

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: Biological modelling powered by AI will accelerate drug development and simulate disease progression for more efficient therapies. 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. 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: Integrated modelling platforms combining AI simulations, non-animal models, and traditional animal research to refine drug development pipelines. National biobanks containing genomic, phenotypic, and clinical data that integrate results from both animal and non-animal models to support precision medicine. Automated platforms for generating and testing CRISPR-modified models to explore genetic disorders and their therapeutic solutions. Obsolete or Diminishing Infrastructure Needs: Standalone animal testing facilities that are isolated from non-animal and computational models will no longer align with modern research goals. Fragmented, siloed biobanks without cross-model integration will become increasingly inefficient and less relevant. Small-scale, disconnected computational platforms will be replaced by larger, centralized, AI-powered research infrastructures to enhance data integration and predictive capabilities.

Q24.
Defence

Emerging Research Directions: Biodefence modelling will evolve with the help of genetic engineering to rapidly develop countermeasures against potential biological threats. 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. Non-animal models will become more integrated into biodefence research, offering preclinical alternatives for testing pathogen resistance or treatment options. Critical Infrastructure Needs: Biodefence research centres utilizing genetic modification platforms for rapid response to emerging threats. National biobanks for storing pathogen samples and genetically modified organisms used in biodefence research. Biosecurity simulation systems for modeling genetic interventions and their effectiveness in various biodefence scenarios.

Q25.
Recycling and Clean Energy

Q26.
Space

Q27.
Environment and Climate

Emerging Research Directions: Biological modelling will support climate impact predictions, such as microbial bioremediation to clean polluted environments and ecosystem health monitoring. 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. Non-animal models will play a key role in studying ecological responses to climate change without relying on traditional animal testing. Critical Infrastructure Needs: Gene drive containment facilities that test and ensure the safe application of genetic technologies to address invasive species and disease control. National-scale biobanks integrating environmental DNA from both animal and non-animal systems to track ecological changes and biodiversity loss. 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: CRISPR-based genome engineering will enable more sustainable bio-manufacturing processes, allowing the creation of bio-based materials and sustainable chemicals from engineered organisms. Non-animal models will facilitate the rapid testing of new biotech applications in materials science, as well as bioengineering applications for tissue regeneration. 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: National biomanufacturing hubs for scaling up CRISPR-engineered organisms for sustainable materials and chemical production. Advanced bioreactor systems for large-scale growth and genetic modification of engineered organisms. 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: 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. 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: 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. Advanced genome engineering platforms incorporating CRISPR technologies to modify plants and microorganisms for carbon fixation, biofuel production, or ecosystem restoration. AI-driven modeling 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: 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: Precision health will see a leap in personalized medicine through the integration of genomic data and AI-based modelling to develop targeted therapies for chronic and genetic diseases. Biobanks will be central in collecting genetic samples from diverse populations to identify biomarkers for personalized treatments. CRISPR-based genome engineering will enable the development of gene therapies for genetic diseases and conditions previously deemed difficult to treat. The creation of gene-edited cell lines for testing drug efficacy and safety will replace some traditional testing methods, reducing reliance on animal models. Non-animal models, such as organ-on-chip systems, will be utilized for drug testing, with genetic engineering enabling the creation of more accurate disease models for testing therapeutic interventions. Critical Infrastructure Needs: National biobanks will store not only genomic data but also phenotypic data and environmental exposure information to provide deeper insights into personalized medicine. These will serve as essential repositories for ongoing research into drug efficacy and disease prevention. CRISPR-enabled genome engineering platforms will be needed to produce cell lines and genetically modified organisms to model specific diseases for drug testing and gene therapy development. Non-animal testing infrastructure, such as organ-on-chip systems, combined with AI-based modelling tools for simulating complex biological processes, will reduce reliance on animal testing in drug discovery and safety testing. Infrastructure Needs to be Reconsidered in 5-10 Years: Traditional animal-based testing platforms will evolve with the development of gene-edited models and organ-on-chip systems that can mimic human biology more accurately. However, animal models will remain complementary for specific complex disease models where in vivo testing is essential. Siloed biobanks focusing solely on genomic data will be phased out in favor of integrated platforms that also collect phenotypic and environmental exposure data, creating a more holistic database for personalized medicine.

Q32.

Elevating Aboriginal and Torres Strait Islanders knowledge systems

Emerging Research Directions: 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. 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: National genetic databases integrating Indigenous ecological knowledge and modern biotechnology to support biodiversity conservation and ecosystem restoration efforts. 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. 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: 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: The application of CRISPR to manage invasive species and restore biodiversity will become more prevalent, particularly for species that are at risk due to climate change and human impact. For example, gene drives could be used to control invasive species that threaten native wildlife. Genome engineering technologies, like CRISPR, will also help restore ecosystems by introducing genetic traits that increase the resilience of native species, enabling them to better cope with environmental stressors such as drought, disease, and temperature fluctuations. The development of biotechnologies to combat biodiversity loss and ecosystem degradation will rely on a combination of genetic conservation, biobank data, and biotechnological interventions to monitor and restore ecosystems. Critical Infrastructure Needs: National biodiversity biobanks that store genetic data of native and endangered species, supporting conservation programs and species restoration efforts. Gene editing platforms that use CRISPR to develop strategies for controlling invasive species or improving the resilience of threatened native species. Ecosystem restoration hubs integrating genetic monitoring with biotechnology to address environmental challenges like biodiversity loss, climate resilience, and ecosystem restoration. Infrastructure Needs to be Reconsidered in 5-10 Years: Outdated conservation practices that fail to integrate genetic tools or biotechnological innovations will be replaced with more data-driven and genetically informed approaches to biodiversity conservation and ecosystem restoration.

Q34.

Building a secure and resilient nation

Emerging Research Directions: 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. 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: Domestic biomanufacturing facilities to produce genetically engineered vaccines and biological countermeasures, reducing reliance on international supply chains during crises. 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: 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 NR 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.

1. Need for New Biobanking Infrastructure Australia's research community has identified a growing need for a national biobank 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 biobank 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 biobank would act as a centralized platform for storing and analyzing biological samples (e.g., blood, tissue, saliva) 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. 2. 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 modeling, 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 analyze 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. 3. Collaborative National Framework Initiatives Coordinating diverse existing NRI (such as the NCRIS Health Gp) and applying to the co-design of NRI solutions to community-led research priorities.

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.

CSIRO Futures report - non-animal models <https://www.csiro.au/en/work-with-us/services/consultancy-strategic-advice-services/csiro-futures/health-and-biosecurity/non-animal-models>