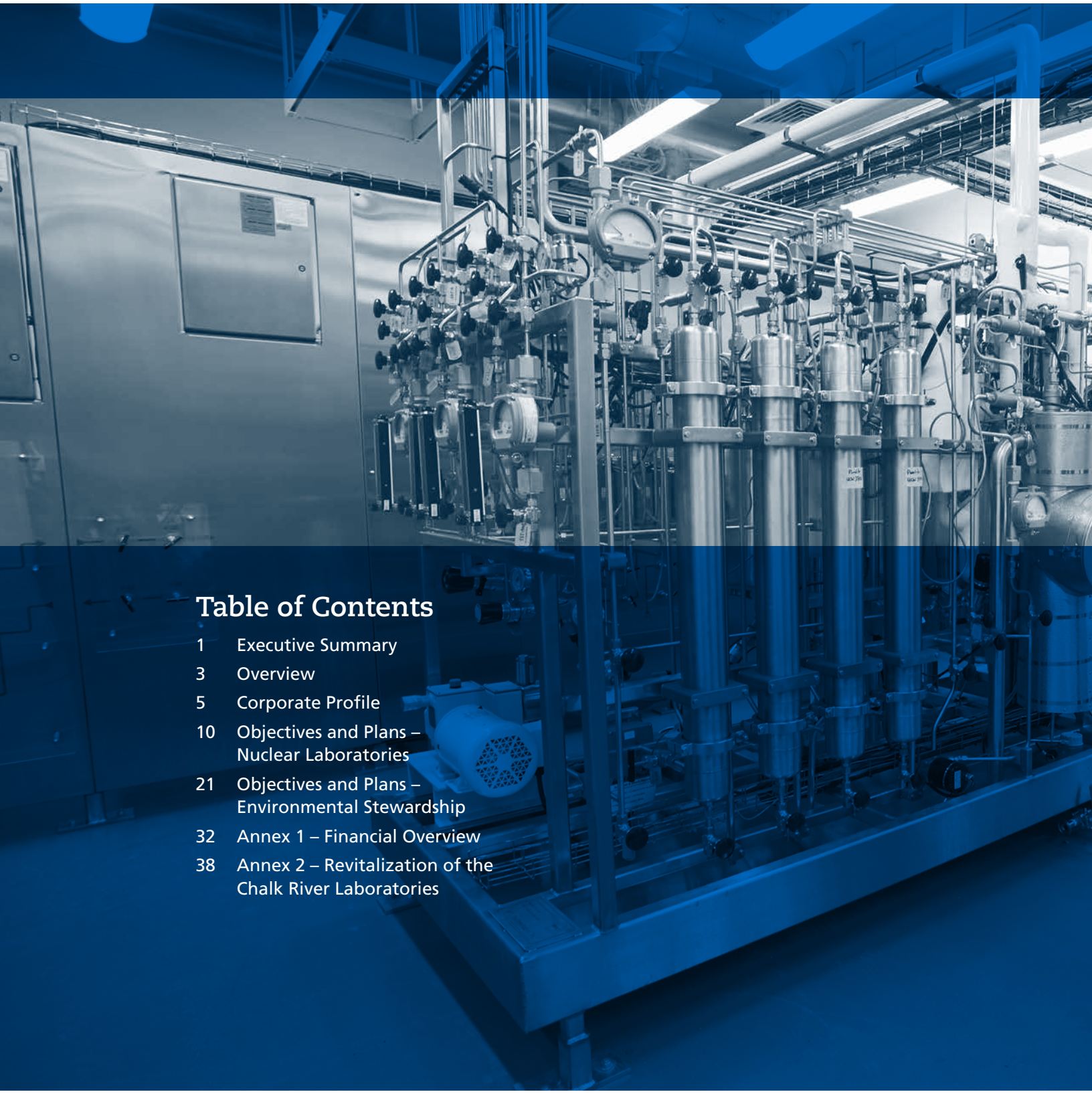
Atomic Energy
of Canada Limited

2020-21 to 2024-25 Corporate Plan Summary

Driving Nuclear Opportunity for Canada

AECL
EACL



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Executive Summary

As a federal Crown corporation, Atomic Energy of Canada Limited (AECL) is working to advance Canada's interests through leading edge nuclear science and technology and environmental protection initiatives. This includes **combating climate change** through clean energy growth and decarbonization strategies, **pioneering new treatments for cancer** and other diseases, and **accelerating Canada's environmental remediation projects**.

Since 2015, AECL has been delivering its mandate through a Government-owned, Contractor-operated model, whereby a private-sector organization, Canadian Nuclear Laboratories (CNL), is responsible for managing and operating AECL's sites.

This change in delivery model has brought about significant transformation in the short amount of time it has been in place. Since the implementation of the Government-owned, Contractor-operated model, more than ninety (90) buildings and structures have been demolished at the Chalk River site, ground has been broken for the construction of three new facilities, and numerous infrastructure upgrades have been completed or are underway. CNL's efforts to advance small modular reactors have enabled it to position itself – and Canada – at the forefront of global efforts in this clean energy area.

Mission

Realize value for Canadians by driving nuclear innovation, creating a state-of-the-art nuclear campus, and cleaning up legacy wastes

Vision

Driving nuclear opportunity for Canada

Nuclear science and technology activities performed at our main research campus, the Chalk River Laboratories, are benefiting both the Government of Canada and the broader nuclear industry. Through the Federal Nuclear Science and Technology Work Plan, AECL oversees research and scientific activities that serve the needs of fourteen federal departments and agencies in the areas of health, energy and climate change, the environment, safety and security. CNL has been leveraging the capabilities and expertise at the laboratories to grow commercial revenues, thereby positioning itself as a key player in the area of nuclear science and technology in Canada and internationally.

As part of AECL's environmental stewardship responsibilities, three projects have been proposed and are undergoing Environmental Assessments. This includes the proposal by CNL to build a near surface disposal facility at the Chalk River site that will enable better protection of the environment by moving existing low-level radioactive waste from temporary storage and other areas (including soils which have been contaminated) into an engineered facility designed to contain contaminants. Delays on all three projects have allowed for additional engagement opportunities. In addition, AECL is responsible for the Port Hope Area Initiative, which represents the Government of Canada's commitment to clean-up and safely manage historic low-level radioactive waste currently located in the municipalities of Port Hope and Clarington.

Both AECL and CNL remain committed to working with stakeholders, communities and Indigenous groups in an open, respectful and cooperative manner to foster mutual understanding, build trust and long-term relationships, and achieve our overall objective to protect the environment.

The COVID-19 pandemic which started in March of 2020 presented one of the biggest global challenges in recent memory. AECL, together with Canadian Nuclear Laboratories (CNL), responded to the pandemic through a multi-pronged approach based on proactive planning, and protection of the health, safety and security of staff and sites. At the same time, AECL and CNL rapidly refocused their broad scientific and technical expertise to contribute to the fight against COVID-19. This included joining national and international laboratories to develop a simple ventilator that could address shortages globally and contributing personal protective equipment to local health authorities. The agility of the laboratories and their ability to mount a response to a global threat demonstrated the importance of the Chalk River Laboratories and of maintaining their world-class expertise and capabilities.

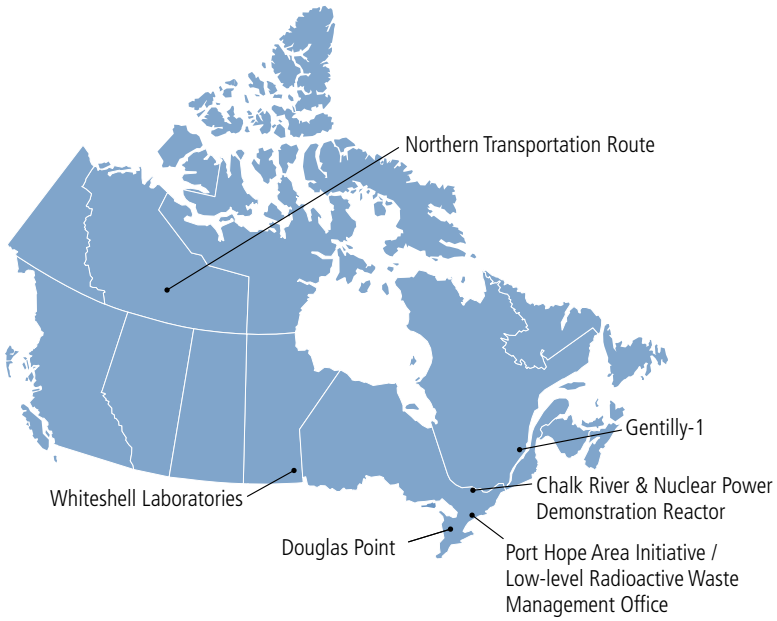
While this Corporate Plan Summary was originally prepared prior to the pandemic, it has been updated to reflect some of the impacts to activities and projects. This Plan outlines AECL's activities, objectives and plans in two main areas: environmental stewardship and nuclear science and technology. This includes work to build a world-class nuclear laboratory at Chalk River through important infrastructure investments of $1.2 billion over ten years, starting in 2016.

This 2020-21 Corporate Plan Summary presents AECL's vision for continued transformation to meet these ultimate objectives, informed by long-term plans prepared by CNL and accepted by AECL, taking into account the known impacts of COVID-19 at the time the document was prepared.

Overview

AECL is a federal Crown corporation that has a mandate to enable nuclear science and technology and to protect the environment by fulfilling the Government of Canada's radioactive waste and decommissioning responsibilities. This work, funded by the Government of Canada, is undertaken at several sites across Canada, with headquarters in Chalk River, Ontario. AECL's operating model allows it to leverage the expertise and experience of the private sector to advance work and drive priorities in two main areas:

AECL Sites Across Canada



Environmental Stewardship

The objective is to safely and responsibly address the environmental responsibilities and liabilities which have resulted from legacy activities at AECL sites. This requires the decontamination and decommissioning of redundant structures and buildings, the remediation of contaminated lands and the management and disposal of radioactive waste at AECL sites, primarily at the Chalk River Laboratories and the Whiteshell Laboratories in Manitoba. AECL is also responsible for the remediation and long-term management of sites contaminated with historic, low-level radioactive waste where the Government of Canada has accepted responsibility, most notably as part of the Port Hope Area Initiative. Responsible decommissioning and radioactive waste management is necessary in order to clean up AECL's sites, protect the environment, and make way for new buildings that will support the ongoing nuclear science and technology mission at the Chalk River site.

Nuclear Laboratories

The Chalk River Laboratories are Canada's largest science and technology complex and host to nearly 2,800 employees, including a large number of engineers, scientists and technical staff. The work undertaken at the laboratories supports Canada's federal roles, responsibilities and priorities in the areas of health, energy and climate change, the environment, safety and security. Services are also provided to industry and other third parties on a commercial basis. The Chalk River site is currently undergoing an important renewal that will transform the site into a modern, world-class nuclear science and technology campus, thanks to an investment of $1.2 billion over ten years by the federal government, beginning in 2016.

AECL receives funding from the Government of Canada and earns commercial revenues to deliver on its mandate. As a federal Crown corporation, AECL reports to Parliament through the Minister of Natural Resources. AECL's most recent Annual Report (2019-20) can be found on its website (www.aecl.ca).

AECL delivers its mandate through long-term contracts with the private sector for the management and operation of its sites. This operating model, known as a Government-owned, Contractor-operated model, is described in more detail below.

Reconciliation

As stewards of the environment, AECL recognizes that our nuclear science and research activities have created radioactive materials and waste, and we are committed to addressing this responsibly. We are dedicated to working in partnership with Indigenous communities to recognize and incorporate Traditional Knowledge, ceremony, and various cultural and stewardship practices. We have much to learn from each other as we work towards our common objective of environmental protection.

AECL is committed to collaborating with Indigenous groups in the spirit of reconciliation. As an organization, AECL is working hard to achieve this by building new relationships and strengthening existing ones, recognizing that meaningful, respectful engagement takes time.

Corporate Profile

A significant restructuring of AECL was completed in 2015 that saw the management and operation of AECL's sites move to a Government-owned, Contractor-operated model. Whereas previously AECL was directly responsible for the management and operation of its sites, today, a private-sector contractor – Canadian Nuclear Laboratories (CNL) – is responsible for the day-to-day management. AECL remains the owner of the facilities, assets, intellectual property and liabilities.

Through the restructuring, the Government of Canada confirmed AECL's mandate, namely to enable nuclear science and technology and to protect the environment by fulfilling the Government of Canada's radioactive waste and decommissioning responsibilities. AECL was also given a mandate to leverage the assets and capabilities at the Chalk River Laboratories to support industry on a commercial basis.

AECL's environmental stewardship activities are in line with the Government of Canada's goals to protect the environment. AECL-funded nuclear science and technology activities contribute to science and innovation goals, which benefit Canada's economy through the development of a highly-skilled workforce, support for industry, and technology development.

Furthermore, we are supporting efforts to meet Canada's climate change goals by funding work to help Canada's utilities to operate power reactors safely and for longer periods of time, and through our efforts to advance small modular reactors. Nuclear power is an important part of Canada's low-carbon energy production – more than 60% of Ontario's electricity and 30% in New Brunswick comes from nuclear power. Similarly, small modular reactor technologies offer a promising opportunity to bring low-carbon energy to the existing grid and to remote locations and communities.

AECL-funded activities in nuclear science and technology also support Canada's target to double research, development and demonstration funding for clean energy and clean technology research to $775 million by 2020 as part of the 23-nation Mission Innovation partnership.

Operating Model: The Government-owned, Contractor-operated Model

The *Government-owned, Contractor-operated* model allows AECL to leverage the expertise and experience of the private sector to accelerate the decommissioning and radioactive waste management program and build a world-class nuclear laboratory at Chalk River that fulfills Government requirements, while reducing costs and risks to Canada. As an agent of Government, AECL brings value to Canada by overseeing the Government-owned, Contractor-operated arrangement and supporting the Government's development of nuclear policy. Under this model, AECL can advance its priorities efficiently and effectively while ensuring that CNL meets and exceeds rigorous safety, security and environmental requirements.

A key element of AECL's role under the Government-owned, Contractor-operated model is to set priorities for CNL, and to oversee and assess its performance against the contracts in order to provide value for Canada. In other words, AECL sets out "what" needs to be achieved with CNL deciding "how" it is best executed. This is achieved by having a small organization that, staffed by experts, provides oversight of the Government-owned, Contractor-operated agreement.

On an annual basis, AECL provides strategic guidance to CNL for the development of its annual plans, which in turn are supported by, and aligned with, longer-term plans which are accepted by AECL. CNL's performance is tracked based on the activities set out in these plans, including specific project milestones and deliverables.

To systematically monitor and assess contractor performance, a performance plan is issued by AECL annually. The Plan is based on, and developed in parallel with, the annual plan. It outlines AECL's priorities for CNL and sets out areas where the contractor stands to earn fee for the management and operation of AECL's sites, as per contractual arrangements. Two specific projects, the closure of the Whiteshell Laboratories and the Nuclear Power Demonstration reactor site, are managed separately under target-cost contracts.

AECL leverages other project management and performance measurement tools to track the performance of CNL, including an Earned Value Management System (an internationally-recognized tool that allows for the simultaneous tracking of work scope, schedule and cost) and a Contractor Assurance System (a comprehensive and integrated performance assurance regime that allows for the capture of performance metrics across a wide array of work areas).

For more information on the Government-owned, Contractor-operated model visit our website www.aecl.ca.

AECL's Oversight Activities

AECL oversees all CNL activities:

- We set priorities for CNL;
- We approve their long-term plan;
- We provide guidance for, and approve their annual plan and budgets;
- We use internationally-recognized tools to track performance based on activities set out in the plans;
- We review their performance and perform audits; and
- We can reduce fee if performance is not adequate.

Internal Environment

AECL oversees an important portfolio of work. Effective management, including strong contract management, oversight capabilities and risk management is at the core of the organization's strategy to deliver results for Canada. Amongst key internal challenges and strategic issues being managed by AECL, three are notable and presented below.

Contractor performance. As AECL relies on a private-sector contractor to execute scope related to its mandate, an inherent internal risk is the inability of the contractor to consistently execute and perform based on agreed-upon plans. To mitigate this risk and drive the appropriate behavior, the contract with CNL is carefully structured to include several mechanisms for AECL to track CNL's performance, as discussed in the Operating Model section above. On an annual basis, AECL sets priorities supported by achievable stretch targets in order to drive value for money for Canada. Ongoing evaluation of the contractor throughout the year provides AECL the opportunity to highlight strengths and weaknesses and the contractor the opportunity to correct course where needed.

Costs to operate Chalk River Laboratories. The shutdown of the National Research Universal (NRU) reactor in March 2018 is creating cost pressures going forward. The combination of lost revenue from the activities of the reactor (including isotope sales) and diminishing funding for the NRU, together with site costs that have not proportionally decreased, contribute to funding pressures. As this was anticipated at the time of the restructuring of AECL, the *Government-owned, Contractor-operated* contract includes requirements for CNL to look at all options for lowering costs, increasing revenues and managing the cost pressures to mitigate this risk. This is actively being pursued and implemented with a view to enable a sustainable and science-focused organization in the long-term.

Human resources. AECL is a small organization that relies on a small complement of national and international experts who bring a range of experience in the management of similar *Government-owned, Contractor-operated* arrangement, both from a government and contractor perspective. In 2019-20, AECL had 45 employees and it is expected that employee levels will remain in the range of 40 to 45 over the planning period. AECL's goal is to maintain the necessary expertise and capabilities to oversee the *Government-owned, Contractor-operated* contract and bring value for money for Canada.

AECL is committed to supporting diversity and inclusion, from identifying discrimination, harassment or lack of opportunities, to recognizing the different perspectives that employees bring to the workplace. Women make up 44% of AECL's workforce and visible minorities 6.5%. In 2019-20 AECL established a diversity and inclusion strategy, with three over-arching goals:

- Workplace Inclusion: Promote a culture that encourages collaboration, flexibility, and fairness to enable individuals to contribute to their highest potential;
- Workplace Diversity: Attract, retain, and develop a talented and diverse workforce; and,
- Employee Capability: Enable employees' knowledge and understanding of what is meant by diversity and inclusion.

Given AECL's small size, an ongoing challenge is to adapt to fluctuating resourcing requirements across different areas of the organization and backfill those on short-term leave, where appropriate. To manage this, AECL strives to be adaptable and flexible, deploying a handful of third-party service contracts to bolster resourcing when and where required and cross-training employees when the opportunity arises. A succession plan has also been developed and is reviewed on an annual basis at a minimum. Furthermore, AECL regularly reviews its total compensation package to remain competitive amongst similar employers nationally and internationally.

External Environment

External factors such as the dynamic nature of the COVID-19 pandemic have shifted the environment in which AECL and its contractor operate. In alignment with recommended actions by the Government of Canada and public health authorities to reduce the risk to its personnel and of the surrounding communities at large, CNL reduced operations at all sites starting on March 18, 2020. Only safety-essential activities were performed, along with a skeleton science and technology crew to continue limited operation of certain facilities, support the safety-critical requirements of customers (particularly the nuclear facility operators), contribute to COVID-19 scientific response, and to support safety and emergency capabilities at our sites.

It is expected that workers will slowly be transitioning back to work through a phased approach based on guidance provided by federal, provincial and local health authorities. So far, beyond delays in physical work, there have been significant disruptions to the supply chain, sales/revenue and certain regulatory processes. Moreover, the COVID-19 countermeasures and adapted work process that remain in effect, including physical distancing and use of personal protective equipment, have reduced the efficiency of some work. This is expected to have a cumulative effect well beyond the current fiscal year. The full consequences of these disruptions are not yet known. Overall, the impact of these disruptions has been reflected to the extent possible in this document.

Environmental Stewardship

As part of AECL's environmental stewardship responsibilities, three projects are currently undergoing Environmental Assessments through the Canadian Nuclear Safety Commission:

- Construction of a near surface disposal facility at the Chalk River Laboratories.
- In-situ decommissioning of the WR-1 research reactor at the Whiteshell site.
- In-situ decommissioning of the Nuclear Power Demonstration facility in Rolphton, Ontario.

AECL and CNL are dedicated to engaging stakeholders, the public and Indigenous communities early and often, and throughout the regulatory process. Project timelines have been extended to ensure all comments and concerns are considered; to accommodate additional scientific and technical studies requested by the Canadian Nuclear Safety Commission; and to adjust aspects of the project, where possible, based on public, Indigenous, government and regulatory feedback. While planning activities could continue, the COVID-19 pandemic has affected CNL's ability to engage stakeholders and Indigenous groups.

Small Modular Reactors: CNL is pursuing opportunities related to small modular reactors, which are nuclear reactors designed to be built at a smaller size but in larger numbers than most of the world's current nuclear fleet. As part of its long-term vision, CNL seeks to become an incubator for small modular reactor demonstration by the private sector and for supporting associated research and development. To that end, CNL's goal is to have a demonstration unit built by third parties at an AECL site by 2026. The objective is to advance SMR technologies in Canada in order to contribute to Canada's broader economic growth, competitiveness, science, innovation, sovereignty, and climate change objectives.

In Canada, small modular reactors have the potential for three major areas of application:

- On-grid power generation, especially in provinces phasing out coal. Utilities want to replace end- of-life coal plants with non-emitting base-load nuclear plants of similar size.
- On- and off-grid combined heat and power for heavy industry. Oil sands producers and remote mines have expressed interest in medium-term options for bulk heat and power that would be more reliable and cleaner than current energy sources.
- Off-grid power, district heating, and desalination in remote communities. These currently rely almost exclusively on diesel fuel, which has various limitations (e.g., cost, emissions). Renewables and batteries can mitigate these limitations to some extent for residential power, but may not supply building heat, nor are they likely to offer reliable bulk energy to support economic development. Very small modular reactors have potential to catalyze development in the North, contributing to national sovereignty, energy security and the economy.

The opportunity related to small modular reactors is noteworthy given Canada's expertise in nuclear technology, including its existing supply chain and potential markets. Economic benefits for Canada derived from small modular reactor development and deployment include an estimated 6,000 new jobs (direct and indirect) supporting a highly skilled labour force and an estimated $10 billion in direct impacts and $9 billion in annual indirect impacts between 2030 and 2040.[1] There is also significant export potential for technology and services related to this industry should Canada be at the forefront, including an estimated total global export potential of approximately $150 billion per year between 2030 and 2040.[2]

[1] *A Call to Action: A Canadian Roadmap for Small Modular Reactors*. Small modular reactor roadmap steering committee, November 2018. Available online at smrroadmap.ca.

[2] Ibid

These activities are responsive to the small modular reactor roadmap, which specifically recommended that "Governments, utilities, industry, and the national laboratory support demonstration of small modular reactor technologies, preferably more than one, at appropriate sites in Canada." Also, AECL and CNL are responding to all four recommendations specific to AECL and CNL, including doing preliminary site identification work, undertaking small modular reactor research and development, continuing the invitation process and collaborating with international partners on small modular reactors.

New Area of Cancer Research

CNL is leveraging its world-class expertise in medical isotope production to advance the development of targeted alpha therapy – a next-generation cancer treatment. To date, CNL has developed a generator to produce actinium-225 from its available nuclear materials and has used this in pre-clinical trials to demonstrate the efficacy of the proposed therapy. Based on the promising results, CNL is exploring opportunities to partner with others in the production of actinium-225 on a scale that could support clinical trials and more widespread use in treatment across Canada and internationally.

Funding Requirements

Federal funding for the next five years is required to achieve the objectives presented in this Corporate Plan Summary. The following sections of the Corporate Plan Summary provide more information on work planned for environmental stewardship and the nuclear laboratories.

Total AECL Five-Year Projection of Federal Funding Requirements

			Plan					
(millions of Canadian dollars)	**Actual 2018-19**	**Budget 2019-20**	**2020-21**	**2021-22**	**2022-23**	**2023-24**	**2024-25**	**5 Year Total**
Funding Requirements								
Environmental Stewardship	528	589	660	808	819	355	384	3,026
Nuclear Laboratories – Operating	227	167	236	229	203	182	249	1,099
Nuclear Laboratories – Capital	71	110	113	152	195	123	40	622
Federal Funding Requirements AECL	**826**	**866**	**1,009**	**1,189**	**1,216**	**660**	**673**	**4,746**

AECL's detailed financial performance information and annual report can be found on our website https://www.aecl.ca/reports-resources/.

AECL's objectives under the Government-owned, Contractor-operated model include accelerating decommissioning, site remediation and waste management activities to protect the environment and build a world-class nuclear laboratory that fulfills government requirements and grows commercial revenues while reducing or containing costs and risks to Canada.

Objectives and Plans – Nuclear Laboratories

AECL has been leading nuclear science and technology for over six decades. The organization was the birthplace of Canada's nuclear industry, having hosted the first sustained criticality (controlled nuclear chain reaction) outside of the United States. More importantly, the Chalk River Laboratories were the birthplace of the CANDU reactor technology developed and commercialized by AECL's former CANDU Reactor Division, a technology that today is used at 19 reactors in Canada and 30 (CANDU or CANDU-derivatives) internationally. It also provided the research and facilities for breakthroughs in the life saving application of medical isotopes, including cobalt-60. Work undertaken at the Chalk River Laboratories has led to numerous and important scientific achievements – including two Nobel Prize winners.

Over the years, AECL has played an important role in supporting public policy and in delivering programs for the Government of Canada. This includes the production of medical isotopes and the provision of nuclear science and technology in the areas of energy, non-proliferation, emergency preparedness, counterterrorism, health, and security. AECL's unique facilities have made it an attractive research destination for scientists across Canada and the world, leading to home-grown innovation and the development and retention of highly qualified nuclear workers and scientists.

The restructuring of AECL and the implementation of the Government-owned, Contractor-operated model have brought new opportunities for building on this important scientific legacy. AECL's mandate has been clearly defined by Government to leverage the capabilities at the Chalk River Laboratories to support the federal government's needs and responsibilities in the area of nuclear science and technology, as well as to provide services to third-parties on a commercial basis. This has been further enabled by an investment of $1.2 billion for new and renewed science and site support infrastructure at the Chalk River Laboratories, with the objective of building a world-class, state-of-the-art nuclear science and technology campus.

Through the Government-owned, Contractor-operated model, AECL's objective is to leverage the vast experience and expertise at the Chalk River Laboratories to contribute to the Government's science, innovation and clean energy objectives. Nuclear science and technology activities at the Chalk River Laboratories support the Federal Nuclear Science and Technology Work Plan, which helps the Government of Canada deliver on its responsibilities in the areas of health, nuclear safety and security, energy and the environment.

To sustain and grow the expertise and capabilities at Chalk River, AECL has asked CNL to make technical services and research and development products available to third parties on a commercial basis.

AECL's planned results in this area include servicing the nuclear science and technology needs of federal departments and agencies and advancing nuclear knowledge, innovation, job creation, and the use of clean technologies. AECL is focused on increasing collaboration and partnership with other nuclear industry members, academia and other national laboratories. As well, the advancement of nuclear technologies for the benefit of Canadians and the growth of commercial business opportunities remain a top priority.

CNL has developed a 10-year plan outlining its strategic approach to delivering an integrated, effective, project-based and customer-focused science and technology mission that serves the needs of the federal government and other customers. Based on an assessment of existing capabilities, the external environment and market opportunities, CNL has identified eight strategic initiatives that will help the federal government and third-party customers tap into new and expanded markets:

- **Long-term reliability of existing reactors:** Support for Canada's fleet of existing reactors through work on life extension and long-term reliability of the existing fleet of CANDU reactors domestically and internationally, and expansion to include support for other reactor designs. CNL is in the process of transforming from a historical CANDU focus to a broader "CANDU and more" perspective and building on capabilities in advanced nuclear materials and fuels research and nuclear chemistry applications.
- **Small modular reactors:** CNL's goal is to demonstrate the commercial viability of the small modular reactor by 2026 with a view to positioning Canada to take a leadership role in this emerging nuclear technology with CNL recognized globally as a leader in small modular reactor prototype testing and science and technology support. The objective is for Canada and CNL to best leverage that position to provide low-carbon, reliable, load- following, scalable and cost-effective energy options to remote communities, mining and oil and gas applications.
- **Advanced fuel fabrication:** Development of advanced nuclear fuel concepts in order to support the long-term reliability of existing reactors and the development of advanced reactors. These advanced fuels offer higher performance, improved failure tolerance, increased safety, proliferation resistance and accident tolerance, and are recycled or recyclable. As new methods are required to fabricate these fuels, CNL is reviewing the go forward strategy on advanced fuels to align with emerging markets in small modular reactors.

Conceptual image: Third Way

Small Modular Reactors

Small Modular Reactors are small reactors aimed at new markets, tackling a critical and time sensitive global need for safe, clean, economic energy. In Canada, this could mean vital, new clean energy options for replacing coal, greening resource extraction and improving energy security for remote communities. Canada is at the forefront of the small modular reactor industry thanks to the release of a roadmap and action plan convened by the Government and CNL's work to site a demonstration reactor at an AECL site by 2026. This small modular reactor program is attracting significant attention worldwide as evidenced by the strong response to CNL's process to invite applications. Currently, three respondents have successfully completed the pre-qualification stage, and one has further progressed in the process, including submitting an application for a licence to prepare a site, which would make it Canada's first small modular reactor.

(image courtesy of Third Way)

- **Decarbonizing the transportation sector:** Building on capabilities developed to support hydrogen safety and heavy water and tritium management in CANDU reactors, and leveraging recent capital investment in modern hydrogen laboratories, CNL's goal is to play a leading role in the demonstration of hydrogen-based bulk transport. As hydrogen technologies have matured, costs have dropped to the point that hydrogen solutions are financially competitive with similar energy conversion technologies. Hydrogen technology offers low-carbon options for the energy and transportation sectors, which supports Canada's international commitments for carbon reduction.
- **Nuclear cyber security:** Cyber security of industrial control systems is a growing concern in all industries, and particularly in the nuclear industry where it represents a multibillion-dollar worldwide market. While a large commercial industry caters to the cyber security of information technology systems, most solution providers are focused on conventional hacking and data theft. The cyber security of industrial control systems used in nuclear power plants and other critical energy infrastructure, as well as non-nuclear process plants, is a priority in the new era of modernization. CNL has already commissioned a nuclear cyber security test facility located in New Brunswick, and is now working to develop, commercialize and deploy a nuclear industrial control cyber intrusion detection and mitigation system by 2022. This remains on track despite COVID-19, with work ongoing to involve industrial partners.
- **Nuclear forensics, detection and response:** The need for science and technology activities in nuclear security continues to grow in Canada, as evidenced by the Government's renewed commitments to nuclear threat reduction, both domestically and abroad. There is a growing demand from government departments and agencies for nuclear science and technology expertise to inform their response to emergent national and international issues concerning nuclear safeguards, safety and security. CNL is working to establish a centre for government agencies and commercial partners to develop, test, calibrate and validate nuclear forensics, non-proliferation, security and response technologies and materials. Furthermore, CNL is supporting work to improve safeguards and security at Canadian borders by developing essential tools to detect contraband nuclear materials.

Targeted Alpha Therapies

While current forms of radiation treatments affect many cells in the body, both healthy and cancerous, targeted alpha therapy is significantly more focused and delivers the radiation directly to the cancerous cells by chemically binding appropriate radionuclides with targeting biomolecules. This is both more effective in killing cancer cells as well as protecting healthy cells. A radionuclide with significant potential in this therapy is Actinium-225 but is extremely rare and difficult to produce. CNL first demonstrated research quantity production of Actinium-225 through the Federal Nuclear Science and Technology Work Plan. Subsequently, and in partnership with TRIUMF (Canada's particle accelerator centre) the first production run of Actinium- 225 has recently been completed. The objective is to demonstrate commercial viability in order to support this important and exciting healthcare research and treatment going forward.

- **Targeted alpha therapy research:** Targeted alpha therapy is a new area of research in the battle against cancer and other diseases. The benefit of this therapy is that the radiation is targeted at just the cancer cell, unlike existing treatments that often involve radiation of all cells in the vicinity of a tumor, healthy and cancerous. There is currently an international shortage of key nuclides for this research. The result is severely restricted research in this area, which delays and puts at risk the availability of effective treatment technology. CNL aims to become the centre of international research efforts and a key supplier for these alpha-emitting isotopes by applying its expertise in isotope separation, scaling up of processing and handling radionuclides. Strategic partnerships are being pursued with the academic and commercial sectors to leverage CNL's radiobiology, animal studies and isotope separation capabilities and grow revenues in the pharmaceutical market. CNL's goal is to develop and complete early demonstration of a suite of targeted alpha therapy compounds by 2022. This remains on schedule despite COVID-19.
- **Decommissioning and waste research and development:** CNL is working to expand the understanding of the behavior of contaminant radionuclides, and further develop safe, economical nuclear waste management technologies. The environmental technology capability will also continue to support the Government in monitoring for the presence and potential of low levels of contamination.

The scope for activities relating to nuclear laboratories is set out below.

Nuclear Laboratories Five-Year Projection of Funding Requirements

			Plan					
(millions of Canadian dollars)	**Actual 2018-19**	**Budget 2019-20**	**2020-21**	**2021-22**	**2022-23**	**2023-24**	**2024-25**	**5 Year Total**
Nuclear Laboratories								
Nuclear Laboratories - Operating	312	236	287	298	273	258	330	1,445
Revenue	85	69	51	69	70	76	80	346
Capital	71	110	113	152	195	123	40	622
Federal Funding Requirement	**298**	**277**	**349**	**380**	**397**	**305**	**289**	**1,720**

Science & Technology

Federal Nuclear Science and Technology Work Plan

Overview: AECL oversees the delivery of the Federal Nuclear Science and Technology Work Plan for nuclear research and development to support the Government's priorities and core responsibilities in the areas of health, nuclear safety and security, energy, and the environment. The Federal Nuclear Science and Technology Work Plan serves to build, maintain and maximize those capabilities that are unique to CNL. AECL engages with fourteen federal departments and agencies to develop a program of work that meets broad federal needs and priorities and fosters innovation through the development of technologies and applications, while supporting Canada's international partnerships, commitments, and obligations.

AECL's Federal Nuclear Science and Technology Work Plan focuses on four research themes:

1) **Supporting the development of biological applications and understanding the implications of radiation on living things.** This includes:
   - Improving the understanding of radiological health risks caused by exposure to radiation at levels found in occupational and public environments.
   - Contributing to the body of evidence that informs the international radiation protection framework (e.g., United Nations Scientific Committee on the Effects of Atomic Radiation, International Commission on Radiological Protection, International Atomic Energy Agency).
   - Collecting or generating evidence to inform the application of international recommendations in Canada and incorporation into Canadian regulations and national guidance.
   - Increasing knowledge of the uncertainties in low-dose risk assessment to address challenges in regulatory policy, health assessment and public communication.
   - Quantifying radiation health risks.

2) **Enhancing national and global security, nuclear preparedness and emergency response.** This includes:
   - Developing exercises and response for cyber security industrial control systems.
   - Developing novel techniques and methodologies for nuclear forensics to support federal agencies in their effort to establish and advance the national nuclear forensics capability.
   - Ensuring that Canada is ready to respond in an event of a radiological, nuclear and mix-threats emergency, in Canada or abroad.

3) **Supporting safe, secure and responsible use and development of nuclear technologies.** This includes:
   - Implementing the Pan-Canadian Framework and help achieve Canada's international greenhouse gas targets by reducing the environmental impacts of energy production, bringing clean electricity onto the grid, reducing industrial emissions, and reducing diesel use in remote communities.
   - Increasing competitiveness and promoting the use of clean technology—including in Canada's natural resource sectors—through research, development, and demonstration of innovative nuclear energy technologies.
   - Supporting the Government of Canada's small modular reactors initiatives.
   - Delivering on Canada's commitment under Mission Innovation to advance clean energy research, development, and demonstration while encouraging private sector investment and increasing domestic and international partnerships.
   - Informing potential programs, regulations, and policies for new nuclear energy technologies.

4) **Supporting environmental stewardship and radioactive waste management.** This includes:
   - Supporting Canada's national and international leadership to reduce environmental impact of nuclear energy.
   - Enabling Canada's environmental stewardship by ensuring that nuclear energy is developed within a robust framework that addresses environmental and waste management concerns.
   - Developing and demonstrating innovative technologies to reduce environmental impacts, increase competitiveness, and promote the use of clean technology including in Canada's natural resource sectors.

AECL's Federal Nuclear Science and Technology work plan includes the participation of:

1. Canada Border Services Agency
2. Canadian Nuclear Safety Commission
3. Canadian Space Agency
4. Communications Security Establishment
5. Defense Research and Development Canada
6. Department of National Defence
7. Environment and Climate Change Canada
8. Global Affairs Canada
9. Health Canada
10. Innovation, Science and Economic Development
11. Natural Resources Canada
12. National Research Council of Canada
13. Public Safety Canada
14. Royal Canadian Mounted Police

Status: In 2019-20, the federal interdepartmental committees, representing fourteen departments and agencies, continued to work with CNL on developing a program of work that addresses the medium and long-term Government priorities in the areas of climate change and a clean environment, innovation for economic growth and prosperity, and the health, safety and security of Canadians. This includes work to:

- demonstrate the production of hydrogen without greenhouse gas emissions using a copper-chlorine (Cu-Cl) thermochemical cycle. This work contributes to the Generation IV Forum and CNL's work on hydrogen to decarbonize the transportation sector;
- advance small modular reactor technologies and deployment for Canada in order to inform regulatory guidance, assessments and policies such as experimental validation of predictive models to support safety analysis and licensing and the development of sensor monitoring of remote and underground structures;
- support regulatory and licensing decisions for projects to understand the behavior of materials in advanced reactors, small modular reactors and the current fleet in extreme environments and the effects of aging, corrosion and degradation of in-core materials such as concrete and cables;
- examine the potential for small modular reactors to meet the needs of a near-zero carbon remote mining operation;
- develop improved biodosimetry techniques for rapid triage in emergency response which can reduce dose triage estimations from up to three days to one day;
- develop a thorium generator to produce research quantities of Actinium-225 in support of new medical applications for cancer treatments;
- understand the effects of gamma radiation and its effects on cancer;
- advance technologies for the detection of special nuclear materials at the border;
- reduce uncertainties in low-dose risk assessment to address challenges in regulatory policy, health assessment and public communication through scientific studies;
- improve the understanding of environmental impacts and waste of SMR operations in support of the Pan-Canadian SMR Roadmap activities;
- host an international exercise to test cyber security resilience for nuclear power plants in a full- scale cyber physical simulation of the control and safety systems; and,
- support Canada's interests, commitments and arrangements in non-proliferation, counter- terrorism and disarmament priorities such as the International Partnership for Nuclear Disarmament Verification and the Comprehensive Nuclear Test Ban Treaty Organization though international engagements and technology demonstrations at the Chalk River site.

Work in 2020-21 and over the planning period is consistent with and responsive to AECL's priorities and those of the Government of Canada, including commitments through the Pan-Canadian Framework on Clean Growth and Climate Change, Mission Innovation, the Clean Energy Ministerial and NICE Future Initiatives. On the international front, priorities include strengthening Canada's bilateral partnerships on nuclear science and technology with countries such as the United States and the United Kingdom, as well as multilateral partnerships including the Nuclear Energy Agency, the International Atomic Energy Agency, the Generation IV International Forum, the Fissile Material Cut-off Treaty, the Comprehensive Nuclear Test Ban Treaty, and the International Partnership for Nuclear Disarmament Verification.

As in previous years, the measures of success are related to meeting federal priorities through delivering on milestones and targets set out in CNL's annual plan.

To minimize the impact of reduced operations due to COVID-19, CNL has shifted and prioritized work that could be carried out remotely while most laboratory (experiment and field) work was suspended. This reprioritization of work allowed CNL to respond to immediate government needs for COVID-19, including activities to support vaccine development, ventilator design, risk-based modelling, scenario planning, and technology development such as material sterilization equipment.

Planning for new projects starting in the 2021-22 fiscal year continued as scheduled with all interdepartmental committee meetings held virtually. Leveraging the governance of the Federal Nuclear Science and Technology Work Plan, CNL continues to actively engage fourteen departments and agencies to look for opportunities where CNL capabilities and expertise could be used to help government respond to COVID-19 and future pandemics.

TARGETS		
Short-term 1-2 years	Medium-term 3-4 years	Long-term 5+ years
Research projects as set out in the Federal Nuclear Science and Technology Work Plan are delivered on time and with high quality, as per milestones and targets included in CNL's annual plan.	Project objectives identified are met and the results are disseminated with uptake from the stakeholders.	Canada's position as a global player in areas of security, health, energy and nuclear regulation is supported. Highly-qualified personnel for the next generation of nuclear workers and scientists are developed. Unique technical knowledge and understanding is advanced to support nuclear policy and regulation; and Canada's ability to actively and effectively participate in international fora, and to meet international obligations with respect to energy technology, safety, security and nonproliferation is maintained.

CNL as a Federal Laboratory

Overview: In addition to work for federal departments and agencies under the Federal Nuclear Science and Technology Work Plan, CNL provides services and access to its unique expertise and facilities on a commercial basis. These capabilities are also made available to international agencies such as the International Atomic Energy Agency and the Nuclear Energy Agency.

Status: In 2019-20, CNL continued to work with various Government departments and agencies on nuclear research in safety and security.

In 2020-21, CNL will continue to further develop science and technology roadmaps for the radio-nuclear and biological threat areas. It should be noted that due to COVID-19, most experimental work was suspended early in March 2020. A comprehensive review and prioritization of work was done to identify that which can be done remotely.

TARGETS		
Short-term 1-2 years	Medium-term 3-4 years	Long-term 5+ years
Between 3 and 5 collaborative agreements, memoranda of understanding or other agreements with organizations are being proposed and developed.	Between 3 and 5 collaborative agreements, memoranda of understanding or other agreements with organizations are signed.	Nuclear science and technology activities are leveraged to increase collaboration in support of federal roles and needs, for the benefit of Canadians.

New Technology Initiative Fund

Overview: The New Technology Initiatives Fund allows CNL to undertake science and technology activities to build expertise and capability at the Chalk River Laboratories, with a long-term view to attracting and retaining world-class expertise and building skills and knowledge for future or emerging opportunities. Consistent with similar programs at national laboratories around the world, this fund supports work that may be at very early stages, peripheral to current research priorities, high risk, or exploratory.The New Technology Initiatives Fund is expected to promote innovative thinking, reward initiative, balance near-term priorities with long-term vision, and improve employee engagement.

Status: Projects underway in 2019-20 to support CNL's Strategic Initiatives in its four program areas are expected to continue into 2020-21:

- Developing novel testing and analysis techniques to enhance capabilities to analyze hydrogen ingress and corrosion of zirconium alloys, which can benefit the nuclear industry.
- Completing the qualification of additive manufacturing of reactor components and materials.
- Completing the characterization of boron nanotube composite materials for radiation protection in space.
- Completing the development of a CNL database of irradiated materials and artefacts.
- Completing the implementation of new test equipment to stand-up the capabilities of the centre for reactor sustainability.

Due to COVID-19, CNL shifted and prioritized remote work to minimize the impacts of reduced operations to the New Technology Initiative Fund. Experimental and field work was suspended and the risk to project schedules will depend on the availability of facilities and resources as operations resume.

TARGETS		
Short-term 1-2 years	Medium-term 3-4 years	Long-term 5+ years
Expertise and capabilities are maintained and enhanced.	Expertise and capabilities are maintained and developed.	World-class expertise, new capabilities, and building skills and knowledge are developed for future or emerging opportunities.

Science and technology for commercial purposes

Overview: CNL continues to provide commercial services to third parties and to build a strong, vibrant and sustainable nuclear science and technology mission.

Status: Building on previous years' efforts, CNL continued to engage with and respond to existing customers' requests and explore new markets. Going forward, CNL will continue to expand commercial opportunities based on identified strategic directions and opportunities, with growth expected in the areas of light water and small modular reactors.

Commercial opportunities in science and technology service to federal and industry customers continue to be pursued in the areas of health, safety and security, energy, and environment – with energy being the single largest area of current work and the largest growth area. Work for industry customers included energy-related services to the CANDU Owners Group and major utility companies.

Anticipated work for 2020-21 includes:

- Materials, chemistry and corrosion testing on irradiated and unirradiated materials for CANDU facilities.
- Post irradiation examination of light-water reactor fuel, including non-destructive and destructive examination of advanced fuel assembly designs and investigations into fuel cladding corrosion.
- Support for domestic SLOWPOKE reactors, including refueling activities and decommissioning.
- Production and supply of radionuclides for purposes of target alpha therapy in the battle against cancer and other diseases. This is in alignment with efforts to become an internationally recognized centre of excellence in this domain. CNL can apply existing expertise in isotope separation, scaling up of processing and handling radionuclides. Strategic partnerships are being pursued to grow revenues in the pharmaceutical market. CNL's goal is to develop and complete early demonstration of a suite of targeted alpha therapy compounds by 2022.
- Commercial opportunities related to environmental remediation. CNL has significant and unique expertise in this area and consideration is being given to leveraging these skills commercially for domestic and international purposes.
- Early commercial opportunities related to small modular reactors. In particular, CNL has pursued opportunities in areas such as fuel development and materials corrosion, where CNL has existing expertise and competitive advantage to participate in the emerging global market.

The COVID-19 pandemic has so far affected clients and services across the board in this area, with the exception of select essential work which was carried out as planned. Going forward, COVID-19 is anticipated to significantly and disproportionately affect new business lines due to continued limitations on in-person meetings, conferences and other relationship-building opportunities.

TARGETS		
Short-term 1-2 years	Medium-term 3-4 years	Long-term 5+ years
Revenues are more than $48.3M.	3%-5% growth year-over year.	2%-3% growth year-over year.

National Research Universal Reactor

Overview: After 60 years of operation, the National Research Universal reactor was shut down in March 2018. Designed in the early 1950's, the low-temperature, low pressure, research reactor enabled great advances across a wide variety of globally important industrial sectors. The National Research Universal reactor was used to prove out many concepts which later appeared in the CANDU reactor. It spawned a global medical radioisotope industry and provided the neutron source to conduct research across a wide spectrum of sciences, both applied and basic.

Leading up to March 2018, the use of the National Research Universal reactor was maximized for a variety of science and technology activities and the production of isotopes other than molybdenum-99.

Status: Activities in 2019-20 continued to focus on implementing the safe shutdown of the reactor. With the reactor core defueled and dewatered the orderly shutdown of the support systems began and progressed on schedule. By 2021, the reactor and 30 ancillary buildings will be placed into storage with surveillance awaiting final decommissioning with the balance of NRU operations relating to the ongoing need for the rod bays in the short-term. The reactor fuel will subsequently be transferred to dry storage and the rod bays (the large pools which were used to store the fuel after it was taken out of the reactor) will be drained and processed. To date the shutdown plan has progressed to schedule.

The shutdown of the National Research Universal reactor has significant impacts on the CNL workforce. CNL has been working over the past few years to retrain and redeploy its staff in order to retain talent and expertise where possible.

TARGETS		
Short-term 1-2 years	Medium-term 3-4 years	Long-term 5+ years
Safe shutdown activities are completed and the NRU reactor facility and associated buildings are ready to be turned over to the Facilities Decommissioning group at CNL.	Continue to progress storage with surveillance activities.	Continue to progress storage with surveillance activities.

Revitalization of the Chalk River Laboratories

CNL's long-term plans for targeted and strategic capital investments will allow the laboratories to grow the unique complement of science and technology capabilities, while remaining flexible to quickly adapt to the evolutionary opportunities of nuclear and energy-related, leading edge innovation. These investments will contribute to an efficient and cost-effective campus, replacing aged facilities and infrastructure that are costly to operate and maintain.

As part of AECL's role in overseeing CNL's activities for the management and operations of our sites, a clear focus is placed on the ongoing, safe operations of the nuclear laboratories and decommissioning sites. Above and beyond the role of Canadian Nuclear Safety Commission, which as a regulator ensures that all nuclear activities in Canada are delivered safely, AECL expects high levels of performance from CNL in the areas of health, safety, security and environmental protection.

AECL has also asked CNL to transform its operations to increase value for money and reduce costs and risks to Canada. The overall objective is to have in place a cost-effective, modern campus-like site with new and refurbished facilities to support the future growth of CNL. Any capital investments at AECL sites will take into consideration best practices with respect to sustainability and green building standards, with due consideration for cost, schedule and feasibility. Details on capital plans are provided in Annex 2.

TARGETS		
Short-term 1-2 years	Medium-term 3-4 years	Long-term 5+ years
Completion and commissioning of the new non-nuclear facilities.	Construction started on the new Advanced Nuclear Material Research Centre.	Construction and commissioning complete for Advanced Nuclear Material Research Centre.
Stability in health, safety, security and environmental industry-standard metrics against industry standard benchmarks.	Continued improvement in health, safety, security and environmental metrics.	
Implementation of actions to achieve CNL's objectives to manage operating costs while maintaining safety and the protection of the environment, with a view to ensuring a sustainable and science-focused organization in the long-term.	Continued achievement of industry best practices for the management of all of AECL's sites and the Chalk River Laboratories.	

Other Areas of Focus

Heavy water

AECL currently owns heavy water assets which can be used either in a CANDU reactor or for non-nuclear purposes. Activities associated with this are limited to managing and selling the existing inventory. Through the Government-owned, Contractor-operated model, CNL acts as an agent for AECL for the marketing, sale and distribution of AECL's heavy water inventory. CNL also manages AECL's inventory of heavy water at AECL's facility in Laprade, Quebec. CNL is also examining how to treat inventories of heavy water that have small amounts of tritium and other contaminants, such that it could also be sold.

In 2020-21 and onwards, AECL will be looking to CNL to continue its work to optimize the management and sales of heavy water.

Wrap-Up Office (retained liabilities from former CANDU Reactor Division)

These activities relate to legal matters related to AECL's former CANDU Reactor Division, the assets of which were sold to Candu Energy Inc. in 2011. The few remaining claims and litigations that comprise the business of the Wrap-up Office are being managed by AECL's legal team, supported by external counsel. This includes the commercial and legal work required to defend, assert and settle outstanding claims.

Objectives and Plans – Environmental Stewardship

AECL's objective is to protect the environment by advancing key decommissioning, remediation, and waste management projects to address risks and hazards.

AECL has been conducting nuclear science and technology activities for decades. While these activities have had important benefits for Canada and Canadians – for example the production of medical isotopes used in the detection and treatment of cancer – they also produced radioactive waste. AECL has various types of radioactive waste at its sites, including high-level waste (which includes used fuel), intermediate-level waste and low-level waste. Several sites and/or buildings have also been contaminated as a result of nuclear science and technology activities and past waste management practices. These now need to be decontaminated and demolished, sites cleaned up and remediated, and the radioactive waste managed properly and safely.

AECL is also responsible for fulfilling Canada's responsibilities with respect to historic low-level waste at sites where the original owner no longer exists, or another party cannot be held liable and for which the Government has accepted responsibility. This includes the cleanup and safe long-term management of historic, low-level radioactive waste in the municipalities of Port Hope and Clarington in Ontario, pursuant to an agreement between Canada and the municipalities. This project is one of the largest and most complex environmental projects in Canada.

With the implementation of the Government-owned, Contractor-operated model, AECL was given a mandate to accelerate these activities to reduce risks and costs for Canada in a safe manner, consistent with international leading practices. Specifically, AECL has asked CNL to propose long-term radioactive waste disposal solutions and to advance other decommissioning activities to reduce its environmental liabilities.

This work is well underway, with significant progress having been made at the Chalk River Laboratories where more than ninety (90) old and outdated buildings and facilities have been demolished. This not only reduces AECL's environmental liabilities and overall site maintenance costs, but it also paves the way for new facilities to be constructed as part of the site's revitalization.

AECL's planned results under Environmental Stewardship include working safely to reduce environmental risks and hazards in the short-term, working towards environmental remediation and closure of four nuclear sites, and ultimately protecting Canadians and the environment through decommissioning and waste management activities.

Activities in Environmental Stewardship are focused into the areas set out below.

Environmental Stewardship Five-Year Projection of Funding Requirements

				Plan					
(millions of Canadian dollars)	**Notes**	**Actual 2018-19**	**Budget 2019-20**	**2020-21**	**2021-22**	**2022-23**	**2023-24**	**2024-25**	**5 Year Total**
Environmental Stewardship									
Total Environmental Stewardship		529	591	662	810	821	358	387	3,038
Revenue	1	1	2	2	2	2	3	3	12
Federal Funding Requirement		**528**	**589**	**660**	**808**	**819**	**355**	**384**	**3,026**

1 Assumed Third Party Waste Costs and offsetting Revenue of $2-3 million are equal each year.

Remediation, Decommissioning and Radioactive Waste Management at the Chalk River Laboratories

Activities in this area include all waste and decommissioning activities to address AECL's environmental, decommissioning and waste management responsibilities at its Chalk River Laboratories.

Activities in this area include:

Waste management and disposal at the Chalk River site

Overview: Existing radioactive waste is safely stored at the Chalk River site. However, long-term management and disposal solutions must be developed for various types of wastes to allow for the remediation of contaminated buildings, lands and soils and to move away from continuous temporary storage. As such, CNL has proposed to build a near surface disposal facility for the disposal of AECL's low-level radioactive waste, as well as small amounts of waste from other Canadian producers such as hospitals and universities. Near surface disposal is an internationally proven method of disposing of such wastes. The facility would allow for the disposal of the vast majority of AECL wastes currently in interim storage, as well as waste which will be generated as a result of contaminated land remediation activities, decommissioning activities and continued operations of the nuclear laboratories. As noted above, this project is critical to advance decommissioning and remediation activities at AECL sites, and to further protect the environment.

With respect to AECL's intermediate-level waste, CNL will continue to explore options over the planning period; plans for stakeholder and Indigenous engagement on this will also be developed. Of note, AECL's high-level waste (used fuel) is destined to be disposed of in the proposed repository that is currently being explored by the Nuclear Waste Management Organization. Projects to manage used fuel are discussed in more detail in the section on *Management of used fuel and repatriation of highly-enriched uranium* below.

CNL also manages AECL's inventory of highly radioactive stored liquid waste which is a byproduct of medical isotope production. A project is in place to safely remove and process the legacy radioactive liquid wastes from existing tanks at the Chalk River site and to decommission the tanks and associated structures.

Until disposal solutions are approved and available, CNL will continue to manage existing radioactive waste inventories at dedicated waste management facilities at the Chalk River site in a manner that is safe and minimizes the impacts on the environment.

Status: CNL has been working with the regulator, Canadian Nuclear Safety Commission (CNSC), and meeting with stakeholders, Indigenous groups and local communities to discuss the proposed near surface disposal facility since 2016. In 2017, CNL submitted a draft Environmental Impact Statement and subsequently responded to comments from both federal and provincial regulators and organizations.

Higher-than-anticipated public and Indigenous engagement, as well as a request from the Canadian Nuclear Safety Commission to provide additional technical studies have led to delays in the project of almost three years.

In the 2019-20 fiscal year, the Environmental Impact Statement documents for the near surface disposal facility were advanced and submitted to the regulator. CNL is working with the regulator to establish a public hearing date. Engagement with stakeholders and Indigenous groups will continue as the project progresses.

The COVID-19 pandemic has led to some delays in projects, including in stakeholder and Indigenous engagement. With respect to the management of stored liquid wastes, field work was halted due to reduced operations.

TARGETS		
Short-term 1-2 years	Medium-term 3-4 years	Long-term 5+ years
Implement characterization and certification processes for NSDF destined wastes.	Develop a program for radioactive waste that does not currently have a disposition route (where there are no plans for disposal).	Determine the disposal path for intermediate level waste. Explore options and engage with appropriate Indigenous communities and stakeholders regarding clean-up criteria for certain areas that need to be remediated at the Chalk River site.
The Chalk River site is ready to receive low-level radioactive waste from the Whiteshell site for storage and/or disposal. Ready to receive intermediate-level radioactive waste from the Whiteshell site for storage.	Radioactive waste continues to be safely stored and/or is disposed of while protecting the environment.	
Near Surface Disposal Facility: regulatory approval received to begin construction	First waste emplacement at the Near Surface Disposal Facility.	

Environmental restoration at the Chalk River site

Overview: For more than 60 years, nuclear science and technology activities at the Chalk River site have led to the production of a variety of radioactive and other hazardous wastes. These wastes are carefully managed in dedicated areas, otherwise known as waste management areas. While most of the Chalk River site remains undisturbed, certain areas, including the waste management areas have contaminated soil and waste requiring retrieval and processing to allow for final disposal. As there remains a significant amount of buried waste, soil contamination and associated plumes, remedial actions are required to further protect the environment. Until such a time, legacy waste is being safely managed and closely monitored.

Status: Activities in the short term are mostly focused on site characterization, assessment, and remedial planning. Large-scale remediation of contaminated lands and soils is required to further protect the environment; however, this can only be achieved if the contaminated material has a proper long-term disposal pathway. The near surface disposal facility, which is currently undergoing an Environmental Assessment, is meant to provide a solution for these materials. As such, planning activities will continue to enable key remediation projects to be ready once the near surface disposal facility is available to receive waste. This includes the characterization of key areas requiring remediation at the Chalk River site, as well as the execution of targeted remedial actions; for example, soil remediation around a recently removed pipeline which was used historically to transport contaminated liquids to the waste management areas on the site.

Like most other areas, field work was halted during the period of reduced operations as a result of COVID-19. Where possible, CNL re-assigned staff to projects which could be done remotely, including planning and preparation for certain building decommissioning projects.

TARGETS		
Short-term 1-2 years	Medium-term 3-4 years	Long-term 5+ years
Characterization and remediation plans for various Waste Management Areas at the Chalk River site are completed.	Remediation of Waste Management Areas begins once the Near Surface Disposal Facility is available.	Waste Management Areas and site remediation activities are completed.

Decommissioning of buildings at the Chalk River site

Overview: The Chalk River site includes multiple redundant buildings which require decontamination, decommissioning and demolition. The site has been in existence since the 1940s, and some buildings still standing today date back to that era. Some facilities were used as nuclear science and technology facilities (and therefore may have some level of radioactive contamination), while others were used as support buildings (for example machine shops, garages, etc.). Most of these facilities and buildings are outdated, no longer needed to meet operational needs and contribute to high site costs through ongoing maintenance for safety and security purposes, energy consumption, etc. Buildings also need to be removed to make way for the Chalk River site revitalization.

Status: Since 2015 there has been significant acceleration of decommissioning work at the Chalk River site; more than ninety (90) buildings and structures having been decontaminated, decommissioned and demolished.

As a result of the COVID-19 pandemic, all field work was halted during the period of reduced operations. However, a significant portion of work was able to continue remotely as many projects were in a planning phase. That said, overall work has progressed more slowly under remote conditions as many activities require physical site access.

TARGETS		
Short-term 1-2 years	Medium-term 3-4 years	Long-term 5+ years
Demolition of 10 buildings and structures.	Approximately 65 structures are decommissioned between 2017 and 2022 (cumulative). A program of works is developed and implemented to reduce the liability associated with the inventory of waste and assets in the NRU rod bays.	Long-term liabilities are reduced through the safe and environmentally responsible removal of redundant facilities and structures. With the exception of NRU, 122 structures have been eliminated and NRX has been decommissioned to an agreed end-state, helping reduce the site footprint.

Management of used fuel and repatriation of highly enriched uranium

Overview: Highly-enriched uranium originating in the United States was used at the Chalk River site as reactor fuel and in the production of medical isotopes. This material requires high levels of security as well as costly and complicated storage. As part of the Global Threat Reduction Initiative (an initiative which aims at reducing proliferation risks by consolidating highly-enriched uranium inventories in fewer locations around the world), AECL is working with the United States Department of Energy and CNL to return (repatriate) this material to the United States for conversion and reuse. This initiative provides a safe, secure, timely and permanent solution to Canada's long-term management of this material.

CNL also manages AECL's used fuel inventory. The Fuel Packaging and Storage facility is used to safely store fuel from existing tile holes that have shown signs of corrosion and place it in a state-of-the-art, above-ground storage facility for continued storage until a final repository for the used fuel is available.

Status: The fuel repatriation program continues to be very successful, with shipments of highly enriched uranium fuel rods now complete and shipments of target residue material (liquid highly-enriched uranium) planned to be completed sometime in 2020. CNL is also advancing its efforts to consolidate AECL's inventory of used fuel at the Chalk River site.

TARGETS		
Short-term 1-2 years	Medium-term 3-4 years	Long-term 5+ years
Target residue material shipments continued as per plans and fuel rod shipments completed.	Target residue material shipments completed.	AECL continues to investigate and pursue the disposition or repatriation of fresh and irradiated fuel material in order to further reduce liabilities for Canada.
Remaining tile hole stabilized to enable safe transfer to the Fuel Packaging and Storage Facility.	Drying operations at the Fuel Packaging and Storage Facility are complete, with only surveillance activities remaining.	

Port Hope Area Initiative

Overview: The Port Hope Area Initiative represents Canada's commitment to clean up and safely manage historic low-level radioactive waste situated in the municipalities of Port Hope and Clarington, in Ontario. The objective is to safely relocate and manage roughly 2.1 million cubic metres of historic low-level radioactive waste and contaminated soils. Two near surface long-term waste management facilities have been constructed (one in each municipality) and have started receiving waste from existing waste management facilities, as well as other wastes which are dispersed in the local area.

Status: Significant progress is being made in advancing this complex remediation project, however, there continues to be challenges associated with the number of properties requiring remediation and the timelines associated with this. At the Port Granby Project, the total estimated waste volume increased by more than 50% from the original estimates due to the wider spread of contamination. That said remediation is expected to be completed in 2020 and the facility will subsequently be capped and closed. The site will then transition to a long-term monitoring and maintenance phase.

As part of the Port Hope Project, activities continued for the construction of the Long Term Waste Management Facility, however additional waste volumes have pushed construction completion into 2020-21. The remediation of the Port Hope harbor got underway in 2019-20 with bulk dredging commencing, however other harbor front remediation work has been delayed given record-high water levels in Lake Ontario.

The largest challenge associated with this project relates to the scope and execution of the remediation of residential properties. As characterization activities have advanced, the number of individual properties requiring remediation work has increased. Port Hope property owners and residents have expressed dissatisfaction about the length of time it takes to complete the remediation of their properties and CNL's experience in the field have determined that a significant number of property cleanups are being driven by the generic, conservative cleanup criteria for arsenic and uranium in soil. As such, CNL is recommending changes to the PHAI Cleanup Criteria for arsenic and uranium to minimize unintended negative environmental impacts and the disruption caused by the PHAI in the community. The proposed revised criteria would still be protective of human health.

In March 2020, all physical work at the Port Hope Area Initiative paused as a result of the response to COVID 19. Some limited essential operations continued, for example, to ensure the safety and security of the long-term waste management facilities and associated groundwater collection systems and waste water treatment plants. That said, a portion of planning activities were maintained, including work with regulators and stakeholders to revise the clean-up criteria for the remediation of residential properties. Should adjustments to the clean-up criteria be accepted, this would have significant positive impacts on the project, including reducing the current timelines and reducing risks associated with increases to the number of residential properties requiring remediation.

TARGETS		
Short-term 1-2 years	Medium-term 3-4 years	Long-term 5+ years
Port Granby Long-Term Waste Management Facility closed and capped.	Port Granby Long Term Waste Management Facility in long-term monitoring and surveillance.	
Engagement of community and Indigenous groups to explore options and gather feedback on potential changes to the clean up criterial for the Port Hope Project.	Port Hope Project: The large-scale industrial remediation projects are completed.	Port Hope remediation of low-level radioactive waste is completed. Port Hope Long Term Waste Management Facility is closed and capped and in long term surveillance.

Decommissioning of the Whiteshell Laboratories

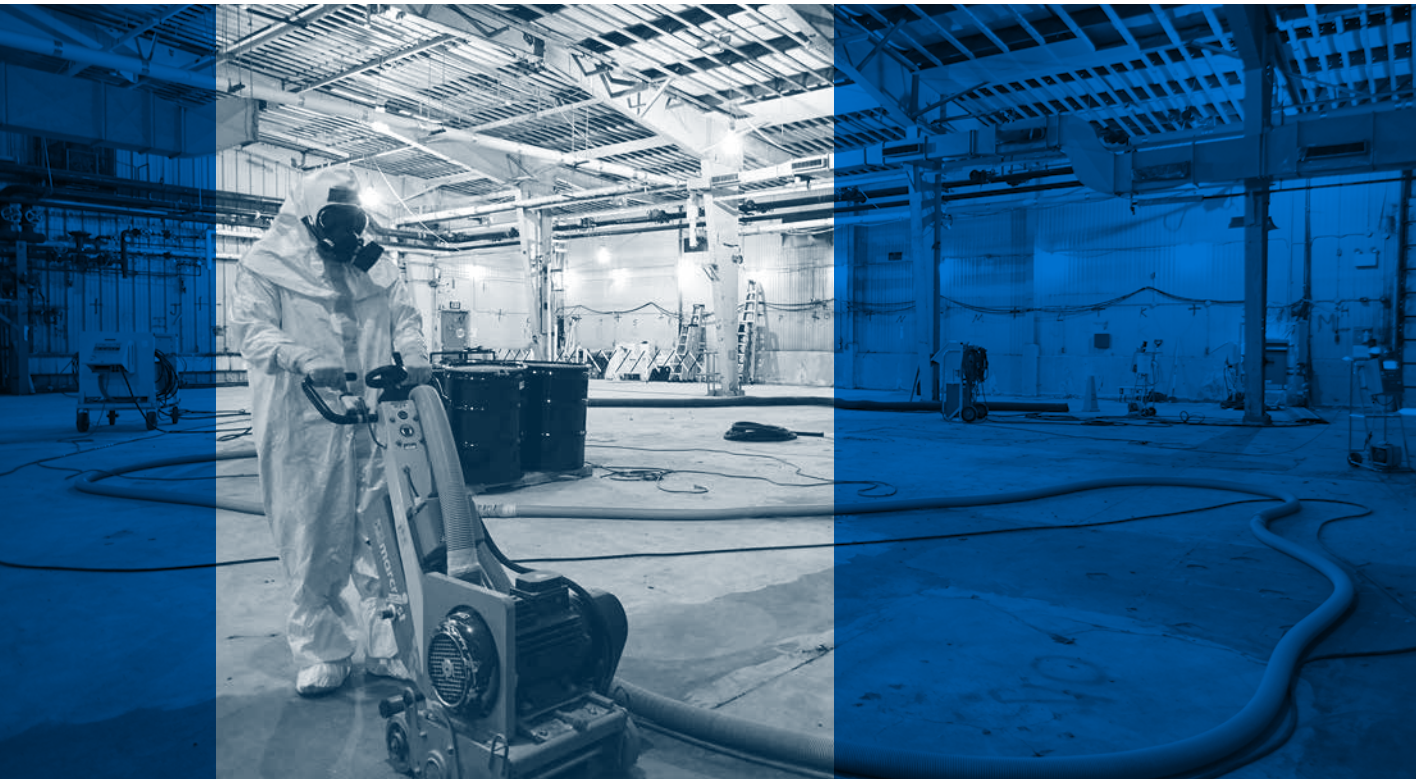
Overview: The Whiteshell Laboratories, located in Pinawa, Manitoba, is the second largest of AECL's sites operated by CNL. It was established in 1963 as a research laboratory, with a focus on the largest organically cooled, heavy water moderated nuclear reactor in the world, the WR-1. Facilities also included a SLOWPOKE reactor as well as shielded hot cell facilities and other nuclear research laboratories. The site also includes a radioactive waste management area which serves to provide interim storage of radioactive waste for the Whiteshell site which was created as a result of the operations of the research reactor and nuclear laboratories.

In 1998, the Government announced the closure of the Whiteshell Laboratories, and decommissioning activities have since been underway. With the implementation of the Government-owned, Contractor-operated model and the increased emphasis placed on tackling its environmental and decommissioning responsibilities, AECL has asked CNL to accelerate and complete the decommissioning and closure of the site. As a result, CNL is proposing to decommission and close the site by 2027 approximately 30 years ahead of the previous schedule. The acceleration of the decommissioning of the site is based on the bid that was accepted by Canada as part of the procurement process and includes a proposal to decommission the WR-1 reactor in situ. That specific project is currently undergoing an Environmental Assessment.

Status: CNL has been progressing the decommissioning of the site, with several buildings being decontaminated and demolished. However, significant challenges have emerged with respect to the complexity and level of hazard related to the retrieval, processing and transport of radioactive waste currently being stored in a radioactive waste management area known as the 'standpipes' and bunkers. These are concrete structures, mostly below grade, which contain intermediate-level waste and potentially fissile nuclear material that cannot be fully characterized before retrieval begins. Given the level of risk involved with their remediation, CNL has had to adjust its approach which is now more complex and costly (as it is based on remote tooling and robotics), in order to protect workers and the environment.

CNL also continues to engage the public and Indigenous groups on its proposal to decommission the WR-1 reactor in situ. These include extensive engagement with Indigenous groups and local communities, providing funding for Traditional Knowledge studies and other capacity-building activities, hosting site tours, and open houses, etc. AECL has also been participating in many of these engagement activities, with a view to building relationships over the long-term. That said, and as noted in the previous sections, higher-than-anticipated public and Indigenous engagement, as well as requests from the Canadian Nuclear Safety Commission to provide additional technical studies have led to delays in the project of almost three years. While these have had a financial impact on the project, they are allowing for more public and Indigenous engagement, and the development of additional studies in support of the project's safety case (which are also facilitating public and Indigenous engagement). It is expected that CNL will be submitting a revised Environmental Impact Statement in the spring of 2020, as a lead up to a public licensing hearing expected in 2021-22.

Looking to the final site closure and being mindful of the impact on the local community, AECL will continue to work with the communities and Indigenous groups to discuss the future of AECL's lands, with a view to finding acceptable solutions to support economic development, which could include consideration for siting a small modular reactor at the Whiteshell site.



TARGETS		
Short-term 1-2 years	Medium-term 3-4 years	Long-term 5+ years
The retrieval system for the standpipes and bunkers is ready to start operations. Public hearings held to consider CNL's proposal for the in situ decommissioning of the WR-1 reactor. Majority of buildings at the main campus are decommissioned.	Waste retrieval completed for all the standpipes in the waste management area. All high-level radioactive waste and used fuel are removed and transported to the Chalk River Laboratories.	The Canadian Nuclear Safety Commission accepts as completed all active decommissioning and waste management activities, with only long-term monitoring and surveillance activities remaining.

Decommissioning of the Nuclear Power Demonstration reactor

Overview: The Nuclear Power Demonstration reactor, located in Rolphton, Ontario, was the first Canadian nuclear power reactor and the prototype for the CANDU reactor design. For 25 years, the reactor produced low-carbon energy and operated as a training centre for nuclear operators and engineers from Canada and around the world. Operations at the Nuclear Power Demonstration reactor ended in 1987, after which the first stages of decommissioning were completed, including the removal of all fuel from the site and the draining of the systems. The site has been in a safe shutdown state for the last 30 years. As part of its objectives to protect the environment and address its environmental and decommissioning responsibilities, AECL has asked CNL to propose plans to safely decommission and close the Nuclear Power Demonstration reactor site. As a result, CNL is proposing to decommission the reactor in situ, meaning that it would be immobilized in place by grouting (i.e. cementing) the reactor which is located below the surface. The project is currently undergoing an Environmental Assessment.

Status: In 2017-18, CNL submitted a draft Environmental Impact Statement to the regulator. Subsequently, it has undertaken additional work and studies with a view to providing all necessary supplemental documentation and responding to stakeholder and Indigenous group concerns. It is expected that an updated Environmental Impact Statement will be submitted in 2020 for consideration by the regulator. While this is more than two years later than the original schedule, it has allowed for additional engagement of stakeholders and Indigenous group on the project in order to gather input and adjust the proposed approach, as necessary. Activities included meetings, site tours and outreach to Indigenous groups, including providing funding for capacity building and Traditional Knowledge studies, and to enable Indigenous groups to engage technical experts to comment on the Environmental Assessment.

In the meantime, CNL continues its work to characterize radioactivity and contamination, decommission and decontaminate other hazards and maintain the facilities. CNL will also continue to actively engage with local stakeholders and Indigenous groups on its proposal.

TARGETS		
Short-term 1-2 years	Medium-term 3-4 years	Long-term 5+ years
Regulatory approval received for the in-situ decommissioning of the NPD reactor.	NPD reactor site contamination is remediated with a long-term monitoring and surveillance in place. Canadian Nuclear Safety Commission accepts as completed all active decommissioning and waste management activities, with only long-term care activities remaining.	Ongoing long-term monitoring and surveillance.

Decommissioning of prototype reactors

Overview: Gentilly-1 and Douglas Point are shutdown prototype nuclear reactors owned by AECL and located in Becancour, Quebec and Kincardine, Ontario, respectively. The reactors operated in the late 1960's through the mid 1980's to advance the understanding of boiling light water power reactors (Gentilly-1) and steam condenser power reactors (Douglas Point). Both reactors are now shutdown and in a safe state prior to being fully decommissioned.

Status: Originally, the decommissioning of these prototype reactors wasn't planned to occur for many decades. However, to reduce costs associated with storage and surveillance of this aging infrastructure, decommissioning plans are being made to advance this scope. To move forward with the decommissioning of certain non-nuclear buildings at the Douglas Point site, CNL requested an amendment to its operating licence. Associated public and Indigenous engagement, including a public hearing held by the Canadian Nuclear Safety Commission, are expected in 2020. At Gentilly-1, asbestos and bulk waste removal will continue in 2020-21.

TARGETS		
Short-term 1-2 years	Medium-term 3-4 years	Long-term 5+ years
Supporting and/or redundant facilities at the Douglas Point and Gentilly-1 reactors are demolished.	Review options for Douglas Point and Gentilly-1 for transport of fuel to the Chalk River Laboratories.	Plans are in place for the decommissioning of the Douglas Point and Gentilly-1 reactors.

Low-level Radioactive Waste Management Office

Overview: The Government of Canada, through AECL, has assumed responsibility for historic, low-level radioactive waste where the original owner no longer exists and the current owner cannot reasonably be held responsible. Through CNL, AECL is managing these responsibilities which include the cleanup of historic low-level radioactive waste at various sites across Canada (excluding the Port Hope Area Initiative, discussed above). This includes ongoing interim waste management and remediation projects mostly in Ontario, Alberta and the Northwest Territories.

Status: Planning and stakeholder and Indigenous engagement continues to enable the remediation of sites along the Northern Transportation Route. Some of the remediation activities which were expected to start in 2020-21 were postponed due to COVID-19.

TARGETS		
Short-term 1-2 years	Medium-term 3-4 years	Long-term 5+ years
Engagement of local and Indigenous stakeholders to agree on clean-up plans for the Northern Transportation Route. Remedial Action Plans agreed for select South Slave sites along the Northern Transportation Route.	Engagement of local and Indigenous stakeholders (continued). Remediation commences for Sahtu sites along the Northern Transportation Route.	Remediation completed for all sites along the Northern Transportation Route.

Third-party waste

AECL's sites and waste management capabilities are unique in Canada. Historically, AECL has accepted small amounts of radioactive waste from Canadian facilities, most notably hospitals and universities. CNL continues to provide these services to third parties for the handling, storage and disposal of radioactive waste. These activities are delivered on a full cost-recovery basis and do not require government funding. Budgets have been included for completeness.

TARGETS
Ongoing
CNL accepts radioactive waste from small waste generators on a fee-for-services basis.

Annex 1 – Financial Overview

Financial statements and notes

This section presents AECL's financial statements reflective of AECL's role under the Government-owned, Contractor-operated model, which include payments to CNL and its parent company, Canadian National Energy Alliance. The CNL-related mission budgets (e.g. science and technology, decommissioning and waste management and capital) include both direct and indirect costs.

Under the Government-owned, Contractor-operated model, AECL receives funding from the Government of Canada to deliver on commitments, priorities and objectives related to the nuclear laboratories (including nuclear science and technology and the revitalization of the Chalk River site), as well as environmental stewardship (decommissioning and waste management). CNL manages and operates AECL's sites and undertakes the necessary activities to respond to AECL priorities as per its contractual arrangement with AECL. Revenue from third-party work performed by CNL using AECL sites, facilities and assets is recognized by AECL. Revenue is generated from work to support the nuclear energy industry, the sale or lease of heavy water, and research and development services provided to third parties.

AECL's financial statements are prepared under Public Sector Accounting Standards. Changes to Public Sector Accounting Standards adopted during the year did not result in any changes to the financial statements while changes proposed have yet to be incorporated in the financial statements.

The statements below have been updated to reflect AECL's current outlook and use of existing funding, which is significantly altered due to impacts from COVID-19, including those which are known and understood (i.e., the period of reduced operations), and those which have yet to fully materialize (i.e., impacts on suppliers, revenues and the medium to long-term impact of the 'new normal').

Statement of Financial Position

(millions of Canadian dollars)	Actual 2018-19	Budget 2019-20	Plan 2020-21	2021-22	2022-23	2023-24	2024-25
Financial Assets							
Cash	62	80	80	80	80	80	80
Long-term disposal of waste fund	31	43	52	57	62	68	74
Investments held in trust	54	56	58	60	62	64	66
Trade and other receivables	43	94	45	45	45	45	45
Appropriations receivable	69	100	120	140	145	80	80
Inventories held for resale	177	151	135	118	102	85	68
	435	524	489	500	496	422	413
Liabilities							
Accounts payable and accrued liabilities	33	35	37	36	35	34	33
Employee future benefits	20	18	15	12	9	7	5
Due to Canadian Nuclear Labratories	100	164	135	155	160	95	95
Decommissioning and waste management provision	6,614	7,185	6,961	6,632	6,266	6,153	6,004
Contaminated sites liability	1,055	877	736	535	345	348	355
	7,822	8,280	7,883	7,370	6,815	6,637	6,492
Net Debt	(7,387)	(7,756)	(7,394)	(6,869)	(6,318)	(6,215)	(6,079)
Non-Financial Assets							
Tangible capital assets	665	716	781	888	1,037	1,118	1,108
Prepaid expenses	1	1	1	1	1	1	1
	666	717	782	889	1,038	1,119	1,109
Accumulated Deficit	**(6,721)**	**(7,040)**	**(6,612)**	**(5,981)**	**(5,280)**	**(5,095)**	**(4,970)**
Accumulated deficit is comprised of:							
Accumulated operating deficit	(6,722)	(7,041)	(6,612)	(5,981)	(5,280)	(5,095)	(4,970)
Accumulated remeasurement gains	1	2	–	–	–	–	–
	(6,721)	**(7,040)**	**(6,612)**	**(5,981)**	**(5,280)**	**(5,095)**	**(4,970)**

The long-term disposal of waste fund will increase as AECL sets aside funding to account for future liabilities arising from the ongoing operation of the site which create radioactive waste and/or decommissioning liabilities.

The Decommissioning and waste management provision and Contaminated sites liability represent the future obligation to address waste management and decommissioning liabilities. The liability is expressed in terms of the net present value of future expenditures required to discharge the obligation. AECL's decommissioning and waste management provision and contaminated sites liability are adjusted annually to reflect progress to date, new estimates as they become available and new waste liabilities arising from ongoing CNL operations. The year-over-year change in these accounts represents the increase in the net present value with the passage of time (accretion) offset by the reduction in the liability from the spending incurred each year.

Changes to the liability may occur in future years as CNL advances decommissioning activities. The assessment and planning of projects, which are understood in more detail as projects are undertaken, could result in adjustments to expected cost estimates, which would impact the value of the liability.

However, as decommissioning work ramps up in the coming years, the liability will be decreasing commensurate with the liabilities being settled. As the decommissioning and waste management provision and contaminated sites liability decrease, so will AECL's overall negative Accumulated Deficit. The above projections do not attempt to capture the impact of potential future changes in the interest rate used to derive the net present value changes of the reported liability.

Tangible capital assets are expected to increase in line with increased investment in infrastructure at the Chalk River site, as reflected by the important funding provided for revitalizing the Chalk River Laboratories in the coming years.

Accumulated deficit changes are largely reflective of changes in surplus for the period.

Statement of Operations and Accumulated Deficit

(millions of Canadian dollars)	Notes	Actual 2018-19	Budget 2019-20	Plan 2020-21	2021-22	2022-23	2023-24	2024-25	5 Year Total
Revenues									
Parliamentary appropriations		829	868	1,009	1,189	1,216	660	673	4,746
Commercial revenue		109	112	78	96	98	104	109	484
Interest income		5	6	4	4	4	4	4	20
Other proceeds		–	50	–	–	–	–	–	–
		943	1,036	1,090	1,289	1,318	767	785	5,250
Expenses									
Cost of sales		74	77	54	67	68	72	76	339
Operating expenses	1	72	83	65	62	63	59	69	318
Contractual expenses	2	263	241	252	250	225	207	276	1,210
Decommissioning, waste management and contaminated sites expenses	3	713	955	289	278	261	244	240	1,312
		1,122	1,355	661	658	617	582	660	3,179
Deficit (surplus) for the year before the following	4	(179)	(319)	430	631	701	185	125	2,071
Gain from elimination of reported obligation related to government funded heavy water proceeds	5	333	–	–	–	–	–	–	–
Surplus for the year		155	(319)	430	631	701	185	125	2,071
Accumulated operating deficit, beginning of year		**(6,869)**	**(6,722)**	**(7,041)**	**(6,612)**	**(5,981)**	**(5,280)**	**(5,095)**	
Transfer to deferred decommissioning and waste management funding		(6)	–	–	–	–	–	–	
Transfer to repayable contributions		(2)	–	–	–	–	–	–	
Accumulated operating deficit, end of year		**(6,722)**	**(7,041)**	**(6,612)**	**(5,981)**	**(5,280)**	**(5,095)**	**(4,970)**	

1 These amounts represent AECL's operating expenses.

2 Contractual expenses include payments to CNL (less payments for decommissioning and waste management, cost of sales and capital) and contractor fees.

3 Decommissioning, waste management and contaminated sites expenses represent the accretion expense on the decommissioning and waste management provision and Contaminated sites liability.

4 Large surpluses are a result of Capital and DWM funding received for which there are smaller corresponding accrual expenses. Capital funding received is partially offset by amortization expense, and DWM funding is partially offset by accretion expense.

5 This adjustment is the removal of the deferred decommissioning and waste management funding and amounts due to related parties (recorded in accounts payable and accrued liabilities) on the Statement of Financial Position as discussed and agreed with Government.

Parliamentary appropriations are aligned with projected expenditures.

Operating expenses are comprised of AECL oversight operations and amortization of tangible capital assets. Reported Contractual expenditures are expected to decrease over the planning period as a result of decreased spending for the National Research Universal reactor, as the reactor is being shut down.

Decommissioning, waste management and contaminated sites expenses include the increase in the net present value (accretion of discount) of the decommissioning and waste management provision and contaminated sites liability. As these obligations decrease, the decommissioning, waste management and contaminated sites expenses will decrease as well.

It should be noted that COVID-19 has led to a delay in execution of scope across many projects within the organization, leading to a delay in required Parliamentary Appropriations. 2020-21 and 2021-22 Parliamentary Appropriations have been reduced by approximately $245M and $50M respectively. These delays are ultimately expected to lead to cost increases over the lifecycle of the projects as they now confront supply chain claims, extended schedules and associated overhead costs. Commercial revenues have also been impacted in 2020-21, with total revenues expected to be approximately $20M lower than previously forecasted.

Statement of Cash Flows

			Plan					
(millions of Canadian dollars)	**Actual 2018-19**	**Budget 2019-20**	**2020-21**	**2021-22**	**2022-23**	**2023-24**	**2024-25**	**5 Year Total**
Operating transactions								
Cash receipts from Parliamentary appropriations	864	837	1,029	1,209	1,221	595	673	4,726
Cash receipts from customers	107	111	78	96	98	104	109	484
Cash paid to suppliers	(344)	(250)	(313)	(327)	(287)	(203)	(340)	(1,471)
Cash paid to employees	(14)	(12)	(14)	(14)	(14)	(14)	(14)	(70)
Cash paid for decommissioning, waste management and contaminated sites activities	(506)	(562)	(660)	(808)	(819)	(355)	(384)	(3,026)
Cash invested for waste management and disposal activities	(5)	(12)	(11)	(7)	(7)	(8)	(8)	(41)
Interest received	3	4	4	4	4	4	4	20
Cash provided by operating transactions	104	116	113	152	195	123	40	622
Capital transactions								
Acquisition of tangible capital assets	(80)	(98)	(113)	(152)	(195)	(123)	(40)	(622)
Cash applied to capital transactions	(80)	(98)	(113)	(152)	(195)	(123)	(40)	(622)
Increase in cash	**24**	**18**	**–**	**–**	**–**	**–**	**–**	
Cash at beginning of year	**38**	**62**	**80**	**80**	**80**	**80**	**80**	
Cash at end of year	**62**	**80**	**80**	**80**	**80**	**80**	**80**	

Operating Budget And Notes

Government of Canada Funding – Operating

(millions of Canadian dollars)	Actual 2018-19	Budget 2019-20	Plan 2020-21	2021-22	2022-23	2023-24	2024-25	5 Year Total
AECL								
Environmental stewardship	528	589	660	808	819	355	384	3,026
Nuclear Laboratories – Operating	227	167	236	229	203	182	249	1,099
Total Government Funding – Operating	**755**	**756**	**896**	**1,037**	**1,022**	**537**	**633**	**4,124**

Decommissioning and waste management funding has increased due to a ramp up of activities at the Port Hope Area Initiative and accelerated decommissioning and waste management at the Chalk River Laboratories. Science and Technology funding is expected to decline as a result of the shutdown of the National Research Universal reactor which occurred in March 2018.

Capital Budget And Notes

Government of Canada Funding – Capital

(millions of Canadian dollars)	Actual 2018-19	Budget 2019-20	Plan 2020-21	2021-22	2022-23	2023-24	2024-25	5 Year Total
AECL								
Capital	71	110	113	152	195	123	40	622
Total Government Funding – Capital	**71**	**110**	**113**	**152**	**195**	**123**	**40**	**622**

More details on AECL's Capital Plan are found in Annex 2 - *Revitalization of the Chalk River Laboratories*.

Annex 2 – Revitalization of the Chalk River Laboratories

AECL's plan to revitalize the Chalk River Laboratories is based on CNL's ongoing assessments of infrastructure needs, including consideration for health, safety, security and environmental risks, current facility conditions, regulatory requirements and ongoing business needs. All investments are in support of the renewal and revitalization of the Chalk River site, to create a world-class nuclear science and technology campus that serves the needs of the Government of Canada and of commercial customers.

Revitalization activities are meant to address two main areas:

- **New and Renewed Science Infrastructure –** These investments are part of a longer-term plan to revitalize the Chalk River site and construct new and renewed science facilities in order to build a modern, world-class nuclear science and technology campus that serves the needs of government and industry.
- **Site Support Infrastructure –** Immediate investments are required to renew existing and aging infrastructure systems and facilities at the Chalk River site such as potable water, storm sewer, sewage treatment, electrical system and other utilities. These investments are necessary to respond to regulatory and health, safety, security and environmental requirements, as well as to maintain a cost efficient and reliable site.

Further details on specific projects for 2020-21 are presented below. The projected capital expenditures reflect the estimated inflation adjusted expenditures for the portfolio and is based on the best current estimates for each planned project.

Capital Five-Year Projection of Funding Requirements

			Plan					
(millions of Canadian dollars)	**Actual 2018-19**	**Budget 2019-20**	**2020-21**	**2021-22**	**2022-23**	**2023-24**	**2024-25**	**5 Year Total**
Capital								
Capital	71	110	113	152	195	123	40	622
Federal Funding Requirement	**71**	**110**	**113**	**152**	**195**	**123**	**40**	**622**

New and Renewed Science Infrastructure

Projects in this category include modern, low-carbon, world-class science facilities and infrastructure to enable delivery of CNL's commitments set out in its long-term plan. The projects to be undertaken are aligned with the strategy to revitalize the Chalk River site and include:

Advanced Nuclear Materials Research Centre

Overview: This is Chalk River Laboratories' most significant capital investment, with the objective to combine the capabilities of existing but outdated facilities into a modern shielded facility and laboratory research complex. This new facility will allow further advancements in the nuclear science and technology program, including on alpha research, small modular reactors, advanced fuels fabrication, nuclear forensics and response, as well as ongoing work in support of utilities and their reactor life extension and reliability.

Status: The project is being delivered through an Integrated Project Delivery approach, whereby the design and construction teams collaborate at all stages of the project. Planning and design activities are underway.

Conventional New Builds

Conventional or non-nuclear new builds are under construction at Chalk River Laboratories to enable the revitalization of the site by consolidating work and enabling the demolition of outdated buildings.

Status: The Conventional New Builds are a part of the Integrated Project Delivery approach to create efficiencies and incentivizing the construction and design teams to work together. A logistics/warehouse building is under construction to facilitate shipping and receiving at the site, enhance security at the entrance and reduce the need for non-CNL staff to be on site. Similarly, a Business Hub is being planned to consolidate office space. Finally, a support/maintenance facility is under construction to consolidate maintenance resources and equipment into a single, centralized location at the Chalk River site. This includes the consolidation of 32 maintenance shops into 3, which will allow CNL to achieve efficiencies and provide safer, more cost-effective support to the programs on site.

With respect to COVID-19, construction project activities were put on hold in the spring of 2020, with construction slowly resuming following updated COVID-19 safety protocols.

Integrated Project Delivery

As the Chalk River Laboratories are being revitalized, CNL is leveraging the $1.2 billion of capital funding made available by AECL over ten years to implement the vision set out in the Site Master Plan. Amongst other innovations, CNL has introduced an integrated project delivery approach for the delivery of large capital projects.

This collaborative, one-team approach brings together designers, architects, constructors, suppliers and the end-user to facilitate detailed planning by having all stakeholders take part in the design, fabrication and construction phases, and share associated risks. This is showing early signs of increasing the reliability of project outcomes and increasing efficiency throughout the project, with the ultimate intent being increased value to Canada.

Revitalization

Overview: Numerous facilities at the Chalk River site require revitalization to enable long-term reliability and continued compliance with regulatory and licensing requirements. Over the past few years, efforts were focused on the refurbishment of the Chemistry and Radio Analytical Lab (exterior work), Biological Research Facility, Nuclear Fuel Fabrication Facility and Waste Treatment Center, while ensuring that fume hoods across the site remain compliant with applicable safety, and environmental requirements.

Status: During 2020-21, it is expected revitalization work will be completed in the Chemistry and Radio Analytical Lab and that the fume hoods project will be completed. Work on mechanical systems will continue in the Biological Research Centre with completion currently forecast for 2021-22. These projects are focused on eliminating known safety hazards, improving working conditions and enabling the ongoing availability of facilities. Despite COVID-19, most of the projects remain on track as planning work was performed remotely.

Site Infrastructure

Part of the revitalization of the Chalk River site includes the implementation of new utilities and services as a key enabler to the site's transformation. These are necessary to respond to regulatory requirements, address risks and hazards and reduce overall site operating costs. Projects include:

Information Technology (IT) Investment Projects

Overview: Investments in IT infrastructure include upgrades, replacements and implementation of hardware, software, applications, networks, and communications technologies throughout the CNL organization. The multiple improvements being implemented are broken down as follows:

- Base infrastructure – to upgrade current hardware and software company-wide.
- Business enablement – mostly focused on business intelligence solutions to provide dynamic reporting capability in the areas of finance, procurement and human resources.
- Collaboration – mostly focused on providing collaborative IT workspace through the implementation of solutions such as SharePoint.
- Security – the outcome of a comprehensive cyber program assessment, this project is focused on delivering a strong cyber security framework.

Status: In 2019-20, the focus was on modernizing and integrating IT applications and systems, automating business system processes and improving reporting capabilities. A new business intelligence system was launched, a number of services were moved to the Cloud and voice service upgrades were made across site. Work will continue in this area to upgrade to a fiber optic link to site and increase cyber security through the selection and use of a managed security service provider.

Domestic Water System

Overview: The construction of the domestic water system addresses current deficiencies with the supply of potable water for food preparation, sanitary and personal facilities, and safe drinking water at the Chalk River site. The objective is to conform to current provincial and/or federal standards by bringing potable water to the Chalk River Site. This involved extending potable water supply from the town of Deep River to the Chalk River site, which was completed in 2017-18.

Status: With potable water brought to site in 2017-18, work has been ongoing to make this water available throughout the Chalk River site, extending the water main throughout the site and beginning to make potable water available to facilities. In 2019-20 both the heavy water upgrade facility and one personnel shower complex in the active area were connected to potable water. Work will continue in this area to bring domestic water to service the new build projects as well as several key existing buildings.

Site Utilities Revitalization

Overview: The purpose of this project is to further enable reliable electrical power and other essential utility services, continuing the upgrades to aging infrastructure at the Chalk River site.

Status: Activities in 2019-20 were centered around the utilities distribution work. In 2020-21, work will continue to determine an overall approach to maintenance and upgrades for a reliable utilities system now that it has been determined that new infrastructure will not be implemented in the short-term.

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