

**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**

Proteomics, metabolomics, lipidomics, and immunopeptidomics can play a role in bioremediation and biomonitoring in critical minerals processing. Advanced omics technologies can help identify microbial and biochemical pathways that optimize metal recovery from ores and waste streams, improving efficiency and sustainability. National-scale infrastructure is required to support high-throughput proteomic and metabolomic profiling of microbial communities involved in bioleaching and metal recovery. This includes high-resolution mass spectrometry, integrated computational pipelines, and biobanking capabilities for extremophiles and bioengineered strains.

Q22.

## Food and Beverage

Omics technologies are transforming food quality, safety, and nutritional profiling. National infrastructure is needed to develop high-throughput metabolomics and lipidomics platforms to analyze food components, contaminants, and bioactive compounds. Proteomics can also play a role in characterizing allergenic proteins and ensuring food authenticity. Future needs include large-scale reference databases, advanced analytical instrumentation, and cross-sector collaboration for real-time monitoring of food systems. Integrated metabolomics and lipidomics research can support precision nutrition and the development of functional foods tailored to individual health needs.

Q23.

## Medical Products

Precision medicine and biomarker discovery depend on robust proteomics, metabolomics, lipidomics, and immunopectidomics infrastructure. Emerging areas such as multi-omics integration for disease diagnostics, personalized drug responses, and vaccine development require large-scale data repositories, cloud-based analytical platforms, and cutting-edge mass spectrometry capabilities. National coordination is needed to develop standardized workflows for clinical omics research, ensuring reproducibility and interoperability across institutions. Investment in automation and AI-driven data processing will enhance scalability and clinical translation.

Q24.

## Defence

Proteomics, metabolomics, and lipidomics play a crucial role in defence-related applications, including biomarker discovery for stress and performance monitoring, chemical and biological threat detection, and forensic analysis. National infrastructure should support high-throughput omics screening for rapid identification of exposure to toxins and pathogens. Portable mass spectrometry and AI-driven omics analytics can improve real-time battlefield diagnostics. Immunopectidomics can enhance vaccine development against emerging biological threats, necessitating investment in high-performance computing and secure biorepositories.

Q25.

## Recycling and Clean Energy

Omics technologies can support microbial and enzymatic approaches to waste degradation, biofuel production, and circular economy initiatives. Advanced proteomics and metabolomics can characterize microbial consortia for efficient bioconversion of waste into biofuels or biodegradable materials. National-scale investment is needed for biofoundries with high-throughput screening of enzymes and metabolic pathways involved in waste valorization. Lipidomics infrastructure is essential for optimizing algal biofuel production, requiring high-resolution mass spectrometry, automated culturing systems, and biorepositories.

Q26.

## Space

Proteomics, metabolomics, lipidomics, and immunopectidomics are crucial for understanding the impact of space travel on human health. Infrastructure is needed to analyze astronaut metabolomes and immune responses to microgravity, radiation, and closed-loop life support systems. Portable mass spectrometry and automated sample processing are essential for space missions. National coordination is required for long-term biospecimen storage and spaceflight simulation studies. Lipidomics research on membrane adaptation to space conditions can inform biomanufacturing and regenerative medicine strategies for space exploration.

Q27.

## Environment and Climate

Omics technologies are essential for monitoring ecosystem health, biodiversity, and biogeochemical cycles. Metabolomics and lipidomics enable biomarker-based assessment of environmental stressors, while proteomics and immunopectidomics contribute to pathogen surveillance and climate adaptation strategies. National infrastructure must support large-scale environmental omics databases, AI-driven analytics, and field-deployable mass spectrometry for real-time monitoring. Long-term biobanking and standardization of sampling protocols are critical for tracking ecosystem changes over time.

Q28.

## Frontier Technologies and Modern Manufacturing

Omics-driven synthetic biology and biomanufacturing require advanced NRI to support high-throughput screening, precision fermentation, and bioengineering of novel biomolecules. Proteomics and metabolomics infrastructure is crucial for optimizing cell factories producing pharmaceuticals, biomaterials, and sustainable chemicals. AI-enhanced omics analytics will drive the next generation of bio-based manufacturing. National investment is needed in automated bioprocessing platforms, high-throughput lipidomics screening for novel bioactive lipids, and immunopectidomics for next-generation biologics development.

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

Omics technologies can drive breakthroughs in bio-based carbon capture, microbial solutions for methane mitigation, and precision agriculture for sustainable land use. National-scale investments in carbon-tracking metabolomics, AI-driven microbial engineering platforms, and integrated omics-environmental data repositories are critical. Conventional carbon monitoring methods will become inadequate compared to omics-based real-time environmental assessments.

Q31.

## Supporting healthy and thriving communities

Omics-driven personalized medicine, microbiome research, and nutrition optimization will be key to improving public health outcomes. National investments in patient-centric multi-omics databases, real-time health monitoring using metabolomics, and community-based omics studies are essential. Current one-size-fits-all healthcare models will become obsolete as precision health initiatives gain traction.

Q32.

## Elevating Aboriginal and Torres Strait Islanders knowledge systems

Omics technologies can support Indigenous-led research in traditional medicine, environmental stewardship, and sustainable food practices. Research should focus on characterizing bioactive compounds in native plants, integrating omics with traditional ecological knowledge, and supporting Indigenous biocultural heritage initiatives. Infrastructure needs include culturally appropriate biobanking, Indigenous-led omics research centers, and collaborative data governance frameworks. Conventional Western-centric research approaches will need to evolve to incorporate Indigenous perspectives.

Q33.

## Protecting and restoring Australia's environment

Omics-driven biodiversity monitoring, biosecurity innovations, and restoration ecology will be crucial for environmental sustainability. National investments are needed in environmental DNA (eDNA) monitoring networks, AI-enhanced omics analysis for species conservation, and proteomics-driven stress biomarker identification. Traditional conservation methods relying solely on observational data will become inadequate.

Q34.

## Building a secure and resilient nation

Omics technologies will enhance biosecurity, pandemic preparedness, and resilience to environmental hazards. Research directions include real-time pathogen surveillance, personalized response strategies based on immune profiling, and metabolomics-driven early warning systems for environmental stressors. National-scale investments in rapid-response omics infrastructure, integrated biosecurity databases, and AI-driven biosurveillance are essential. Current reactive approaches to biosecurity will no longer be sufficient as threats become more complex and unpredictable.

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.

**Identified Need** The fields of proteomics, metabolomics, lipidomics, and immunopeptidomics are becoming essential in addressing major scientific and societal challenges, including precision medicine, sustainable agriculture, biomanufacturing, and environmental monitoring. However, Australia's current research infrastructure for multi-omics studies remains fragmented, with limited integration across disciplines and insufficient capacity to meet future demands. A national-level investment is required to establish a dedicated Advanced Multi-Omics Research Platform (AMORP) to support cross-sectoral and translational research efforts. **Proposed Infrastructure Capability** The AMORP would be a distributed yet centrally coordinated national facility providing: High-throughput omics analysis: Next-generation mass spectrometry, nuclear magnetic resonance (NMR) spectroscopy, and high-resolution imaging for comprehensive biomolecular profiling. Integrated multi-omics data platforms: Advanced computational resources, bioinformatics tools, and AI-driven analytics for data integration and interpretation. Standardized biobanking and sample processing: Harmonized workflows for sample collection, preparation, and storage to ensure reproducibility and interoperability across research disciplines. Access to expertise and training programs: Workforce development initiatives, including training programs in multi-omics technologies, data analysis, and regulatory compliance. Collaborative research environments: National and international partnerships to foster innovation and accelerate translational applications in health, agriculture, and environmental sciences. **Medium-Term Goals (5-10 Years)** Enhance national research capacity by providing researchers with scalable, state-of-the-art omics technologies. Accelerate discoveries in precision medicine through integrated biomarker discovery and validation for disease diagnostics and therapeutics. Support sustainable agriculture and food security by enabling metabolic and lipidomic profiling of crops and livestock. Advance environmental and climate resilience through real-time biomonitoring of ecosystems and pollutants. Drive biomanufacturing and synthetic biology innovation by providing infrastructure for metabolic engineering and product development. **Impacted Research Communities** Biomedical and clinical researchers working on precision medicine, vaccine development, and disease biomarker identification. Agricultural scientists studying crop resilience, animal health, and sustainable food production. Environmental researchers analyzing the impact of climate change on biodiversity and ecosystem health. Biomanufacturing and synthetic biology industries seeking to develop next-generation biomaterials, biofuels, and pharmaceuticals. Defence and biosecurity sectors monitoring emerging biological threats and ensuring national health security. **Timeframe for Establishment** The establishment of AMORP should be phased over a 10-year period: Phase 1 (1-3 years): Strategic planning, national consultation, and pilot infrastructure development. Phase 2 (4-6 years): Expansion of analytical platforms, recruitment of expertise, and establishment of integrated data systems. Phase 3 (7-10 years): Full-scale implementation, international collaboration, and translation of research outputs into industry and policy applications. **References and Supporting Reports** Australian Academy of Science (2023): "Future Directions in Multi-Omics Research." NCRIS (2022): "Australia's Research Infrastructure Needs for the Life Sciences." Australian Government (2024): "National Science and Research Priorities Report." A coordinated national investment in AMORP will position Australia as a global leader in omics-driven innovation, ensuring sustainable economic and societal benefits for the coming decades.

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:

☐ I did not know about it

☐ Other facilities suit my needs better

☐ I would like to, but cannot get access due to geographical location

☐ I would like to, but believed that access was only available to academic researchers

☒ I am not aware of any capability that meets my needs

☐ Other (please specify)

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.