

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

Synthetic biology & biotechnology are already transforming industrial processes & will likely generate multi-billion-dollar outcomes in medicine, food, manufacturing, waste remediation & other fields. Critical future infrastructure needs include advanced labs equipped for high-throughput DNA sequencing, synthetic gene assembly, and cellular manipulation, as well as the ability to rapidly generate & test novel molecules, DNA/RNA sequences, metabolic pathways and entire synthetic organisms. Large-scale bioreactors & biofabrication systems also are required to scale up engineered organisms or biomaterials production. Future discovery & innovation focused on RNA-based technologies & therapies likewise will require a range of research facilities to feed RNA therapeutics production facilities in NSW & Victoria, which have been built or are being built via government and/or private investments. Genome Foundries play a critical role in converting basic science into products/IP that can be commercialised. Increased foundry capacity is essential to ensure Australia continues to lead in this field. Currently, genomics, transcriptomics, and epigenomics infrastructure and high-performance computing with AI integration are not widely available and will be critically lacking in coming years. Enhanced infrastructure to support deep sequencing in genomics, transcriptomics, and epigenomics is required. Deep sequencing demands significant investment in scalable data storage as well as advanced computational resources. High-performance computing with AI integration will also be essential for processing large datasets, as well as cloud-based bioinformatics platforms for data analysis. Additionally, bioinformatics training will be crucial. Neuroscience research and brain-computer interfaces with a view to producing new treatments and medical devices for neurological/neurodegenerative diseases. Critical future infrastructure needs include cutting-edge neuroimaging and neural recording devices, such as high-density EEG and fMRI machines, along with data processing platforms to handle and process vast amounts of neural data. Given the trend towards reduced use of animal models, other research facilities might include in-silico first-principles simulations for testing and exploring research questions, early drug discovery testing etc, facilities for large-scale organoid production from patient cells and testing of existing therapies and/or potential new drugs. Other important and potentially national facilities in this area could include a national production facility for research and clinical applications of AAV-mediated gene therapies in neuroscience, as well as many other diseases. There also would be merit in a national research facility that produces high-quality and clean animal models (mostly rodents) for use in research across Australia, especially where animal models must be used in later stages of pre-clinical research, fundamental physiological research etc.

Q24.

Defence

One important future infrastructure need for defence research is developing a multi-institutional integrated simulation facility across Australian universities for command, control, communication, and computer systems research and training. The aim would be to establish state-of-the-art centres dedicated to research, development, training, simulation, and AI development, fostering a collaborative environment between academia, government agencies, and defence industries. By integrating advanced command and control centres with robust communication and computing platforms, these facilities would offer realistic, adaptive training scenarios for defence, emergency services, and security forces. Implementing such hubs across multiple institutions would ensure standardised, integrated training and operational readiness, enabling swift adaptation to evolving threats while also enhancing national resilience through cutting-edge simulation and technology development. Note that such networked facilities are already available and in use within the US Defence Forces and research environment.

Q25.

Recycling and Clean Energy

One important future research trend in this domain explores sustainable energy solutions for AI-intensive business operations, including small modular nuclear reactors, advanced renewables, and energy efficiency algorithms. Critical infrastructure needs include a data centre energy efficiency laboratory and energy-AI integration testbeds.

Q26.

Space

Macquarie University researchers believe that astronomy infrastructure should be considered carefully and mentioned explicitly in the next NRI roadmap. The Australian Academy of Science's Decadal Plan for Australian Astronomy 2026-2035 process recently released an exposure draft that highlights the need to secure access to international large optical telescope facilities (see <https://www.science.org.au/supporting-science/science-policy-and-analysis/decadal-plans-for-science/astro2035/background-white-papers-and-facilities-papers-september-2024>). The discipline's highest priority is securing Australia's membership into the European Southern Observatory, which would critically enable access to large scale 8-metre class telescopes and the next generation European Extremely Large Telescope. Macquarie's astronomy community is not aware of any large-scale NRI in space technology, but nationally supported facilities linked with critical astronomy infrastructure would offer greater potential for technology translation from university to industry sectors. Australia's growing space industry would benefit from nationally supported facilities in areas including tech development, component qualification and testing.

Q27.

Environment and Climate

One important future research trend in this domain involves climate-resilient business models; specifically, how businesses can adapt to and mitigate climate change through technological innovation, new business models, and sustainable practices. Critical infrastructure needs for this next generation work will include a climate data analysis centre with advanced modelling capabilities and open access sustainability metrics and Environmental, Social and Governance (ESG) data repositories. Other expanding research areas in this domain include plant pathogens and transgenic plants as well as animal synthetic biology. Critical infrastructure in these areas include expanded access to glasshouses to work with plant pathogens and transgenic plants. While existing, or soon to come, resources that generate and house transgenic animals are currently sufficient, the field will outgrow them in the next five years.

Q28.

Frontier Technologies and Modern Manufacturing

On a national scale in this domain, it is important to address the lack of an accessible, government-funded or supported network of sovereign data centres specialised for AI compute. This limitation significantly hampers Australia's capabilities & potential to benefit from AI. Building high-performance data centres that can adequately meet research & general business needs is prohibitively expensive for any single research institution. Current alternatives involve accessing secure cloud providers, which results in research grant money benefiting foreign hyperscalers such as Microsoft, AWS, or Google. This dependency on foreign entities poses substantial risk because it limits our ability to utilise AI meaningfully. In comparison, both US & European governments have invested significantly in recent years in their sovereign capabilities. It is crucial that our research does not become fully dependent on companies like Microsoft & others. This is especially important in highly sensitive research areas such as the defence sector. Another future research trend is agentic AI for business decision-making, including autonomous AI systems that can set goals, make complex decisions, & augment human expertise in business contexts, with a particular focus on ethical implications & governance frameworks. Critical infrastructure needs to enable this trend will include high-performance computing clusters for training large-scale AI models, & robotics testing environments (simulated real-world spaces such as warehouses & retail hubs) to study automation's societal & economic impacts. Macquarie's experts in AI also suggested the following research trends in this domain (some of which overlap with the needs identified above): humanoid robots, AI chips, AI for science, AI for technologies, AI engineering, AI safety, AI regulation, smart cyber-physical-social systems, such as AI agents, smart digital twin, & omniverse. Critical infrastructure needs for long-term strategic development and R&D in AI will include (but are not limited to): national data centres, national AI infrastructure, a national AI computing centre & national AI algorithm repositories. Finally, our research community noted that in the Omics analytical research & translation area, NCRIS has developed several valuable platforms, principally mass spectrometry infrastructure (e.g., proteomics, metabolomics, lipidomics). As research moves into single cell multi-omics, mass spectrometry infrastructure needs to keep pace with industry developments, & consider state-of-the-art chromatography & mass spectrometry, which will radically improve sensitivity & detection within Australian Omics research. Many current chromatography & mass spectrometry instruments no longer meet necessary requirements for speed, sensitivity & separation. Many of these instruments are no longer supported by manufacturers for maintenance, repair or spare parts, so do not fit the definition of NRI now, let alone in 5-10 years' time.

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

For this priority, large scale climate and environmental modelling (e.g., energy-demand simulations) require intensive compute capabilities. NCI KSU allocations and wall time limitations frequently are cited as a constraint on research and development. Local high-performance computing and commercial options (e.g., Amazon) are expensive and possibly prohibitive for many projects yet are critical infrastructure gaps. This is especially relevant to important projects (e.g., conservation genomics) that struggle to attract large amounts of funding from industry. In addition, living labs that are co-developed with industry (e.g., energy firms, manufacturers) are needed to pilot net zero technologies (e.g., smart grids, carbon capture).

Q31.

Supporting healthy and thriving communities

For this priority, one area of critical research is “therapies that use precision medicine to treat diseases”. Macquarie’s experts in this area predict that RNA, structural and synthetic biology, and omics in general will grow rapidly in coming years. The advent of AI models for deciphering and predicting biological structure and function requires a huge amount of high-performance computing infrastructure. Increasingly, research is moving towards high throughput multi sample analysis. This not only requires the development of analytical hardware, but the development of bioinformatic solutions to analytical interpretation as well as computing infrastructure to interpret and store high volumes of data. In contrast, emerging research at the multi-omics level requires low throughput approaches to optimise analysis of such things as protein and DNA/RNA modifications, which still require method development and optimisation. This is achieved by very different instruments to those required for high throughput analysis. Other critical infrastructure needs identified for this priority include: • Secure, anonymised health-data repositories that are compliant with privacy laws (e.g., GDPR and the Australian Privacy Act); and • Behavioural simulation tools to model societal impacts of AI/automation policies.

Q32.

Elevating Aboriginal and Torres Strait Islanders knowledge systems

For this priority, collaborative platforms for Indigenous communities to co-design research are needed (e.g., digital knowledge-sharing portals). This will help to address the NSRP research outcome: “research that affects or draws from Aboriginal and Torres Strait Islander knowledge and knowledge systems is done in collaboration with Aboriginal and Torres Strait Islander people”.

Q33.

Protecting and restoring Australia’s environment

One area of critical research identified in the NSRPs is “tools and techniques to collect and analyse environmental data”. Under this priority, our research community has flagged the need for environmental data repositories that link corporate ESG disclosures with ecological datasets.

Q34.

Building a secure and resilient nation

As described in the previous section on ‘future trends’, Australia needs cross-institutional cybersecurity hubs with the defence sector, tech firms, and critical infrastructure providers. This will address the NSRP research outcome: “increased security and resilience of our critical infrastructure and democratic institutions, including to cyber threats”. In addition, many of the challenge areas listed above and emerging capabilities described in this response are (in and of themselves) and enable (research in) critical technologies that require careful consideration of risk management controls in addition to significant, ongoing funding. Provision of such infrastructure is increasingly beyond the ability of any single institution and requires national coordination and investment.

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.

Macquarie University's researchers suggest two domains for new capabilities and their infrastructure requirements, as follows: Artificial Intelligence Large language models (LLMs) are a rapidly growing branch of Generative AI technologies that are transforming many areas and are of special interest in language and linguistic research. Most leading LLMs developed by private industry are made available in a limited capacity as black-box technologies: very useful for many applications but limited as research tools because of restrictions on how they can be accessed. LLMs are very large-scale technologies that need to be developed and trained with enormous amounts of data. The type and scale of resources required to deploy these technologies as open-source research tools exceed the capabilities of most universities and research centres but could be developed on a national scale with the right kind of infrastructure. Open-source independent LLMs would offer tremendous advantages to researchers not currently available through proprietary systems and would be a very valuable asset to the Australian research community, across a host of disciplines. Other new AI capabilities, or capabilities to be enhanced, include: • Access to frontier models in AI platforms, as these are expensive for universities. • Next-generation capability set and talent pipeline such as AI scientists and AI engineers to enable AI4Science and AI4Tech. • In general, Macquarie's researchers consider many facets of AI to be an emerging research trend with critical infrastructure requirements: AI for science (AI4Science), such as AI for medicine, AI for biology, AI for human science. Also, AI for technologies (AI4Tech), such as AI4Finance, AI4Bio, AI4Health, AI4Care, AI4Arts, AI4City, AI4Transport, AI4Agriculture, AI4Security, etc. Glycoscience Glycoscience and its analysis is increasingly recognised as crucially important in many aspects of health and disease, environment and sustainability. See Glyco 2030: A Roadmap for Glycoscience in Europe <https://euroglyco.com/> .To enable this glycoscience to occur, new mass spectrometric, array, modelling and enzyme technologies are proliferating in the literature , indicating that these capabilities are essentials for research advance and innovation across many projects in many research areas.

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) interacted 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.

NCRIS has made a substantial contribution to the research infrastructure, capabilities and expertise available in Australia and is now deploying these in the service of the most significant societal problems in Australia while at the same time supporting the development of the next generation of Australia's leading-edge scientists. This successful strategy needs to be continued and expanded. However, one major issue with the current range of schemes, including NCRIS and LIEF, is that they do not provide long term stable and secured funding. Science infrastructure projects can be particularly large scale and require many years of development, sometimes greater than 10 years. This does not fit well with the shorter-term year-by-year funding cycles available. Another challenge noted by our researchers involves a future roadmap for NCRIS capabilities, especially one that protects significant investment already made in valuable infrastructure. Links between existing areas of technology development currently supported under NCRIS and the new NSRPs are not yet clear. The future roadmap should consider the pathway to longer-term support of enabling capabilities and facilities, including provision of expert technical support.