Please note: the substantive content of the 2026 NRI Roadmap Survey begins at Question 20 (with prior questions dealing with administrative and other information).

As such all submissions that are published include the responses submitted from Question 20 onwards only.

Q20.

Part 2: Research themes

2.1 NRI comprises the assets, facilities and associated expertise to support leading-edge research and innovation in Australia and is accessible to publicly and privately funded users across Australia and internationally. We are seeking your input on possible directions for future national-level investment - i.e., where the requirements are of such scale and importance that national-level collaboration and coordination are essential.

The 2021 Roadmap used a challenge framework to support NRI planning and investment. With this in mind, consider likely future research trends in the next 5 - 10 years, and with respect to one or more of the 8 challenge areas identified in the 2021 Roadmap as listed below:

- describe emerging research directions and the associated critical research infrastructure requirements that are either not currently available at all, or not at sufficient scale and
- describe current national infrastructure requirements that you anticipate will no longer fit the definition of NRI in 5-10 years.

Do not limit your commentary to NCRIS funded capabilities.

Q21.

Resources Technology and Critical Minerals Processing

The ACNS and NDF provide critical infrastructure for molecular level understanding of and advances in minerals processing technology, including critical minerals. ACNS's neutron beamlines, support scientists, and associated facilities enable researchers to develop new insights into structures of minerals themselves, as well as of mineral dispersions, foams, emulsifiers and other additives used to design new, more efficient and sustainable processing pathways. Maintenance of the current suite of neutron beamlines is essential to this ongoing effort, but there are also gaps in the instrumentation provided by ACNS as evidenced by instrumentation available at similar facilities around the world. This can be addressed in the medium-long term by expansion of the number of beamlines including a second guide hall to accommodate new suites of instruments. Planning for this can be addressed alongside an interim solution by providing easier access for Australian researchers to major international neutron facilities that already house such instruments. This will have the additional benefit of developing a more informed user community to contribute to the design and development of new, fit-for-purpose beamlines and upgrading of existing facilities. The NDF provides critical support for ACNS experiments through specialised chemical and biological deuteration of compounds as they are discovered or developed by researchers, which is essential to take full advantage of the suite of neutron-beam techniques afforded by ACNS.

Q22.

Food and Beverage

The ACNS and NDF infrastructure are key to developing molecular level understanding of advanced formulations for food technologies ranging from infant formula and other dehydrated and rehydratable materials to fresh and frozen foods. ACNS's neutron beamlines, support scientists, and associated facilities enable researchers to develop new insights into the diverse forms of biological and synthetic soft matter present in foods and beverages, informing the development of new products and more efficient and sustainable processing pathways. Maintenance of the current suite of neutron beamlines is essential to this ongoing effort, but there are also gaps in the instrumentation provided by ACNS as evidenced by instrumentation available at similar facilities around the world. This can be addressed in the medium-long term by expansion of the number of beamlines including a second guide hall to accommodate new suites of instruments. Planning for this can be addressed alongside an interim solution by providing easier access for Australian researchers to major international neutron facilities that already house such instruments. This will have the additional benefit of developing a more informed user community to contribute to the design and development of new, fit-for-purpose beamlines and upgrading of existing facilities. The NDF provides critical support for ACNS experiments through specialised chemical and biological deuteration of compounds as they are discovered or developed by researchers, which is essential to take full advantage of the suite of neutron-beam techniques afforded by ACNS.

Q23.

Medical Products

The ACNS and NDF also provide critical infrastructure for molecular level understanding of and advances in pharmaceutical formulations. This is clearly illustrated by the use of ACNS's neutron beamlines to understand the structure and function of the complex lipid nanoparticle formulations used to deliver the mRNA COVID vaccine and under development for delivery of a wide variety of other medicines. While maintenance of the current suite of neutron beamlines is essential to this ongoing effort, new and upgraded instrumentation will broaden the research and speed up development. This can be addressed in the medium-long term by expansion of the number of beamlines including a second guide hall to accommodate new suites of instruments. Planning for this can be addressed alongside an interim solution by providing easier access for Australian researchers to major international neutron facilities that already house such instruments. This will have the additional benefit of developing a more informed user community to contribute to the design and development of new, fit-for-purpose beamlines and upgrading of existing facilities. The NDF provides critical support for ACNS experiments through specialised chemical and biological deuteration of compounds such as lipids, drugs and biopolymers: This capability is key to designing and developing multicomponent lipid nanoparticle formulations take full advantage of the suite of neutron-beam techniques afforded by ACNS.

Q24.

Defence

Q25.

Recycling and Clean Energy

The ACNS and NDF infrastructure are key to developing molecular level understanding of complex synthetic materials including persistent pollutants like micro and nanoplastics that can inform the design and development improved separation and recycling technologies, as well as understanding the structure of recycled materials that may contain a different profile of impurities than pristine materials. Clean energy generation relies on multicomponent devices, such as batteries and supercapacitors comprised of semiconductors, diodes, electrodes and electrolytes, whose design and development rely on insights provide by neutron beam science. Maintenance of the current suite of neutron beamlines is essential to this ongoing effort, but there are also gaps in the instrumentation provided by ACNS as evidenced by instrumentation available at similar facilities around the world. This can be addressed in the medium-long term by expansion of the number of beamlines including a second guide hall to accommodate new suites of instruments. Planning for this can be addressed alongside an interim solution by providing easier access for Australian researchers to major international neutron facilities that already house such instruments. This will have the additional benefit of developing a more informed user community to contribute to the design and development of new, fit-for-purpose beamlines and upgrading of existing facilities. The NDF provides critical support for ACNS experiments through specialised chemical and biological deuteration of compounds as they are discovered or developed by researchers, which is essential to take full advantage of the suite of neutron-beam techniques afforded by ACNS.

Q26.

Space

Q27.

Environment and Climate

The ACNS and NDF infrastructure are key to developing molecular level understanding of complex naturally-occurring biological materials in our environment as well as of synthetic materials including persistent pollutants such as micro and nanoplastics. ACNS's neutron beamlines, support scientists, and associated facilities enable researchers to develop new insights into the structure and properties of natural and benign biomaterials as well as of synthetic organic and inorganic materials and multicomponent composites that may impact the environment, contributing to the informed design of remediation processes as well as development of non-harmful replacements. Maintenance of the current suite of neutron beamlines is essential to this ongoing effort, but there are also gaps in the instrumentation provided by ACNS as evidenced by instrumentation available at similar facilities around the world. This can be addressed in the medium-long term by expansion of the number of beamlines including a second guide hall to accommodate new suites of instruments. Planning for this can be addressed alongside an interim solution by providing easier access for Australian researchers to major international neutron facilities that already house such instruments. This will have the additional benefit of developing a more informed user community to contribute to the design and development of new, fit-for-purpose beamlines and upgrading of existing facilities. The NDF provides critical support for ACNS experiments through specialised chemical and biological deuteration of compounds as they are discovered or developed by researchers, which is essential to take full advantage of the suite of neutron-beam techniques afforded by ACNS.

Q28.

Frontier Technologies and Modern Manufacturing

The ACNS and NDF infrastructure are key to developing molecular level understanding structure in advanced materials and advanced manufacturing technologies such as semiconductors, diodes, electrodes and electrolytes, and in additive manufacturing processes. ACNS's neutron beamlines, support scientists, and associated facilities enable researchers to develop new insights into the structure and properties of synthetic organic and inorganic materials and multicomponent composites used in modern manufacturing processes and technologies. Maintenance of the current suite of neutron beamlines is essential to this ongoing effort, but there are also gaps in the instrumentation provided by ACNS as evidenced by instrumentation available at similar facilities around the world. This can be addressed in the medium-long term by expansion of the number of beamlines including a second guide hall to accommodate new suites of instruments. Planning for this can be addressed alongside an interim solution by providing easier access for Australian researchers to major international neutron facilities that already house such instruments. This will have the additional benefit of developing a more informed user community to contribute to the design and development of new, fit-for-purpose beamlines and upgrading of existing facilities. The NDF provides critical support for ACNS experiments through specialised chemical and biological deuteration of compounds as they are discovered or developed by researchers, which is essential to take full advantage of the suite of neutron-beam techniques afforded by ACNS.

Q29.

2.2 The 2024 statement of National Science and Research Priorities (NSRPs) includes outcomes linked to each priority to assist in identifying critical research needed in the next 5 to 10 years.
Consider the priority statements and, with respect to one or more of the 5 priority areas as listed below:

- describe emerging research directions and the associated critical research infrastructure requirements that are either not currently available at all, or

- not at sufficient scale and describe current national infrastructure requirements that you anticipate will no longer fit the definition of NRI in 5-10 years.

Do not limit your commentary to NCRIS funded capabilities, and where relevant, refer to the underpinning outcomes and research identified in the NSRPs document.

Q30.

Transitioning to a net zero future

Q31.

Supporting healthy and thriving communities

Q32.

Elevating Aboriginal and Torres Strait Islanders knowledge systems

Q33.

Protecting and restoring Australia's environment

Q34.

Building a secure and resilient nation

Q35.

2.3 The case for a new NRI capability, or enhancements to existing capabilities, typically emerges through advocacy from research communities clustering around rigorously identified needs and goals. Such a concept

could respond to a requirement for novel or expanded capacity within a domain, or across domains, and must be such that it could only be made available with national-level investment.
If you have identified such a requirement, briefly describe the need, the proposed infrastructure capability, the medium-term goals, impacted research communities, and the timeframe over which you advocate its establishment. Your response can include links to relevant existing reports.

Both the ACNS and NDF are Landmark rather than National infrastructure facilities insofar as each is one of a small number of such international facilities around the world that house complementary instruments, techniques and expertise. ACNS's suite of instrumentation and the associated expertise of its instrument scientists serves an international as well as the Australian science community through collaborations as well as direct merit-based access applications (user community). Informed decisions about future new and upgraded replacement instrumentation (beamlines) at the ACNS will be more effective if both ACNS scientists and the Australian user community are able to access new and state of the art beamlines not currently available in Australia at comparable facilities around the world (e.g. Oak Ridge National Laboratory, US; Rutherford-Appleton Laboratory UK, Institut Laue-Langevin, France, J-PARC, Japan). Such access is already merit-based through grants of instrument time by facilities, but travel costs can prevent researchers, especially early- and mid- career researchers, from utilising access granted to these facilities, or simply discourage application. Prior to the establishment of ACNS and the operation of OPAL at ANSTO, the Access to Major Facilities Program funded travel for such purposes. It was a critical element in the establishment of an informed community of researchers able to contribute to the design, construction and operation of each new tranche of beamlines, and to take best advantage of the ACNS's facilities. Future developments at ACNS will benefit greatly from a similarly informed and experienced user community, including the next generation of researchers. The NDF provides critical support to experiments at the ACNS through bespoke deuteration of chemical compounds for research that are not commercially available. It is a leader among an international network of such facilities with expertise in biological and chemical deuteration technologies.

Q36.

Part 3: Industry perspectives

This section is seeking input specifically from industry-based respondents. Other respondents can skip this section.

Recommendation 6 of the 2021 Roadmap related to improvements in industry engagement with NRI. To complement work on this topic that has occurred since then, we are seeking additional advice on NRI requirements as perceived by current or potential industry-based users.

Q37.

3.1 Have you (or your organisation) interreacted with or used Australia's NRI?

- ◯ Yes
- ◯ No

Q38.

3.2 If so, please briefly outline the NRI capabilities you (or your organisation) have interacted with or used. Do not limit your response to NCRIS capabilities.

This question was not displayed to the respondent.

Q39.

3.3 Please indicate your (one or more) primary reasons for interacting with NRI:

This question was not displayed to the respondent.

Q40.

3.4 If you answered no, please indicate your (one or more) primary reasons:

This question was not displayed to the respondent.

Q41.

Part 4: Other comments

4.1 Please elaborate on any of your above responses or add any other comments relevant to the development of the 2026 Roadmap. Your response can include reference or links to existing reports that you recommend be considered during the 2026 Roadmap development process.