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

Q22.

Food and Beverage

Q23.
Medical Products

Q24.
Defence

Numerous current and emerging opportunities exist to enable dual-use of astronomy NRI. These are complementary with those outlined below against the "space" category. Accordingly they are not repeated in this section.

Q25.
Recycling and Clean Energy

Q26.
Space

The past decade has seen the Australian astronomy community grow in breadth, improved in scientific excellence and increased in achieving broader societal impact, supported by access to institutional, national and international RI through careful engagement with the community and prioritisation via the decadal planning process. The last Decadal Plan reflected the move of astronomy and astronomy infrastructure into the global era, resulting in a shift in resources away from national-scale facilities by AAL and others, and investments in access to international scale facilities and infrastructure. The next Decadal Plan (2026-2035) is in the process of being finalised but is expected to shift focus to “interconnection” – reflecting efforts to ensure that astronomy investments and capability deliver benefit and impact across the entire astronomy community, to other disciplines, industry and to society more broadly. The global trend for astronomy includes multi-wavelength, multi-messenger astronomy, with mega-telescopes, international collaboration with large teams and a requirement for high-level HPC to answer some of the most enigmatic questions about the universe. Australia has a unique competitive advantage in survey-based astronomy and instrumentation development. For Australia to remain at the forefront of astronomy worldwide and continue to deliver other benefits to industry and the community, the community needs continued access to appropriate international facilities. International partnerships such as SKAO and ESO provide not only Australian astronomers access to these world class facilities, but instrumentation projects flow back to Australian industry, opportunities for technology development and transfer, student training and exchange, and development of international collaborations. There are opportunities to leverage Australia's existing investment in, or undertake additional investment in, the following areas: - access to next generation optical/infrared astronomy through ESO or a hybrid set of capabilities that includes access to 30m-class telescopes. - continued implementation of the SKA - a dedicated radio transient monitoring array in the southern hemisphere that would leverage ATCA to undertake rapid follow-up and monitoring of transient radio emissions from extreme cosmic objects - design and development of an Australian gravitational wave pathfinder to lay the foundations to future construction and operation of a full next-generation southern hemisphere gravitational wave detector hosted by Australia. - ongoing access to next generation survey work via LSST - ongoing access to very-high energy and high-energy particle physics, including via CTAO - access to appropriate HPC to support astronomy infrastructure - leveraging access to space astronomy facilities which would also support development of the Australian space sector capabilities, drawing on space and astronomy capability to achieve mutually beneficial outcomes.

Q27.

Environment and Climate

Q28.

Frontier Technologies and Modern Manufacturing

The astronomy community has a need for, and benefits from access to HPC facilities. There are particular needs for Tier 0 and Tier 1 HPC facilities for theoretical simulations, and Tier 1 / 2 facilities for telescope data reduction, and analysis. There is a heightened requirement for high performance data storage, and robust data archives. These requirements are not limited to astronomy – many disciplines will have similar requirements so a national approach is warranted. There are opportunities to better connect Tier 2/mid-scale facilities and ensure they are integrated at a national level. Mid-scale facilities, such as OzStar and Ngarrgu Tindebeek at Swinburne are open to all astronomers in Australia upon request, and provide vital computing infrastructure for the majority of the community. These facilities also offset pressure by the community to seek access to limited Tier 1 facilities because they are the only form of HPC available nationally and when mid-scale capabity will suit science needs. While the astronomy community benefits from these investments, Australia benefits from the community's use of this capability to develop frontier technologies as spillovers. This includes the software development techniques that are derived from using HPC to interrogate astronomy data. The Astronomy Data and Computing Services (ADACS) was established in 2017, which is helping to modernise data pipelines to be especially benefitting research teams working with ESO, MWA and AAT. This service is already being used in other disciplines - benefitting from the expertise of the astronomy community - and has the potential to expand to use AI, machine learning, and big data analytics to handle and interpret complex astronomical data. There are opportunities to more systematically use these approaches to enable additional technological development. Australia has a long history of pushing the technological frontier by finding new technological solutions to advance astrophysical knowledge, spanning multiple wavelength, frequency, and messenger, domains. In addition to CSIRO's instrumentation experience, a national optical instrumentation capability has been established through the Astralis Instrumentation Consortium, which delivers support for major instrument projects and directly benefits broader industry. Eg it has invested in the decade-scale multinational MAVIS facility instrument for the VLT at ESO. These instrumentation capabilities are highly valued by international partners and often used as in-kind contributions to offset financial investments into international facilities. Australian teams have made similarly innovative and key contributions to the development of radio and gravitational wave instruments. Commercial opportunities presented by this innovation are exemplified by successful spinout companies Quasarsat and Pentalym (CSIRO), Liquid Instruments (ANU), Fourier Space (Swinburne) and Redback Systems (Macquarie) and there is scope for more.

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.

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.

AAL supports an Industry Engagement Committee which seeks to increase the opportunities for engagement between the astronomy community and industry. AAL has requested representatives from the Committee provide feedback independently. However we also provide the following insights from discussions at these meetings which will be relevant for NRI and the NCRIS program specifically: - Industry participants are unlikely to know whether what they have used is NRI or not, and as such it may be difficult for them to understand the direct benefits accruing from NCRIS and therefore provide constructive advice on the NRI consultation process. - To take a specific example, industry has made frequent use of the National Space Qualification Network (NSQN), which is 'Space Infrastructure' and therefore arguably NRI funded by the Australian Space Agency. However it is unclear whether this capability is in scope of the Roadmap process. - There are some views that access to NRI is limited by real or perceived administrative burden. Often industry doesn't use services because of fears around IP loss or the complexity of legal agreements, liability concerns. - Investments in RI provide a huge opportunity for high-tech firms to de-risk activities, however this process is currently ad hoc and could be supported through support for more systematic approaches

Q39.
3.3 Please indicate your (one or more) primary reasons for interacting with NRI:

- [ ] For expertise or advice
- [ ] Access to research resources or products
- [ ] Access to equipment for research
- [ ] Access to equipment for operational reasons
- [ ] Help in translating research
- [ ] Access to data
- [ ] Support for clinical trials
- [x] 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.

Astronomy is supported by diverse RI, spanning institutionally operated RI (via investments by both universities and CSIRO), national RI, access to international facilities, and landmark scale investments in RI (e.g. the SKA). This RI is underpinned variously by different funding - institutional support programs, NCGP (e.g. via LIEF), NCRIS, specific programs such as AWLAI, and standalone policy decisions eg. Government's treaty-level and multi-decadal commitment to the SKA. Identification of priorities for the community is articulated through Decadal Plans but investment decisions are a patchwork. The SKA project could not have occurred without other investments – several are discretionary, and many are still unfulfilled leading to an underutilisation of the opportunities of the project. Investments in significant facilities requiring multi-year commitment have often been made through the vagaries of competitive granting processes, e.g LIEF or discretionary decisions. Australian participation in CTAO and LSST required a significant portion of the finances to come via LIEF, accompanied by un-funded support by AAL. The AAT is supported by co-investment from 9 universities, but conditional on identifying additional ad hoc investment from Government, leading to significant uncertainties. These uncertainties have led to key personnel considering their future, with individual career choices by high-skilled and specialised workers putting the viability of national facilities at risk. There is scope to consider how to consolidate NRI funding approaches to better enable delivery against priorities while maintaining predictability and reflecting the multi-year nature of these investments. AAL underscores the critical importance of NCRIS in the funding landscape, especially in moving beyond the competitive approaches which have led to duplication, unhelpful competition and an inability to achieve the scale necessary to get efficient use of expensive RI. The NCRIS delivery model has been tried and tested for 20 years. NCRIS capabilities play a key role as stewards of their areas, working to support the Department in delivering impact from RI while managing often competing and conflicting interests of institutions and researchers across the system. It is an internationally recognised and highly respected program and its stability and predictability gives confidence to partners, particularly international partners, considering how to collaborate with Australian researchers. Its multi-year approach enables access to international-scale infrastructure, to which Australia leverages access using very small funds. Without these commitments international partners are often reluctant to engage with Australia in building the next generation of facilities. The Collaborative component of NCRIS could potentially be amplified by increasing the scale and scope of NCRIS-supported activities, crowding in other research funding decisions in a coordinated fashion.

Q49.

4.2 Optional Document Attachment.

Note: Our strong preference is that answers are provided against the relevant questions in the survey. However, this file upload option is available for submissions in file format, where needed. Please ensure the document includes your name or organisation.