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

Resources sector is generally underpinned by a broad range of analytical tools spanning relatively simple walk up instruments all the way up to state of the art highly specialised instruments. There are many gaps between the basic instruments and the highly advanced instruments. Industry and resources technology researchers often need access to bottom and middle tier instruments (spanning SEM, TEM, LIBS, ICP-MS etc) and most Universities are critically short of middle tier instruments - those which provide the information underpinning important resources/minerals work. These middle tier instruments are difficult to fund through LIEF - since LIEF has a focus on the 'latest and greatest', and too expensive for Universities to self fund. In recent years NCRIS has also revolved around the latest innovations in hardware, and especially in the Resources/Minerals sector, a multipronged approach is required from NCRIS to fund both latest innovations in infrastructure development, and the higher level work-horse instrumentation which is desperately required to remain able to deliver the infrastructure access which is required to keep this sector performing at a high standard with respect to the rest of the world. There needs to be an acknowledgement that the tools required to underpin high level academic research at Universities are often different to those required for more Industry centric research to remain at the global forefront. Striking the right balance will be difficult, but it is very clear that across most Universities we are approaching a critical point with respect to access to the middle tier / advanced-workhorse style research infrastructure. Perhaps in addition to building NCRIS around infrastructure capability, it could be additionally built around research topic capability.

Q22.

Food and Beverage

Food and Beverage is very much reliant upon high end latest innovations in analytical chemistry infrastructure. Speed and sensitivity has increased markedly over recent years - enabling detection of more analytes at lower concentrations - leading to better control of quality of the products. NCRIS nodes have invested in a great deal of critical infrastructure from various vendors, although there can sometimes be a leading of the choice by the vendor. Various instrument vendors have strengths in diverse fields - we should ensure that we do have a variety of solutions from multiple vendors across the nodes. In this way we can ensure to reap the advances made by all vendors. The key technologies will be gas, liquid & perhaps super critical fluid chromatography, mass spectrometry, high thoughput screening methods including Desorption Electrospray, DART, acoustic desorption, MALDI, spectroscopic detection, and ICP-MS.

Q23.

Medical Products

Medical products require a very broad range of analytical infrastructure, and certainly many nodes of NCRIS routinely provide crucial access to this infrastructure. NIF, Microscopy Australia, ANFF, and Bioplatforms Australia are all very important resources to assessment of medical products. These facilities will require a mixture of middle-tier and latest advancement infrastructure - across all nodes and including technologies such magnetic resonance imaging, electron microscopy, mass spectrometry, and many other analytical and fabrication tools across these aforementioned NCRIS nodes. The most critical requirements will be best determined by obtaining feedback from the researchers involved. A great deal of this research has commercial/industry elements, and the NCRIS activities mentioned all have a track record of working with these.

Q24.

Defence

Q25.

Recycling and Clean Energy

Q26.

Space

Q27.

Environment and Climate

Environmental Science is generally under-pinned by a broad range of analytical chemical and biochemical technologies. Over the last 5-10 years the speed and sensitivity has increased many orders of magnitude. NCRIS and LIEF (and many other sources) has funded a broad range of research infrastructure which has under-pinned a great deal of environmental science. Improved links between the NCRIS activities could help to bring more researchers together, and make many more aware the technologies that already exist. Topics such as nano and micro plastics are an excellent example of a topic requiring input from a very broad set of analytical tools (spectroscopic, mass spectrometry, liquid & gas chromatography, SEM, TEM, etc), and these projects generally span multiple NCRIS nodes. There are also numerous examples of environmental challenges being addressed by new and emerging technologies - the use of Desorption Electrospray for PFAS analysis in concrete is one recent one. Much of the environmental research greatly benefits from access to the newest analytical chemical tools - which are frequently infrastructure invested in by NCRIS nodes. This should remain the case. Environmental analyses are also aiming for more portable analytical solutions - for field based measurements. A number of instrument vendors are working very activily in this space, and these technologies should be entertained by NCRIS facilities. The technologies in question are ambient ionisation sources being coupled to highly minaturised mass spectrometers. In terms of specification these instruments will be lower than the laboratory based instruments, but they will be portable, which can be a crucial requirement in environmental assessments. How NCRIS nodes manage provision of both portable solution and laboratory based tools will be a challenge, but the field based instruments can be used to triage samples that require more in depth laboratory assessments.

Q28.

Frontier Technologies and Modern Manufacturing

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

Increased involvement of indigenous groups and individuals is crucial to us all. There are many examples already of partnerships between Indigenous groups and University researchers - some of which are advanced stages of commericialisation. There have also been some fantastic examples of combining Indigenous Art with Microscopy Images - which are ultimately the most visited parts of events such as conferences. Macro/Microscope and Chemical characterisation of Indigenous knowledge will lead to many new products. The critical research infrastructure will be in the chemical and imaging realms - very much in line with NIT, Microscopy Australia and Bioplatforms Australia. Middle and high end SEM/TEM, advanced mass spectrometry, and spectroscopic tools will likely underpin much of this sort of work. Analysis of precious Indigenous art works and other samples will benefit from tools which either require very small amounts of material (SEM/TEM, Mass Spectrometry), or zero to minimal sample damage (TOF SIMS, XPS, IXRF, and others). It would be reasonable to provide reduced access fees for project involving Indigenous groups.

Q33.

Protecting and restoring Australia’s environment

Much of this priority revolves around enabling our environmental scientists, who generally need access to the broadest of research infrastructure. Investment into present and future portable/field-deployable analytical tools will enable more measurements to be made on-site. These portable devices allow for immediate assessments to be made, and possible triage of samples to be re-directed to laboratories with higher end instruments for more thorough characterisation. This priority will require that investment continues into the lastest chromatography and mass spectrometry instruments - to continue to have cutting edge sensitivity, but also multiple levels of electron microscopy (routine, middle tier SEM/TEM in particular).

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.

The biggest hole in NRI in Australia is middle tier electron microscopy. Most Universities now have top end Cryo electron microscopes and scanning transmission electron microscopes, but lack (or have extremely aging) instruments to bridge the gap between basic workhorse instruments and the high end CryoEM / STEM instruments. This gap is going to become critical over the next 5 yrs as instruments age. The reason it is so important is that the high end Cryo EM / STEM instruments are often operated by a few experts (due to the very long time it takes for people to develop enough skill to operate them properly). Generally only very few people get trained on these - since the training often takes longer than the number of samples that need to be analysed. The walk TEM/EMs are used quite heavily generally - because the users are trained in a shorter time. The big hole to be plugged is a better SEM/TEM - somewhere between the basic walk up and the extremely complicated STEM/cryoEM which users can be trained to use. Having the 3 levels of instrument will make better use of tax payer money in that more access to walk up instruments will reduce the back log on the cryoEM / STEM and those users who can book and use rather than wait to have experts run their samples get their data faster. Essentially we need to acknowledge that infrastructure facilities require 3 levels of electron microscopy - the basic walk-up, the middle-tier with improved performance, and the high level which requires a highly trained expert. Each of the microscopy nodes around Australia could identify the specific instruments required - or feedback from the user groups could help. We need to ensure that this middle tier level of electron microscopy is retained and developed into the future. Almost all industry requiring a little more than the basic walk-up SEM would only require a middle tier instrument.

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.

Microscopy Australia, NIF, Bioplatforms Australia, ANFF

Q39.

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

- [x] For expertise or advice
- [ ] Access to research resources or products
- [x] Access to equipment for research
- [ ] Access to equipment for operational reasons
- [ ] Help in translating research
- [ ] Access to data
- [ ] Support for clinical trials
- [ ] Other (please specify) _____

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.