Australian Government

Nuclear-based science benefiting all Australians

Submission to the Joint Select Committee on Trade and Investment Growth

Inquiry into Australia's Future in Research and Innovation

Contents

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1. About ANSTO

The Australian Nuclear Science and Technology Organisation (ANSTO) is Australia's national nuclear research and development organisation, and the centre of Australian nuclear expertise. ANSTO operates a large proportion of Australia's landmark research infrastructure, including the OPAL nuclear research reactor, the Australian Synchrotron and the Centre for Accelerator Science. This infrastructure places Australia at the forefront of innovation for the benefit of public health, industry and the environment, and is used by researchers and industry from around Australia and internationally.

In addition to its world-class research capabilities, ANSTO produces vital nuclear medicines relied on by one in two Australians for the diagnosis and treatment of a range of diseases and cancers.

ANSTO has a responsibility to serve the scientific and research interests of Australia and act as a trusted, expert advisor to Government on nuclear matters. As legislated by the *ANSTO Act 1987*, ANSTO's mandate includes undertaking research and development in relation to the uses of nuclear science and nuclear technology, and to produce radioisotopes for medicine, science, industry, commerce and agriculture. The government's Statement of Expectations for ANSTO also outlines ANSTO's responsibility to Australian industry and the economy, being to maximise its commercial returns from investments made in research and to work in partnership with industry to address complex problems and increase Australia's economic competitiveness.

Scientific research and innovation and its interconnectivity with industry is fundamental to the economic and social prosperity of our country. The combination of ANSTO's unique infrastructure and nuclear expertise positions ANSTO as an important player in Australia's innovation system. ANSTO is committed to using its resources to support economic growth and assist Australian companies to compete internationally by:

1. Maintaining landmark research infrastructure;
2. Engaging widely with industry;
3. Commercialising its research; and
4. Expanding its commercial operations and businesses.

2. Landmark infrastructure

Research infrastructure is a critical part of Australia's economic base – enabling knowledge production and technological breakthroughs; solving problems for industry; maintaining a highly skilled workforce; and sustaining Australia's competitiveness and global relevance. Therefore, strategically developing, maintaining and effectively using this infrastructure is crucial to Australia's economic and social prosperity.

ANSTO is the custodian and operator of *multi-user, multi-disciplinary, multi-decadal* landmark research infrastructure. This infrastructure has particular importance in sustaining Australia's research competitiveness, innovation and support for Australian industry. Its unique capabilities are instrumental for innovation in major economic sectors, including mining, manufacturing, agriculture and healthcare. The OPAL research reactor (through the Bragg Institute), the Australian Synchrotron and the Australian Centre for Accelerator Science attracted approximately 5,000 Australian and international researcher and industry visits in 2014/15 and supported over 1,500 experiments in that year. Australian industries benefiting from the capabilities include SMEs and multinationals who are seeking insights that only this infrastructure and nuclear expertise can provide. From enhancing water monitoring equipment, optimising minerals exploration, creating new pharmaceuticals, improving aircraft safety to increasing food nutrition, the combination of landmark infrastructure and nuclear expertise are providing solutions for Australian industry.

Industry will derive the most benefit from collaboration if Australian research capabilities remain world class through strategic planning, including predictable long term funding over the long term. Maximum return for investment will be achieved through capitalising on pre-existing research infrastructure through both capital expansion and ongoing operating costs.

In this regard, ANSTO welcomes funding of $520 million over 10 years for the continued operation of the Australian Synchrotron and the continuation of funding for the National Collaborative Research Infrastructure Strategy (NCRIS) announced in the National Innovation and Science Agenda (NISA). Under the current NCRIS scheme, ANSTO receives funding for the operation of the Australian Centre for Accelerator Science, the National Deuteration Facility and three neutron beam instruments. These facilities are allowing Australian and international researchers to partner with industry to address the world's most pressing issues, including energy and resource security, population health, environmental sustainability and economic productivity.

ANSTO strongly supports the NISA's proposal for an expert group, chaired by the Chief Scientist, which will undertake a road-mapping process to identify specific future research infrastructure needs and required funding into the future. Given ANSTO's expertise in managing most of Australia's landmark research infrastructure, it is well placed to provide a valuable ongoing contribution to the expert group.

3. Engaging with Industry

Without a strategic innovation agenda, Australia risks economic stagnation, including declining economic growth and international competitiveness, both of which have the potential to negatively impact on our national standard of living. Therefore, it is essential that innovative research organisations, such as ANSTO, and industry interact, collaborate, support and engage with one another to ensure a sustainable innovation pipeline.

Publically funded research agencies (PFRAs) are placing an increasing priority on industrial engagement and technology transfer. This emphasis has arisen from a combination of factors, including greater recognition of the value of research to the local and national economies and transfer of ideas to the marketplace; government priorities, including NISA; and the need for diversified sources of income. Industrial engagement, technology transfer and commercialisation of intellectual property are now recognised as key aspects of a research organisation's activities, where they once were viewed as an optional add-on.

To ensure that ANSTO remains responsive to the needs of industry, it has recently renewed its strategy for engagement in these areas. ANSTO maintains a focus on strong partnerships and leveraging its landmark infrastructure and expertise (see below). This helps drive innovation and deliver outcomes for Australia. As part of this strategy, ANSTO has established Industry Engagement Offices and Industry Champions, which are imbedded into its research areas and aligned with its landmark research infrastructure. ANSTO will continue to build on these engagement activities, as it acknowledges that creating industry partnerships are part of a long-term strategy built on trust.

a. The OPAL Research Reactor's Bragg Institute

ANSTO established the Bragg Institute Industrial Liaison Office in 2014 to manage technology transfer and promote the use of Bragg Institute facilities in applied industrial research.

The Bragg Institute leads Australia in the use of neutron scattering and x-ray techniques to solve complex industrial and research problems, and improve productivity, reliability and efficiency for Australian industry. The institute is home to 13 neutron beam instruments, which are attached to the OPAL research reactor.

Industry has access to the neutron beam instruments through a proprietary, user-pays access system, or free on a merit basis when the application is made via a university collaboration. Industry-relevant academic research undertaken through the merit-based access scheme equates to over 35% of merit usage at the Bragg Institute. As a result of the strategic focus on industry engagement, commercial usage (across four instruments) has tripled since 2014.

When planning the suite of neutron beams, ANSTO deliberately constructed instruments likely to attract major industrial usage. For example, the Kowari strain-scanner is used to measure residual stress in pipeline components, railways and aircraft turbines. The Dingo instrument uses neutrons to image the inner structure of objects, such as oil flows in a working engine. ANSTO has responded to the needs of industry by not just providing beamtime, but also provide analysis of data and expert technical advice to ensure that the industry problems are fully addressed.

The businesses that utilise the Bragg Institute's neutron beams include multinationals (like BHP-Billiton, Toyota and Boeing) and a range of SMEs. On some occasions, the SMEs are supported by the New South Wales Technology Voucher scheme.

Case Study: Keeping Australian Railways Safe

In collaboration with RailTech Australia, the Institute of Railway Technology and Monash University, ANSTO's expertise and unique research infrastructure has helped the Australian railway industry to improve the reliability of rail welds. The integrity of rail welds is key to increasing reliability and reducing maintenance costs in the railway industry.

ANSTO's neutron beam instrument, the KOWARI Strain Scanner, was used to examine rail tracks to assess them for residual stress and the development of cracks. The results showed that by optimising welding procedures, the company could reduce residual stresses in critical parts of the rail weld.

b. The Australian Synchrotron

A formal commercial access program has been in place at the Australian Synchrotron since 2012, supported by a dedicated Industry Engagement team. The Australian Synchrotron's commercial program assists industry in improving products and processes, to ultimately bring positive change to the way we work, eat and live. Since ANSTO took over operation of the Synchrotron in 2013, industry utilisation of the Synchrotron has tripled.

In addition to paid access by industry to the Synchrotron, industry is also supported by the New South Wales Industry Synchrotron Access scheme, a $1.4 million project funded by the NSW Government. The scheme lowers the barrier to access for NSW industry by funding access and targeting industry-specific support to companies. The

scheme has demonstrated success in introducing NSW-based companies to the benefits of synchrotron-based analysis. In its first three years the NSW scheme enabled 35 experiments for 27 NSW-based companies in the agricultural, biotechnology, manufacturing and mining sectors. In the current financial year the scheme is supporting NSW-based companies' access to some 100 fully supported synchrotron beamline shifts. A case recommending extension of the scheme beyond 30 June 2016 for a three-year period has been submitted to the NSW Government. Given the success of the program, the roll-out of similar schemes across other states could be considered by governments.

Case Study: Helping SMEs Innovate

Aqua Diagnostic Pty Limited, a Melbourne SME producing advanced water quality monitoring equipment and consumables measuring chemical oxygen demand (COD), used the Australian Synchrotron to enhance the quality of its propriety nanotechnology PeCOD ® sensors through increased understanding of its manufacturing process.

The Synchrotron findings have assisted the company's plans to scale up to higher volumes in response to expected global demand as it expands its share of the international COD measurement market, valued at more than $100 million per annum.

c. Australian Research Council

Another mechanism by which ANSTO collaborates with industry is through the Australian Research Council (ARC) Linkage Grant Scheme. However, as a PFRA, ANSTO is not eligible to directly apply for linkage grants from the ARC (and the National Health and Medical Research Council). If this was changed ANSTO could extend and better support industry, and take on the role of administering organisation. ANSTO's participation is currently mainly through partnerships with higher education institutions.

The rationale for this approach has been that since PFRAs already receive government funding, they should not be eligible to apply for ARC and NHMRC grants. However, given that the bulk of university research activities are also funded by government (through block grants), ANSTO suggests a review of the eligibility rules for the Scheme.

The Scheme, as currently constructed, encourages industry to partner with a university for a project. In some (but not all) cases, this adds an unnecessary layer *"interaction"* to what could be direct industry engagement with PFRAs. Opportunities for PFRAs to engage with industry should be supported, especially in instances where PFRAs are the custodians and operators of key landmark research infrastructure, which can deliver great benefits to industry. ANSTO's research and commercial expertise can play an important translational research role and assist in enhancing innovation and technological progress for new products as they traverse

the 'valley of death'. ANSTO submits that the ARC linkage scheme should provide support for direct interaction with PFRAs by industry; eligibility should be based on merit and suitability.

Similarly, ANSTO supports PFRA access to the $250 million Biomedical Translation fund proposed by NISA, as well as the Medical Research Future Fund. If Australia's competitiveness is to be maintained, it is essential to encourage industry to collaborate with PFRAs as well as universities to ensure Australia's landmark infrastructure is being used to the maximum benefit of the nation.

4. Commercialisation at ANSTO

Commercialisation of research provides economic return on investment, enhances Australia's global competitiveness and provides solutions to complex problems faced by industry. As part of ANSTO's strategy to increase engagement with industry, ANSTO has intensified its focus on translational research and commercialisation.

Case Study: Synroc

Synroc is a smart Australian innovation, developed by the Australian National University in 1978. Synroc can provide a safe, long term storage solution for radioactive waste, significantly reducing volumes.

As a result of research translation and development strategies, ANSTO is currently designing and scoping the construction of a Synroc waste treatment plant, to be co-located with the new nuclear medicine production facility. The Synroc plant will enable ANSTO to showcase its capability for this technology, creating opportunities to provide the technology overseas, as well as create spin-off opportunities.

Case Study: RemLife

Researchers in ANSTO's Institute of Materials Engineering have improved the way in which large coal-fired power stations around Australia and the world manage their infrastructure to determine the most efficient and effective ways in which plants should be used to respond to fluctuations in the grid.

Ever-increasing stresses are being placed on coal-fired power stations by the changing way in which electricity is generated and used. With the widening distribution of intermittent power supply in the form of wind and solar, baseload suppliers such as coal fired power plants have to respond to large swings in supply and demand. This places stresses on plant infrastructure beyond what was originally intended when these plants were designed and built. ANSTO's Remlife software, which was created using ANSTO's materials engineering expertise, is being used at coal-fired power stations across Australia to characterise the stresses being placed on ageing infrastructure.

ALS Global, an Australian-owned multinational company and a global leader in analytical and technical services markets, acquired the RemLife technology from ANSTO in 2015 to drive international expansion in the provision of technical services to the global power generating industry.

5. Expanding Commercial Operations

ANSTO's commercial activities seek to maximise return on the Government's investment in landmark research infrastructure and ANSTO initiated research to improve Australia's economic competitiveness in areas such as radiopharmaceutical production, silicon doping and rare earths processing expertise. By responding to the needs of government, industry and society through strategic business planning, ANSTO's business and commercial operations continue to grow, with revenue totalling $68 million in 2014/15. These businesses also provide a conduit for ANSTO research to be commercialised and taken to the market. The activities of three of ANSTO's businesses are outlined below.

a. ANSTO Health

ANSTO manufactures radiopharmaceuticals through ANSTO Health. Currently, ANSTO Health, through more than 220 nuclear medicine centres, supplies approximately 85 per cent of the radioisotopes used in Australia for the diagnosis and treatment of diseases such as heart disease and a range of cancers.

The most widely used radioisotope is molybdenum-99 (Mo-99), which decays to technetium-99m (Tc-99m) and is used for the diagnosis of cancers, heart disease, muscular and skeletal conditions. ANSTO currently delivers the equivalent of 10,000 patient doses of Mo-99 across Australia each week. It is estimated that Mo-99 is used in around 45 million medical procedures worldwide every year, and demand is growing particularly in the Asia-Pacific region.

Currently, most of the global Mo-99 supply is produced in ageing reactors, many of which are scheduled for closure by 2020. In response to the increasing global demand and market shortage of Mo-99, ANSTO will utilise the capacity of the relatively new OPAL research reactor (opened in 2007) and is building a new production facility that will enable ANSTO to triple its production of molybdenum-99 (Mo-99). The $168 million ANSTO Nuclear Medicine (ANM) Project will secure a domestic supply of this vital radiopharmaceutical and position Australia as a global leader in the manufacturing of nuclear medicine. The increased capacity will enable Australia to meet domestic demand, as well as being able to supply up to 20-25% of global demand. This project also has particular significance on the world stage because ANSTO will be producing these medicines using proliferation-proof low enriched uranium (LEU).

The benefits of this project to the Australian economy will also be seen through the creation of high-tech manufacturing jobs in an era when traditional manufacturing is in steady decline.

b. ANSTO Silicon

The multi-purpose design of the OPAL research reactor enables both researchers and industry to benefit from this infrastructure. Using the capabilities of OPAL, ANSTO has become the global leader in the irradiation of silicon to produce Neutron Transmutation Doped (NTD) Silicon. The NTD process changes the electronic properties of silicon optimising its high voltage performance and reliability. The silicon is used in integrated circuits and microelectronic components in hybrid cars, fast trains, renewable energy systems and wind turbines.

As a result of ANSTO's expertise in applied nuclear science and the investment in the OPAL research reactor, Australia is recognised as delivering the highest quality single crystal silicon in the world for a specialised niche of the microelectronics market. Australia has captured more than 28 per cent of the global market for NTD silicon by volume and is now the world's primary supplier of this irradiation service.

c. ANSTO Minerals

ANSTO Minerals provides consultancy and process development services for the Australian and international mining industry. ANSTO's clients range from small domestic explorers to major international companies, including, Alkane Resources, BHP Billiton, Cameco, Iluka, Lynas, Rio Tinto and Paladin. ANSTO's nuclear science and technology expertise is putting ANSTO Minerals at the forefront of innovative minerals extraction technologies, uranium ore processing, and controlling radioactivity in minerals and ores containing naturally occurring radioactivity.

In particular, the researchers and engineers at ANSTO Minerals are improving efficiencies in the extraction of rare earths, which are under heavy demand for use in high-tech hardware such as smart phones, laptops and wind turbines. The work being done at ANSTO is assisting industry in securing a financially viable and environmentally responsible, diversified supply of rare earth minerals.

Case Study: Rare Earth Minerals

Rare earths are used in hundreds of high technology applications, including mobile phones, laptop computers and tablets, and green technologies such as wind turbines and electric vehicles. With China currently responsible for 95 per cent of global rare earth production, the development of rare earths mining in Australia has important implications for the security of supply world-wide.

ANSTO currently hosts pilot processing plants for Australian-based rare earth companies including Alkane, which is working to establish zirconia and rare earths operations near Dubbo in central west NSW. The Dubbo Zirconia Project is estimated by Alkane to be worth ~$1 billion has the potential to put over $30 million a year into the local economy through salaries alone.

Conclusion:

Australia's international competitiveness and its economic and social prosperity are inextricably linked to our ability to innovate. To foster an environment suitable for innovation our nation must ensure a strong and dynamic partnership between research and industry.

ANSTO recognises this, and outlined above, has been working hard to strengthen its engagement with industry and contribute to innovation in Australia.