All responses are limited to 300 words per question. You can upload additional information on the website however submissions over 1,000 words may not be considered.

1. Are the recommendations appropriate to the current NRI environment?

Word count=

Researchers are increasingly focused on investigating solutions to complex problems that are not easily solved by a single discipline. NRI investment must support all fields of research and encourage their interconnectedness. Increased collaboration, within and between different research areas and with industry, will require facilities to be multipurpose and serve many disciplines and industries. Although infrastructure needs are siloed under challenges, much of this infrastructure has broader application and can be used to solve many problems.

Researchers of the future will expect a seamless ecosystem of facilities and services. Interfaces will be easily accessible, with no separation between physical instrumentation, digital tools and the necessary supporting skills and expertise. Providing a seamless ecosystem of NRI services for researchers will require an even greater level of collaboration across the NRI system.

NRI needs to engage more effectively with industry and other research end users through user-centric approaches.

NRI Workforce Strategy to support career pathways, address technical skills shortages and identify capability gaps. Human capital is vital, with both technical expertise and a skilled workforce becoming increasingly important. NRI is underpinned by a highly skilled and increasingly specialised workforce that needs job security and opportunities for career mobility and professional development. address career pathways and technical skills shortages. The continual training and development of skilled staff is important to provide technical support to the research community. Career progression and mobility for NRI staff within the sector is often limited due to their specialised skills, particularly as their roles typically make traditional academic pathways unavailable. provide opportunities for training and professional development, such as staff exchanges, mentoring and participation in conferences.

Digital research infrastructure is fundamental to Australia's research effort and requires a national strategy. Improving researcher training and access to such tools will enable better analysis and utilisation of large-scale datasets, such as those from social media, health, agricultural and environmental databases.

Support establishment of an Expert NRI Advisory Group to provide ongoing independent, long-term strategic advice on NRI priorities, trends and opportunities.

2. Do the principles articulate the vision and key elements required of NRI, including investment?

Word count=

- NRI maximises the capability of the research and innovation system to contribute to economic outcomes, national security, social wellbeing and environmental sustainability.
- Research infrastructure is collaborative and planned in a way to provide a network of capabilities that serve the national interest and are aligned to government priorities.
- NRI includes the people, skills and knowledge, data, processes and equipment required to realise the value of the NRI.
- NRI resources are focussed to achieve maximum impact in national priority areas.
- NRI is managed to deliver maximum impact as efficiently as possible. Synergies with complementary and related capabilities drive an ecosystem of support for researchers.
- NRI is widely accessible to researchers and industry across Australia. Barriers to access are as low as practicable.
- NRI enhances participation of researchers in, and provides access to, the international research system.
- Funding for investment in NRI is in areas of national significance that can demonstrably support Australia's research and innovation system.
- Investment should balance the long-term nature of NRI development together with changes in national priorities and identified gaps in the research and innovation system.
- Investment should produce NRI that facilitate and enhance industry and international engagement.
- Investment cases describe the intended impact and reflect the resources and governance needed to develop and manage world class research infrastructure capability. These include the equipment, processes, data, skills and knowledge needed to deliver maximum value.
- Investment encourages and leverages opportunities for co-investment from states and territories, university, public and private sectors.
- Investment supports the development of a cohesive suite of NRI that strives to create an ecosystem of seamless services for researchers.

Public investment in research infrastructure supports collaboration and linkages across the innovation system, fosters multidisciplinary approaches and increases opportunities for research translation.

3. The NRI Roadmap has a clear focus on identifying the NRI investments required to support Australian research over the next 5 to 10 years. Are there any national research infrastructure needs missing in the draft Roadmap?

Word count=

Physical collections are a vital resource for research and underpin activities from health and medical research to ecological and agricultural fields. Physical collections of specimens and taxonomy are also critical to support the identification of biosecurity risks and determine action, supporting Australia's environmental and climate adaptation strategy.

Metadata capture of physical collections is essential to ensure specimens are findable and accessible to researchers. Metadata standards are also necessary for data to be interoperable across institutions and platforms and to address current disparity in discoverability, accessibility and quality of data. Evolving analytical technologies are also generating new opportunities for specimen or sample use and reuse.

Biodiversity and environmental sample biobanks have significant potential as baseline infrastructure to support environmental monitoring and management, biosecurity, biodiscovery and bioprospecting.

The value of current biological and environmental sample collections could be improved, creating an open-access infrastructure through development of unified sample management, metadata and access models and shared data infrastructure. Rapidly evolving analytical technologies (genomics, digitisation etc) are generating new opportunities for specimen and sample use and reuse that have not been previously possible and help manage the finite resources of biobanks. Application of new technology means old samples are becoming valuable in new ways and across new domains and can assist researchers in addressing the challenges.

Australia also has a range of high-quality biobanks that are immensely valuable to biomedical and clinical research and provide important information for synthetic biology research. However, they are currently not coordinated or integrated. Medical and human biobanks are implemented at the state and territory level and involve complex ethics and regulatory frameworks.

Roadmap consultations highlighted the need for a skilled workforce and expertise to support physical collections and biobanking. While researchers are adept at collection, there are skills gaps in the curation and preservation of collections.

Biobanking NRI would allow for opportunities for greater integration and alignment of functions across the network, and increased use of existing NRI, eg Microscopy Australia

Biobanking investment can support

- synthetic biology research infrastructure to deliver new bioindustries
- research translation infrastructure to drive increased industry investment
- world-leading environmental and climate infrastructure to underpin Australia's national adaptation strategy… help identify regions and communities at greatest risk from climate threats and enable Australia to better adapt to a changing climate

Management of datasets and collections

- Careful curation and improvements to the reliability, interoperability, accessibility and management of datasets and collections is crucial to ensure use and reuse of data.

Measurement and characterisation

- Measurement and characterisation analyse the properties of individual samples, including subatomic particles, molecules, materials and organisms.

4. A key priority for Australia is to enhance research translation. The 2021 NRI Roadmap identifies some reforms and investments to achieve this. What other reforms would help deliver this priority?

Word count=

Successful research translation will require a range of elements working together in harmony across jurisdictions. NRI can play a critical role in bridging the gap between discovery research and the point of value inflection, beyond which industrial support becomes available. NRI needs to be more visible and accessible to industry and the mutual benefits from closer collaboration should be promoted.

NRI plays a vital role in Australia's research and innovation ecosystem, optimising the use of resources and creating scale through nationally networked and accessible infrastructure. It supports researchers across the research pipeline (from fundamental to applied) and enables them to make the critical discoveries that drive innovation and economic growth and improve social outcomes

NRI needs to be more visible and accessible to industry and the mutual benefits from closer collaboration should be promoted. the industry sector has limited awareness of NRI, its benefits and how it can be accessed.

- lack of awareness of NRI capabilities due to limited targeted industry promotion and networking
- difficulties accessing NRI, including time and resource constraints, and lack of technical capability and expertise to navigate the process
- issues with data management and quality frameworks.

National biobanking would support scale-up of production processes to supply early testing (such as phase-I clinical trials).

5. The Roadmap proposes that Australia could make landmark investments to drive step changes in research and innovation over the next 10 to 15 years. Do you agree with the assessment of potential areas for investment in the report? What other areas do you consider might fit the definition of landmark investment?

Word count=

Research to improve health outcomes should be underpinned by the following research infrastructure:

- National integration of health datasets (experimental outputs, large-scale genomic data, clinical data, population data and those relevant to social determinants of health (such as education and employment status)). Disparate datasets could be integrated in an open-access national platform, with appropriate privacy protections.
- Biologics development facilities would support basic and translational research in e.g. mRNA vaccines, cell and gene therapies.
- Small molecule development facilities would support basic and translational research for small molecule therapeutics.
- National facilities supporting pre-clinical research and clinical research.

Research into frontier technologies and modern manufacturing should be underpinned by the following research infrastructures (ensuring ongoing basic research excellence):

- Synthetic biology infrastructure supports research, development and manufacturing of novel products.
- Omics facilities analyse molecular components of cells (DNA, RNA, proteins and metabolites) in biological samples.
- Advanced imaging facilities include transmission and scanning electron microscopes and X ray photoelectron spectroscopes to characterise biological and non-biological materials. Additionally, imaging facilities (such as magnetic resonance imaging, positron emission tomography and computed tomography scanners) are used in preclinical studies.

Research into biodiversity conservation is necessary to ensure the protection of Australia's unique species. In the marine domain, there is need for increased observational capacity in coastal zones and on the ocean floor, with better integration of marine, freshwater and terrestrial monitoring. The need for greater capacity in atmospheric and air quality monitoring has been identified in both regional and urban areas. There is also significant potential for enhanced biodiversity and biosecurity monitoring infrastructure that can identify the DNA of animals and microbes from soil and water samples. Research to safeguard future prosperity against environmental and climate threats should be underpinned by the following research infrastructure:

- Biodiversity monitoring, collection and analysis infrastructure
  - Biodiversity monitoring, collection and analysis infrastructure includes collections of species and specimens as baseline infrastructure. These support environmental monitoring and management, biosecurity management, long-term biodiversity monitoring at a national scale and underpin taxonomic data.
- Marine, coastal, freshwater and atmospheric monitoring and observation infrastructure
  - Marine, coastal, freshwater and atmospheric monitoring and observation infrastructure includes sea-floor mapping vehicles, observation and monitoring of Australia's coastal, estuarine and freshwater environments and atmospheric measurement.
- Integrated, publicly accessible environmental datasets

o Integrated publicly accessible environmental datasets include urban, biodiversity, terrestrial, ocean, freshwater, estuarine and atmospheric datasets from state and territory monitoring programs and NRI. Additionally, it includes large-scale collections of earth, soil and water samples.

o Pre-clinical research support includes modelling for both disease mechanisms and early drug candidate testing, as well as medical imaging infrastructure. This is performed both in animal models and newer ex vivo and in vitro models. It is recognised that alternatives to animal models are becoming more prominent, but also that it is unlikely live models can be fully replaced for some time. With the current research infrastructure provider at risk, the need for reasonably urgent national consideration of animal model provision has been identified through Roadmap consultation.

The gap between research discovery and real-world impact is one of the most pervasive challenges faced by the Australian research and innovation sectors. the Roadmap consultation process found that the industry sector has limited awareness of NRI, its benefits and how it can be accessed.

- Access to high quality datasets requires strong national leadership, direction and coordination to deliver systematic data management and archival mechanisms.
- Increased collaboration, within and between different research areas and with industry, will require facilities to be multipurpose and serve many disciplines and industries.
- Next generation Omics underpin a range of research areas, such as environmental DNA monitoring and bioprospecting, precision medicine and agriculture.
- Synthetic biology: the application of engineering principles to biology and involves the design and construction of biological systems and devices.

Advanced climate modelling: greater detail and granularity are required to identify which climate risks will most severely affect Australians, when and where they will happen and how they can be effectively managed. This will improve our understanding of climate systems and enable greater accuracy in predicting the impact of future climate changes.

6. Please add any other comments you would like to provide to the Expert Working Group.
Word count=