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

Emerging Research Directions: Next-Generation Precision Medicine Platforms Single-cell multi-omics and AI-driven biomarker discovery for real-time diagnosis and treatment. Expansion of miRNA-based diagnostics for early disease detection. AI-driven integration of genomic, transcriptomic, and proteomic datasets for personalized therapies. Lab-on-a-Chip and Point-of-Care Technologies Miniaturized clinical diagnostics using nanopore sequencing and CRISPR-based detection. Ultra-rapid COVID-like outbreak surveillance integrated with wearables. Humanized 3D Organoid & Bioprinting Platforms for Drug Testing Bioprinting patient-derived organoids to model disease progression, reducing reliance on animal models. AI-assisted in silico drug development. Critical Research Infrastructure Needs: National AI-driven bioinformatics hubs to support real-time genomic data interpretation. High-throughput single-cell sequencing infrastructure for integrating disease-specific multi-omics data. Automated organoid culture platforms linked with AI-based drug response modeling.

Q24.
Defence

Q25.
Recycling and Clean Energy

Emerging Research Directions: Biotechnological Approaches for Biodegradable Medical Waste Engineering microbes for bio-degradation of PPE, plastic syringes, and biohazardous waste. Synthetic biology solutions for self-disposing biopolymers in medical applications. Sustainable Biomanufacturing of Therapeutics Cell-free protein synthesis for on-demand production of life-saving biologics. Using AI-driven metabolic engineering for sustainable bio-manufacturing of insulin, monoclonal antibodies. Critical Research Infrastructure Needs: National-scale biowaste management research centers integrating molecular biology solutions. Automated fermentation platforms for sustainable biomanufacturing.

Q26.
Space

Q27.
Environment and Climate

Emerging Research Directions: Impact of Climate Change on Infectious Disease Epidemiology AI-driven predictive models linking climate change and vector-borne disease spread. Development of precision epidemiology tools integrating genomic surveillance. Bioengineered Microbes for Carbon Sequestration Genetically engineered microbes for methane-to-biofuel conversion. Critical Research Infrastructure Needs: National microbiome engineering facilities for synthetic biology-based climate solutions. Advanced epidemiology surveillance centers using AI for climate-driven disease prediction.

Q28.

Frontier Technologies and Modern Manufacturing

Emerging Research Directions: CRISPR-Based Gene Therapy Production Scale-Up In vivo gene editing to treat genetic disorders at a national scale. Scalable production of synthetic mRNA-based therapeutics beyond COVID-19. AI-Powered Drug Discovery and Repurposing Quantum computing for molecular docking simulations to speed up drug development. AI-guided design of peptide-based therapeutics. Critical Research Infrastructure Needs: National CRISPR-editing core facilities for scalable in vivo gene therapy. AI-enabled molecular simulation hubs.

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

Emerging Research Directions: AI-Assisted Digital Biomarkers for Mental Health and Chronic Disease Non-invasive AI-based detection of early-stage neurodegenerative diseases using voice and gait analysis. Wearable biosensors tracking real-time blood biomarkers. Advanced Molecular Diagnostics for Aging Populations miRNA-based biological aging clocks for personalized longevity therapies. Critical Research Infrastructure Needs: AI-driven digital health platforms integrating molecular and behavioral biomarkers. Nationwide biobank expansion to include neurodegenerative and aging-related samples.

Q32.

Elevating Aboriginal and Torres Strait Islanders knowledge systems

Emerging Research Directions: Indigenous-Led Bioprospecting for Drug Discovery Exploring traditional medicinal plants using metabolomics and synthetic biology. Genomic Studies for Indigenous Precision Medicine National-scale population genomics projects tailored for Aboriginal and Torres Strait Islander health. Critical Research Infrastructure Needs: Culturally respectful national Indigenous genomic databases. Bioprospecting centers that incorporate Indigenous knowledge in drug discovery.

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.

Proposal for a National Multi-Omics & AI-Driven Translational Research Infrastructure (NMO-TRI) Identified Need: The future of precision medicine, biomarker discovery, and therapeutic development is increasingly reliant on multi-omics integration (genomics, transcriptomics, proteomics, metabolomics, epigenomics) and AI-driven analytics. Current national research infrastructure (NRI) in Australia is fragmented, lacking a dedicated, integrated platform that connects molecular-level discoveries to real-world clinical applications at scale. There is also a growing demand for high-throughput, standardized, and federated data infrastructure to facilitate multi-site translational research, particularly in clinical medicine, molecular biology, and disease modeling. This is especially critical for miRNA-based diagnostics, CRISPR-based therapies, AI-assisted drug repurposing, and microbiome-driven therapeutics. Proposed Infrastructure Capability: The National Multi-Omics & AI-Driven Translational Research Infrastructure (NMO-TRI) will: Provide a federated national platform integrating genomics, transcriptomics (including miRNA), proteomics, metabolomics, and epigenomics datasets. Integrate AI and machine learning pipelines for biomarker discovery, drug repurposing, and precision medicine applications. Support next-generation gene therapy and RNA-based therapeutic development, leveraging CRISPR and synthetic biology innovations. Facilitate real-time clinical data integration with biobanks, hospitals, and epidemiology studies. Enable rapid, scalable molecular diagnostics development, including lab-on-a-chip and organoid-based platforms. Harmonize national ethical and regulatory frameworks for AI-driven molecular research and genomic medicine. Medium-Term Goals (5-10 Years) Establish Australia's first national multi-omics research infrastructure linked with AI-driven analytics, accelerating the translation of molecular discoveries into clinical applications. Scale up high-throughput sequencing, single-cell transcriptomics, and real-time epigenomics platforms at a national level. Develop an AI-assisted biomarker validation framework for disease prediction, miRNA-based diagnostics, and aging-related molecular interventions. Strengthen Australia's capabilities in CRISPR therapeutics and RNA-based drug discovery, making it a global leader in molecular medicine. Provide real-time, federated access to harmonized omics data, improving research reproducibility and multi-center collaborations. Impacted Research Communities: Molecular biology and clinical researchers working on miRNA, transcriptomics, and epigenomics. Biopharmaceutical industry developing next-generation RNA-based therapeutics. Genomic medicine experts and bioinformatics specialists needing large-scale multi-omics data integration. Public health and epidemiology researchers studying disease prediction through molecular biomarkers. AI and machine learning communities working on predictive analytics for molecular diagnostics. Timeframe for Establishment: Phase 1 (0-2 Years): Infrastructure blueprint development, regulatory framework alignment, pilot funding allocation. Phase 2 (3-5 Years): AI-powered omics data integration, single-cell sequencing scale-up, national CRISPR/RNA therapeutic platforms. Phase 3 (5-10 Years): Full-scale implementation, multi-center translational research, global collaboration in AI-driven precision medicine. This initiative will position Australia as a global leader in AI-integrated molecular medicine and precision health research, addressing urgent national health challenges while fostering innovation

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.

Australian Plant Phenomics Network, of which the University of Sydney has recently become a node, providing agricultural data collection and analysis support via staff and infrastructure at our Narrabri campus and SIH on main campus.

Q39.

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

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

1. Strengthening Multi-Omics and AI Integration in NRI Given the rapid advancements in genomics, transcriptomics (including miRNA), proteomics, metabolomics, and epigenomics, there is a growing need for a dedicated national research infrastructure (NRI) focused on multi-omics integration. This will enhance precision medicine, disease modeling, and biomarker discovery, particularly for RNA-based diagnostics and therapeutics. A federated AI-powered omics platform should be prioritized to enable real-time data integration across institutions, hospitals, and research centers. This would position Australia as a leader in AI-driven molecular medicine and biomarker discovery, while also addressing challenges in data harmonization, ethical frameworks, and translational research. 2. Expanding NRI to Support Translational Medicine & Clinical Trials Bridging the Gap Between Discovery and Application: A major challenge in molecular medicine is the translation of research findings into clinical applications. Future investments should focus on automated high-throughput validation platforms, including CRISPR-based gene editing, organoid models for drug screening, and synthetic biology for biopharmaceutical development. National-Scale Clinical Trial Infrastructure: AI-powered synthetic control arms and decentralized trial models should be integrated into Australia's clinical trial ecosystem to reduce costs and improve trial efficiency. 3. Building National Capacity for RNA-Based Therapeutics and Biomanufacturing The COVID-19 pandemic demonstrated the importance of scalable RNA-based vaccine and therapeutic development. Australia should establish a dedicated infrastructure for scalable RNA synthesis, lipid nanoparticle formulation, and next-generation RNA therapeutics, including miRNA-based diagnostics and CRISPR-based gene therapies. 4. Industry Engagement & Commercialization Pathways AI-powered drug repurposing initiatives should be supported, allowing biotech and pharmaceutical industries to leverage national-scale omics and epidemiological datasets for precision medicine and novel therapeutic discovery. Biotech Start-Up Hubs linked to NRI would help translate discoveries into commercially viable products. 5. Ethical, Regulatory, and Indigenous Genomics Frameworks Future NRI investments should integrate Indigenous knowledge systems into biomedical and environmental research, ensuring culturally appropriate frameworks for genomics and bioprospecting. Standardized data-sharing policies across omics platforms should be developed to ensure ethical and equitable access to genomic and biomedical data. These recommendations align with the goals of advancing biomedical innovation, strengthening translational research, and ensuring Australia remains globally competitive in precision medicine, molecular diagnostics, and AI-driven research infrastructure.

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.