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: o Biological modelling powered by AI will accelerate drug development and simulate disease progression for more efficient therapies. o Non-animal models, such as organ-on-a-chip systems and 3D printed tissues, will enhance drug screening, reducing the need for traditional animal testing. o While non-animal models are advancing, animal models will remain essential for understanding systemic effects and validating therapeutic outcomes at the whole-organism level. • Critical Infrastructure Needs: o Integrated modelling platforms combining AI simulations, non-animal models, and traditional animal research to refine drug development pipelines. o National biobanks containing multimodal genomic, phenotypic, and clinical data that integrate results from both animal and non-animal models to support precision medicine. o Automated platforms for generating and testing CRISPR-modified models to explore genetic disorders and their therapeutic solutions.

Q24.
Defence

• Emerging Research Directions: o Biomonitoring and environmental sampling will evolve with the help of genetic engineering to rapidly develop countermeasures against potential biological threats. o Dual use technologies with both defence and civilian applications, such as biomarker detection. o Gene editing technologies, such as CRISPR, will be key in developing new ways to combat infectious diseases in both humans and animals, though animal models will remain essential for final validation. o Non-animal models will become more integrated into biodefense research, offering preclinical alternatives for testing pathogen resistance or treatment options. • Critical Infrastructure Needs: o Biodefence research centres utilizing genetic modification platforms for rapid response to emerging threats. o National biobanks for storing pathogen samples and genetically modified organisms used in biodefense research. o Biosecurity simulation systems for modelling genetic interventions and their effectiveness in various biodefense scenarios.

Q25.
Recycling and Clean Energy

Q26.
Space

Q27.
Environment and Climate

• Emerging Research Directions: o The impacts of climate change on human health (such as bushfire smoke inhalation and heat stresses). o Biological modelling will support climate impact predictions, such as microbial bioremediation to clean polluted environments and ecosystem health monitoring. o Gene drive technology—aided by CRISPR—will be essential for controlling invasive species or managing vector-borne diseases. However, non-animal models can help simulate these environmental impacts before applying such technologies in the field. o Non-animal models will play a key role in studying ecological responses to climate change without relying on traditional animal testing. o Genetic and environmental impacts on food security and agricultural productivity and sustainability. o Application of established phenomics infrastructure to study genetic and environmental contributors to veterinary health and disease. • Critical Infrastructure Needs: o Gene drive containment facilities that test and ensure the safe application of genetic technologies to address invasive species and disease control. o National-scale biobanks integrating environmental DNA from both animal and non-animal systems to track ecological changes and biodiversity loss. o Hybrid modelling systems combining in vitro toxicology data with field-based assessments for long-term ecological impact evaluations.

Q28.

Frontier Technologies and Modern Manufacturing

• Emerging Research Directions: o CRISPR-based genome engineering will enable more sustainable bio-manufacturing processes, allowing the creation of bio-based materials and sustainable chemicals from engineered organisms. o Non-animal models will facilitate the rapid testing of new biotech applications in materials science, as well as bioengineering applications for tissue regeneration. o Animal models may still be needed for final product safety evaluations, especially where complex multi-organ or immune system effects are involved. • Critical Infrastructure Needs: o National biomanufacturing hubs for scaling up CRISPR-engineered organisms for sustainable materials and chemical production. o Advanced bioreactor systems for large-scale growth and genetic modification of engineered organisms. o Collaborative platforms for testing bioengineered products in both in vitro and in vivo systems.

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

• Emerging Research Directions: o The development of bio-based solutions to address climate change will heavily rely on biotechnology and genome engineering, particularly using CRISPR to modify microorganisms and plants for enhanced carbon capture, bioenergy production, and climate resilience. o Synthetic biology, including genome-engineered organisms, will lead to the creation of sustainable biofuels, biodegradable materials, and more efficient carbon capture technologies. • Critical Infrastructure Needs: o National biobank systems that store genetic information and phenotypic data on microorganisms and plants for bioenergy and carbon capture efforts, facilitating research on the most effective species and strains. o Advanced genome engineering platforms incorporating CRISPR technologies to modify plants and microorganisms for carbon fixation, biofuel production, or ecosystem restoration. o AI-driven modelling tools integrating genomic data and phenotypic traits to predict the performance of genetically modified species in real-world environments, accelerating the transition to net-zero solutions. • Infrastructure Needs to be Reconsidered in 5-10 Years: o Fossil fuel-based research infrastructure will likely be phased out as focus shifts toward biotechnological research, with genetic engineering playing a central role in advancing sustainable energy solutions.

Q31.

Supporting healthy and thriving communities

• Emerging Research Directions: o Precision health will evolve with the integration of genomic sequencing and non-animal models for personalized medicine, focusing on drug discovery, disease prevention, and gene therapy. The use of CRISPR for gene editing will allow for targeted treatments for genetic diseases, enhancing patient-specific therapies. o Biobanks will play a crucial role in collecting and analysing genetic data from diverse populations, providing critical insights into disease biomarkers and the efficacy of personalized medical treatments. • Critical Infrastructure Needs: o National biobanks storing diverse genetic, phenotypic, and environmental data will be essential for advancing precision medicine. These biobanks will also support drug discovery and clinical trials with genetically diverse datasets. o Platforms enabling genetic modification through CRISPR to create disease-specific cell lines for more accurate testing in drug discovery, reducing reliance on animal models in favour of more relevant in vitro models. o Non-animal testing systems, such as organ-on-chip technology, will become increasingly essential for drug testing and disease modelling, facilitating the transition to more human-relevant research models. • Infrastructure Needs to be Reconsidered in 5-10 Years: o Traditional animal-based testing systems will evolve as more advanced non-animal models (e.g., organ-on-chip) are developed, but animal models will remain complementary in certain contexts, especially for diseases that require in vivo complexity.

Q32.

Elevating Aboriginal and Torres Strait Islanders knowledge systems

• Emerging Research Directions: o The integration of Indigenous ecological knowledge with modern biotechnological tools, including genome sequencing and CRISPR-based technologies, will offer new opportunities for species conservation and restoration of ecosystems. o Combining traditional ecological practices with genetic conservation methods will enhance our ability to restore and protect native species and ecosystems, using biotechnological innovations such as CRISPR for species restoration. • Critical Infrastructure Needs: o National genetic databases integrating Indigenous ecological knowledge and modern biotechnology to support biodiversity conservation and ecosystem restoration efforts. o Genome editing platforms for the restoration of native species or control of invasive species through gene drive technologies will help manage biodiversity and strengthen ecosystems. o Research hubs that combine both traditional ecological knowledge and modern biotechnology to create comprehensive, effective conservation strategies. • Infrastructure Needs to be Reconsidered in 5-10 Years: o Traditional conservation models that do not integrate biotechnological tools and Indigenous knowledge will evolve towards more holistic approaches combining biotechnology and Indigenous practices for biodiversity conservation and ecosystem restoration.

Q33.

Protecting and restoring Australia’s environment

• Emerging Research Directions: o CRISPR gene drive technologies will play a pivotal role in managing invasive species and restoring biodiversity. Using genetic engineering to create resistance in native species or control invasive species will be key to ecosystem restoration. o The use of biotechnologies to enhance plant resilience through genetic modification (e.g., drought resistance) and microbial communities for improved soil health will be essential for environmental restoration and management. • Critical Infrastructure Needs: o National biodiversity biobanks for storing genetic data of native species, focusing on endangered species, and supporting biodiversity conservation and ecosystem restoration. o Gene editing platforms to develop tools for controlling invasive species and enhancing native species' resilience to climate change and disease, supporting environmental restoration. o Ecosystem restoration research hubs that combine genomic data, biotechnological tools, and traditional knowledge for comprehensive ecosystem management. • Infrastructure Needs to be Reconsidered in 5-10 Years: o Conventional conservation tools that do not incorporate biotechnological advancements in genetic engineering will be replaced by genetically informed conservation approaches that combine biotechnology, genetic monitoring, and restoration technologies.

Q34.

Building a secure and resilient nation

• Emerging Research Directions: o To enhance sovereign capability in biosecurity and biodefense, Australia will need to develop domestic biotechnology and genome engineering capabilities, such as CRISPR, for rapid response to biological threats, including disease outbreaks and bioterrorism. o Advancements in genetically modified crops, disease-resistant livestock, and other biosecurity innovations will strengthen Australia's food and health security by providing more resilient species tailored to local conditions. • Critical Infrastructure Needs: o Domestic biomanufacturing facilities to produce genetically engineered vaccines and biological countermeasures, reducing reliance on international supply chains during crises. o Biosecurity research hubs focused on developing and testing biological solutions to local biosecurity threats, including CRISPR-based interventions for disease resistance and pest control in agriculture. • Infrastructure Needs to be Reconsidered in 5-10 Years: o Foreign dependence for biological solutions and biomanufacturing will no longer be viable as Australia focuses on building sovereign biotechnology capabilities to ensure self-sufficiency in biosecurity and disease management.

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.

Need for New Biobanking Infrastructure Australia's research community has identified a growing need for a national coordination that consolidates existing and new biological samples, genomic data, and health records to support precision medicine, biomedical research, and environmental health studies. While there are valuable health samples stored in various Australian biobanks, these collections are often fragmented and siloed across different institutions. A centralized, well-coordinated national effort would allow for the integration of these existing resources, enabling more comprehensive studies that can drive major breakthroughs in public health and medicine. Proposed Infrastructure Capability The proposed national infrastructure would act as a centralized platform for storing and accessing biological samples alongside genomic, phenotypic, and environmental data from existing Australian biobanks. This infrastructure would: • Integrate data from existing biobanks, ensuring that health samples and genomic information stored across various institutions are accessible for large-scale research efforts. • Create a comprehensive longitudinal dataset by adding new health samples over time, enabling studies on chronic diseases, genetic predispositions, and environmental impacts. • Facilitate research in precision medicine, drug discovery, public health, and climate change, enabling researchers to make more informed decisions based on a complete and unified dataset. By incorporating samples and data already held in Australia's biobanks (e.g., those in the Australian Diabetes, Cancer, or Indigenous Health biobanks), this infrastructure would enhance the depth of existing research and ensure that past investments in data collection can be fully utilized in the context of new studies. Impacted Research Communities • Public health researchers will gain access to integrated, rich datasets for studying disease prevention, risk factors, and health outcomes across Australia's diverse populations. • Genomics and precision medicine will benefit from a comprehensive and diverse collection of genetic and environmental data, allowing for the development of personalized health strategies tailored to Australian populations. • Environmental researchers will have access to health data linked with environmental exposure information, enabling them to study the long-term effects of environmental changes on public health and biodiversity. • Indigenous health research will be empowered by the inclusion of health data from Indigenous populations, ensuring research outcomes are representative and culturally relevant. Need for New Biological Modelling Infrastructure Australia's research community has recognized the increasing need for advanced biological modelling capabilities to support the growing demand for more precise, ethical, and cost-effective methods of studying biological systems, disease mechanisms, and therapeutic interventions. While traditional animal models have been crucial in research, there is a compelling need to expand Australia's capacity for non-animal models, such as organ-on-a-chip systems, computational biology, and AI-driven simulations. The development of a national infrastructure for biological modelling would address these needs by providing advanced tools for predictive modelling, drug discovery, and personalized medicine. Proposed Infrastructure Capability The proposed infrastructure would include both animal and non-animal biological modelling platforms designed to address key challenges in drug development, disease modelling, and toxicology: • Animal-based modelling: Ensuring humane, high-throughput systems for preclinical trials and disease models in species such as rodents, primates, and genetically modified organisms for research on diseases like cancer, neurological disorders, and infectious diseases. This would include ethical considerations, ensuring animal welfare while enhancing research outcomes. • Non-animal modelling: Expanding capabilities in organ-on-a-chip technology, 3D tissue engineering, and computational simulations. These systems simulate human biology at a cellular or organ level, providing more relevant insights into human disease processes without the ethical concerns and limitations of traditional animal models. • In silico modelling and AI integration: Using machine learning, artificial intelligence, and computational biology to analyse biological systems at scale, predict outcomes in human diseases, and optimize drug development pipelines. • Data integration and sharing: Developing infrastructure to connect animal, non-animal, and computational models with large datasets, enabling predictive analysis of disease mechanisms, drug responses, and personalized medicine applications. Impacted Research Communities • Pharmaceutical and biomedical research: Advancing both non-animal and animal-based disease models for more accurate and efficient drug discovery and testing, reducing the need for animal testing and speeding up the translation of research into clinical settings. • Toxicology and regulatory research: Enabling more comprehensive testing of chemicals, pharmaceuticals, and environmental factors on human biology, with non-animal alternatives being central to reducing animal testing. • Personalized medicine: By using data from both biological models and patient-specific models, researchers can develop customized treatment strategies, particularly for complex diseases like cancer and neurological disorders. • Environmental and ecological modelling: Ensuring sustainable research into the impact of toxins or pollutants on both ecosystems and human health through non-animal models.

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:

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. The 2026 NRI Roadmap should achieve stable and perpetual Commonwealth funding for the National Collaborative Research Infrastructure Strategy (NCRIS), as a primary structural dependency to the growth of national science and innovation capability. The current decadal NCRIS funding horizon, which ends in 2028, has brought with it significant operational cohesion and infrastructure sophistication (which in many cases is now world-leading) as well as improved retention of a national workforce of highly-skilled technical experts and infrastructure professionals, though the staggered 5-year periods of funding activity with inevitable 'funding cliffs' have stunted service planning and capability investments. Equivalent long term funding assurance as provided to entities such as the MRFF, ARC and NHMRC will properly enable NCRIS to get more value from investment in research across universities, industry and government; harness and grow business investment in R&D; and leverage our scientific strengths to help address national priorities and foster new industries. 2. Australia requires concerted national leadership for the strategic development and delivery of biological models as research infrastructure. The fragility of this sector, as demonstrated by the persistent disruption caused by the transition of ownership of the Animal Resources centre to a new commercial provider of lab animals, and the significant national opportunity of supporting non-animal modelling infrastructure (the CSIRO have estimated that annual revenue from medical product development using complex non-animal models could reach $1.6 billion by 2040, creating more than 5000 new jobs in Australia) requires a deliberate national infrastructure response. 3. Biobanks have been persistently neglected in responses to successive roadmaps, and the deferral of the collections step change opportunity as part of the 2021 Roadmap response is a sign that they will once again miss out for meaningful support. Biobanks are vital infrastructure for Australia’s medical research effort, curating millions of unique and irreplaceable biological and clinical samples which, when discoverable and reusable, provide individual and population level health insights to improve healthcare and disease prevention nationwide. International examples of successful coordination of biobanking infrastructure, such as the BBMRI-ERIC and the UK Biobank, show what can be achieved if properly supported. 4. The digital science revolution will underpin research and research infrastructure in ways that we don’t yet fully comprehend. The National Digital Research Infrastructure Strategy is a welcome and necessary first step towards underpinning current and future research infrastructure with digital support, and this should be continued in the 2026 Roadmap.

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.