chapman Space Centre, in Saint-Hubert, Quebec. Other CSA workplaces include the DFL in Ottawa, Ontario; the Policy and Planning offices in Gatineau, Quebec; and liaison offices in Houston, Washington, and Paris.

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

Information on the Canadian Space Agency's raison d'être, mandate and role is available on the CSA's website.[lxxix]

Information on the Canadian Space Agency's mandate letter commitments is available in the Minister's mandate letter.[vii]

Operating context

Information on the operating context is available on the CSA's website.[lxxix]

Reporting framework

The CSA approved Departmental Results Framework and Program Inventory of record for 2022–23 are as follows.

Core Responsibility: Canada in Space		Internal Services
Departmental Result: Canada remains a leading space-faring nation	Indicator: Ranking of Canadian Government civil space budget as a share of GDP among OECD and BRIC nations	
	Indicator: Canada's Rank among OECD nations on the citation score of space-related publications	
Departmental Result: Space information and technologies improve the lives of Canadians	Indicator: Number of Canadian space technologies adapted for use on earth or re-use in space	
	Indicator: Number of services offered to Canadians dependent on space data	
Departmental Result: Canada's investments in space benefit the Canadian economy	Indicator: Number of employees in the Canadian space sector	
	Indicator: Value of GDP of the Canadian space sector	
Program: Space Capacity Development		
Program: Space Exploration		
Program: Space Utilization		

Departmental Results Framework and Program Inventory for 2022–23—Text version

In 2022–23, to align the CSA's Departmental Results Framework (DRF) results to the Space Strategy for Canada,[viii] a new departmental result "Canada remains a leading space-faring nation" and its respective indicators are added to support the core responsibility Canada in Space. With the same objective, the result "Canadians engage with space" was removed.

Supporting information on the program inventory

Supporting information on planned expenditures, human resources, and results related to the CSA's program inventory is available on GC InfoBase.[lxxvi]

Supplementary information tables

The following supplementary information tables are available on the CSA's website.[lxxxii]

- ‣ Reporting on Green Procurement
- ‣ Details on transfer payment programs
- ‣ Gender-based analysis plus
- ‣ Response to Parliamentary Committees

Federal tax expenditures

The tax system can be used to achieve public policy objectives through the application of special measures such as low tax rates, exemptions, deductions, deferrals and credits. The Department of Finance Canada publishes cost estimates and projections for these measures each year in the Report on Federal Tax Expenditures.[lxxxiii] This report also provides detailed background information on tax expenditures, including descriptions, objectives, historical information and references to related federal spending programs as well as evaluations and GBA Plus of tax expenditures.

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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 an appropriated department over a 3-year period. Departmental Plans are usually tabled in Parliament each spring.

departmental priority *(priorité)*

A plan or project that a department has chosen to focus and report on during the planning period. 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 quantitative measure of progress on a departmental result.

departmental results framework *(cadre ministériel des résultats)*

A framework that connects the department's core responsibilities to its 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.

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. For a particular position, the full-time equivalent figure is the ratio of number of hours the person actually works divided by the standard number of hours set out in the person's collective agreement.

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

An analytical tool used to support the development of responsive and inclusive policies, programs and other initiatives; and understand how factors such as sex, race, national and ethnic origin, Indigenous origin or identity, age, sexual orientation, socio-economic conditions, geography, culture and disability, impact experiences and outcomes, and can affect access to and experience of government programs.

government-wide priorities *(priorités pangouvernementales)*

For the purpose of the 2022–23 Departmental Results Report, government-wide priorities are the high-level themes outlining the government's agenda in the [November 23, 2021, Speech from the Throne](#)[lxxxiv]: building a healthier today and tomorrow; growing a more resilient economy; bolder climate action; fighter harder for safer communities; standing up for diversity and inclusion; moving faster on the path to reconciliation; and fighting for a secure, just and equitable world.

horizontal initiative *(initiative horizontale)*

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

Indigenous business *(enterprise autochtones)*

For the purpose of the *Directive on the Management of Procurement Appendix E: Mandatory Procedures for Contracts Awarded to Indigenous Businesses* and the Government of Canada's commitment that a mandatory minimum target of 5% of the total value of contracts is awarded to Indigenous businesses, an organization that meets the definition and requirements as defined by the [Indigenous Business Directory](#). [lxxxv]

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 to the expected result.

planned spending *(dépenses prévues)*

For Departmental Plans and Departmental Results Reports, planned spending refers to those amounts presented in 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 the department's programs and describes how resources are organized to contribute to the department's core responsibilities and results.

result *(résultat)*

A 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.

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.

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