Australian Government

ANSTO

Corporate Plan

2018 - 2019

Science. Ingenuity. Sustainability.

Contents

A message from the Chief Executive Officer

Our prosperity and growth requires a national innovation ecosystem underpinned by basic, strategic and applied research that delivers positive outcomes for industry, science and the public. Over the next four years, ANSTO will continue to play a leadership role in the transformative science and innovation drive in Australia.

User access to Australia's research and science infrastructure – a major mission of ANSTO – will enable the country's most ingenious scientists and engineers to address a wide range of national and regional challenges. Importantly, we are continuing to expand these facilities. ANSTO is delighted by the overwhelmingly positive response from universities, research institutes and governments to Project BR—GHT. Twenty-six institutions have secured $94 million in capital contributions to advance the Australian Synchrotron's world-class capabilities through the addition of eight new beamlines, almost doubling the facility's research capacity.

ANSTO also welcomes the Australian Government's *Research Infrastructure Investment Plan* in response to the *2016 National Research Infrastructure Roadmap*, which provides a stronger foundation for long-term investment, well beyond the forward estimates period.

Our organisation is committed to improving health outcomes for Australians, including through the provision of more than 10,000 doses of life-saving nuclear medicines to 250 medical facilities across Australia and our region each week. Continuing our long and proud history of local and reliable manufacture and distribution of these important medicines remains an upmost priority for the organisation, recognising that consistent supply can be challenging. To this end, ANSTO will be undertaking a full review of our aging nuclear medicine production facility to help ensure and increase reliability. More importantly strategic investment in a replacement facility that can also respond to future demand for new therapeutic isotopes should be treated with high priority.

ANSTO has developed an integrated Health Strategy detailing the numerous ways in which our organisation can support Australia's broader medical research and translation community. This includes the opportunity to advance Australia's health care through the inclusion of particle therapy capabilities. ANSTO welcomed plans for the development of the first proton therapy centre in South Australia. ANSTO will continue to collaborate and lead discussions to develop a nationally integrated strategy and to attract further investment into this capability; ensuring Australian patients are able to gain the full benefits of proton and carbon therapy.

ANSTO is committed to creating a more sustainable world. We participate in and contribute to important environmental research, helping make Australia a world leader in this regard. For example, ANSTO is a major contributor to research that improves our understanding of short and long term impacts of climate change and its likely effects. Notable projects include research into climate variability and producing important data sets to inform sustainable water management practices.

ANSTO's Innovation Precinct will act as a critical vehicle for supporting an internationally competitive and technologically advanced Australian economy. ANSTO looks forward to fostering further collaboration and realising the benefits of co-locating industrial partners, research institutes, university postgraduates and early career researchers around its landmark scientific infrastructure and world-class scientists.

Significant progress has been made in establishing the Precinct, for example through the recent opening of the *nandin Deep Technology Incubator*. Our focus on supporting Australia's best minds will be extended with the development of the Graduate Institute. Post-graduate students will have the opportunity to engage with multi-disciplinary teams and industry partners in the context of unique access to research infrastructure and mentoring by ANSTO experts. We are continuing to strengthen our partnerships with universities and academic institutions through the Graduate Institute and AINSE.

ANSTO has a wide range of partners nationally and across the globe, and utilises these important linkages to facilitate forward-thinking discussions and to enable important scientific discoveries and technological innovations. Domestically, ANSTO continues to provide support to the Department of Industry, Innovation and Science's program to deliver a predictable path forward for Australia's radioactive waste management. To reflect the growing and diverse partnership with the National Measurement Institute (NMI), an update of the Memorandum of Understanding (MoU) between the two organisations is in train.

ANSTO engages with a number of international counterparts across a targeted portfolio of projects and opportunities, and we will continue to foster these relationships and expand them. ANSTO will anchor and strengthen the Australian partnership with Sri Lanka; deepening an understanding of chronic kidney disease of unknown aetiology, and focusing on delivering innovative mitigations and sustainable medical outcomes. ANSTO's convening power for engagement with major international science and engineering projects, including the Generation IV International Forum (next generation of nuclear energy) and ITER (fusion energy technologies) and CERN (particle therapy, accelerator technology and particle physics), will ensure that Australia continues to advance national expertise and remain engaged with important global developments in nuclear technologies. Further commitment and investment in these projects will be critical in ensuring Australia derives the maximum benefit from these types of engagement.

People, culture and safety are central to everything ANSTO does and are critical to its ability to continue to deliver benefits for all Australians. The safety of our workforce remains our top priority and we are committed to driving a culture of continuous improvement, helping ensure the highest standards of safety are achieved.

Dr Adi Paterson
Chief Executive Officer

I present ANSTO's 2018 - 2019 Corporate Plan, which covers the period 2018 - 2019 to 2021 - 2022, as required under section 35(1)(b) of the *Public Governance, Performance and Accountability Act 2013*.

Key documents that have informed the development of this Corporate Plan include:

- *Australian Nuclear Science and Technology Organisation Act 1987*
- Industry, Innovation and Science Portfolio Budget Statements 2018-19
- Australia's National Science Statement 2017
- Australia 2030: Prosperity through Innovation
- Australia's National Science and Research Priorities

Vision

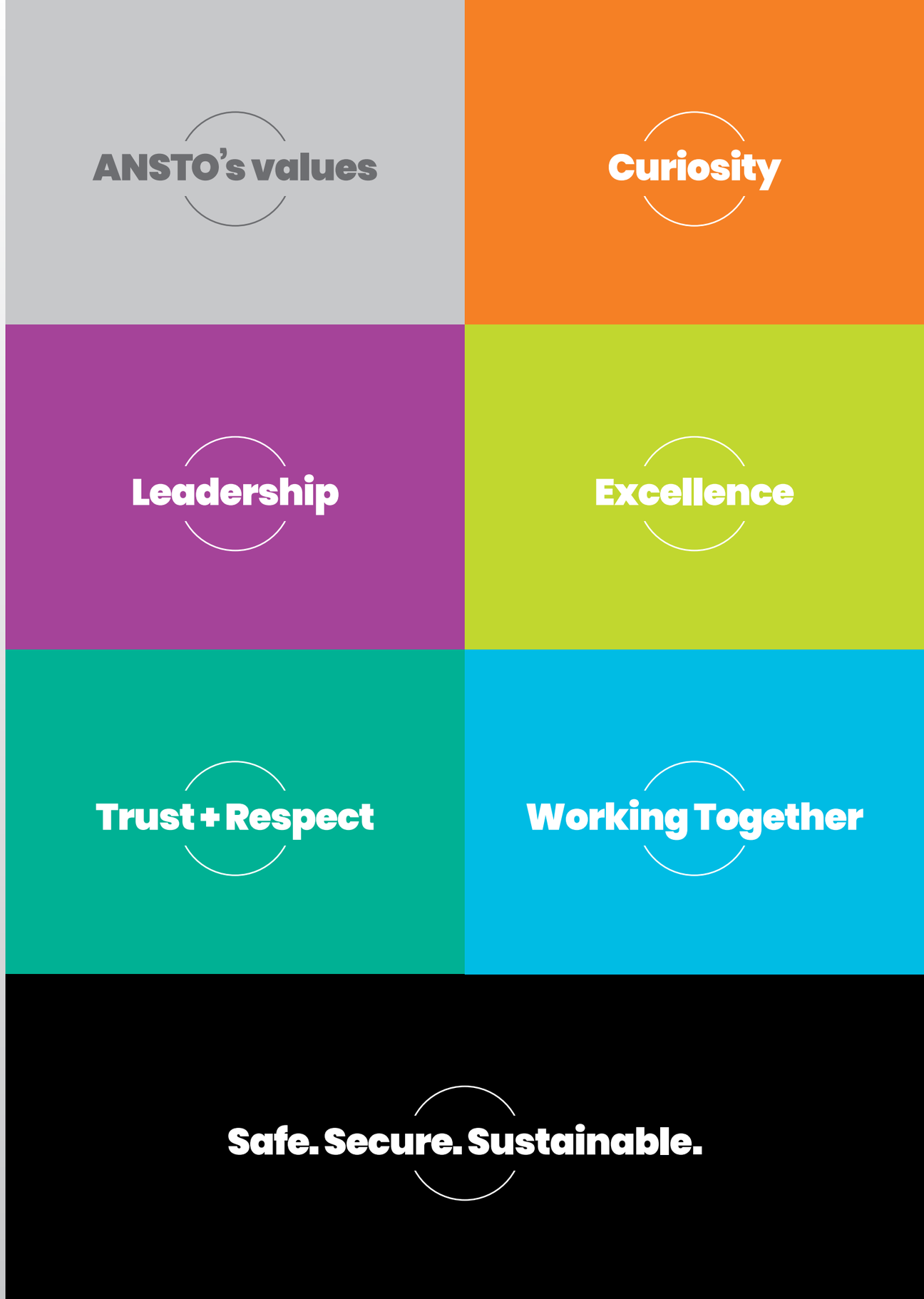
To be a global science, research and engineering partner with a reputation for tackling complex problems and delivering outcomes to create a more sustainable world.

Values

ANSTO's values underpin our vision, capabilities and strategic objectives, and are critical to how we carry out our work. They also describe how our people will engage with one another and external stakeholders. Our values extend to the way we partner with government, universities, industry, communities and other stakeholders.

FIGURE 1

ANSTO's Values underpin our work. These were developed by our staff and have been widely communicated and supported since 2014.



ANSTO's purpose

ANSTO's purpose is defined by the following functions set out in section 5 of the *Australian Nuclear Science and Technology Organisation Act 1987*:

- Conduct research and development in relation to nuclear science and technology
- Produce and use radioisotopes, isotopic techniques and nuclear radiation for medicine, science, industry, commerce and agriculture
- Encourage and facilitate the application and use of the results from research and development
- Manage radioactive materials and waste arising from various prescribed activities
- Provide goods and services related to core activities
- Provide advice to government and liaise with other countries on behalf of Australia in nuclear-related matters
- Make available to other persons, whether or not on a commercial basis, the knowledge, expertise, equipment, facilities, resources and property of the Organisation for the purposes of scientific research, innovation and training
- Publish scientific and technical reports, periodicals and papers, and provide public information and advice
- Facilitate education and training in nuclear science and technology, including through granting scientific research studentships and fellowships, in cooperation with universities, professional bodies and other education and research institutions.

ANSTO is a Corporate Commonwealth Entity within the Australian Government's Jobs and Innovation Portfolio with accountability to the Minister for Jobs and Innovation as well as the Assistant Minister for Science, Jobs and Innovation.

ANSTO operates under the oversight of a Board which is appointed by the Governor-General in Council (Executive Council). ANSTO's Chief Executive Officer, who is also a Board member, is employed by the Board.

ANSTO's operating environment

Australia continues to advance its position and capabilities in the global innovation and science landscape, as outlined in the ministerial Statement of Expectations (SOE), Innovation and Science Australia's 2030 Strategic Plan, the National Innovation and Science Agenda and the Australian Government's Research Infrastructure Investment Plan in response to the 2016 National Research Infrastructure Roadmap.

To advance Australia's innovation economy, driving greater synergies between industry, researchers and universities and longer-term planning and investment, particularly in relation to Australia's research infrastructure, is a key focus area for ANSTO and Australia.

Australia's economic prosperity rests heavily on its ability to translate research and innovation advancements into high impact outcomes through industry linkages. Through the combination of its unique infrastructure, distinctive competencies and nuclear expertise, ANSTO is a critical part of Australia's innovation system and is well positioned to convene key stakeholders from business, research and universities to drive innovation and growth in Australia. ANSTO is responding to the need for greater connectivity through a number of key initiatives, including the development of the ANSTO Innovation Precinct, which is detailed later in this Plan.

As important developments occur across the global science landscape, Australia must remain committed to highly networked collaborations and draw on major international science projects. Australia's engagements with advanced science and infrastructure groups such as ITER (fusion reactor) and CERN (fundamental physics research) are critical to ensuring Australia's ongoing status as a highly innovative and engaged global player. Connecting with international counterparts in these forums enables Australia to capitalise on the unique skills, leading expertise and world-class capabilities brought together in a highly collaborative environment. Ensuring that there is sustainable support for ongoing active involvement in these facilities is key to fulfilling Australia's aspirations in the global science and technology landscape.

Research infrastructure is a core component in facilitating breakthroughs, industrial problem solving and supporting a highly specialised workforce. Australia's capabilities competitively position the country in the broader global science landscape, and enable some of the brightest minds to undertake ground-breaking research. For Australia to lead the innovation drive, our research capabilities must remain world class through strategic long-term planning, including predictable funding. In this regard, ANSTO welcomes the Government's Research Infrastructure Investment Plan. Three of ANSTO's research facilities will receive additional funding under the Plan, enabling us to maintain the world-class capabilities that attract over 5,000 Australian and international researchers and industry clients each year. The Government's $1.9 billion investment over 12 years through the National Collaborative Research Infrastructure Strategy (NCRIS) will provide a solid foundation in securing the future of Australia's national research and infrastructure.

With climate change, sustainability, energy security and economic competitiveness at the forefront of public discourse, both locally and internationally, there has been increasing attention paid to the future of the nuclear fuel cycle in Australia. As a trusted adviser to government and other stakeholders, ANSTO continues to lend its unique technical expertise and globally informed perspectives to these discussions.

ANSTO has been encouraged by progress made by the Department of Industry, Innovation and Science towards establishing the National Radioactive Waste Management Facility (NRWMF). This includes the Government's release of the Australian Radioactive Waste Management Framework, which sets out the principles, policies and arrangements for radioactive waste management in Australia. The Framework puts in place a whole-of-lifecycle strategy to deal with the waste by-products from medical, industrial and research processes from which we all benefit. It provides a basis for Australia's waste holders, including ANSTO, CSIRO, the Department of Defence, universities, hospitals and private industry, to implement a holistic approach to the management of waste. Importantly, it also puts in place policy settings for the NRWMF, which will dispose of Australia's low-level radioactive waste and temporarily store its intermediate-level waste. It will also guide the development and implementation of a process for the disposal of intermediate level waste.

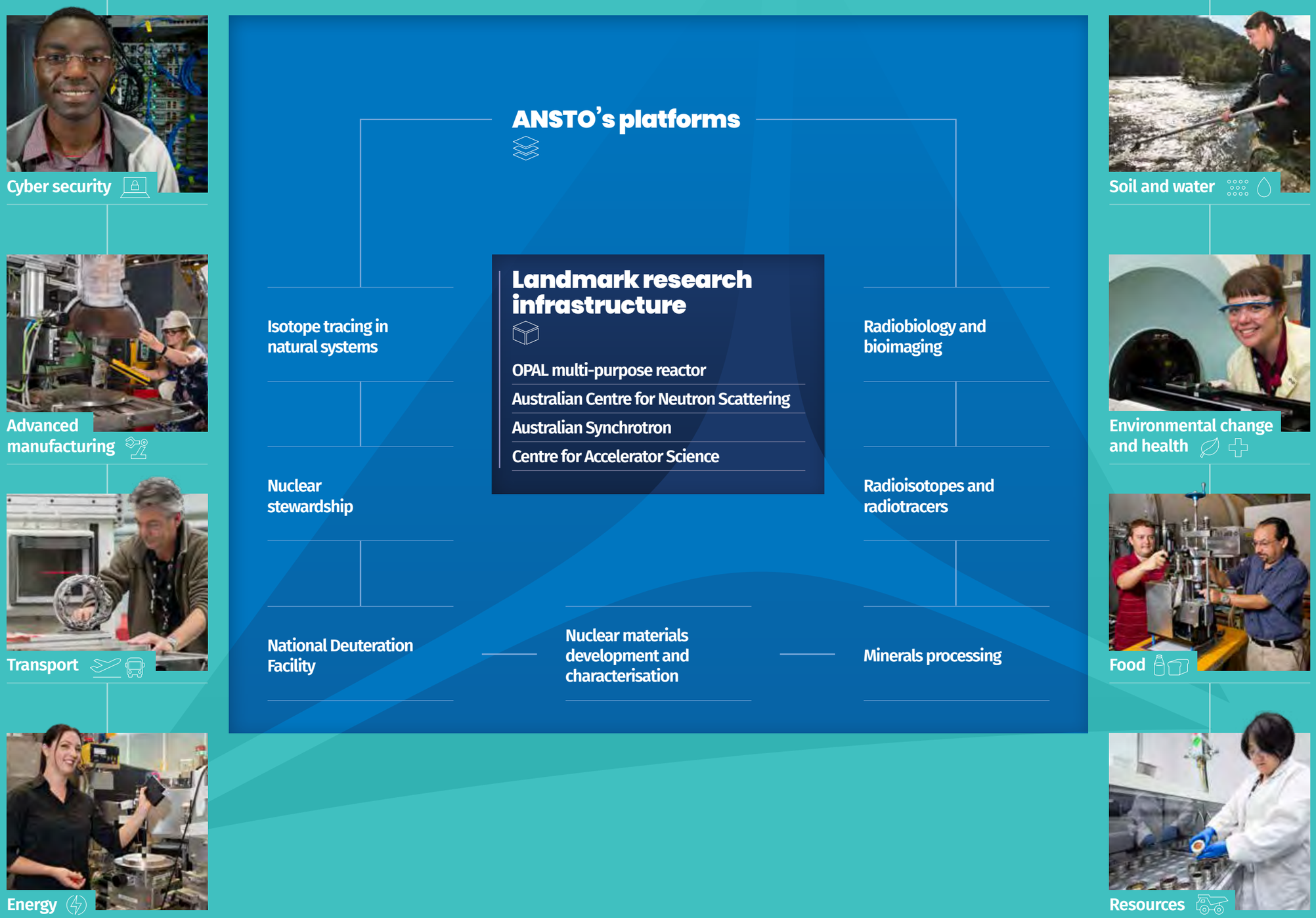


FIGURE 2

ANSTO's capabilities link to the strategic research priorities identified by the Australian Government. This figure indicates the wide reach of our research infrastructure and expertise.

ANSTO's core capabilities

ANSTO is the custodian of Australia's nuclear capabilities and expertise.

We are responsible for:

1. the operation and strategic management of much of Australia's landmark and national research infrastructure
2. the application of ANSTO's unique nuclear expertise for research and industry
3. the provision of specialised nuclear advice, education and training
4. the provision of products and services - most significantly, the supply of nuclear medicine for the diagnosis and treatment of cancer and a range of other diseases.

These important and diverse capabilities will be maintained and enhanced through the five Strategic Objectives outlined in this 2018-19 Corporate Plan.

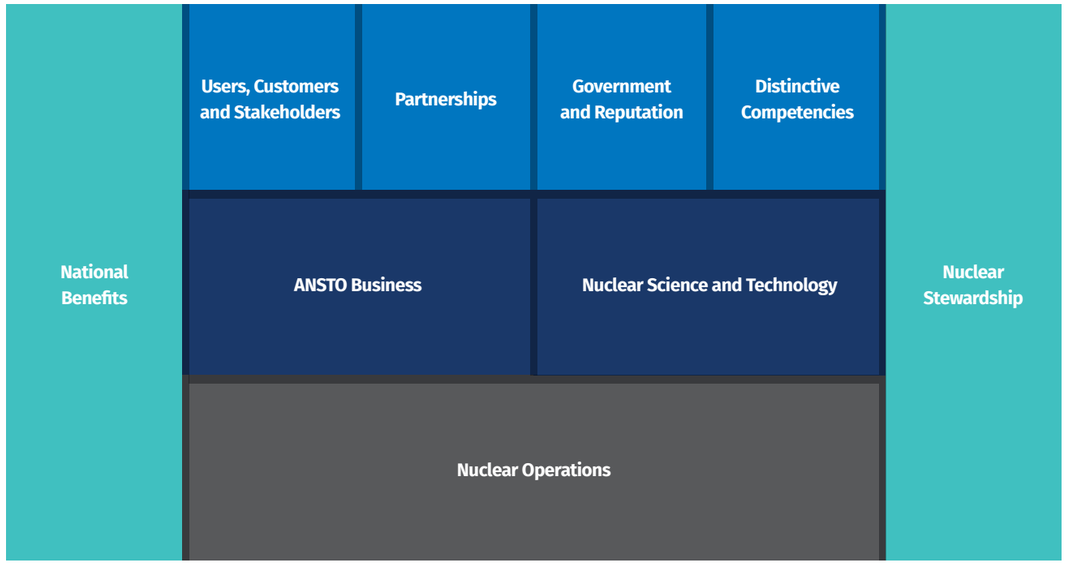


FIGURE 3

This figure shows key components of ANSTO's capability to deliver to our stakeholders.





ANSTO's core capabilities are supported by our organisational framework.

Nuclear Operations encompasses the operation of Australia's world-class multi-purpose reactor, OPAL; the provision of essential radiation safety services; and the management of radioactive waste from the production of nuclear medicines as well as a broad range of research. Importantly, this capability will be maintained and strengthened through the provision of $7.7 million in the 2018-19 Budget to allow us to undertake critical waste management and decommissioning activities over the coming financial year. This funding will ensure we continue to operate within our regulatory framework and with strong community support, and allow us to continue to work with Government to establish a sustainable long-term funding plan for Australia's nuclear decommissioning, asbestos and radioactive waste management, and spent fuel management responsibilities.

While ANSTO awaits the establishment of the NRWMF, provision has been made for the extension of waste management facilities at ANSTO's Lucas Heights campus. The intermediate level waste project has been completed, and construction of the low level waste extension is well underway. ANSTO is encouraged by the progress made towards establishing the NRWMF, with the communities surrounding the three nominated sites (Wallerberdina Station near Hawker and Lyndhurst and Napandee in Kimba, South Australia) currently undergoing community consultation and site assessment processes.

ANSTO has a complete 'end-to-end' spent fuel management plan in place for the lifetime of the OPAL reactor. Under this plan, OPAL's spent fuel will be progressively sent to France for reprocessing, with residual waste returned to Australia for long-term storage at the NRWMF. In accordance with French law, the arrangement is underpinned by a treaty-level intergovernmental agreement between France and Australia. Following review by the parliamentary Joint Standing Committee on Treaties and an exchange of letters between representatives of the Australian and French Governments, the treaty entered into force in June 2018. The first shipment of OPAL spent fuel to France was completed in July 2018.

ANSTO has a wealth of distinctive competencies, including the strategic management of multi-user, multi-disciplinary, multi-decadal research infrastructure; end-to-end logistics management (for the critical production and distribution of nuclear medicines); operational and safety management experience in research reactors, radioactive waste management, nuclear applications in health care, maintenance of the measurement standard for radioactivity (the Becquerel), and nuclear forensics (ensuring that Australia has the necessary tools to prevent and respond to nuclear security threats).

ANSTO provides benefits to society by means of its businesses and Nuclear Science & Technology and Landmark Infrastructure (NSTLI) cluster. These groups provide a range of benefits to Australia, including the provision of products and services, research within key themes aligned with issues of national priority in collaboration with numerous other organisations, and importantly the facilitation of access by users from across Australia and the globe to ANSTO's landmark research infrastructure. Complementing this are a number of activities in which ANSTO undertakes nuclear stewardship on behalf of Government to ensure that Australia's reputation and leadership in the peaceful use of nuclear technology continues to develop over time. By emphasising benefits and stewardship, ANSTO can be responsive to a wide range of Australian and international institutions.

One of ANSTO's key modalities to deliver value is through partnerships. The very nature of research depends upon partners working together so they might better understand and solve complex problems in the world around us.

Partnership and collaboration have formed the foundation of ANSTO since its establishment. ANSTO remains a strong government partner, providing trusted advice across government. Research partnerships across many industries and sectors facilitate the provision of expert advice and access to our landmark infrastructure.





Major projects

ANSTO has a number of key major projects to support its mandate.
These projects are in different stages of development.

ANSTO Innovation Precinct

In line with the national priority to drive Australian innovation through greater synergies between science and business, as articulated in the National Science and Innovation Agenda (NISA) and Australia's National Science Statement 2017, ANSTO will be establishing an Innovation Precinct at its main campus in Southern Sydney.

The ANSTO Innovation Precinct will have three major components; an Innovation Hub, including the nandin Deep Technology Incubator, a Graduate Institute, and a Technology Park. It will 'crowd in' and co-locate knowledge-intensive businesses, high-tech industry, science, technology, engineering, mathematics and medicine (STEMM) graduates from Australian universities, and scientific partners around Australia's centre of nuclear capabilities and expertise. This will create an innovation community that nurtures and drives technology development and transfer, commercialisation, entrepreneurialism, collaboration and market-ready postgraduates.

In September 2017, the Federal Parliament passed changes to ANSTO's governing legislation, the *Australian Nuclear Science and Technology Organisation Act 1987*, to support the vision of the ANSTO Innovation Precinct. Since the passing of the Bill, planning for the precinct has intensified.

The *nandin Deep Technology Incubator* opened in early 2018. Its members include Australian businesses and start-ups engaged in advanced manufacturing and smart technology, defence and cyber-security. As well as these businesses, nandin is also attracting local business groups and will host a newly established robotics cluster in Southern Sydney.

The Graduate Institute will establish a formal program of postgraduate training and development for students undertaking postgraduate research studies at ANSTO's Sydney and Melbourne campuses, as well as working with innovative businesses such as those located in the ANSTO Innovation Precinct. The Graduate Institute is set to launch in late 2018.

The proposed Technology Park will cluster SMEs, high-tech industry and knowledge-intensive businesses, which will have the benefit of close access to ANSTO's people, unique capabilities, nuclear applications and research infrastructure. Businesses that have already approached ANSTO regarding possible co-location include those in the high-end medical manufacturing, robotics, sports science and nutrition sectors.

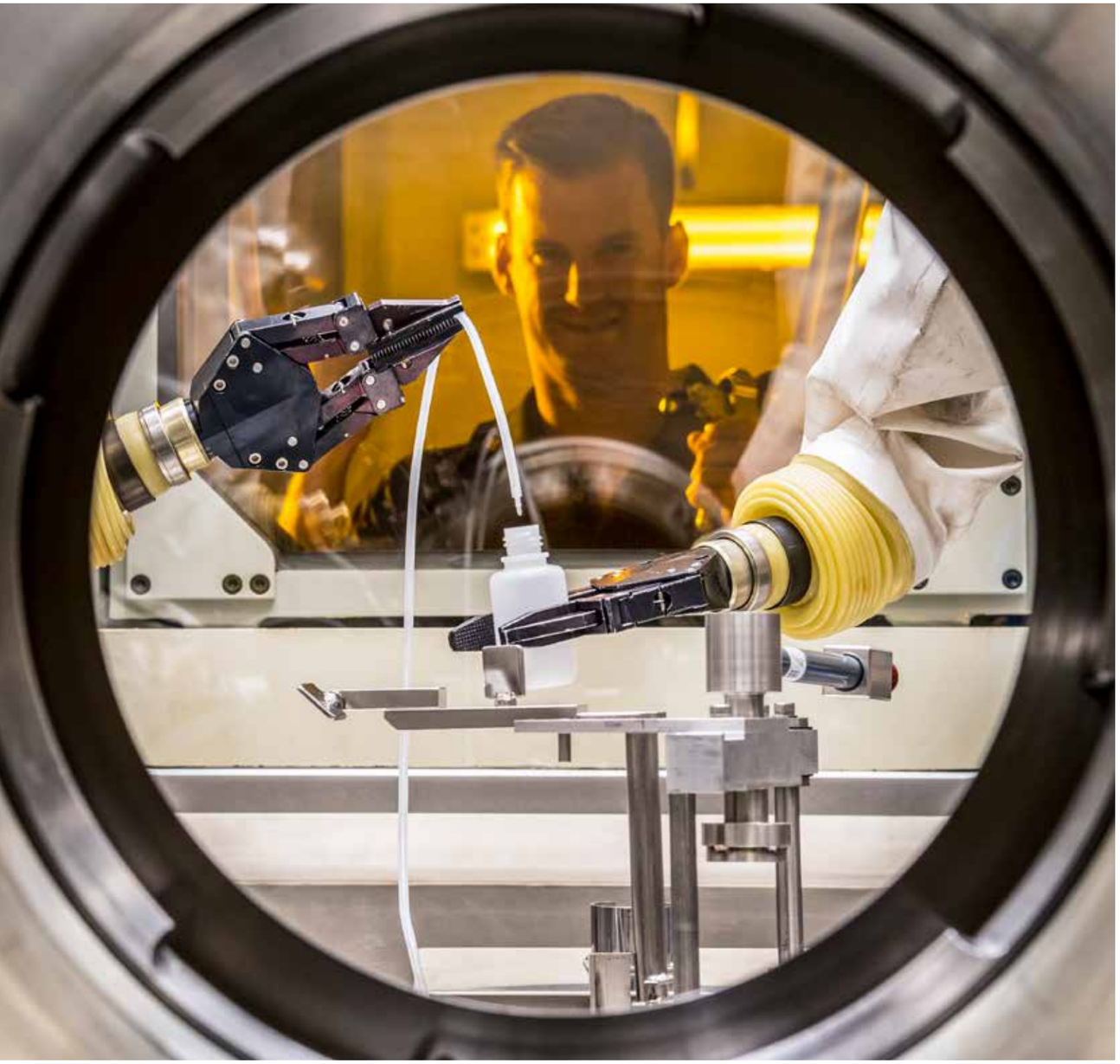
Industry groups, universities and all levels of government have been actively engaged in the planning process for the ANSTO Innovation Precinct and are excited about the opportunities it will bring, including smart jobs, a boost to the local economy, industry-experienced graduates and a drive in Australian innovation.

Growing ANSTO's research and technological facilities with a precinct at Lucas Heights has also been identified in the Greater Sydney Commission's South District Plan. The ANSTO Innovation Precinct is designated as a Collaboration Area for 2018-19 and identified as a planning priority for Sydney. The Collaboration Area will convene the Sutherland Shire Council and relevant NSW government departments and agencies to facilitate the successful establishment of the precinct, including the implementation and delivery of an infrastructure investment plan. ANSTO is looking forward to the advances that will be made in the project through the Greater Sydney Commission's Collaboration Area in 2018-19.

ANSTO has completed a draft Concept Master Plan and over the coming months, in partnership with the community and stakeholders, will continue to develop and refine the Master Plan.

Major projects

Mo-99 Production Facility



The new ANSTO nuclear medicine (ANM) facility will commence operations in 2018. The facility will enable ANSTO to significantly increase its production of molybdenum-99 (Mo-99), the precursor to technetium-99m (Tc-99m), which is used in 80 per cent of diagnostic nuclear medicine procedures worldwide – approximately 45 million medical procedures every year.

Critically, the facility will support the ongoing security of supply of these lifesaving nuclear medicines for all Australian and New Zealand patients. On average, one in two Australians will require a technetium-99m scan during their lifetime to diagnose heart disease, skeletal injuries and a range of cancers.

Globally, the Mo-99 market remains extremely dynamic, demonstrated by the unexpected and prolonged shutdowns of the South African nuclear medicine production plant in the first half of 2018 due to regulatory concerns. Additionally, most of the world's Mo-99 is still produced in ageing reactors which are unlikely to operate for more than another decade.

Volume demand in established markets is not as previously forecast, including studies conducted by the OECD Nuclear Energy Agency (NEA) under the oversight of the High-level Group on the Security of Supply of Medical Radioisotopes (HLG-MR). To support the new facility and to offset this reduced demand, potential opportunities in new and emerging markets, including China, are being explored.

Most of the world's Mo-99 is still produced in ageing reactors which are unlikely to operate for more than another decade.

Major projects

Nuclear medicine production facility

In the coming years, ANSTO will be seeking to undertake a capital program to replace its nuclear medicine production facility. The current facility at ANSTO has supplied millions of doses of lifesaving medicine to patients and doctors at hospitals and clinics across Australia, but is coming to the end of its operating life and must close relatively soon.

The facility is the final critical step in the Mo-99 manufacturing supply chain for the domestic market. In this facility, the Mo-99 from the manufacturing plant is dispensed under sterile conditions onto ANSTO-designed radiopharmaceutical generators, where it decays to Tc-99m. These generators, known as Gentech generators, are then delivered to hospitals and nuclear medicine practices across Australia and have become the mainstay of nuclear medicine in Australia.

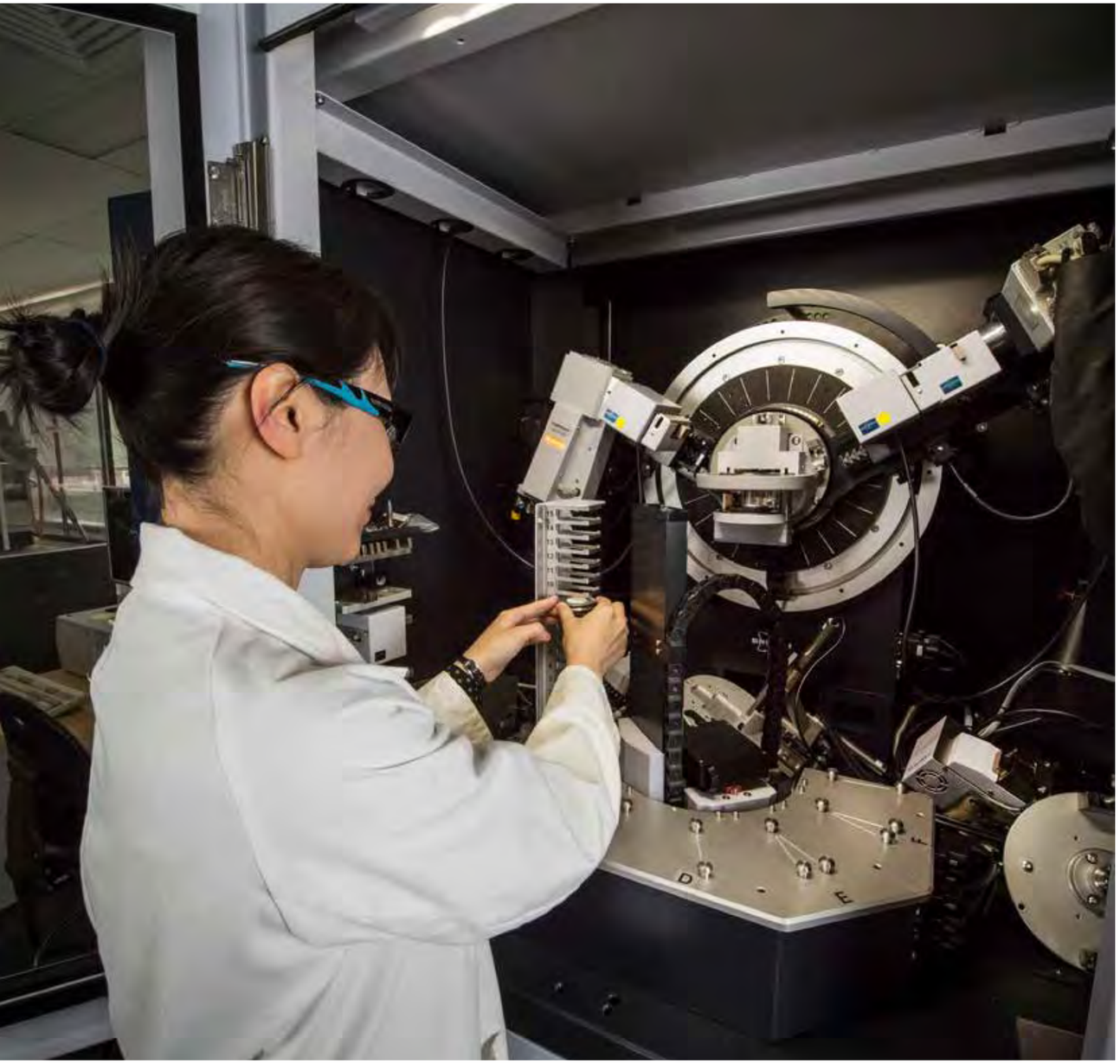
The facility also has processing capabilities for products under development or to be introduced into Australia, including lutetium-177 (Lu-177), which is currently in clinical trials for the treatment of prostate and neuroendocrine cancers.

In 2018, a mechanical failure in ANSTO's current facility caused a significant disruption in supply of Gentech generators and led to unsustainable temporary measures in the interim to supply generators to patients.

This event highlighted the increased risk to domestic and international patients as the aged existing facility reaches the end of its operating life. ANSTO will undertake a comprehensive mechanical review of the nuclear medicine production facility, which has been in operation for almost six decades, to identify actions that can be undertaken immediately to help ensure reliable operations over the short term. ANSTO is also currently developing plans for a replacement facility with additional processing lines that will not only meet current and future compliance requirements but also enable the elimination of a number of single points of failure, limiting the impact of any future mechanical faults on medicine production. The design phase of the plant will leverage domestic and international experience in order to secure the reliable future supply of a range of critical nuclear medicines. This proposed facility is a critical component in ensuring that ANSTO maintains an ongoing and reliable supply of nuclear medicine.

Major projects

Expanding our waste management capabilities



Synroc technology is an exciting Australian innovation that dramatically reduces the volume of radioactive waste compared to other methods of waste disposal. ANSTO is delivering a Synroc waste treatment plant to be co-located with the new Mo-99 production facility.

The Synroc facility will enable waste from past, current and future Mo-99 manufacturing to be treated in a permanent, safe and economical way. ANSTO is aiming for this first-of-a-kind plant to be operational in late 2020.

As well as the delivery of the Synroc plant, over the coming years ANSTO will undertake research into disposal solutions for niche waste, not currently suitable for treatment with Synroc. As the custodian of Australia's radioactive waste management expertise, there is potential for ANSTO's research and technologies to take advantage of opportunities to apply these capabilities in radioactive waste management at overseas facilities. ANSTO will also be preparing its low-level radioactive waste for disposal at the proposed NRWMF using world-class waste management and treatment facilities.

ANSTO continues to provide technical advice on the full life-cycle management of radioactive waste including operational requirements, safety case development, design parameters and governance structures. This includes advice to the Department of Industry, Innovation and Science and to the communities surrounding sites that have been shortlisted to potentially host the proposed NRWMF.

Critical interim funding provided in the 2018-19 Budget will allow ANSTO to continue to manage radioactive waste from past life-saving nuclear medicine production and research, and to carry out urgent decommissioning. This interim measure provides appropriate resources for this work to continue safely throughout 2018-19. ANSTO and the Government are working together to establish a sustainable long-term funding plan that addresses Australia's nuclear decommissioning, asbestos, spent fuel, and radioactive waste management responsibilities.

The Synroc facility will enable waste from past, current and future Mo-99 manufacturing to be treated in a permanent, safe and economical way.

Major projects

Project BR—GHT

ANSTO has worked hard to leverage the $520 million of operational funding provided to the Australian Synchrotron as part of the National Innovation and Science Agenda to secure capital investment.

The response from the Australian and New Zealand research community has been overwhelming and is testament to the importance of the facility to the Australian and New Zealand innovation and science ecosystem. To date, over $94 million has been secured from more than 25 universities, research institutes, and government agencies, which will enable ANSTO to construct eight additional beamlines at the facility, nearly doubling its research capacity. ANSTO's engineering and planning expertise is a significant part of the BR–GHT project; an integrated common systems approach is reducing cost and complications that have arisen in the past from a beamline-independent design philosophy. Detailed design of the first two new beamlines is underway, with construction expected to commence later this year. These are the microcomputed tomography (MCT) and medium energy X-ray absorption spectroscopy (MEX) beamlines.

The MCT beamline will open a window to the micron-scale 3D structure of a wide range of samples relevant to many areas of science including life sciences, materials engineering, anthropology, palaeontology and geology. A key feature will be the speed of data collection, allowing numerous samples to be imaged as well as enabling experiments where a single specimen is imaged many times to observe dynamic responses to changing conditions. The beamline will facilitate important research for Australian industry, such as analysing the microstructure of coal and coke for the mining and energy industries and the development of high-grade medical implants.

The MEX beamline will provide medium energy absorption spectroscopy on a bending magnet, optimised for cutting-edge applications in biological, agricultural and environmental science. Excitingly, it will provide an energy range not currently available to Australian and New Zealand researchers. The beamline will assist Australian industry in a number of ways, including aiding the mining industry in developing improved sulphide mineral processing and investigating sulphur in food and beverages, particularly in the form of preservatives.

These beamlines will be closely followed by a Small Angle X-ray Scattering (BioSAXS) beamline. Supported by the New Zealand Synchrotron Group's significant $25 million investment, the beamline will allow for detailed protein studies focused on improving drug design and validation processes.

Major projects

Particle Therapy

Particle therapy is a cutting edge treatment that destroys cancer non-invasively using charged ions. Particle therapy offers advantages in treatment efficacy over conventional radiotherapy using X-rays. It allows clinicians to target cancers more effectively, reducing radiation doses to healthy surrounding tissues, and has the potential to reduce the number of treatments required.

The Australian Government's welcome investment in Australia's first particle therapy facility, at the South Australian Health and Medical Research Institute (SAHMRI), will assist the South Australian Government in delivering the most mature form of particle therapy, which uses proton beams, for the first time in Australia. Proton-based particle therapy is a well-understood and well-utilised technology that was first trialled internationally in the 1950s. There are now more than 65 proton facilities internationally, and a further 40 under construction as of April 2018. Proton-based particle therapy in Australia will allow Australian clinicians to deliver effective treatments to a cohort of patients who would otherwise receive sub-optimal care.

Particle therapy is not restricted to the use of protons. Heavy ions, principally carbon (which is twelve times heavier than a proton), bring additional advantages. The targeting enhancement with carbon is significantly more pronounced than in the case of protons, allowing a greater concentration of the delivered dose into the target tumour. In comparison to proton beam therapy, the use of carbon ions has the lowest integral radiation dose and therefore can be utilised for tumours that are near vital organs and/or tissues.

Carbon ion-based particle therapy is an emerging technology being applied in Japan, Germany, Austria, Italy and China. Studies are demonstrating that patients receiving carbon ion particle therapy require fewer treatments, experience fewer side effects and achieve better outcomes compared to other treatment options. The potential for hypo-fractionation, which makes the patient experience shorter as a result of the significantly reduced number of treatments in each course, means that carbon ion treatment can potentially improve cost effectiveness. Its deployment would significantly improve patient outcomes and take Australia into a community of nations adopting the most advanced approach to cancer treatment.

In addition to the clinical benefits of carbon ions, a carbon ion treatment facility also offers much greater scope for research. Where a proton therapy facility is typically limited to just protons, a carbon facility's accelerator system is capable of delivering beams beyond protons and carbon, including helium, lithium, boron and potentially heavier ions such as oxygen. For instance, the National Institute of Radiological Science (NIRS) facility in Chiba, Japan, can deliver a comprehensive range of services, from any ion up to neon. This capability opens up a wide range of potential non-clinical research areas including advanced materials development and characterisation, space science (simulating cosmic ray radiation), fundamental physics and radiation biology. This type of facility would offer significant new research capabilities for Australia, equal to the world leaders in the field.

ANSTO is facilitating a national discussion on Australia's approach to particle therapy that encompasses the well-established proton-based technologies, and the emerging carbon ion-based technologies. This includes the creation and coordination of a National Particle Therapy Steering Group, which brings together important stakeholders from across Australia to discuss a national approach. ANSTO has collaborated in the creation of an annual Particle Therapy Symposium held in Australia, with attendees representing government agencies, health services, research organisations and universities from Australia, New Zealand and other countries. At the conclusion of the 2018 event hosted at Westmead in Western Sydney, a joint statement was released stressing the need for a national, collaborative approach to ensure the best possible outcome for Australia patients, researchers and communities.

ANSTO is also providing technical assistance and access to overseas experts through its international networks to the various state-based proposals that are being developed. In particular, ANSTO has assisted the NSW Government in developing the only proposal to date that would deliver a carbon ion particle therapy facility, at the Westmead medical precinct. ANSTO is also engaged with SAHMRI on the development of the new proton facility, and will continue to provide technical assistance.

Radiation treatment in the Heidelberg Ion-Beam Therapy Center (HIT).
Source: Heidelberg University Hospital.

Health strategy

ANSTO makes a significant contribution to the Australian public's health and wellbeing, primarily through fundamental research and the production of critical nuclear medicines. ANSTO also plays an important convening role in driving national collaborations to address some of the most significant challenges facing the medical industry.

ANSTO has completed an integrated health strategy to document how ANSTO delivers and will continue to add value across a number of innovative health-related ANSTO projects. This has been summarised into five key strategies, underpinned by three broader organisational objectives that focus on delivering health benefits to all Australians.

This integrated strategy highlights ANSTO's unique value as a body that can undertake fundamental and translational research, produce a secure supply of nuclear medicine and enable life-changing clinical trials for Australian patients. Through the utilisation of ANSTO's world-class capabilities and leading expertise, ANSTO will continue to work with collaborators to drive further commercialisation of products and services that deliver high impact clinical outcomes.

VISION

A society in which all Australians experience good health

OBJECTIVES

I Build knowledge and optimise the beneficial impacts of nuclear science on human health

II Produce current and future nuclear medicine

III Conduct and enable research for prevention, improved detection and diagnosis and treatment of disease using nuclear and accelerator infrastructure

STRATEGIES

A Increase understanding of the role of key processes that lead to the development of disease and the maintenance of good health

B Undertake research to fully characterise the impact of radiation on living matter

C Enable Australia to become a global leader in the supply of nuclear medicine

D Enhance imaging techniques to detect and diagnose disease

E Support the development of novel treatments and therapies

F Develop and support projects that drive innovation in health

TACTICS

A

1. Investigate the links between food quality and metabolism — *Emergent*
2. Develop tools to assess food provenance and quality production — *Emergent*
3. Contribute to identifying multiple environmental factors that induce complex diseases — *Established*
4. Deliver greater understanding of the impact of increasing levels of toxic substances in the environment — *Advanced*

B

1. Understand the biological response to radiation — *Advanced*
2. Increase precision and efficiency in the use of radiation — *Advanced*
3. Support the introduction of advanced radiation therapies using X rays and increase their accuracy and efficiency — *Emergent*
4. Provide stewardship activities and services for the safe and effective delivery of radiation — *Advanced*

C

1. Increase the production of radiotracers for biomedical imaging — *Established*
2. Establish a molybdenum-99 production facility — *Advanced*
3. Develop next generation radiotracers and radiopharmaceuticals for enhanced detection of disease and optimised therapies — *Established*
4. Support clinical trials into the development of new nuclear products to detect diagnose and treat cancer — *Emergent*

D

1. Undertake research to develop next generation radiotracers and radiopharmaceuticals — *Emergent*
2. Undertake research on the development of multi-modal imaging technologies — *Emergent*

E

2. Develop new capabilities by enhancing expertise, technologies and infrastructure — *Emergent*
3. Facilitate access to the Imaging and Medical and other instruments for biomedical investigations — *Advanced*
3. Provide deuteration to support development of pharmaceuticals — *Advanced*

F

1. Support research and development of particle therapy — *Emergent*
2. Contribute to development of next generation accelerators — *Emergent*
3. Advance the establishment of an ANSTO Innovation Precinct — *Emergent*

ENABLERS

Partnerships and collaborations

Infrastructure

Our People

Strategic objectives

ANSTO has established five strategic objectives that will drive and inform its capability development and service delivery over the next four years, to fulfil its purpose and functions. These objectives have been aligned with its core values to link the development of ANSTO's culture to drive outcomes that are valued in our society. They are supported by ANSTO's five year Business Plan.

1	**Putting people first**	To equip and empower our people to respond to the growing nuclear science and technology needs of Australia and the world	*Organisational renewal*	*Safety and security culture*	*Growth and development*	*Agility*
2	**World class science and technology outcomes**	To create innovative solutions to complex problems and provide new insights into our world	*Aligned research*	*Partnerships and collaboration*	*Build human capital*	*Distinct national competencies*
3	**Strategic management of landmark and national infrastructure**	To serve users, enable world-class research and create economic impact and benefit	*Meet user requirements for quality and reliability*	*Operational excellence*	*Asset management and expansion*	
4	**Nuclear and related expertise and advice**	To provide expert advice, education and services to support Australian policy and strengthen Australia's nuclear knowledge base	*Trusted advice*	*International leadership*	*Outreach and education*	
5	**ANSTO business and innovation**	Provide services and products to our customers that benefit the broader community	*Responsive service*	*Translate research*	*Realise new opportunities*	*Partner with industry*	*Engineering and nuclear consulting capability*

1

Strategic objective 1

Putting people first

To equip and empower our people to respond to the growing nuclear science and technology needs of Australia and the world.

A. Organisational renewal
To support an engaged, flexible, inclusive and empowered workforce with a focus on diversity and gender equity initiatives.

B. Safety and security culture
To continue to strengthen our commitment to provide a safe, secure and healthy workplace.

C. Growth and development
To support the learning and development objectives of our people to allow them to reach their full potential.

D. Agility
To equip and empower our people to work effectively in diverse environments and across boundaries, locally, regionally and internationally, and with industry, government, researchers and academia.

ANSTO has a diverse workforce, with more than one-third involved in research and predominately based at two sites in NSW and Victoria. Over the coming years, there may be opportunities for ANSTO to increase its presence, both nationally and globally. Having our people located across Australia and the world creates great opportunities for sharing skills and building capabilities, while presenting challenges in maintaining common values.

ANSTO is focussed on early engagement with high potential STEMM students and developing a strong pipeline of talent to support the increasing use of nuclear science and technology in areas as diverse as health, the environment and assisting industry in solving complex problems. Initiatives include the Big Ideas Forum, a STEMM role model program that provides 22 students from across Australia with an immersive, week-long experience at ANSTO's Lucas Heights campus to meet leading Australian researchers and discover first-hand the diverse uses of cutting-edge Australian science. The Girls in the Lab program is a successful work experience program run each year for 24 talented high school students from the local area, providing insight into day-to-day work of various STEMM careers, and how that work contributes to solving some of the major problems facing Australia and the world.

Additionally, ANSTO offers a number of early career entry programs to support the transition from education to employment, including trade apprenticeships, business traineeships, university student internships, a highly competitive Graduate Program and Post-Doctoral Fellowships.

ANSTO seeks to be a leader in diversity and inclusion and in early 2018 participated in the Australian Academy of Science's Science in Australia Gender Equity (SAGE) program, seeking an Athena Swann Bronze accreditation. ANSTO has committed to significant changes over the next four years to build a more inclusive and diverse workplace. Recent advancements include a staff LGBTQI+ support network; a meditation and multi-faith prayer space; a Parental Career Phase Toolkit; a Domestic and Family Violence Support program; and an Indigenous Community Working Group. Aimed at increasing the visibility of diversity data to staff, ANSTO will publish an interactive dashboard in 2018 with key diversity metrics, targets and progress available for all staff to view and explore.

Additionally, ANSTO is taking active steps to ensure that our leadership groups and influential committees have diverse representation. ANSTO understands that a flexible workplace not only enables those with different responsibilities and interests to balance demands, but also leads to better productivity and fosters an environment of innovation. ANSTO has made a number of work options to facilitate flexibility through Individual Flexibility Agreements available to staff, allowing employees and managers to be creative in meeting the needs of staff and the business.

Self-awareness and reflective learning are at the forefront of ANSTO's learning and development strategy. Over the next two years, ANSTO will roll out career management tools to assist employees in developing important competencies including collaboration, engagement and science communication. The Nuclear Science and Technology and Landmark Infrastructure (NSTLI) cluster of ANSTO has been building and piloting the suite of tools over the past year for rollout across the whole group by the end of 2018. Rollout will then be expanded across the engineering, technical, corporate and commercial areas of the organisation.

Our safety culture works within the context of a strong regulatory framework, including oversight from the nuclear regulator, the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), the Therapeutic Goods Administration, Comcare and the Australian Safeguards and Non-Proliferation Office. ANSTO will continue to engage its regulators in proactive dialogue to ensure continuous improvement in its performance across all areas.

In 2018, ARPANSA's CEO issued a Direction to ANSTO to initiate an external independent review of its nuclear medicine processing and distribution facility, particularly in relation to the quality control of Mo-99. The expert team will review the adequacy and appropriateness of current arrangements for safe operation in the facility, an important next step on a path of continuous improvement.

ANSTO has already taken actions to reduce risks including retraining, equipment replacement and modifications, event reporting, process changes and safety culture. Using recommendations from the review, ANSTO will identify further improvements to facility operations from a mechanical perspective, and further improvements to safety performance.

ANSTO will continue to develop a common work health and safety management system certified to the international standard, ISO 45001. ISO 45001 was published in early 2018, and ANSTO is leading the way in its application in Australia. This standard will allow for smooth integration with other existing management systems, such as quality, environment and risk, due to a common system structure. ANSTO's focus is to have a work health and safety management system that both exceeds the latest standards and provides practical guidance on maintaining a safe and healthy workplace for all our staff. An audit of ANSTO's Clayton campus was successfully completed earlier in the year; an audit of ANSTO's Lucas Heights campus is to be conducted in late 2018 which will be the final step prior to certification.

ANSTO has made a commitment for the organisation to comply with the requirements as described by the International Atomic Energy Agency (IAEA) Safety Standards Series publication No. GSR Part 7, *Preparedness and Response for a Nuclear or Radiological Emergency* (2015). This is a significant body of work and it will ensure we operate under a common framework for radiological emergency preparedness and response.

ANSTO recognises that there is no room for complacency with nuclear security, and that a mature nuclear security culture directly contributes to a safe and secure workplace. Following the success of the 2017 IAEA International Physical Protection Advisory Service (IPPAS) peer-review mission, ANSTO will continue to foster a strong security culture to protect its people, information, assets, nuclear material and reputation. To achieve this, we will explore innovative solutions to improve preventative and protective security measures, including insider threat indicators, at all levels throughout the organisation to positively enable ANSTO's commercial operations and research endeavours.

Strategic objective 2

2 World class science and technology outcomes

To create innovative solutions to complex problems and provide new insights into our world.

A. Aligned research
To engage in research that has scientific and commercial priorities, with a focus on human health, the environment and the nuclear fuel cycle.

B. Partnerships and collaboration
To build strategic partnerships and collaborations to leverage more effective research and innovation outcomes for Australia.

C. Build human capital
To develop the next generation of nuclear engineers and scientists using nuclear techniques and the graduate and post-doctoral career pipeline, and to promote STEMM careers in Australia.

D. Distinct national competencies
To leverage ANSTO's nationally distinctive capabilities for the national interest.

ANSTO undertakes research and development that responds with agility to the important issues and key challenges facing Australia. ANSTO applies its unique nuclear expertise to research in areas of national priority including human health, environmental sustainability and the nuclear fuel cycle.

ANSTO's world-class scientists lead important mission-based research utilising ANSTO's landmark facilities. These projects are focused on research that aligns with the National Science and Research Priorities as well as improving platform capabilities. ANSTO's mission-based research reflects the organisation's commitment to using its expertise to provide solutions to some of the greatest challenges facing Australia and to remain at the forefront of international nuclear-based research and innovation.

ANSTO conducts a program of research in the key areas of Defence Industry and National Security Research. ANSTO's collaborative research supports the development of the defence industry and strengthening national capabilities. ANSTO will look to continue strengthening its participation in Australia's defence industry through research and development, capitalising on ANSTO's key capabilities and expertise. Advancing its existing partnership with the Defence Science and Technology Group (DSTG) is a priority for ANSTO. Additionally, as a founding core participant in the Defence Materials Technology Centre (DMTC), ANSTO will continue to look for further research projects to participate in, building on years of project engagement.

ANSTO Synroc continues its development of technologies for immobilisation of existing and potential new waste streams from nuclear processes. The technologies are being tested in an engineering demonstration plant using high fidelity surrogate waste streams. This engineering scale facility is a one to one replica for the Synroc Facility that will immobilise the intermediate level liquid waste by-product from ANSTO Nuclear Medicine (ANM) radiopharmaceutical production.

ANSTO has been the standards body for radioactivity measurement in Australia for over 50 years. The technical function for measuring radioactivity is housed within Radionuclide Metrology, where scientists employ unique, highly specialised radiation detection techniques to carry out precise measurements of radioactivity without reference to a calibration. A major capital investment has funded a capability upgrade, enabling Radionuclide Metrology to increase its portfolio of primary standards and keep up with the evolving metrology requirements of the Australian nuclear medicine community, ensuring they have access to precise standards for measurement of radiopharmaceuticals administered to patients.

ANSTO also works with radiopharmacies to ensure the provision of correct radiopharmaceutical activities to nuclear medicine practices and compliance with legislative trade measurement provisions. Additionally, the radionuclide metrology group operates a program that offers annual traceable measurements and calibration services to nuclear medicine practices, underpinning the accurate and reliable administration of radiopharmaceutical doses to patients and assisting with regulatory compliance.

ANSTO will continue to participate in its existing strategic national and international research collaborations to ensure Australian scientists are connected to a global network of experts and important global research projects. These important partnerships give Australian scientists access to some of the world's most sophisticated research infrastructure, techniques and researchers, enabling discoveries that benefit Australia and the world.

Conducting research with a wide range of partners where key synergies or shared goals have been identified enables ANSTO to make significant contributions in a range of scientific and engineering fields. In metrology for instance, ANSTO has worked with the National Measurement Institute (NMI) and the University of New South Wales to improve understanding of the interface and structure of the stabilising ligand layer of gold nanoparticles. The information is important for understanding measurements obtained using routine particle sizing techniques. These types of measurements are used to inform how the particle size or layers may be controlled or manipulated, and have various applications including drug development, cement manufacture and food production.

At a global level, ANSTO has worked with the Instituto Nazionale di Recerca Metrologica (Italy), the University of Pavia (Italy) and the National Metrology Institute of Germany on a seminal project to redefine the fundamental measurement of the kilogram in terms of a universal constant. The resulting paper was selected by the international group, Cooperation on International Traceability in Analytical Chemistry (CITAC), as the Best Paper in 2017.

ANSTO has a long established and highly collaborative relationship with CERN through a Memorandum of Understanding (MoU) that was signed more than 20 years ago. ANSTO holds this MoU on behalf of Australia. CERN operates the world's largest accelerator, the Large Hadron Collider (LHC). ANSTO's strategic collaboration with CERN allows Australian scientists to connect with important global research projects, benefit from cutting-edge research, and develop expertise through the use of CERN's particle accelerator platforms and large-scale accelerator facilities, particularly in the ATLAS collaboration. However, obtaining the maximum benefit from engagement in this project will require further investment.

In the coming years, ANSTO will continue to mature and grow its partnerships in alignment with its strategic priorities.

2

Strategic objective 2

World class science and technology outcomes

Nuclear Fuel Cycle

Research under this theme extends to all aspects of the nuclear fuel cycle, and currently includes:

1. the development of improved fuels for advanced reactor designs;
2. investigation of materials for use in nuclear systems, structures and components, and the effects of irradiation and high temperature on their structural properties; and
3. advancing the understanding of back-end fuel cycle processes.

This research takes advantage of ANSTO's unique capabilities including specific expertise in waste forms, the capacity to undertake theoretical predictions of fuel properties, and other nuclear materials expertise. The current focus on properties of accident-tolerant fuels and inert matrix fuels has strengthened scientific collaborations with industry and other research groups and created the potential for commercial linkages.

In June 2016, Australia became the fourteenth member of the Generation IV International Forum (GIF). GIF is a consortium of advanced nations committed to collaborative long-term research on advanced nuclear power reactor technologies that will provide enhanced safety, security and non-proliferation characteristics, and improved efficiency and economics.

Australia's participation in GIF will, at minimal cost, enable the nation to benefit from involvement in this major international research program, which has the potential to develop reactor designs which will further Australia's non-proliferation and nuclear safety objectives. It will also ensure that Australia has a full understanding of these technologies as they are rolled out across the world in the coming decades, including throughout the Asia Pacific region.

Australia's accession to the GIF Framework Agreement took effect on 13 December 2017, enabling Australia to participate fully in GIF research and development activities. Research will focus on the Very High Temperature Reactor (VHTR) and Molten Salt Reactor (MSR) systems. ANSTO's ongoing involvement utilises its extensive experience and expertise in materials engineering and structural integrity research. ANSTO staff are also leading and coordinating a cross-cutting GIF activity investigating how Advanced Manufacturing and Materials Engineering could be used to reduce the deployment time of Generation IV reactors.

Australia will host important GIF meetings over the next two years, including one of the bi annual Policy Group and Experts Group meetings. Over the coming years, ANSTO will also look to participate in other high level GIF activities including the GIF Risk and Safety Working Group, as well as public education and communication in line with GIF outreach.

Environment

Research under this theme applies nuclear-based techniques to fill critical knowledge gaps which will inform sustainable management strategies and capacity to respond to environmental challenges. ANSTO's focus currently includes:

1. water resources sustainability;
2. environmental change
3. contaminant impacts.

The **Water Resources Sustainability** program focuses on the delivery of science-based outcomes for Australian industry and contributes expertise to international projects. An example of this work is our partnership with the NSW Department of Primary Industries and the University of New South Wales on sustainable seafood production research. Outcomes of this study will contribute to the National Marine Science Plan to help provide sustainable aquaculture management decisions. Internationally, we continue to provide targeted expert scientific training to the Asia-Pacific region through the International Atomic Energy Agency-sponsored project on the use of isotopic tools to understand groundwater resources.

The **Environmental Change** program will continue to deliver a better understanding of climate variability in key areas of agricultural production in Australia. Cave studies and monitoring programs, complemented by key studies on lake sediments from the Westerly Winds zone (bringing winter rain to key agricultural areas of southeast Australia and southwest Australia), will provide new and more detailed insights on the variability of the climate. This work is in partnership with the University of New South Wales and further funded by a collaborative Australian Research Council (ARC) - Discovery grant with the University of Melbourne.

The **Contaminant Impacts** program is delivering research outcomes as part of the East Australia Air-Monitoring Program. The program contributes to the World Meteorology Organisation's baseline air pollution station by measurement of the naturally occurring radioactive tracer radon-222. The group also delivers a much deeper understanding of the behaviour of radionuclides in waste legacy sites around the world, by providing a targeted research example in Australia. The program also provides radionuclide transfer and dose parameters for Australian site conditions to assist in meeting new Australian guidance for radiological protection of the environment.

Human Health

Research under this theme aims at reducing the risks which lead to population health impairment and disease. Focus currently includes:

1. investigation and early mitigation of environmental (biological, chemical, physical and societal) risk impact on health
2. the development of new tools to deliver highly effective and lifesaving therapies to patients
3. generation of knowledge and methods to maintain good health through improving food quality and function.

In response to the needs of society, ANSTO has developed an integrated strategy for health, which will leverage ANSTO's suite of research infrastructure to develop new treatments, enhance engagement in clinical trials and increase ANSTO's focus on prevention through food and nutrition. More information on the strategy can be found on page 26.

In partnership with international and national institutions, such as the University of Wollongong, ANSTO is also undertaking important research to improve the effectiveness of radiation therapies, including the development of a new hybrid technique that enhances the effectiveness of an advanced form of radiation therapy for cancer. The process involves injecting a patient with a neutron capture agent shortly before irradiation with proton or heavy ion therapy, which boosts the target dose without impacting surrounding healthy tissues. Simulation data has shown promising results, demonstrating the capability for targeting deep seated tumours that are often too difficult to reach.

Using a range of platforms, including deuteration techniques available at the National Deuteration Facility (NDF), ANSTO will continue to focus on the development of novel strategies to increase the range and efficiency of radiopharmaceuticals. Over the coming years, ANSTO will seek to enable researchers to investigate novel radioisotopes such as alpha emitters, which would open up a new class of radiopharmaceuticals.

ANSTO's total-body imaging research program based on the PET-Explorer prototype is designed to be 40 times more sensitive than current state-of-the-art scanners. Critically, this new prototype allows all organs and tissues in the body to be seen at once using only background-level radiation exposure. In bringing this new technology to its full potential in partnership with the University of Sydney and the National Imaging Facility, ANSTO will deliver a powerful tool for disease evaluation in vulnerable populations and long-term preventive care.

In mid-2017, ANSTO signed a MoU with Sri Lanka to facilitate work between ANSTO and the Sri Lankan Presidential Taskforce to investigate the epidemiology of chronic kidney disease of unknown aetiology CKDu. CKDu has emerged as a significant public health issue in Sri Lanka, with an estimated 1,500 people dying from the disease each year. This disease disproportionately affects agricultural workers, the majority of whom are male, between 40-60 years of age and do not suffer from conditions associated with kidney disease, such as diabetes or hypertension. The only available treatments at present are dialysis and kidney transplant, which place a substantial strain on the country's health system.

ANSTO facilitates this collaboration by bringing together skilled nephrologists, physiologists, public health and environmental researchers to use its world-class nuclear science infrastructure. ANSTO is specifically facilitating research into the hydrogeological, demographic, and toxicology aspects of CKDu.

3

Strategic objective 3

Strategic management of landmark and national infrastructure

To serve users, enable world-class research and create economic impact and benefit.

A. Meet user requirements for quality and reliability:
To provide excellent user experience and engage users in future capability development.

B. Operational Excellence:
To provide effective and efficient utilisation, best practice facility operation and continual improvement.

C. Asset management and expansion:
To strategically plan and invest in the lifecycle and development of landmark and national research infrastructure to serve the needs of users, collaborators and partners.

The strategic development, effective use and maintenance of ANSTO's research infrastructure are crucial to Australia's economic and social prosperity. The Australian Government has committed to further investment in research infrastructure through the National Research Infrastructure Investment Plan. The will result in strategic investment into ANSTO operated facilities including ACNS, the Centre for Accelerator Science (CAS), NDF and the National Research Cyclotron Facility.

As custodian of these nationally important facilities, ANSTO has a strong mandate to operate them to ensure maximum utilisation, enable world-class research and deliver real-life benefit and impact. Under a range of access arrangements, ANSTO delivers research outcomes aligned with its research mission, often in partnership with external researchers.

ANSTO continues to develop access programs to ensure that the scientific and technical needs of users are well supported. Outreach, training and workshops, including a program of ANSTO User meetings, will be strengthened as part of the ANSTO User Experience program. An eResearch (or digital research infrastructure) strategy has been developed and will support researchers through the entire user experience – from scientific concept to innovation and impact. Reinforcing best practice user-focused support enables excellent science discovery and delivers innovation outcomes that benefits the nation.

The ANSTO Research Portal (ARP) continues to provide the national and international user community with access to all of ANSTO's landmark and national research infrastructure. Continuing development will result in evolution of the ARP into a broader research management system, including greater capability to provide usage and performance metrics, grant management and publication analysis.

Over the coming years, ANSTO will continue to grow Australia's neutron scattering capabilities. In 2019, the installation of the SPATZ neutron beam instrument will be completed, after being gifted and transferred from Helmholtz-Zentrum Berlin. The instrument complements existing capabilities and will be used for a wide range of applications in biomedicine, energy and materials science. ANSTO will also commence scoping studies for new neutron beam capabilities, to be housed within a second neutron beam guide hall. The second guide hall was identified as a priority for Australia in the 2016 National Research Infrastructure Roadmap.

The Federal Budget provided $7.7 million to ANSTO in 2018-19 to support critical radioactive waste management and decommissioning programs. These programs underpin ANSTO's nuclear science and technology activities and are fundamental to ensuring ongoing regulatory and community support. Importantly, the funding will allow ANSTO to continue to work with Government to establish a long-term funding plan for Australia's decommissioning, asbestos and radioactive waste management; and spent fuel responsibilities.

Additionally, over the coming years, ANSTO will be undertaking essential upgrades to critical site infrastructure that is ageing and deteriorating to maintain safety and efficiency.

TABLE 2

Performance measures as per the Australian Government Portfolio Budget Statements 2018-19, Industry, Innovation and Science portfolio.

		2018-19	2019-20	2020-21	2021-22
Full utilisation of Landmark Infrastructure					
OPAL	Days	300	285*	300	300
Australian Synchrotron	% of availability	95	95	95	95
Neutron beam instruments	% of availability	85	85	85	85
Accelerators	% of availability	65	65	65	65
Human health products					
Radiopharmaceutical doses	Potential doses	3,086,776	3,764,828	3,877,650	3,993,856

** due to scheduled shutdown for maintenance*

*** The target figures reported in last year's Corporate Plan included forecast doses for the ANM facility. The 2018-19 Corporate Plan reflects updated figures. ANSTO is reviewing the method used to estimate doses based on changes in utilisation in clinical practice.*

3

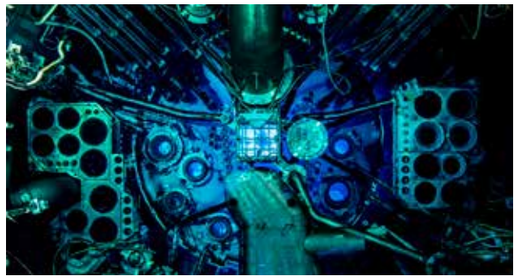
Strategic objective 3

Strategic management of landmark and national infrastructure

ANSTO's landmark and national research infrastructure

ANSTO operates a large proportion of Australia's landmark and national research infrastructure. This multi-user, multi-disciplinary, multi-decadal infrastructure places Australia at the forefront of innovation for the benefit of public health, industry and the environment.

OPAL multi-purpose reactor



LUCAS HEIGHTS CAMPUS | NSW

As one of the world's newest and most productive multi-purpose reactors, OPAL:

- Produces 85 per cent of Australia's life-saving nuclear medicines, which will be required on average, by one in two Australians.
- Supplies neutrons for research at the Australian Centre for Neutron Scattering.
- Produces 48 per cent of the world's irradiated silicon used by the semiconductor industry in high-reliability and high-precision applications, such as fast trains and hybrid cars.

In 2018, ANSTO received ARPANSA approval for three projects that enabled an increase in the reactor power to 20 MW. The approvals have allowed a revision of the safety case and an increase in the fuel temperature limit. The implementation of these changes has optimised reactor capacity for irradiations and neutron based research.

Australian Centre for Neutron Scattering (ACNS)

LUCAS HEIGHTS CAMPUS | NSW

- ACNS uses neutrons from the OPAL reactor to help Australian industries solve complex problems, and enables research into areas of national importance including health and materials engineering.
- ACNS is a global leader in neutron science and is home to 15 neutron beam instruments.
- It services more than 1400 domestic and international visits each year.

Australian Synchrotron

CLAYTON CAMPUS | VIC

- The Australian Synchrotron uses accelerator technology to produce a powerful source of light, a million times brighter than the sun.
- The beamlines can be used for a wide variety of research purposes including human heath, agriculture and manufacturing.
- The Australian Synchrotron hosts more than 5000 researcher visits annually.

Centre for Accelerator Science (CAS)

LUCAS HEIGHTS CAMPUS | NSW

- Ion accelerators have a vast array of applications and can be used for everything from agriculture to zoology.
- Accelerator science is now more important than ever in addressing challenges of climate change and particle pollution, and in detecting and preventing nuclear proliferation.
- Funded in part by the National Collaborative Research Infrastructure Strategy (NCRIS), CAS houses four world-class accelerators and is the largest centre of its kind in the southern hemisphere.
- CAS welcomes several hundred users annually.

National Research Cyclotron Facility

CAMPERDOWN CAMPUS | NSW

- The Cyclotron is operated by ANSTO and is used by researchers from a wide range of organisations, universities and industry.
- The National Research Cyclotron Facility forms the centrepiece of the ANSTO/University of Sydney node of the National Imaging Facility and was Australia's first cyclotron dedicated entirely to biomedical research.
- This facility produces radiotracers and radiopharmaceuticals that enable researchers to make profound discoveries about the mechanisms and diagnosis of human disease, as well as potential treatments.
- In 2017, radiotracer supply supported more than 150 national and international users.

4

Strategic objective 4

Nuclear and related expertise and advice

To provide expert advice, education and services to support Australian policy and strengthen Australia's nuclear knowledge base.

A. Trusted advice
To assist the Australian Government in protecting the national interest through the provision of specialised advice and support; and provide accessible information to enhance public knowledge of ANSTO's work.

B. International leadership
To engage with key international nuclear organisations and contribute to global and regional nuclear discussions, implementing Australian Government policy and ensuring that Australia remains a nuclear science and technology leader.

C. Outreach and education
To provide resources that meet the needs of the education and academic communities, and demonstrate the benefits of nuclear science and technology to the wider community.

Under the *ANSTO Act*, and as the custodian of Australia's nuclear expertise, ANSTO engages with the community and a wide range of stakeholder groups at all levels, both within Australia and internationally. ANSTO provides trusted advice and support to Government, and liaises with the international community on nuclear issues on behalf of Australia.

As mandated by the *ANSTO Act*, ANSTO plays a vital role in providing expert advice to the Australian Government on all matters relating to nuclear science, technology and engineering and related matters. ANSTO also contributes to and informs policy-making in this area. This is achieved through frequent engagement with ANSTO's responsible Ministers and their offices, the Department of Industry, Innovation and Science and the Chief Scientist of Australia.

Expert and technical advice is also provided across Government, particularly to the Foreign Affairs and Trade portfolio in the areas of peaceful uses of nuclear energy, nuclear security and nuclear non-proliferation. ANSTO also contributes to major policy inquiries and expert working groups to support the broader national science and innovation policy environment. Over the course of the coming year, ANSTO will continue to provide technical support and advice to the National Radioactive Waste Management Facility project as requested.

As well as supporting the Australian Government's interactions with the International Atomic Energy Agency (IAEA), ANSTO provides direct support to the IAEA in a number of areas. ANSTO staff serve on high-level committees and participate in IAEA missions and activities in the areas of nuclear security, nuclear safety, nuclear law, environmental studies, human health and waste management. ANSTO acts as the interface between the IAEA and Australia on all matters related to nuclear applications and technical cooperation.

ANSTO also has strong involvement with the OECD Nuclear Energy Agency (NEA), based in Paris, including representation on its Steering Committee for Nuclear Energy (the highest policy-setting body) and the Nuclear Development Committee.

We also continue to engage in the NEA's High-Level Group on the Security of Supply of Medical Radioisotopes, which is the major forum for engagement with the global nuclear medicine industry. ANSTO will also continue to coordinate Australia's contribution to the Forum for Nuclear Cooperation in Asia, sharing experience and knowledge on the peaceful applications of nuclear technology in our region. Ongoing support for Australia's participation in the Global Initiative to Combat Nuclear Terrorism will continue to position ANSTO as a leader in nuclear security issues.

Additionally, ANSTO has a comprehensive education and outreach program, connecting with thousands of high school and primary school students and teachers each year. Activities include tours of the facilities tailored to school curricula, school incursions, virtual tour programs and a range of educational events. ANSTO also acts as an expert advisor to the IAEA on the development of education and outreach materials for developing countries.

ANSTO provides information to stakeholders and engages the wider community through a variety of activities and events. This includes our Fact or Fiction shows and Citizen Science programs, through our web and social media platforms and traditional media.

5

Strategic objective 5

ANSTO business and innovation

Provide services and products to our customers that benefit the broader community.

A. Responsive service
To operate our businesses to effectively serve our clients and the community.

B. Translate research
To leverage and translate research outcomes into new products and services.

C. Realise new opportunities
To serve new markets, create opportunities and introduce new products and services for the benefit of the Australian people and industry nuclear science and technology to the wider community.

D. Partner with industry
To respond to the needs of industry to drive Australian innovation

E. Engineering and nuclear consulting capability
To expand and serve new opportunities in nuclear decommissioning and new research reactor projects.

ANSTO manufactures and distributes nuclear medicines throughout Australia, and increasingly to hospitals and clinics overseas. These products are used in a variety of nuclear medicine imaging scans to help diagnose a wide range of cancers and heart, brain, bone, lung and endocrine diseases. ANSTO also produces and distributes therapeutic nuclear medicine products. Therapeutics provide an alternative approach for cancers that are difficult to treat. This rapidly growing area of nuclear medicine represents an important opportunity to deliver better outcomes for Australian patients.

Currently, ANSTO supplies approximately 85 per cent of the nuclear medicines used in diagnostic scans in Australia. ANSTO currently delivers the equivalent of 11,000 patient doses of Tc-99m, the most widely used nuclear medicine, across Australia each week.

Over 2018-2019, ANSTO will increase the supply of therapeutic agents to the domestic market, as well as continuing to provide a reliable supply of nuclear medicine for diagnostic scans. This security of supply will provide accuracy and speed of diagnosis for Australian patients, which in turn ensures they receive the most appropriate clinical management and treatment of debilitating and life-threatening conditions.

ANSTO will continue to work with domestic and international partners to improve access to established and new nuclear medicine products to facilitate medical treatments in Australia, developing countries in the Asia-Pacific and the broader global community.

With a large and growing population, China is highly motivated to develop its domestic capability around the use of nuclear medicine products. ANSTO is well situated to play an important role in supporting the growth of cost-effective diagnostic imaging isotopes, as well as highly effective therapeutic products. Over the last couple of years, ANSTO has been focused on establishing strong relationships with a range of strategic stakeholders in the Chinese nuclear medicine community. The aim is to position ANSTO to enable it to capitalise on predicted future growth in the Chinese nuclear medicine market.

ANSTO is focused on being the pre-eminent national radiation safety training centre in Australia. As a high-calibre and comprehensive expert in radiation protection and instrument calibration, ANSTO is well placed to provide consultancy services, resulting in a favourable outlook for the continued growth of this area.

ANSTO provides consulting and process development services to the minerals industry, in addition to conducting long-term R&D focused on the needs of future clients. ANSTO Minerals has specialised facilities where laboratory studies and pilot scale operations can be conducted. These activities provide added value to customers in a range of minerals areas, including minerals containing naturally occurring radioactivity and minerals processing operations with complex metallurgy.

ANSTO has been able to enhance value for key projects in Australia and overseas and will continue its focus on strategic metals, including uranium, rare earths and lithium. Utilising their expertise along with new technologies, ANSTO Minerals can overcome challenges of lower grades and more complex ores. This is critical to advancing projects and ensuring ongoing world supply of these critical materials.

Utilising the OPAL multi-purpose research reactor, ANSTO supplies the world's most reliable silicon irradiation services to provide clients with the highest quality neutron transmutation doped (NTD) silicon. This NTD silicon is for special applications in high-powered microelectronics, including in fast trains, electric cars and high voltage switching gear. The silicon ingots are delivered by customers to ANSTO, irradiated in the OPAL reactor and returned back to customers for use further along the microelectronics supply chain. ANSTO has almost 50 per cent of the global market share for NTD silicon, achieved through a dedicated focus on improving logistics and meeting customer needs in a cyclical market.

TABLE 2

ANSTO subsidiaries operate in the context of the Corporate Plan to enhance our capabilities or provide transitional arrangements as we reorganise our activities.

ANSTO subsidiaries	Juristiction of operation	Status
Australian Synchrotron Holding Company Pty Ltd	Victoria	Will be deregistered following the termination of its role during FY19
Synchrotron Light Source Australia Pty Ltd	Victoria	Deregistered as of 24 June 2018
PETTECH Solutions Pty Ltd	New South Wales	Operating provider of cycltron-based nuclear medicines
ANSTO Nuclear Medicine PTY Ltd	New South Wales	Will undertake production of Mo-99 following commissioning of the new ANM facility in 2018-19
ANSTO Inc.	Delaware, USA	Inactive

Organisational capabilities and framework

Integrated Business Planning

Integrated business planning combines our commitment to customers and partners, effective planning for predictable outcomes and responsive operations to continuously improve our products, processes and operations. At the organisational level, ANSTO deploys the excellence approach and key performance indicators to plan, deliver and report on our progress and alignment with strategy. This approach ensures attention to all stakeholders and customers through integrated planning of supply and demand reconciled against financial outcomes with a 36 month rolling forecast and five year plan.

The ANSTO Enterprise (Ae) program has delivered a robust platform digitising and integrating ANSTO's processes and systems, and implemented best practice processes. The implementation of a new SAP suite of applications, the core component of Ae, has become a pillar for ANSTO's digital transformation. The Clayton campus rolled out Ae in July 2018.

With Ae, ANSTO has a unified, connected enterprise system to underpin key processes throughout the organisation. It has harmonised asset management processes across our campuses and for our national and landmark infrastructure. The deployed learning management system provides transparency on the training status of all staff, a financial planning/forecasting system and a digital travel management system. The Ae systems include tools to provide better planning, governance and transparency across our capital portfolio and projects. The enabling tools include systems that support ANSTO's supply chain and Integrated business planning processes such as demand planning, supply planning, manufacturing of Nuclear Medicines, OPAL reactor scheduling and quality management.

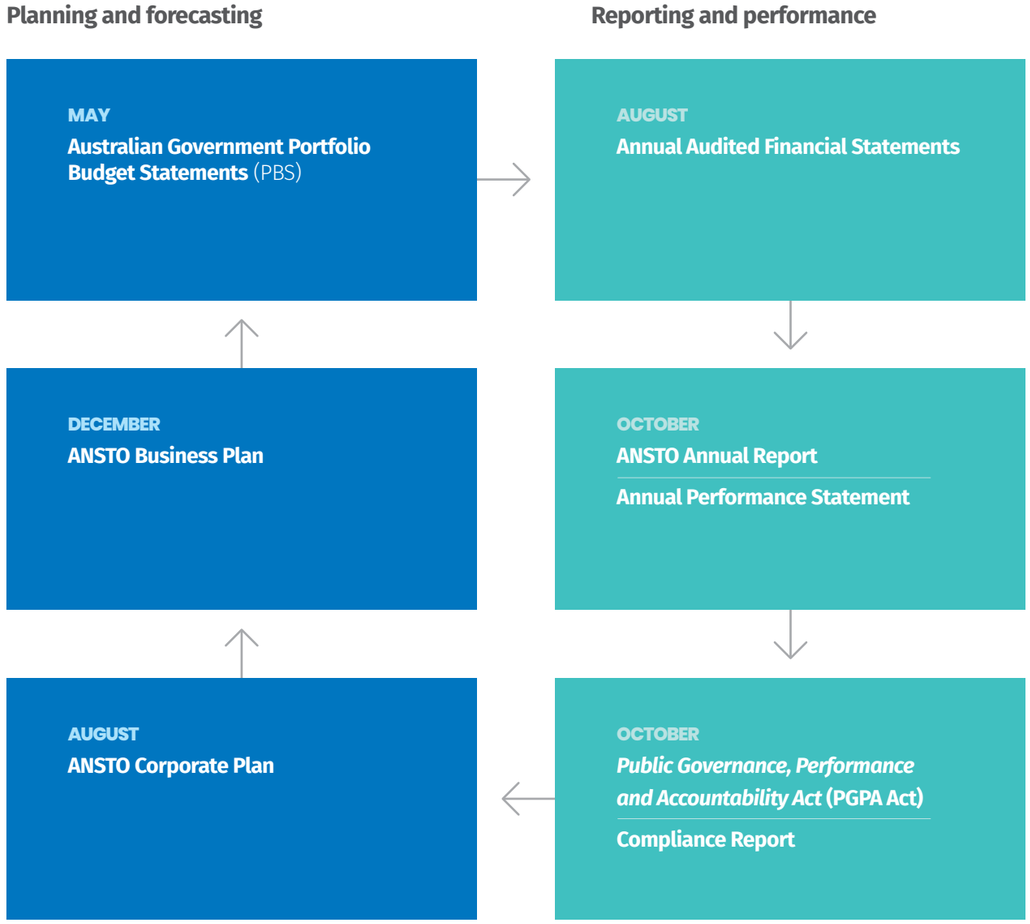
A new digital on-boarding system has provided a transformed user experience to new employees and non-employees joining ANSTO. With Ae's digital systems, ANSTO managers now can perform many of the time-critical processes simply by using their mobile phones, improving process velocity. With Ae, an effective customer and stakeholder management system has been deployed, which is ensuring that industry-facing ANSTO team members can effectively nurture stakeholder relations.

The digitisation and integration of end-to-end systems and processes are aimed at achieving long term efficiencies, as well as enabling greater transparency to minimise operational surprises.

Ae has delivered a reliable information and decision-making support mechanism for ANSTO's current capabilities and operational needs with a solid digital backbone for the future.

Business planning framework

ANSTO's business planning cycle and framework respond to the Public Management Reform Agenda. It ensures the coherence of our planning and agreed timescales in the annual cycle.



Governance and risk management

The ANSTO Board provides oversight of ANSTO's systems of risk management, compliance and internal control; and also sets ANSTO's risk appetite and tolerance. Management is accountable to the Board for implementing, monitoring and continuously improving these systems, and for their integration into the day-to-day activities of the organisation.

ANSTO employs a comprehensive Enterprise Risk Management (ERM) Framework that is aligned with contemporary risk management thinking and global best practices.

ANSTO's compliance landscape is complex. Consequently, compliance management is a key component of our internal control and risk management frameworks.

At executive level, the Risk Oversight Committee (a sub-committee of the Executive Standing Committee) is responsible for oversight of governance, risk and compliance.

The ANSTO Board has a Risk and Audit Committee in compliance with section 16 of the *Public Governance Performance and Accountability Act 2013* (PGPA Act).

The Committee provides independent assurance and assistance to the Board on the appropriateness of ANSTO's systems of risk oversight and management, and systems of internal control, and its external accountabilities and legislative compliance.

The primary duties of this Committee are overseeing the adequacy and effectiveness of ANSTO's:

- governance framework
- risk management process and framework – including insurance arrangements and business resilience
- fraud, corruption prevention and business ethics strategies
- overall internal control environment and specific elements of the control environment – including the optimisation of assurance coverage through the adoption of a combined assurance model, legal and regulatory compliance management process and framework
- quality, safety and environmental management systems and performance
- external financial reporting
- Internal Audit function – including approval of Internal Audit plans, review of Internal Audit reports and monitoring management's implementation of Internal Audit recommendations.

ANSTO endeavours to understand and effectively manage risks to minimise losses while maximising opportunities. ANSTO takes a structured, consistent and ongoing approach to risk and compliance management and consistently strives to improve its risk management practices, risk awareness and risk culture. Effective risk management is viewed as essential to achieving our strategic and business objectives, by understanding and appropriately responding to threats and opportunities to the ANSTO Group.

At executive and management level, the Risk Oversight Committee is responsible for oversight of governance, risk and compliance. ANSTO aligns its risk oversight and management practices to relevant standards and frameworks, including:

- Australian / New Zealand Standard ISO 31000:2009 (Risk Management Principles and Guidelines)
- Commonwealth Risk Management Policy 2014
- Australian/New Zealand Standard ISO 19600 (Compliance Management System)
- Fraud Control Plan
- COSO Internal Control – Integrated Framework (Internal Control)
- Australian / New Zealand Standard ISO 9001 (Quality Management System)
- Therapeutic Goods Administration standards
- ARPANSA (in full) licencing and safety requirements

ANSTO is committed to the effective management of risk in pursuit of strategic objectives, in line with stakeholder expectations. This is achieved through the implementation and consistent application of a comprehensive enterprise risk management (ERM) framework. This framework is supported by the ANSTO Risk Appetite Framework, the Risk and Audit Committee, the Risk Oversight Committee, ERM processes and supporting tools, ERM performance requirements and Executive / Board reporting.

ANSTO policies seek to provide fit-for-purpose risk management procedures, empowerment of staff through learning and the development of risk management skills and competencies as well as monitoring, reviewing and reporting on ANSTO's risk management performance.

In alignment with ANSTO's Risk Management Policy and ERM Framework, the ANSTO Business Resilience Framework provides a method for managing disruptions to key business processes, as well as providing the opportunity to enhance ANSTO's resilience program.

ANSTO Business Recovery Plans (BRP) are used to develop pre-planned responses that can be used as a guide for the recovery of critical business functions and activities. In 2018, ANSTO Health's BRP was a key guiding document for the management strategy in addressing disruptions to ANSTO's generator production as a result of a mechanical fault in ANSTO's technetium-99m Gentech Generator production line. In accordance with the BRP, strong mitigation strategies to minimise the impact on patients were implemented immediately and included securing generators from ANSTO's American partner, LMI, to ensure ongoing supply to Australian patients. Regular communication with all customers and professional societies including the Australia and New Zealand Society of Nuclear Medicine also assisted physicians in managing the disruption and allowed for the triaging of available supply to where the need was greatest.

The Board of ANSTO Nuclear Medicine Pty Ltd also has a Risk and Audit Committee that undertakes a similar role to the Risk and Audit Committee of the ANSTO Board.

ANSTO endeavours to understand and effectively manage risks to minimise losses while maximising opportunities. ANSTO takes a structured, consistent and ongoing approach to risk and compliance management and consistently strives to improve its risk management practices, risk awareness and the overall risk culture. Effective risk management is viewed as essential to achieving our strategic and business objectives, by understanding and appropriately responding to threats to and opportunities for not only ANSTO but also our subsidiaries.

Compliance Management is a key element of ANSTO's internal control framework and is integrated with our Risk Management Framework. ANSTO's compliance landscape is complex, but we enable our staff by training initiatives and an annual management certification process. In 2016, the ANSTO Board endorsed a new Fraud Control Plan established under the *PGPA Act*, which will further enhance our Risk Management Framework.

Australian Government

ANSTO

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