Australian Government
Department of Education

Compiled responses to question 35 of the 2026 NRI Roadmap survey

Please note:

- This document contains survey responses to question 35 of the initial 2026 National Research Infrastructure (NRI) Roadmap Consultation Survey.
- Question 35 of that survey was as follows:

  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.
- This document can be used to support responses to question 13 of the [2026 NRI Roadmap Issues Paper Consultation Survey](#).
- Each submission's unique response number is found at the beginning of the submission's identifier.
  - Example: for submission **123_Roadmap Survey_Jane Doe,** the response number will be '**123**'.
- Responses may span across multiple pages.
- The responses listed below only include those submissions where the respondent agreed to their submission being published and attributed to them.

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001_Roadmap Survey_Katherine Bode	A number of countries are developing AI research capacity in national libraries (Norway and the UK are key examples here). This development is important because it protects culturally sensitive data and enables initiatives that are focused on issues that are specific to and pressing for those contexts. It also brings together experts in technology with the experts in curation, management and protection of data (librarians and other information professionals in this sector). Libraries are also leaders in life-long learning, especially in the area of literacy, so having these capacities together creates potential for libraries to continue in this role with emerging technologies, including helping people across the lifetime to manage the harms and take advantage of the possibilities of these systems. Not taking this step in Australia risks exacerbating the current situation, where we are increasingly users of overseas (US and Chinese) systems rather than designers, makers and participants in diverse local cultures.
002_Roadmap Survey_Thomas McGoram	For Australia to continue to support groundbreaking, sovereign research in plant science, medicine, fundamental nuclear science, environmental and climate research, and to support the growing space sector, there is a need to increase our capability to accelerate ion beams to higher energies, and with higher intensities, across a broad range of the periodic table. The desired end-state capability is a substantial upgrade to the HIAF Superconducting Linear Accelerator (LINAC) to more compact, contemporary technology by 2040, allowing for at least a doubling in the maximum beam energy currently available. The technology for such an upgrade to the HIAF LINAC is well-proven, operating successfully and reliably at facilities in the US, Europe and South Korea. The new LINAC would be coupled with a stand-alone ion source to enable an increase in the range of beam species and beam intensities currently achievable at the facility. This new capability would establish HIAF as world-class translational RI in support of radiobiology, plant science, nuclear medicine, space technology and fundamental nuclear physics. It would maintain Australia as an internationally competitive destination for nuclear science, attracting high quality researchers from a range of disciplines to come to Australia to conduct research, and/or take up positions in Australian tertiary institutions. It would also allow independent operation of the parallel, continually-used and still in-demand 14UD Pelletron accelerator, increasing support for climate and environment research such as groundwater dating and environmental monitoring, underpinning social license for AUKUS and responsible storage of Australia's nuclear waste. Important intermediate steps in establishing this capability would include growing the specialist engineering workforce to install and maintain the LINAC and establishing the building and other infrastructure requirements to house the new facility. The workforce component would leverage relationships with comparable facilities in the US and Japan, who would play an important role in developing our engineering base. Ideally, these components would be in place no later than 2035. For more than 50 years, Australia's accelerator facilities have rewarded forward-looking investment. Their innate versatility, ability to pivot to the scientific priorities of the day make them a low-risk, high benefit investment in national research infrastructure. They serve a broad and diverse research community in the service of the national interest, they serve as important symbols of our Australia's scientific

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	credibility on the international stage, and they are integral to building scientific and diplomatic links in Australia's region.
003_Roadmap Survey_Karthik Subramanian Krishnan	The scale of experiments is continuously increasing There is a constant shift and change of technology (short equipment technology lifecycle) which only NCRIS can accommodate There are increasing bioinformatics and computational demands.
004_Roadmap Survey_South Australian Genomics Centre	See comments provided under medical products which provides thoughts on what is needed in terms of enhancements to existing capabilities.
005_Roadmap Survey_Gabby Walters	A new NRI capability that supports biometric research would indeed enhance the research capabilities of all researchers seeking to better understand human behaviour across multiple domains. Currently, there exists a research community of practice (Biometric Research Hub, Australia) comprising researchers who are applying biometric techniques to human behaviour research in the fields of marketing, psychology, management, neuroscience, education, economics and tourism. There has been great enthusiasm among this group to build the human and technological capital necessary to provide new insights on human behaviour, something that would only be possible with national-level investment The aspirations of this community align well with the Australian Government's science and research priorities, many of which require an understanding of human behaviour to drive positive change in society, processes, and practice. For example, the Australian Government has identified a need to increase policy and analytical capability across the Australian public service, including the experience of customers. This is noted as requiring collaboration with the university sector for the development of research led solutions to guide the reform of their internal and external human focused practices – all of which rely on a deeper understanding of human behaviour (https://ministers.pmc.gov.au/gallagher/2022/albanese-governments-aps-reform-agenda). Human behaviour and the decisions they make have a significant impact on job creation, economic growth, and the overall quality of life. An NRI capability that supports the development of sophisticated human behaviour laboratories that house biometric equipment at scale will provide a unique research environment where researchers across Australian academic institutions will have access to the latest technology and multi-disciplinary expertise to better understand these processes and offer effective solutions to complicated problems that continue to impact society. As a result, Australian researchers will be well-positioned to lead the development of new knowledge capable of offering effective solutions to complicated problems that impact the well-being of society now and in the future. With regards to the timeframe over which we would advocate the establishment of biometrics research laboratories across our institutions, we believe a seven year period would enable the accomplishment of our key goals, including but not limited to the following: • Establishment of a minimum of 8 fully equipped and administered Biometric Laboratories across Australian Universities • Generate awareness of the capabilities of biometric research technologies to industry and government with a focus on ground-breaking industry relevant research that aligns with key priorities of the public and private sectors

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	• The provision of a physical, fit-for-purpose and clearly branded laboratories on all participating campuses where researchers from across the university can collaborate on projects that use high quality infrastructure for behavioural experiments. • Develop a national early career academic program that focuses on educating our next generation of human behaviour researchers in the use and application of biometric technologies.
006_Roadmap Survey_OTBC Pty Ltd	Need: Acqusition of high quality geochemical measurements in conjunction with existing hyperspectral meaurements at state geological surveys. Capability: Scanning XRF like the Minalyzer CS type alongside each HyLogger. Impacted Commumities: Geochemistry. Mineral exploration. Geology Timeframe: Three to five years
007_Roadmap Survey_Nick Thieberger	There is a desparate need for a national service to curate research data, in particular HASS research data. A new capability should be : Building the national infrastructure necessary to curate HASS research data in order to capitalise on existing investment This is NOT the storage we can get from ARDC, NECTAR, or our Universities. Storage is a necessary but insufficient solution, as it does not provide a catalog, apply deposit conditions, or convert data to delivery formats, and to new archival formats over time. An example of good research infrastructure for HASS data in Australia is the internationally recognised Pacific and Regional Archive for Digital Sources in Endangered Cultures (PARADISEC), a sovereign Australian initiative at the University of Melbourne, Sydney, and the ANU. A model to look to for data curation is Humanum in France: https://documentation.huma-num.fr/humanum-en/
009_Roadmap Survey_Lingbo Jiang	We need a data hub like auscope-portal to host the national data for all sorts of resources(mineral, land, water, and environment) and advanced tools to analysis it.
010_Roadmap Survey_Karen Rodriguez	No response to question 35 submitted.
011_Roadmap Survey_ Tim McCubbin	Substantial funding has been directed towards the establishment of 'omics analysis capabilities to underpin research and industry through BioPlatforms Australia. This is excellent, but the capability for these groups to utilise and learn from these datasets, especially from a systems biology, design-build-test-learn iterative design workflow, is underdeveloped. A deeper investment into developing data analysis and rational design capabilities that can enhance our ability to learn from these data sets, and guide rational design, would be transformative to the establishment of industry in Australia. Further investment into understanding how machine-learning can potentially enhance and improve are ability to learn from these datasets is also an area for promising additional development. Current strategies rely on investing in high-throughput strain building in the form of BioFoundries, but this remains somewhat time-intensive and expensive. The ability to have more hits on target with a data-driven approach underpinned by mechanisms such as metabolic-modelling should

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	accelerate this approach, which needs to be complemented by sufficient fermentation capability. To retain industry, we also need to have additional fermentation capability, particularly at the pilot to large scale, as industry will otherwise be forced overseas to utilise systems there. Both of these requirements or capabilities underpin the majority of the key target areas identified by the NRI, and would accelerate the progression of each of these.
012_Roadmap Survey_ Tom Keegan	No response to question 35 submitted.
013_Roadmap Survey_ Miranda Smith	The advantage of (and need for) a more co-ordinated approach to national biobanking, particularly for infectious diseases, was demonstrated during the COVID-19 pandemic where swift access to biospecimens enabled significant early findings (https://doi.org/10.1038/s41591-020-0819-2). Initial efforts to join existing biospecimen collections together has demonstrated the willingness to participate in and acceptability of collective efforts towards more transparent specimen access in Australia (https://doi.org/ 10.33321/cdi.2023.47.66), but this is small scale and does not account for any changes to the ethics and governance arrangements required for more general shareability. It also doesn't address the quality control issues that would add value to a national collection. A joint national biobanking infrastructure for infectious diseases would enable swift and quality-controlled sample collection and sharing around the country, with participating locations in all major cities and capacity to recruit also from regional centres and some more remote areas. It would enable storage and distribution of these collected specimens in a scientifically rigorous and community acceptable manner. This would support a huge variety of research types, including virological, immunological, transcriptomic, genomic, proteomic, metabolomic etc. These efforts could be linked to clinical research and clinical trials, with additional data supporting epidemiological research, modelling, health economic and other investigations.
014_Roadmap Survey_ Briella Rodriguez	No response to question 35 submitted.
015_Roadmap Survey_ Arshiya Sangchooli	No response to question 35 submitted.
016_Roadmap Survey_ Stephanie Palmer	No response to question 35 submitted.
017_Roadmap Survey_ Michael Anenburg	Synthesis of standard reference materials as mentioned in the previous answers. This requires and interlab collaboration of new material characterisation to achieve an agreed-upon composition. Once these materials are made in the few labs that can do it (again, our ANU is on of them, but not the only one), they can be delivered to all academic, government, and even industry labs in Australia. This will also strongly increase data quality hence Australian competitiveness in the

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	international scene. There isn't currently something like that in the world, and this could also be turned into a commercial opportunity (albeit modest), where such materials are sold worldwide (similar to how NIST reference materials are sold commercially). The knowledge on how to do this (both synthesis and analytical) exists in Australia, the greatest challenge is the dedicated personnel to actually do it, in several labs spread across Australia. This is where NCRIS has a role in my opinion, perhaps through established avenues such as AuScope and others. This will positively impact anyone who uses microanalytical equipments. This includes electon microprobes, isotope measurement (LAICPMS, SIMS, etc), scanning electron microscope (a ubiquitous piece of equipment!), and more. Medium-term goals? Essentially a common Australia-wide analytical language, and even global down the track. Timeframe is not necessarily too long, with quite a lot of work feasible to be done in only five years or so.
018_Roadmap Survey_ William Pinzon Perez	No comment
019_Roadmap Survey_ Ming Feng	No response to question 35 submitted.
020_Roadmap Survey_ Andrew Kostryzhev	In my current area of responsibility at the Centre for Microscopy and Microanalysis, the University of Queensland, we are working on new work flows for mineral phase characterisation, in particular approaches to increase the analysis speed and throughput, and accuracy of detection of economically valuable metallic elements in ore bodies and waste. This can be achieved through application of various chemical analysis techniques to the same sample and robotisation of sample preparation and sample loading-unloading to an analytical instrument. This work requires interdisciplinary collaboration from geology, material science, mechatronics, and software technology. Some work has already been done. But it would go faster if there was a direct support to staff hours and prototype manufacturing. Timeframe - 1-2 years. Potential impact - collaboration with an instrument manufacturing company may result in a significantly improved characterisation technique and a machine which will utilise this technique. Research community will be able to generate more of characterisation data of a higher accuracy during a shorter time frame.
021_Roadmap Survey_ Rongkun Zheng	Need more in-situ characterisations at Microscopy Australia and more resource at National Computational Infrastructure.
022_Roadmap Survey_ Arnold Ju	We have a specific need that builds upon foundational advances in super-resolution microscopy by establishing Australia's first Machine Intelligent Structured Illumination Microscope (MI-SIM) infrastructure for comprehensive Disease Cell Atlas development. Current approaches to cellular imaging in Australia cannot resolve structures below 200 nm, creating a critical blind spot in visualizing subcellular mechanisms that drive major diseases. The MI-SIM platform overcomes this limitation by enabling 60 nm resolution imaging, bridging the gap between molecular mechanisms and clinical outcomes across cardiovascular diseases, cancer, infectious diseases, and neurological

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	disorders.
023_Roadmap Survey_ Elin Gray	No response to question 35 submitted.
024_Roadmap Survey_ Jian-Feng Nie	Microscopy Australia directly supports the Challenge areas identified in the 2021 Roadmap, the National Science and Research Priorities and 'Future Made in Australia' outcomes. • Microscopy Australia's NCRIS-enabled instruments and staff supported $1B of ARC/ NHMRC grants over the last five years (NB: based on funding acknowledgments and an under-estimation of total impact of microscopy on Australian research). • 25% of Australia's top 100 cited papers relied on microscopy [2023 SciVal data] • 42% of the research that has relied on Microscopy Australia for critical results is published in the top 10% of ranked journals [2023 SciVal data]. The 2021 Roadmap survey identified microscopy in the top 4 capabilities necessary for planned future use, but it was critically underfunded in NCRIS 2023. Microscopy Australia received just $12M of the total $650M uplift from NCRIS in 2023 (four-year timeframe). This is compounded by significant underfunding in electron microscopy with just $11M in ARC funding through LIEF (over four years). If the lack of investment continues, sovereign capabilities are at risk, and the potential impact for translation and prosperity won't be realised. With the 2026 Roadmap, there is also now an opportunity to bring additional nationally important microscopy facilities into Microscopy Australia to unlock more world-leading facilities through our open access arrangements for research and development. Microscopy Australia regularly assesses the future research needs that rely on microscopy, alongside the emerging technologies that will support them. From consultations in 2024, we identified important areas needing future investment: 1. Analysis of beam-sensitive materials and difficult-to-detect light elements for projects in: • energy generation and storage • advanced alloys • semi- and super-conductors • quantum and optical devices 2. Increased capability to enable correlative and multimodal microscopy solutions for more complete, multiscale and integrated data from samples across the discipline spectrum, especially in the biomedical sciences. New developments in more integrated systems would enhance our ability to capture these types of data, and then to provide support for analysis of these complex data sets. 3. More of the important every-day-use microscopes and staff are needed to enable an increased national focus on translation of academic research into useful products through spin-out companies and licensing agreements. There have recently been situations where spin-outs with microscopy needs have been turned away from our facilities based solely on instrument and staff capacity.

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	Only more instruments and skilled staff can resolve this block and enable us to facilitate increased translation outcomes. 4. Long-term skilled workforce – training and engagement for the future. Our highly skilled and experienced staff are the cornerstone of our capability. Without them, researchers would not be able to acquire the quality of data they require. Building that experience starts with a scientifically literate society and children that see science as a viable career choice. It continues through a commitment to meaningful platform scientist career pathways and ongoing professional development opportunities.
025_Roadmap Survey_ Gang Zheng	No response to question 35 submitted.
026_Roadmap Survey_ Karl Glazebrook	Space Astrophysics in Australia The biggest omission to me in the current research infrastructure landscape is in space astrophysics and space science. Nearly half of all astronomy research and half of papers now utilise space-based research. (See statistics compiled by Simon Driver for the AAL Space Science Leads committee). I myself am now using ~70% space based. It is likely to become the dominant mode of astronomical research as launch costs plunge. There is a thriving but small space astrophysics community in Australia building and orbiting small telescopes (e.g. SPIRT) despite the lack of investment. The major infrastructure problem here is a lack of any science or research remit in the Australian Space Agency. It is not just money for facilities, they are not even empowered to act as a gateway to NASA, ESA etc. for our scientists, even when those agencies want them to! Australia is unique among GO8 nations in that our space agency is not responsible for science. We are also unique in not having an appropriate funding program for space astrophysics. This causes significant structural issues, for example in recent Euclid access negotiations. Who does ESA negotiate with? At least we have a space agency now (unlike at the start of the previous decade). Now we need it to broaden its remit to include science. In an ideal world we would have the agency investing at least several million dollars per year in science missions and science R&D via a competitive process. (Space activities are at the wrong scale for the ARC programs). This would bring a huge boon to the nation and harness our creativity. Space astrophysics is a natural for developing innovative technologies in partnership with industry. The ideal world would also include the concept of an Australian Space Science Institute to coordinate all this, to coordinate our links and collaborations to international agencies and to support an extensive program of data fusion of the large space survey data that is to come (Euclid, Roman, SphereX) with ground-based ones. All of this is part of a Catch-22 type situation, because space astronomy is not funded (unlike in virtually every other country) our astronomical community mainly think in terms of ground optical and radio facilities, the limited wavelengths that penetrate the Earth's atmosphere, as we have done for the last fifty years. Hence our space community remains small (though ingenious!). The two main recommendations of the Astronomy Decadal Plan are very similar to the previous one (ESO and SKA) and need to more strongly consider space astrophysics. I'd recommend such an infrastructure entity be established (this could be with the Australian Space Agency) to manage and fund space

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	science R&D, missions and processing of large data sets, and to be empowered to negotiate with NASA, ESA etc. This would be an 'Australian Space Telescope Science Institute' and would build on highly successful international models.
027_Roadmap Survey_ Oliver Berry	A new way to measure the environment Australia's environment is our most precious asset. However, its size, complexity and high biodiversity mean that it has been expensive and difficult to gather information to manage it effectively. "eDNA" is changing that. In the past few years, eDNA (short for environmental DNA) has revolutionised environmental monitoring. Scientists take environmental samples like water or soil, purify the fragments of DNA present and sequence their four-letter codes. They use those sequences, known as DNA barcodes, to identify the species present. People have used eDNA in diverse ways. They have detected pests like the crown-of-thorns starfish on the Great Barrier Reef, looked for viruses like SARS-CoV2 in wastewater, searched for cryptic species like the platypus, and measured the productivity of fisheries. Worldwide, governments, industries and citizen scientists are adopting eDNA. It's highly accurate and works across the tree of life. It's also a safe and simple way to detect species without harming or disrupting wildlife. **What is needed** eDNA is poised to revolutionise the way we monitor Australia's natural environment. But using eDNA depends on having a reference library of DNA barcodes. To identify a species using eDNA, we need to know its unique DNA barcode. Yet we know the DNA barcodes for only a small fraction of Australia's half a million plants and animals. The shelves of Australia's DNA barcode library are almost empty. Some groups, such as fish, are relatively well covered. Other important groups, such as insects, marine invertebrates and plants are largely missing from the library. This means that during eDNA surveys, many species go undetected because their eDNA can't be identified. A full library of DNA barcodes is necessary for us to make the most of eDNA's amazing potential to provide simple, cost-effectively information on the environment. A complete DNA barcode library for Australia's most important species would create enormous national benefit. It would support multiple industries including biosecurity and agriculture, fisheries, tourism, and biodiversity management. We could detect invasive pests arriving from overseas or map the distribution of endangered or dangerous species, even if they cannot be observed. We could provide the highest assurance to consumers that the food they eat is correctly labelled. If we change the game Major DNA barcode library initiatives exist overseas and, at smaller scales, within Australia. Most DNA barcodes have been generated by a very hands-on, one-at-a-time process, which is slow and expensive. Different scientists also focus on different DNA barcodes. As a result, multiple DNA barcode reference libraries exist that can't be easily combined.

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	At CSIRO we have created new technology to solve this. Our miniaturised high-throughput genome skimming platform can generate DNA barcodes for any type of organism, from microbes through fungi, to plants, insects, mammals, and birds. Not only that, our solution creates a full set of all DNA barcodes for each species. This ensures the results are compatible with existing DNA barcodes used by scientists worldwide – a DNA barcode library to rule them all. Let’s go! For the first time we have the technology to create digital DNA infrastructure to match the next generation needs of environmental monitoring. We are working with biological collections around Australia, industry, philanthropy, and government to build this much-needed resource that will enable Australia to deploy world's best environmental monitoring. This infrastructure would would connect into multiple existing NCRIS and other infrastructures, including ALA, IMOS, Bioplatforms Australia, and museums and herbaria nationally. We believe that this, plus its anticipated impact across health, agriculture, fisheries, and biodiversity sectors, makes it an excellent candidate for inclusion in the NCRIS infrastructure portfolio.
028_Roadmap Survey_ Rajiv Shah	No response to question 35 submitted.
029_ Roadmap Survey_ UniQuest Pty Ltd	For successful translation of medical products each project must traverse the requirements of preclinical development. This stage is the essence of translation and encompasses 3 parts: clinical, non-clinical and Chemistry, Manufacturing and Controls (CMC). The clinical part is covered well in Australia with excellent networks of clinicians and clinical trial capability (will be required to be maintained long term). The non-clinical part is grossly underserved as is the CMC part. To address this we need: • A National Centre for Medicinal Product Safety – such a centre will have long term core funding and include all the needs of preclinical safety testing for new medicinal products (non-GLP and GLP) suitable for assessment of new products for clinical testing. This will include the use of various species that are required such as rodents, dogs and monkeys. Results will be submitted to the TGA for approval of a new product for human testing. The core funding for the centre will reduce the costs to the client to such an extent that the overall cost for doing the required studies becomes less expensive than going to currently preferred overseas suppliers, e.g. WuXi or Pharmaron in China. These costs are currently at least $2m for the key rodent and non-rodent safety testing that is required for a new drug. Note that safety testing does not require specialist models of disease, that will remain the responsibility of the research phase which has other funding mechanisms. • A National Centre for Medicinal Product Manufacturing – such a centre will enable rapid and cost effective chemical development of new drug entities, and devices. This is the largest area of an investigational new drug program and currently is not available competitively in Australia. Entities in Australia that profess to conduct such work and in fact doing the real work in China. This is contrary to our national interests. The ability to develop a manufacturing route and consistently manufacture a new medicinal product is critical for success. It can also generate new intellectual property. This involves chemical development up to a scale

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	suitable for early clinical trials and analytical chemistry able to validate the product quality. Both the above centres could operate on the same basis at the current National Drug Discovery (Screening) Centre (NDDC) at WEHI which covers 90% of the cost of doing a high throughput screen, the client pays 10%. This could work with a 80% subsidy. NDDC has been a great success for early drug discovery screening.
030_Roadmap Survey_ Matthew Nelson	No response to question 35 submitted.
031_Roadmap Survey_ Macquarie University	No response to question 35 submitted.
032_Roadmap Survey_ Michael Archer	I have. Both initiatives, which are both critically important for Australia, are briefly described in the previous sections of this survey--in relation to ARC funding needed to develop far better ways to anticipate and hence mitigate against negative outcomes from climate change; and in relation to Federal funding needed to develop THE most efficient way to generate sustainable energy on the continent. I can't return to them to copy them again here.
033_Roadmap Survey_ Integrated Marine Observing System	There is a great need to expand existing infrastructure, particularly for environmental applications. There are areas where new capability is also required. One of these is outlined in Research Priority 3 related to elevating Aboriginal and Torres Strait Islanders knowledge systems. Another is increasing the efficiency of collecting and processing data. Collecting samples or conducting observing often requires vehicles or vessels as well as a number of staff. The costs of this kind of operation are continually increasing. While it is widely known there is potential for autonomous vehicles to do some of this work, the market for these vehicles is often small or niche, making it unprofitable. Bespoke, one-off research built vehicles can work, but often do not provide an effective model. Therefore, capacity to develop and deliver a suitably sized fleet of vehicles is needed to help drive innovation and spur production. Vehicles need to be readily accessible and easy to use for a range of applications. This attracts a wider range of users. Aerial drones are a good example of a technology that is accessible to many and useful for a range of purposes. There is no marine equivalent. Given our vast marine estate, the need to inform navy, offshore renewable energy, shipping, fisheries, resource managers, conservation agencies, restoration efforts, coastal planning and so much more – a suitable underwater vehicle or fleet of vehicles would increase the efficiency of data collection while reducing cost and effort. For example, vehicles that could dock at the base of offshore wind pylons could send critical data on environmental conditions or threatened species occurrence as well as monitoring cable infrastructure status. Vehicles that could patrol reef or coastal areas could help inform management decisions related to bleaching events, harvest strategies for fisheries and aquaculture, and forecasting of tropical storm path and intensity. These are a few examples of how an adequate autonomous platform

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	could serve as a cost-effective research infrastructure. In conjunction with autonomous technologies is the need for improved AI/ML and data analytics to help sort and manage the vast amounts of data produced. For example, onboard processing with alerts to anomalies could be vital to inform operational decisions. In addition to autonomous vehicles, there is a growing need for real-time data delivery. Forecasts and predictions rely on real-time inputs. Delivering data in real-time or near real-time requires additional infrastructure and data transmission costs. This capability is rarely available in marine applications due to cost. However, as we work to understand the impacts of storms, floods and other environmental disturbances, real-time data will be critical to decisions directly related to public safety (e.g. opening of flood gauges, path projection for cyclones). As with autonomous technologies, improved data delivery and management practices/platforms are needed. Finally, additional modelling capability will underpin many of our future environmental questions and solutions. We need scope to develop digital twins, to project/predict changes, and capacity improve our models through data assimilation. If we want resilient communities and ecosystems we need more integrated approaches to observations, data integration and modelling/analyses than currently exist.
034_Roadmap Survey_ Richard Tilley	No response to question 35 submitted.
035_Roadmap Survey_ David Wood	The mathematical sciences are currently under-served by research infrastructure in Australia, and indeed have received no funding under NCRIS. Currently, there is no national support mechanism for a sustainable mathematical sciences research institute. The Mathematical Research Institute MATRIX (matrix-inst.org.au) has been in operation for about ten years, supported on a shoestring budget by major Australian universities and the US-based Simons Foundation. The only government support MATRIX has received is one ARC LIEF grant. Since its inception, MATRIX has done remarkably well, and is fully booked for 2025. MATRIX is an incubator for many emerging disciplines that utilise mathematical sciences, including AI, space and quantum sciences, optimisation, cyber security and forecasting (weather, finance, epidemics, natural disasters,etc.). MATRIX is now internationally recognised alongside other leading mathematical research institutes (SLMath Berkeley, Newton Institute Cambridge, Banff Institute Canada, etc) with one big difference: all these other institutes receive major funding support from their national governments. Australia is falling behind the result of the world by not funding this key piece of mathematical sciences research infrastructure. Australia needs a multi-million dollar investment in long-term funding for MATRIX.
036_Roadmap Survey_ James Springfield	Microscopy underpins broad science disciplines, from medical, soft matter, plant, materials, agricultural and geological sciences, that require cutting-edge microscopy to address Australia's future research and industry needs. A significant uplift in advanced optical microscopy is urgently required across the country. The continuation of long-term investment (10+ years) in national research infrastructure, such as Microscopy Australia, is critical. A long-term, ongoing timeframe would ensure continuous high-level support for all Australian researchers from emerging early career researchers through to those in national flagship research programs, such as MRFFs, CRCs, ARC Centres of Excellence and Laureates, and NHMRC Investigator Fellowships. Interruption or stagnation of funding would have

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	critical consequences for Australia's future.
037_Roadmap Survey_ Centre of Excellence for Biosecurity Risk Analysis	No response to question 35 submitted.
038_Roadmap Survey_ ShineLab, The University of Sydney	No response to question 35 submitted.
039_Roadmap Survey_ David Rudd	There is a critical need for research infrastructure that can address shortages in the supply of medicines and sovereign manufacturing of medicinal products that are currently restricted. The TGA recently produced a report highlighting a range of products that are restriced in supply: Medicine Shortages Report 2024. The outcome of the report was that it disproportionately affects those that are not experienced with navigating the healthcare system - vulnerable groups including rural communities (limited product choice already), indigenous communities, English as a second language and older communities. The report found that there was no coordinated system to address the issue amongst suppliers, doctors and consumers. Following on from that, there are no mechanisms to investigate and address how to fix the issue from a production point of view. I would proposed a manufacturing research capabilitiy that can connect and support the investigation and establishment of a sovereign manufacturing framework that connects between suppliers of raw material, manufacturers, the pharmaceutical industry as partners (support supply through direct or co-supported manufacture), med and large scale manufacturing facilities and comsumers groups. A facility that can also support validating and providing guidance for pharmaceutical compounding to address very urgent and critical shortages, which can directly collaborate with the TGA to ensure best practice supply. A Medicines Manufacturing Centre that already has a pharmacetical industry connection would be an ideal research platform to provide targeted support to medicine shortages and provide a coordinated centre for facilitating sovergien manufacturing and supply for essential medicines. The medium term goals of this facility would be to build a framework for establishing manufacture of generic medicines in Australia, from supply to scaled manufacturing. The centre would partner with industry to identify candidates that could supply medicines based on a business case study (including when co-support would be essential for manufacture). The impacted research communities would be the healthy communities research sector, biomedical and pharmaceutical research sector and the secure and resilient research sector. The initiative could be established over the next five years and medicine supply shortages and the quality of overseas products (from low stringent regulatory authority locations) is an issue that is going to persist.

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040_Roadmap Survey_ Julian Ratcliffe	The success of Australia's advanced microscopy infrastructure depends on reliable long term funding. This ensures continuity of a long term skilled workforce, who can ensure these instruments are used well, and that the results and outcomes are of a higher standard. This also allows for planning and the ability to keep the equipment up to date and relevant. A microscope is often in service for a minimum of 10 years, and over it's life may receive several upgrades. Planning ahead for future upgrades and keeping workhorse equipment up to date and in a usable condition relies on reliable funding from LIEF/NCRIS
041_Roadmap Survey_ Evan Ingley	As more medical research projects reach maturity and identify new products with therapeutic potential, the capacity to then initiate clinical trials with GMP (Good Manufacturing Practice) grade versions of the research products is currently insufficient for the number of emerging potential therapeutics. More manufacturing facilities for novel medical therapeutics of GMP grade for investigator lead clinical trials will be required in coming years.
042_Roadmap Survey_ Microbial Imaging Facility, The University of Technology Sydney	Spatialomics pipeline across all the omics space
043_Roadmap Survey_ Brett Hamilton	The biggest hole in NRI in Australia is middle tier electron microscopy. Most Universities now have top end Cryo electron microscopes and scanning transmission electron microscopes, but lack (or have extremely aging) instruments to bridge the gap between basic workhorse instruments and the high end CryoEM / STEM instruments. This gap is going to become critical over the next 5 yrs as instruments age. The reason it is so important is that the high end Cryo EM / STEM instruments are often operated by a few experts (due to the very long time it takes for people to develop enough skill to operate them properly). Generally only very few people get trained on these - since the training often takes longer than the number of samples that need to be analysed. The walk TEM/EMs are used quite heavily generally - because the users are trained in a shorter time. The big hole to be plugged is a better SEM/TEM - somewhere between the basic walk up and the extremely complicated STEM/cryoEM which users can be trained to use. Having the 3 levels of instrument will make better use of tax payer money in that more access to walk up instruments will reduce the back log on the cryoEM / STEM and those users who can book and use rather than wait to have experts run their samples get their data faster. Essentially we need to acknowledge that infrastructure facilities require 3 levels of electron microscopy - the basic walk-up, the middle-tier with improved performance, and the high level which requires a highly trained expert. Each of the microscopy nodes around Australia could identify the specific instruments required - or feedback from the user groups could help. We need to ensure that this middle tier level of electron microscopy is retained and developed into the future. Almost all industry requiring a little more than the basic walk-up SEM would only require a middle tier instrument.
044_Roadmap Survey_ Morten Eskildsen	No response to question 35 submitted.

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045_Roadmap Survey_ John Barker	The ACNS currently provides world class performance at several neutron scattering instruments. Recent use of the ACNS scattering facilities show them as comparable or better in performance and their support facilities than the best in Europe and the USA. There is also room for cost effective expansion of these facilities by the addition of a second guide hall. Currently other important neutron scattering facilities (FRM-II, NCNR) are offline or planned closures causing a serious world-wide neutron scattering shortage. I used three of the ACNS scattering instruments in the last year, have worked with ACNS staff regarding instrument design over many years, and kept apprised of past, present and future instrument ACNS instrument designs through the published literature. I am very impressed by the performance of the facility as a whole. The instruments I personally used are of the best, two (Quokka and Bilby) I would say are world class and one (Kookaburra) is far superior and is by far the best in the world, with ten times the brightness of second best which I designed. I was also impressed by the professional performance of support facilities such as the user chemical laboratories, sample environment, and neutron detectors group. It seems to be a very well run facility. The current neutron guide hall appears to be full with all possible guide positions taken by world class instruments. But addition of a second guildhall could relatively cheaply leverage expansion of neutron scattering facilities. Additions of second guide halls has been completed at other facilities: this was done many years ago at the ILL in Grenoble France, the current premier neutron scattering facility in the world where all others are compared, plans are at an advanced stage for a second guide hall addition to the facilities to FRM-II in Germany, and our NCNR facility in the USA have submitted plans to congress for building a new reactor with two guide halls.
046_Roadmap Survey_ Colin Masters	No response to question 35 submitted.
048_Roadmap Survey_ Olivier Alard	Ion-beam facility on the east coast including a nano-Secondary Ion Mass Spectrometry (only available in WA) and last generation large geometry SIMS. Solid Sample preparation facilities (rock, environmental, material sciences) Laser ablation MC-ICP-MS/MS capacity - while many facilities are equipped with laser ablation systems, they all display similar characteristics (e.g., nanosecond, 193 nm). Although this configuration is the most versatile, it restricts more specialised applications, such as assessing high-purity quartz (solar panel) diamonds and CCD films…Likewise, the community tended to concentrate on a specific type of mass spectrometer from a single manufacturer. We must ensure that a certain level of diversity exists at the national scale to enable a wider range of applications.
049_Roadmap Survey_ Australian Submarine Agency	No response to question 35 submitted.
050_Roadmap Survey_ National Deuteration Facility (NDF)-ANSTO	No response to question 35 submitted.

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051_Roadmap Survey_ Phenomics Australia	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.

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	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

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	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.
052_Roadmap Survey_ Centre of Excellence for Biosecurity Risk Analysis_Biosecurity Commons	I think the ARDC Planet RDC initiative is doing an exemplar job of making both data and analytics more accessible to environmental practitioners across the academic, government and industry sectors. However, I think a logical next step it to carefully consider how the data and analytics can be shared across platforms. For example, at the moment Planet RDC invests into 4 platforms: • EcoCommons -- An analytics platform & spatial database focused on species Distribution modelling (mostly for conservation contexts) and largely targeted at researchers. • Biosecurity Commons --An analytics platform & spatial database that provides access to cutting edge risk analytics for informing operational decisions associated with surveillance and risk management. Largely targeted at government and industry stakeholders. • Open EcoAcoustics -- An analytical platform and database of recorded animal sounds data. • WildObs (NEW) -- An analytical platform and database of camera trap data. Each of these 4 offer incredible opportunities in future research directions and their implications on real-world management of our environment. However, to facilitate this I believe there needs to be some thought into how information can be readily exchanged across these disparate platforms. For example, information obtained from WildObs or Open EcoAcoustics can be directly used within Biosecurity Commons to inform the occupancy and/or density of potential disease hosts such as feral pigs and deer. Similarly the information obtained from these platforms can be used to construct my advanced species distribution models in EcoCommons. I do not advocate that all these platforms be merged into one mega platform, but rather there should be some focus on opportunities to pull or push data to other platforms as the need arises. I think the this is where the is huge potential for the "Data Spaces" initiative to have significant impact. I think if NRI/ARDC can work with platform stakeholders, their funding partners and governments more broadly I believe significant progress could be made in this space within the next 5 years. I also think there is an opportunity to embed government and industry users into AAF. Currently government has invested in the development of VanGuard. A single sign on for government users. However, its coverage over government agencies (particular non-

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	commonwealth agencies) is poor. I think there is opportunity for both VanGuard and AAF to collaborate and onboard more organisations
053_Roadmap Survey_ Sharon AI Pty Ltd	In order for Australia to remain competitive across all strategically important industries it is essential the nation has latest generation accelerated computing resources (hardware and software) to encourage and enable innovation, research and development and to keep highly skilled technology workers in country. The proposed infrastructure capability is a '1K GPU Cluster' built on NVIDIA Reference Architecture. This highly advanced compute infrastructure is critical for Australia to remain competitive across multiple industries (defence, medical research, technology, space) as well as maintaining sovereign AI capability. Sharon AI is building this compute infrastructure in Australia, for Australian businesses and would love to be part of the conversation with the National Research Institute Advisory Group.
054_Roadmap Survey_ Grant Webber	No response to question 35 submitted.
055_Roadmap Survey_ Ryan Lowe	**Need for a new nationally-coordinated NRI capability to support research and industry needs in ocean engineering and technology** Australia requires a coordinated national collaborative research infrastructure in ocean engineering and technology to address critical challenges related to coastal resilience, renewable offshore energy developments, sustainable marine infrastructure, climate adaptation, maritime trade and shipping, and national defence. These areas collectively support Australia's blue economy by fostering economic growth, technological innovation, and environmental sustainability. The absence of integrated, nationally-accessible research infrastructure limits Australia's capacity to advance research, innovation, and industry development. Key sectors benefiting from this infrastructure include coastal and offshore engineering, renewable energy (wave, tidal, floating wind), maritime transportation, aquaculture, coastal protection, disaster risk reduction, and climate change adaptation. Currently, ocean engineering and technology research infrastructure is not covered under the NCRIS. While NCRIS supports ocean observing capabilities through the Integrated Marine Observing System (IMOS), IMOS focuses primarily on marine environmental monitoring rather than experimental and engineering research. A dedicated ocean engineering and technology infrastructure would complement IMOS by providing the necessary experimental, computational, and testing facilities to develop innovative solutions for offshore and coastal industries. **Types of Research Infrastructure Needed** Essential infrastructure elements should include: • Large-scale physical modelling facilities (wave basins, wave flumes, current and sediment transport channels, geotechnical centrifuges, etc).

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	• High-performance computational facilities and data management platforms for digital twin and numerical modelling applications. • Dedicated research and industry collaboration hubs facilitating knowledge exchange and innovation partnerships. • Facilities supporting ocean technology development, including sensor development and testing, underwater acoustics, and marine robotics. This would provide a critical platform for advancing ocean monitoring technologies, improving maritime operations, and supporting defence applications. **Current State of Relevant Research Infrastructure** Australia currently has valuable but dispersed ocean engineering and technology research facilities. University-based hydraulics laboratories, such as those at the University of Western Australia (UWA), University of New South Wales (UNSW), University of Queensland (UQ), Australian Maritime College at the University of Tasmania (UTas-AMC), and the University of Melbourne (UniMel), provide foundational capacity in physical modelling. Additionally, government facilities including the Queensland Government Hydraulics Laboratory and Manly Hydraulics Laboratory offer significant capabilities. However, while a collaborative network of facilities exists, there is no national strategy to bring these capabilities together in a coordinated manner. This lack of integration results in underutilized capacity and limited broader accessibility. These existing capabilities and collaborative network that exists provides an excellent foundation for new NCRIS capability that could be efficiently established and rolled out nationally. **International Examples of Coordinated Programs** International examples demonstrate the effectiveness of collaborative, coordinated infrastructure programs to support R&D relevant to the blue economy. Notable examples have included: • HYDRALAB (Europe): Offers transnational access to world-class hydraulic facilities, enabling collaboration and advancement in hydraulic and coastal engineering research. • MARINET and MARINET2 (Europe): Facilitates research and industry access to wave and tidal energy test facilities, accelerating renewable energy technology development. • U.S. National Science Foundation’s Natural Hazards Engineering Research Infrastructure (NHERI): Provides researchers and industry with shared facilities, including wave basins and flumes, to address natural hazards and infrastructure resilience. In the international landscape, this also disadvantages Australia, as researchers and industry stakeholders in other countries can leverage well-coordinated infrastructure programs to accelerate innovation and commercialization. Some of these schemes have also provided access to users worldwide, which has led companies (including in Australia) to leverage this support and, in some cases, relocate overseas to take advantage of R&D support offered abroad. **Anticipated Benefits for Australia** Establishing this capability would:

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	• Help position Australia as a global leader in ocean engineering and technology development. • Accelerate innovative solutions addressing climate adaptation, coastal resilience, protection of Australia's critical coastal infrastructure, and sustainable coastal development. • Drive industry growth and economic diversification by supporting the establishment of new and emerging ocean industries that can leverage Australia's strong offshore expertise in the traditional resource sector, including sustainable maritime sectors and offshore renewable energy. • Leverage both industry and research sector investment to build a critical mass of world-leading research infrastructure capabilities. • Support education and workforce development through accessible world-class facilities and collaborative opportunities. • Enable growth in R&D related to defence, which is expected to expand substantially through initiatives such as AUKUS, by providing critical testing and development infrastructure for next-generation naval and maritime defence technologies.
056_Roadmap Survey_ Western Australian Biodiversity Science Institute	National environmental data supply chains must make possible integration of research and privately held (industry generated) data to enable improved research outcomes and enable regional scale planning, management and reporting.
057_Roadmap Survey_ Joan Licata	Australia has an opportunity to be a global leader in mathematical research, and one clear ingredient for this would be a secure funding line for a national research institute in the mathematical sciences. Sustained investment in the field would strengthen domestic research capacity and establish the nation as a focal point for international collaboration/
058_Roadmap Survey_ Australasian Cognitive Neuroscience Society	**Digital biobanking** Digital population biobanks integrate genetic, imaging, phenotypic, and health data across a population sample, offering researchers secure access under ethical and legal guidelines. The UK Biobank, which has collected anonymised data from 500,000 individuals since 2004, is a prime example of how large-scale, well-structured biobanking can drive breakthroughs in epidemiology, genomics, public health, clinical research, and personalized medicine. Australian researchers are major users of this data, yet no equivalent national resource exists locally. To address this gap, a staged approach could be taken. The first step is strengthening national coordination and standardisation of biobanking data, including digital and physical biobanks. Currently, biobank collections across Australia operate in a fragmented manner, limiting discoverability and accessibility. A coordinated, community-driven strategy would streamline standards and practices, making existing datasets more accessible and reusable through a central digital platform. This would improve efficiency and create a foundation for a more comprehensive system. The second step is investing in a national prospective population biobank, similar to the UK Biobank, which would provide essential normative data to support medical and health research. Such a resource would enhance the productivity of existing studies while enabling

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	new research that is currently unfeasible. A national digital biobank would be an important national research infrastructure and is well aligned to the NCRIS principles. The NCRIS Health Group, and other NCRIS partners, would provide existing capacity and capability platforms to deliver this resource. An Australian national digital biobank would be an important data source for understanding unique Australian health challenges including those associated with a changing environment, indigenous health, and an ageing population.
059_Roadmap Survey_ Sebastian Risse	No response to question 35 submitted.
060_Roadmap Survey_ Perminder Sachdev	I work in the field of ageing and dementia, which is a major challenge for the Australian community now and into the future. I would advocate for a Dementias Platform Australia that brings all the ageing and dementia research together and makes the data accessible to all researchers. I also advocate for infrastructure to deliver interventions for healthy ageing and the prevention of dementia online, which can be accessed by all Australians.
061_Roadmap Survey_ Ausbias and LMA	Establishing bioimage analysis capabilities and infrastructure. Training, upskilling, funding of positions within institutes. Training could be in the form of small training programs to postdoctoral programs, such as in the Broad Institute (https://cimini-lab.broadinstitute.org/training-program).Impact will be on biomedical research that use microscopy within Australia. Timeframe: over next 5 years
062_Roadmap Survey_ Steffen Bollmann	No response to question 35 submitted.
063_Roadmap Survey_ National Space Qualification Network	No response to question 35 submitted.
064_Roadmap Survey_ Zachary Brown	No response to question 35 submitted.
065_Roadmap Survey_ Saskia Bollmann	No response to question 35 submitted.
066_Roadmap Survey_ Esteban Marcellin	No response to question 35 submitted.
067_Roadmap Survey_	I write concerning the mathematical sciences in Australia, which up to now have received no funding from the National NCRIS program.

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Cheryl Praeger	The mathematical sciences play a critical role in every area of Australia's scientific endeavour to face our major challenges: climate change, technological advances, maintaining a healthy, cohesive and resilient society, etc. The mathematical sciences rely on collaborations both nationally and internationally, and I contend that building and supporting networks of mathematicians should be regarded as critical National Research Infrastructure. I comment on several important criteria concerning National Research Infrastructure to support and explain this view. I use as an exemplar the MATRIX Mathematics Research Institute https://www.matrix-inst.org.au/ , uniquely our national incubator for many emerging mathematical disciplines. 1. MATRIX has a wide user base. It runs a national residential weekly workshop program with participants across the country and the world. It reports annually through a book series published by Springer. No individual institution could support such an institute – it is truly National. 2. MATRIX is adaptable: it requires physical infrastructure/space to support its program and this is not completely guaranteed (prepared to change if necessary); during the pandemic the program adapted to pandemic restrictions: this led to online collaborations with more established international residential research institutes. 3. Benefit to Australia: MATRIX is the only one of its kind in Australia. Its existence facilitates national (Australian) linkages with much more established research institutes in the US (MSRI Berkley), UK (INI Cambridge), Germany (MFO Oberwolfach), Japan (MFO Kyoto), China, and other countries: e.g. tandem in-person workshops are run with MFO Oberwolfach and MFO Kyoto. 4. If the MATRIX Mathematics Research Institute failed, Australia would have nothing to offer any other country in terms of its national research infrastructure supporting mathematical networks. We would be absolute paupers! And I consider this as totally inappropriate for a country with our aspirations and challenges. Although the mathematical sciences have received no NCRIS funding, there has been one successful Australian Research Council LIEF grant: building on this funding success, the MATRIX Mathematics Research Institute won a grant from the US Simons Foundation. If there is a zero National Research Infrastructure allotment, then there is no possibility to build/multiply this support for the mathematical sciences. 5. Some History: The first national review of mathematical sciences (by the Australian Research Council and the Australian Academy of Science) in 1995 recommended establishment of such an institute. Subsequent national reviews (2006, 2016) reiterated this. MATRIX was initiated in 2015 – growing from an ARC Centre of Excellence, and then getting support from several universities. It has been built on "shoe-string funding" essentially by the mathematical sciences community and requires (and deserves) national recognition and funding as part of Australia's National Research Infrastructure. Review reports can be found at these sites: • https://www.science.org.au/supporting-science/science-policy/submissions-government/report%E2%80%94mathematical-sciences-adding

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	• https://review.ms.unimelb.edu.au/ • https://www.science.org.au/support/analysis/decadal-plans-science/decadal-plan-mathematical-sciences-australia-2016-2025
068_Roadmap Survey_ Joel Mackay	I repeate the text written several pages earlier: • Nuclear magnetic resonance spectroscopy (distinct from imaging) is a technology that is central to many disciplines ranging from chemistry and biochemistry to agriculture, materials science and beyond. It is essential for many physical, chemical, medical and biological sciences - both for pure and for applied research. There are currently ~$200M worth of NMR hardware (>100 instruments) across universities and other institutions in Australia. These instruments require periodic hardware upgrades to remain functional. Essentially all of these instruments are owned by individual institutions, meaning that these organizations have to work separately to seek the required upgrades though LIEF grants and similar approaches. A national NMR network would be an enormous improvement in the way NMR was managed across Australia and would ensure the best access, hardware, collaboration and coordination of resources - benefitting everyone and provideing direct and essential support for a huge range of researchers. It would allow both (a) the coordination of ambitious goals for cutting edge infrastructure, which are beyond the normal funding mechanisms, and (b) the best possible management and coordination of the diverse and extensive expertise and infrastructure that already exists nationally. In many ways, it would be a mirror of Microscopy Australia in its mode of operation. Discussions have already begun over the last year among major NMR users to work towards establishing such a network, and it is clear from these discussions that the best possible setup would be an NCRIS-type organization. The entire community are enthusiastic about such an arrangement and the value that it would bring. In terms of timeframe, the community are ready now to establish such a framework.
069_Roadmap Survey_ Sarah Turpin-Nolan	No response to question 35 submitted.
070_Roadmap Survey_ Philip Kuchel	Immediately implement at a major University. My preference would be at The University of Sydney.
071_Roadmap Survey_ Scott Blundell	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

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	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:

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	• 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.
072_Roadmap Survey_ South Australian Research and Development Institute	State of Environment reporting is currently weakened by the lack of a reporting system that can integrate data at the appropriate temporal and spatial scales Currently, reporting is done for specific components of ecosystems e.g fisheries, forests, soils etc and at different jurisdictional levels (LGA, State, federal). More integration is required to value add, reduce duplication and take a more whole of system approach. Investment in a more integrated system for state and condition reporting for natural resources is required (e.g. see Accounting for Nature - Wentworth Group of Scientists). Such a framework would help to put a financial value on the ecosystem services provided at the appropriate spatial scales and enable a transparent method for assessing impacts of development applications
073_Roadmap Survey_ Stawell Underground Physics Laboratory	We believe that the research communities dependent of precision measurement in an ultra-low radiation environment would benefit from SUPL being designated as an NRI capability with associated funding. SUPL was established with capital funding from the Federal and Victorian governments and the University of Melbourne, with generous support from Stawell Gold Mines. The initial capital investment and construction of SUPL has been completed. It is structured as a company limited by guarantee, with foundation operational funding coming from member (Adelaide University, ANSTO, ANU, Swinburne, University of Sydney and University of Melbourne) subscriptions and research user and access fees. The current arrangements are due to expire end 2026, with considerable uncertainty over whether all members will continue. Designation of SUPL as an NRI capability of national significance and associated funding over the next five years would provide certainty for this critical infrastructure and enable a greater proportion of research funding to be directed to experimental activities. It is worth noting that UK's Boulby Underground Laboratory is funded by the UK Government through its Science and Technology Facilities Council and Canada's SNOLAB, a deep underground science laboratory, receives the bulk of its funding from the Canadian Government.
075_Roadmap Survey_ Suki Jaiswal	No response to question 35 submitted.

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076_Roadmap Survey_ Suki Jaiswal	No response to question 35 submitted.
077_Roadmap Survey_ Robert Harcourt	No response to question 35 submitted.
078_Roadmap Survey_ Gary Bryant	No response to question 35 submitted.
079_Roadmap Survey_ Bioplatforms Australia	A collaborative, AI-enhanced research ecosystem that advances Australian life-science across disciplines, from healthcare to biodiversity, ecology, and agriculture, enabling researchers to address complex challenges and contribute to societal and environmental wellbeing. Artificial Intelligence, in the form of machine learning and now generative AI, offer transformative improvements in the biological insight achievable from increasingly complex, multi-modal and scaled data. While AI will impact all research, life sciences with its complex and diverse data, often approximate in nature and requiring experienced interpretation, is particularly amenable to the possibilities that are emerging. This opportunity can be pursued in an accelerated manner using the foundation stone provided by previous NCRIS investment in the Australian BioCommons via Bioplatforms Australia. The application of AlphaFold to predict protein structures and resolve the spectrum of fundamental biology through to precision drug targeting, is the most advanced example of AI in Life Science. This invention was awarded the 2024 Nobel Prize in Chemistry. More generally, the prospect of improved analytics combined with a vastly improved ability to describe, relate, compare and re-use the enormous holding of life science data being created today, is being made real by progress in AI. This will bring 1. Productivity uplift through automation, data handling and recalling knowledge from the vast scientific literature 2. New Science uplift through modelling and “seeing” associations and insights that are not possible with existing methods. Bioplatforms embarked on a 12 month consultation into the needs, possibilities and delivery mechanisms for the introduction of an AI platform into an Australian setting. More than 50. Consultations, workshops with AWS and Nvidia, and culminating with the recent tour to Australia by Professor Ewan Birney, Director of EMBL-EBI. This proposal responds to those learnings. AI is not dependent upon new skills, computational environments, availability of data or delivery of unique code – it is dependent upon the rational convergence of all of these things in the context of research sectors and users. Indeed AI is not a singular capability, rather a collection of categories and methods that research infrastructure is well positioned to make accessible not only to experts, but place in the hands of innovative scientists asking probing questions of biology and its application. These categories include

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	1. “Recall” deep learning – analogous to ChatGPT that we are all familiar with, but tailored to respond to the presentation of scientific (genomic, image) features and recall data, literature, subsequent studies, trials and interventions that associate with the features of interest. 2. “Labelling” deep learning – able to automate the association of identifiable features with existing knowledge – for instance the functional annotation of a genome or image – and indeed provide opportunities for multi-modal correlation of data at scale. 3. “Modelling” deep learning – use proximity metadata to generate in silico representations of biological molecules and systems. Alphafold is the first and highest profile example and has reduced protein structure predictions from thousands of years of laboratory time to computational simulations, permitting advanced studies in drug associations and functional assessment. **WHO WILL BENEFIT** Whilst the application of AI will be penetrative to much research across human health and medicine, agricultural security and productivity, and biodiversity analysis and conservation, the delivery mechanism will be patently via research infrastructure – the convergence and integration of NDRI outcomes into accessible AI packages and services. Delivery via user centric Flagship Initiatives, that are somewhat AI ready, discretely valuable programs in their own right and prove the technology in readiness for broader access will ensure the dual benefits of immediate value and longer term generalised access. Examples may include a national Alphafold capability, multi-modal data interpretations (such as ACEMID Melanoma Screening - imaging, 'omics, population health), population biobanking and data integration (PX4/OMICS3), Australian Tree of Life (Biodiversity Genomics). **SOLUTION** Underpinning research infrastructure and capability will include: 1. Fit for purpose integrated computational environments delivered through NDRI participants at NCI, Pawsey, institutional “tier 2” facilities and commercial providers such as AWS and Nvidia. This does not currently exist. 2. Data engineering capability to inform, manage, recruit and synthesize national and global ‘omics datas (in the context of other capability data, eg. imaging) into a form and scale that permit advanced AI analytics. 3. Recruitment and deployment of relevant models and software, often adopted from global sources and collaborators. 4. Significant skills enhancement, both in delivering AI research infrastructure and in support of researchers ability to pose AI relevant queries. **TIMELINES** AI is developing and impacting science and workforce right now. An immediate response, before Australia falls behind the likes of the US and China is necessary to maximise our opportunity and respond to unique Australian challenges and opportunities. Indeed AI will be necessary across the Challenge Framework and National Science Priorities as queried in this survey.

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	Further, the interoperability of NRIs (eg. 'omics, imaging, population health) can not be readily achieved without AI/ML.
080_Roadmap Survey_ Jennifer MacLeod	No response to question 35 submitted.
081_Roadmap Survey_ Dietmar Dommenget	No response to question 35 submitted.
082_Roadmap Survey_ Ann Kwan	No response to question 35 submitted.
083_Roadmap Survey_ Kathy Reid	No response to question 35 submitted.
084_Roadmap Survey_ David Cantor	I have not identified such a requirement. My involvement with the NRI/NCRIS/BioPlatforms Australia spans a number of demains, of which, I am exposed to such advocacies.
085_Roadmap Survey_ Nigel Blundell	No response to question 35 submitted.
086_Roadmap Survey_ Phenomics Australia	1. The 2026 Roadmap should achieve stable and ongoing Commonwealth funding for the National Collaborative Research Infrastructure Strategy (NCRIS), as a primary structural dependency to growth of national science and innovation capability. Equivalent long term funding assurance as provided to entities such as the MRFF and newly Geoscience Australia 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 – annual revenue from organoids and organ-on-chip technologies could reach an estimated $1.6 billion by 2040, creating more than 5000 new jobs in Australia – requires a concerted national 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 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.

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	4. The digital science revolution will underpin research and research infrastructure in ways that we don't fully yet comprehend. The National Digital Research Infrastructure Strategy is a welcome and necessary first step towards underpinning current and future research infrastructure with necessary digital support, and this should be continued in the 2026 Roadmap. Specifically, existing infrastructure capabilities should be enabled to take advantage of digital research opportunities on behalf and in service of their own individual communities, through in house skills and digital infrastructure.
087_ Roadmap Survey_ Will Hobbs	No response to question 35 submitted.
088_Roadmap Survey_ Gabriela Segal Wasserman	No response to question 35 submitted.
089_Roadmap Survey_ Melbourne Data Analytics Platform (MDAP), The University of Melbourne	The Melbourne Data Analytics Platform (MDAP) at the University of Melbourne comprises more than 20 academic specialists drawn from across the academic spectrum, including the humanities, sciences, education and medicine. We have worked collaboratively with more than hundred researchers across a similarly diverse range of backgrounds. While we do not have a singular focus on any one of the key challenge areas, we are well placed to provide feedback on common capabilities and requirements which underpin them all. Our recommendations focus on three critical and interconnected areas: workforce development, AI infrastructure, and data storage capabilities. These elements form the foundation of a robust and competitive national research infrastructure. By addressing these areas in tandem, Australia can create a strategic and synergistic approach to research that maximises the impact of investments and positions the country at the forefront of global innovation. The interdependence of a skilled workforce, advanced AI capabilities, and sufficient data storage underscores the need for a coordinated and holistic approach to NRI development. This integrated strategy is essential to ensure that Australian research entities are not only globally competitive but also able to tackle complex, data-intensive challenges across all research. 1. Workforce The growth and upskilling of a highly qualified workforce are necessary conditions for advancing cutting-edge research in Australia. Coordination and collaboration between different institutions is key to maximise investments marked for the development and sustainability of a skilled national workforce. We propose the creation of a dedicated national body (i.e., a peak body) that could work in parallel with and / or integrate relevant organisations already acting in this space. Challenges and opportunities are common throughout the sector, but solutions are usually developed in isolation, in-house. A peak body would reduce duplication of efforts, inefficiencies and unnecessary waste of energy and resources. MDAP advocated for the creation of a National Digital Research Infrastructure Workforce Coordination Group. This could be easily extended to the non-digital component of NRI. Setting up such a workforce coordination group is a relatively modest investment

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	that will greatly benefit the sector and uplift the quality of Australia's research. 2. AI Recently we have seen an acceleration in the uptake of increasingly more powerful and sophisticated Artificial Intelligence and Machine Learning (AI/ML) models. This creates new opportunities and avenues for research in virtually all domains. For research in Australia to remain internationally competitive, it is essential to boost the national compute and software capability for AI/ML (in parallel to the skilled workforce mentioned above). This has been recognised in the "National Digital Research Infrastructure (NDRI) Investment Plan: Recommendations for Investment by the NDRI Working Group". We recommend to 1) increase the proposed allocation of $45 million to $100 million; 2) identify high-priority areas such as Large Language Models (LLM) infrastructure; 3) allocate part of the funding to the development of appropriate standards, codes-of-conduct, ethical requirements, etc. for the responsible use of AI in research. 3. Data Storage Increasingly, data storage availability is becoming a bottleneck for cutting edge research across domains. The development of AI models typically requires huge amounts of data to train. Whilst some research areas, such as genomics and astronomy, have long battled with processing and storage of large volumes of data, the ubiquitous uptake of AI has seen data requirements soar in many other fields. Raw data storage availability is only a small part of the problem though. The compute infrastructure (i.e. processing GPUs and servers) where the data is to be processed must also have enough storage capacity to temporarily house it and any subsidiary products. Open and reproducible research practices further demand that as much data as possible be retained and made openly accessible to other researchers in the future. We recommend that all new computing infrastructure developments place a strong emphasis on ensuring new compute capabilities are coupled with suitable medium and long-term data storage solutions for all researchers.
090_Roadmap Survey_ Jason Evans	The need is to perform high quality climate change risk assessments and plan adaptation actions before more disasters strike. This requires the creation of high quality, high resolution climate projections that will both help us improve our understanding of these phenomena and their relationships with other aspects of the climate system, and also inform a wide cross-section of Australia's society and environment about their adaptation needs. This requires an order of magnitude increase in the compute and data capacity of our major supercomputing facilities (NCI & Pawsey), as well as the modelling infrastructure to go with it (ACCESS-NRI).
091_ Roadmap Survey_ Centre for Ecosystem Science, UNSW Sydney	No response to question 35 submitted.

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092_Roadmap Survey_ Western Australian Marine Science Institution	Shared Environmental Analytics Facility - is world leading, out of Western Australia, and is the only credible way of undertaking Cumulative Impact assessment. SEAF.org.au
093_Roadmap Survey_ William Rickard	No response to question 35 submitted.
094_ Roadmap Survey_ Australian Urban Research Infrastructure Network (AURIN)	Due to our mandate, AURIN's strategy and investment portfolio is informed by key Government and industry priorities on urban and infrastructure planning, as well as community well-being. Most recent and relevant documents include: • The National Urban Policy (2024), released by DITRDCA • The Sector Pathways Review (2024), released by CCA • The National Health and Climate Policy (2023), released by DHAC • The Critical Infrastructure Resilience Plan (2023), released by DHA • The Strategic Plan 2020-25 (2022), released by the Infrastructure Sustainability Council • The ALC Strategy 2023-25 (2023), released by the Australian Logistics Council Based on the above information, AURIN has made significant progress in leading two major National Research Infrastructure initiatives in collaboration with other NRI facilities, Government agencies and industry partners. These initiatives are: 1. The Australian Urban Climate Research Infrastructure (AUCRI) Establishing a crucial National Digital Research Infrastructure (NDRI) to inform evidence-based urban policies and interventions aimed at future proofing urban and infrastructure systems against climate change. AUCRI will position Australia as an international scientific leader in the field and optimise our investment in climate adaptation in Australian cities. AUCRI will federate five NCRIS facilities (AURIN, ACCESS-NRI, TERN, PHRN and ARDC), two ARC Centres of Excellence (Climate Extremes and Weather of the 21th Century) and two publicly funded research agencies (CSIRO and BoM). AUCRI will need to integrate Tier 1, Tier 2 and Cloud computing capabilities. AUCRI will address emerging research directions associated with Challenge #2, #5, #6 and #7, as well as NSRP #1, #2 and #5. In particular, AUCRI will address the following critical infrastructure needs: • High-performance computing (HPC) and AI-driven climate models with finer resolution for regional climate projections. • Advanced Earth observation systems, including new-generation satellites and drone-based remote sensing technologies, for real-time monitoring. • Next-generation carbon flux monitoring systems, including eddy covariance towers and automated soil carbon measurement technologies.

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	• Urban Climate Testbeds: Smart cities equipped with high-resolution climate sensors, green infrastructure pilots, and urban heat monitoring. • Social and Environmental Determinants of Health Lab: A research facility focused on urban planning, housing, and social infrastructure for mental well-being. • Climate and Health Research Supercomputing Hub: A facility for modelling climate-health interactions and informing policy. • National Air and Water Quality Monitoring Network: Expanded sensor networks and data platforms for real-time environmental health analysis. 2. The Australian Urban Mobility Research Infrastructure (AUMRI) Establishing a crucial National Digital Research Infrastructure (NDRI) enabling Australia to become a global leader in automated and zero or low-emission transport, freight and logistics sector by harnessing emerging technologies at scale and harmonising data sharing between jurisdictions, as well as academic, public and private sectors. AUMRI will advance critical technologies such as artificial intelligence (AI) and robotics to allow us to transition to net zero in environmentally responsible ways. AURIN will partner with the National Transport Research Organisation (NTRO) to implement a network of Smart Mobility Living Labs (SMLLs), in partnership with public and private sectors, and a National Data Exchange (AUM-DX) that will act as long-term technology testbeds. AUMRI will contribute to relevant CRCs, such as RACE2030 or iMOVE. AUMRI will address emerging research directions associated with Challenge #2, #5, #6 and #7, as well as NSRP #1, #2 and #5. In particular, AUCRI will address the following critical infrastructure needs: • Vehicle-to-Grid (V2G) and Microgrid Innovation Centre: A research hub for testing how electric vehicles, batteries, and local energy systems interact with the national grid. • National Smart Grid Research Testbed: A large-scale real-world grid simulation for AI-driven energy management and V2G integration. • Smart Ageing and Inclusive Communities Living Lab: A real-world test environment for age-friendly housing, transport, and digital inclusion. • Sovereign Cloud and Secure Data Centre: A national facility to enhance secure data storage, processing, and digital sovereignty. • Supply Chain Resilience and Advanced Logistics Hub: Infrastructure for modelling and securing supply chains against disruptions.
095_Roadmap Survey_ Timothy Gould	Australia is a laggard in computational infrastructure and competency, with overseas competitors having easier access to computing resources via flexible arrangements. This urgently needs to be fixed to ensure we do not fall behind competitors. Note, the obsession with

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	quantum computing here is a major hindrance, as it (mis)directs funding to unproven - and most likely niche even when proven - technologies away from technologies that are already advancing our competitors compared to Australia.
096_Roadmap Survey_ MATRIX	Mathematical research is a cornerstone of Australia's scientific capabilities and a key driver of national research priorities. Unlike applied fields that focus on addressing specific challenges, mathematics provides the essential theoretical foundations and methodologies that unlock breakthroughs across all scientific domains. A strong mathematical foundation is essential for Australia to navigate uncertainties, safeguard its future, and maintain its global competitiveness in an increasingly complex world. **A National Priority - The Urgent Need for Investment in Mathematical Sciences Infrastructure** Investment in research infrastructure is vital across all scientific disciplines, and the mathematical sciences are no exception. Dedicated infrastructure in the form of a national residential research institute for mathematical sciences provides the most effective environment to develop expertise, tools, and collaborative networks necessary to address emerging threats, drive innovation, and support informed decision-making across critical sectors. This aligns with the NCRIS objective to strengthen Australia's research capabilities and ensures that mathematical sciences are well-supported to tackle rising challenges. **Proposed Infrastructure – A Residential National Research Institute for Mathematical Sciences** Whereas laboratory-based sciences often require large pieces of equipment, research in the mathematical sciences primarily relies on deep collaborative interactions, typically conducted in person and in front of black or whiteboards. Residential research institutes are globally recognised to be the key research enabler for foundational fields like mathematics. A residential mathematical sciences research institute is essential national infrastructure similar to the Australian Synchrotron, the National Computational Infrastructure facility, and the Square Kilometre Array radio telescope. The value and effectiveness of mathematical sciences research institutes have been recognised by nearly every industrialised nation. Globally, most developed countries established significant national infrastructure for mathematical sciences with strong government backing. The Isaac Newton Institute for Mathematical Sciences in Cambridge, UK, is a prime example of a world-class mathematical sciences research institute, and so are the Simons Laufer Mathematical Sciences Institute and the Institute for Pure and Applied Mathematics in the USA. By contrast, Australia is more than twenty years behind in this regard. In 2020, the UK announced a £60 million annual boost for mathematical sciences infrastructure, significantly enhancing the activities of three leading mathematical institutes. Similarly, the USA established the Institute for Mathematical and Statistical Innovation in 2020 to foster innovation across the mathematical disciplines. This century has also seen a new wave of institutes established across the region to address pressing ecological and economic challenges. Brazil has the Instituto Nacional de Matemática Pura e Aplicada (IMPA), and China launched the Shanghai Institute for Mathematics and Interdisciplinary Sciences in early 2024, complementing the Beijing Institute of Mathematical Sciences and Applications founded in 2021.

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	Despite its foundational role in key scientific and industrial advancements, dedicated government funding mechanisms to support research infrastructure for the mathematical sciences in Australia remain absent. More recently, ATSE’s Pre-Budget Submission 2025-26 reinforced this need, recommending that a national mathematics research institute be included in NCRIS funding to strengthen Australia’s research capabilities and align with national priorities. As Australia’s collaborative research-intensive residential institute for mathematical sciences, MATRIX is uniquely positioned to address this infrastructure gap and tackle critical mathematical challenges of both national and global significance. Operating on a lean budget for nearly ten years, MATRIX has been supported by five leading Australian universities (University of Melbourne, Monash University, University of Queensland, Australian National University and University of New South Wales) and the USA-based Simons Foundation. However, it has yet to receive sustained national infrastructure funding. Despite this, MATRIX has achieved impressive results. As of the end of 2024, it has delivered 88 programs, bringing together 1,900 scientists from 47 countries, advancing knowledge across a broad spectrum of mathematical sciences disciplines. MATRIX furthermore provides additional opportunities and support for caregivers and facilitates deep interaction between established and early career researchers. Since its inception in 2015, MATRIX has forged strong international partnerships with leading institutes in Germany, Japan, Canada, USA, and South Korea. **Impacted Research Communities - Extensive Benefits for the Broader Scientific Landscape** Investment in national infrastructure for mathematical sciences will create a national focus of international calibre and elevate Australia’s global standing in scientific research. A dedicated national institute will create a crucial link between academia, industry, and government, fostering a skilled workforce and driving high-impact research with long-term benefits. Investing in national infrastructure for mathematical sciences will grow the national knowledge base and help build sustainable industries. Additionally, it will foster the development of skilled talent, boost innovation, and create a collaborative environment that enables the exploration of emerging fields, from artificial intelligence and data science to quantum computing. The returns from this investment will far outweigh its initial cost.
097_Roadmap Survey_ La Trobe Institute for Sustainable Agriculture & Food, LA Trobe University	I have provided these in previous sections. The need to maintain & enhance existing investments in the biotechnology-related investments- eg. molecular biosciences/imaging/computational infrastructure remains a priority. New investments in food technology/innovation at the pre-pilot/bench scale is vital to maintaining the competitiveness of the food & beverage industries, and importantly to value-add to Australia's agricultural sector by both value-adding to a commodity-based sector & also to improving the health & well-being of our population!
098_Roadmap Survey_ Margaret Sunde	Magnetic Resonance (NMR and EPR spectroscopy) is an essential tool for the chemical, physical and biological sciences. It is critical for scientific research and for manufacturing . Across Australia, existing MR infrastructure is fragmented and aging and urgently needs to be maintained and upgraded in a coordinated way to improve capabilities. New instruments offer additional sensitivity and functionality but have smaller environmental footprints and reduced operating costs with advances in magnet design. Specifically, helium use is much reduced with new designs. Renewal of the national MR capability now lies outside the scope of ARC LIEF and similar schemes because of

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	the very high cost to upgrade existing workhorse instruments or purchase of cutting-edge new instruments. Yet, these instruments remain essential for Australia to remain competitive across quantum computing, chemical synthesis, environmental monitoring and drug discovery. Investing in a national MR network will bring substantial economic benefits, by enabling innovation in pharmaceuticals, agriculture, and renewable energy, a nationally funded and coordinated network of magnetic resonance capability will create jobs and enhance productivity. Investment in MR will underpin progress in with many of the national research priorities, and contribute to the economic development of Australia. The ability to maintain, upgrade, and leverage existing MR infrastructure, provide access to researchers across the country, maximise return on investment and safeguard continued capability will ensure that Australia's research community can continue to produce world-leading scientific and/or manufacturing outcomes.
099_Roadmap Survey_ IDEA bio- AIBN The University of Queensland	1. Bioprocesses scale-up and manufacturing facilities. There is a growing ecosystem in the biotechnology sector driven by the need of sustainable bioprocess for the manufacturing of novel food, beverages and high value molecules. While the Synthetic Biology initiatives have contributed to the development t of proof-of-concept processes which have positioned Australia a reference in that capability, the transition to successful enterprises is limited by the lack of manufacturing facilities. These new facilities will have the required infrastructure to implement a robust tech transfer and production platform for novel and sustainable products. the infrastructure requires should include a pilot plant where upstream and downstream processes can be integrated and tested with the ultimate goal to generate a product that can be commercialised. These new facilities should be operated by specialised staff with backgrounds on biotechnology, engineering, bioprocesses, life cycle analysis, downstream processing, commercialisation, among others. These new facilitates could operate in a fee for service model, and also to provide training as required by the industry sector. 2. Sustainable soil management and agriculture improvement facility. The impact generated by current soil management practices needs to be addressed and a facility where novel solution are generated are needed. This facility should rely on the current expertise and infrastructure on soil science, agriculture and systems biology to generate the next generation of soil amendments seeking to use biological systems into efficient agricultural practises that improve the health and productivity of soils.
100_Roadmap Survey_ The Australian Mathematical Society	The mathematical sciences provide the fundamental theoretical underpinnings of paradigm-changing breakthroughs across all areas of science and technology. Hence a vibrant and healthy research capacity in the mathematical sciences is vital to Australia's ability to respond to emerging and unforeseeable scientific and technological challenges. Like all major areas of research endeavour, the mathematical sciences need suitable research infrastructure. For the mathematical sciences specifically, the needed infrastructure is a national residential research facility. Such facilities are recognised internationally as the optimal way to achieve significant progress and breakthroughs in mathematical research challenges. They therefore align with NCRIS' remit to strengthen Australia's research capabilities and readiness to address future research challenges.

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	We recommend that NRI invest in new capability via an Australian national residential research facility, by investing in the MATRIX Institute. Such facilities host groups of Australian and international researchers with complementary and deeply specialised expertise to collaborate intensively and uninterruptedly for multiple-week periods on important mathematical research challenges. Experts collaborate in person at whiteboards/blackboards in multiple-hour blocks and in small groups whose composition evolves dynamically in response to the mathematical complications encountered, sharing, developing, revising and perfecting ideas. This can only be achieved effectively in an in-person dedicated research environment shared for a protracted period of time. The value and effect of such a "Think-chrotron" facility in the mathematical sciences is similar to that of the The National Computational Infrastructure facility or the Square Kilometre Array in other disciplines. The MATRIX institute, based in Creswick near Melbourne, is the only such residential research institute in Australia. However, MATRIX is entirely reliant on consortium funding from the larger Australian universities and funding from the Simons Foundation (USA), and has been operating (remarkably effectively) on a subsistence budget for many years. There is currently no national funding available for such infrastructure via NCRIS. Consequently, MATRIX lacks both funding stability and sufficient resources to support sovereign capacity in Australia in this critical research area. The Australian Mathematical Society recommends that the NRI Roadmap include significant investment (on the order of $10M) in the MATRIX facility over the next five years. This would provide capability for MATRIX to increase the scale of its operations and its ability to coordinate programs addressing major research problems, running a year-round schedule of research programs. It could also improve links between academia and industry in the mathematical sciences, build the national knowledge base and R&D capacity, and promote training and development of skilled talent.
101_Roadmap Survey_ Aidan Sims	As mentioned above, we lack a sustained and stably funded residential research facility. This may be because the word "infrastructure" usually brings to mind physical research based on experimentation or simulation, and is not often thought of in terms of human infrastructure. But think-tank infrastructure in the mathematical sciences is like supercomputing infrastructure for simulation-based research. Mathematical research occurs inside researchers' heads, but serious breakthroughs on the big questions require a high-intensity and sustained exchange of very dense and technical ideas among complex groups of researchers with complementary expertise. Typically this would involve blocks of 3-4 hours at a time, daily, over a period of 2-4 weeks, sharing space on a blackboard or whiteboard. It is impossible to achieve over videoconference applications - the information bandwidth of such channels is just not sufficient: mathematicians use extremely dense notation, technical language, pictures and physical interaction to achieve enormous conceptual/technical throughput during in-person interactions. The MATRIX Institute is the only facility in Australia that provides this sort of infrastructure, but it has insufficient capacity or funding for the need, and consequently lacks a suitable level of capability. I would recommend at least 5 years of significant investment (on the order of $1.5M-$2M per year) to achieve a sustained period of high-capacity activity at MATRIX.

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102_Roadmap Survey_ Andrew Isaac	No response to question 35 submitted.
103_Roadmap Survey_ Claire Vincent	There is a requirement for coordination and consolidation of infrastructure for support high-resolution climate modelling that will support Australia's adaptation, mitigation and disaster resliance. This includes high-performance computing facilities, data storage, data curation and technical expertise to support these endeavours. This point reflects the recommendations made in the Austarlian Academy of Science Decadal plan for Australian Earth system science 2024-2033.
104_ Roadmap Survey_ Muyang Li	No response to question 35 submitted.
105_Roadmap Survey_ Krispin Hajkowicz	I think we need a national genomics infrastructure, comprising wet lab and sequencing capacity at massive scale, backed up with accessible, rapid bioinformatics with the medium-term goal over 10 years of bringing individualised genomic medicine to every Australian who needs it.
106_Roadmap Survey_ Ryan Gullock	The scale of experiments is continuously increasing There is a constant shift and change of technology (short equipment technology lifecycle) which only NCRIS can accommodate There is increasing bioinformatics and computational demands.
107_Roadmap Survey_ Jose Antonio Lopez-Escamez	Disease-specific reference databases, including aggregated multi-comic data to implement genetic diagnosis and therapies. Population-specific databases are needed to include representatives of the different ethnicities for rare diseases diagnosis.
108_Roadmap Survey_ Naveen Louis	No response to question 35 submitted.
109_Roadmap Survey_ The Australian Centre for Excellence in Antarctic Science	Antarctic observing system. This domain has traditionally been assumed of the Australian Antarctic Division but is not funded and does not have a comprehensive needs based plan for this monitoring, especially of the physical system and downstream impacts on biological system. IMOS extends only into the Southern Ocean but not under the ice or on the ice. Medium term goals: 1. Early detection of change in key marine grounded ice sheet basins in Australian Antarctic Territory from the field and space. Development of technology for robust deployment. 2. Assimilation of observations into model projections as an operational ice sheet-climate model to provide enhanced projections of changes to Australian sea level, weather, fisheries, and those of our regional neighbours (especially Pacific) Establish over period

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	from 2030. Ice sheet response in IPCC AR6 begins to show model-specific differences around early to mid 2030s.
110_Roadmap Survey_ Navid Constantinou	No response to question 35 submitted.
111_Roadmap Survey_ University of Sydney	**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

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	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
112_Roadmap Survey_ Microscopy Australia Node - Centre for Microscopy and Microanalysis	Volume Electron Microscopy or volume EM (vEM) refers to a group of recently developed imaging approaches that use scanning and transmission electron microscopy (SEM and TEM) to allow interrogation of cell and tissue ultrastructure in 3D, at µm to mm volume scales and nm resolutions. A movement started in the UK and Europe is represented in this webpage: https://www.volumeem.org/ and in this publication: https://www.nature.com/articles/s43586-022-00131-9. Within Australia, we have a strong contribution to vEM including instrumentation and expertise. Our Australian community is represented by both Microscopy Australia and by the special interest group of the Australian Microscopy and Analysis Society called Volume Imaging Australia (VIA). As President of this group, we make it a priority to retain close ties to the global vEM community and to locally strengthen our community. We achieve this by sharing knowledge, experience and resources to improve access, reliability, throughput and training of vEM techniques and methodologies. There is vEM instrumentation and expertise distributed across Australia. vEM instrumentation includes the microscopes (Serial Blockface Scanning Electron Microscopes, Focused Ion Beam Scanning Electron Microscopes, Scanning Electron Microscopes (with software capabilities for complex imaging strategies) and Transmission Electron Microscopes (with software capabilities for complex imaging strategies)); the sample preparation instruments (processing microwave, MicroCT, high pressure freezers), skilled staff and strong computing infrastructure. For biological specimens the sample preparation is as critical as the instrumentation. The same can be said for

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	the data management across these techniques which generate large volumes of rich informative data. Where access is given to already existing facilities that are experienced in vEM, researchers can benefit from efficient application of these complex workflows in their areas of research. At the University of Queensland, the Centre for Microscopy and Microanalysis is well equipped in vEM from project design through to microscopy and final image analysis. As are other facilities across Australia, including Sydney Microscopy and Microanalysis (SMM) at the University of Sydney and Bio21 Molecular Science & Biotechnology Institute, at the University of Melbourne. The Centre for Microscopy Characterisation and Analysis at the University of Western Australia is currently procuring their own SBFSEM system to equip the west coast. Together we form the foundation for vEM capabilities across Australia and my hope is to see that these facilities including their staff continue to be supported and recognised for our contribution to research excellence.
113_Roadmap Survey_ Robyn Schofield	Our community interacts with the state of the environment reporting: https://soe.dcceew.gov.au/ "Government policy around air pollution regulation could be improved with an exposure minimisation approach (Zosky et al. 2021). However, such an approach relies on increasing air quality monitoring infrastructure, and active participation by industry and residents to drive down emissions. It is not enough to set new National Environmental Protection Measures targets for air pollution levels if behavioural change is not encouraged in legislation." White papers / peer reviewed community papers on observations: Clean air plan for Sydney https://www.mdpi.com/2073-4433/10/12/774. A Decadal Plan for Earth System Science 2024-2033: https://www.science.org.au/files/userfiles/support/reports-and-plans/2024/decadal-plan-earth-system-science-2024-33 has one of the priorities listed as: R3: Coordinate and prioritise observational programs for research across Australia. Oversight of these observational programs, strategic review of investment in research observations and a strategy to identify emerging needs should be established above the level of individual capabilities. As a community we have been working towards an integrated community network to achieve streamlined atmospheric compositional observations for some time - i.e. Schofield, Robyn (2025). AUSTRAL - Australia's Urban Supersite neTwork for Research on Air quaLity. The University of Melbourne. Poster. https://doi.org/10.26188/28605209 With AUSCOPE in 2019 CSIRO, BoM and Universities worked together to create an AUSCOPE-Atmosphere vision - this report exists as a word document. I can share that upon request.
114_Roadmap Survey_ Bob Furbank	I believe inclusion of a space science component in APPN field facilities and a data warehousing and training facility for helping researchers

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	utilise satellite based remote sensing products could be a game changer if combined with AI tools.
115_Roadmap Survey_ Archer Materials	From my understanding, the Federal Government currently supports the Australian National Fabrication Facility (ANFF), useful for the fabrication of for the fabrication, manufacture of test devices and electronic components, as well as Microscopy Australia - for the imaging of devices and samples. However, there is currently no national facility that allows the electrical testing, characterisation and operation of electrical and quantum devices. For these tasks we routinely need to look offshore for facilities to undertake these tasks, which slows down our R&D and is costly. A national testbed which could provide fully equipped laboratories and support staff to assist in cryogenic characterisation of quantum devices would be a significant asset to my industry
116_Roadmap Survey_ Atlas of Living Australia	The Atlas of Living Australia provides biodiversity data and related services to over 120,000 users a year across research, industry, government, and the public. It supports programs in taxonomy, biodiversity, ecosystem science, biosecurity, contributes to major natural resource management programs and supports the international community as the Australian node of the Global Biodiversity Information Facility (GBIF) and the code base for the successful international Living Atlases community. The ALA was established on open-access principles, with data publishers by default using Creative Commons licences and with an open-source code base. This approach has encouraged re-use and maximised the value of data, especially for data that have been funded, produced or collected by public institutions in Australia. However, innovative approaches to biodiversity monitoring are increasing the variety, volume and velocity of data expected to be managed by the ALA which requires a major re-architecture of core infrastructure. Data types include: • Digital extended specimen' concept from the biological collections sector to make data globally discoverable, interoperable, and accessible, which will allow users to generate new insights into the status, evolution and function of biodiversity. • Biodiversity survey data acquired by major research programs, government, and industry to underpin cutting-edge longitudinal biodiversity monitoring, species distribution modelling, and related ecological analyses. • Transformational advances in genomics-based biodiversity identification and monitoring such as environmental DNA which allow users to identify, describe and monitor species and population genetic distributions. • Sensor network data (e.g., camera traps, ecoaccoustics) which provide the capability to monitor species in near real-time. **New Capability** The 2021 NRI Roadmap proposed a Step Change around a National Approach to Collections, including with respect to biological (biodiversity) collections. In response to this call for a Step Change, in 2024 Australia's biological collections community, end users and research infrastructure partners came together to realise a future vision for a national biological collection. Accelerating discovery and access to Australia's biological collections was recognised as providing a remarkable opportunity to transform science across a suite of disciplines including environmental monitoring, genomics, health, biosecurity, agriculture and artificial intelligence.

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	The importance of biological collections has been recognised through strategies including the National Research Infrastructure Roadmap's call for a 'step change' around a national approach to collections, Taxonomy Australia's Decadal Plan (Discovering Biodiversity: A decadal plan for taxonomy and biosystematics in Australia and New Zealand 2018–2027), the CHAFC National Collection Strategy 2021, the National Plant Pest Reference Collections Strategy 2018 and major investments in digitising our biological collections in several major state collections and CSIRO. In Australia, significant national investment has been made in new collections infrastructure within museums, herbaria, and CSIRO, supported by innovative digitisation programs to ensure physical specimens are databased, documented according to international standards, and imaged. This investment, however, hasn't covered all of Australia's significant biological collections. When combined with the extant data capability provided by the Atlas of Living Australia, Australia is well placed to harness these digital assets, making them accessible nationally and internationally through the Global Biodiversity Information Facility (GBIF). Capability and coordination gaps exist across the sector for building a world-class biological collections system. Yet, the number of users is rapidly increasing, and domains are driven by innovations in deriving information from biological collections. These uses include providing the sequences for a reference library to identify eDNA samples, biosecurity surveillance and AI approaches to species identification and monitoring. Increasingly, users expect rapid access to integrated data. These efficient and powerful technological advances present challenges and opportunities in defining a national approach. The context for this new capability into Australia's biological collections is driven by four factors: • Australia is a mega biodiverse continent with many species found nowhere else. Only 30% of our biodiversity has been identified and described. • Biological collections provide the fundamental infrastructure that underpin all we know and understand about species. • New technologies including genomics, advanced imaging, and artificial intelligence and machine learning are massively expanding the potential of biological collections and the role they will play in supporting science and decision-making. • Australia's biological collections are a remarkable national asset; however, their full benefit is not being realised due to a lack of national coordination and access to skills. A national approach would parallel international trends, for example, the European Union's Distributed System of Scientific Collections (https://www.dissco.eu/), the largest global formal agreement between natural history museums, botanic gardens, and collection-holding universities. The iDigBio (https://www.idigbio.org/) program in the United States delivers a similar ambition focusing on digitisation and data infrastructure. A national workshop hosted by Australia's biological collections community, end users, and research infrastructure partners in May 2023 identified the following five transformations required to deliver on this vision: • Sectoral leadership

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	• Collection digitisation, storage, and management • Digital infrastructure, data access and integration • Emerging transformational technologies • Skills and workforce
117_Roadmap Survey_ UNSW RNA Institute	No response to question 35 submitted.
118_Roadmap Survey_ Steven Meikle	Digital population biobanks integrate genetic, imaging, phenotypic, and health data across a population sample, offering researchers secure access under ethical and legal guidelines. The UK Biobank, which has collected anonymized data from 500,000 individuals since 2004, is a prime example of how large-scale, well-structured biobanking can drive breakthroughs in epidemiology, genomics, public health, clinical research, and personalized medicine. Australian researchers are major users of this data, yet no equivalent national resource exists locally. To address this gap, a staged approach could be taken. The first step is strengthening national coordination and standardization of biobanking data, including digital and physical biobanks. Currently, biobank collections across Australia operate in a fragmented manner, limiting discoverability and accessibility. A coordinated, community-driven strategy would streamline standards and practices, making existing datasets more accessible and reusable through a central digital platform. This would improve efficiency and create a foundation for a more comprehensive system. The second step is investing in a national prospective population biobank, similar to the UK Biobank, which would provide essential normative data to support medical and health research. Such a resource would enhance the productivity of existing studies while enabling new research that is currently unfeasible. A national digital biobank would be an important national research infrastructure and is well aligned to the NCRIS principles. The NCRIS Health Group, and other NCRIS partners, would provide existing capacity and capability platforms to deliver this resource. An Australian national digital biobank would be an important data source for understanding unique Australian health challenges including those associated with a changing environment, indigenous health, and an ageing population.
119_Roadmap Survey_ Anthony Harris	N/a
120_Roadmap Survey_ Weerachai Jaratlerdsiri	No response to question 35 submitted.

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121_Roadmap Survey_ Brian Gloss	No response to question 35 submitted.
122_Roadmap Survey_ Richard Bagnall	Bioinformatics requires access to high computational capacity, data transfer, and data storage.
123_Roadmap Survey_ Christian Jakob	No response to question 35 submitted.
124_Roadmap Survey_ Nitika Kandhari	No response to question 35 submitted.
125_Roadmap Survey_ Sarah Redshaw	Education requires strong input and is changing rapidly. This mostly requires human resources
126_ Roadmap Survey_ Jan Pretorius	**Identified need: A National Priority - The Urgent Need for Investment in Mathematical Sciences Infrastructure** In my response to q2.2 I outlined ways in which advanced mathematical sciences benefit national security and resilience. Australia constantly faces the challenge of having to 'punch above its weight' in many areas of importance. Having identified investment in advanced mathematical sciences as critical in the medium to long term, the question is how to invest in research infrastructure in a highly effective way. My response is based on the observation that Mathematics – in particular advanced mathematics – is an activity that absolutely requires a physical and mental environment that allows deep individual concentration, as well as fruitful collaboration. While everyone is familiar with the possibilities of online engagement, even in the general workplace the limits of virtual interaction have become clearer and are particularly acute in Mathematics. Collaboration in advanced mathematics require dedicated research time in an amenable environment – one that simultaneously allows for solitude and sustained personal and professional interaction. This 'amenable environment' is the 'lab' for mathematics – unlike experimental or other sciences very little other equipment is required, but an appropriate residential facility fulfils the key need. To date national investment in a residential advanced mathematics research centre has effectively been absent. This contrasts starkly with developed countries which established significant national infrastructure for mathematical sciences through the 20th century, with strong government backing: 1. The Isaac Newton Institute for Mathematical Sciences in Cambridge, UK, serves as a prime example of a world-class mathematical sciences research institute. Additionally in 2020, the UK announced a GBP60 million annual boost for mathematical sciences infrastructure, significantly enhancing the activities of three leading mathematical institutes.

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	2. In the US, the Simons Laufer Mathematical Sciences Institute and the Institute for Pure and Applied Mathematics are renowned for their contributions to advancing mathematical sciences. Similar to the UK, the US established the Institute for Mathematical and Statistical Innovation in 2020 under the National Science Foundation to innovation across the mathematical disciplines.
	3. In early 2024 China launched the Shanghai Institute for Mathematics and Interdisciplinary Sciences, complementing the Beijing Institute of Mathematical Sciences and Applications founded in 2021.
	
	Proposed Infrastructure - A Residential National Research Institute for Mathematical Sciences
	
	It is proposed that long-term national support be provided for MATRIX (https://www.matrix-inst.org.au), as it is uniquely positioned to address the infrastructure need for a national residential mathematical research institute. Operating on a lean budget for nearly ten years, MATRIX has been supported by five leading Australian universities (The University of Melbourne, Monash University, The University of Queensland, Australian National University and UNSW Sydney) and the US-based Simons Foundation. However, it has yet to receive sustained national infrastructure funding, with the exception of a single ARC LIEF grant. Despite this, MATRIX has achieved impressive results. As of the end of 2024, it has delivered 88 programs, bringing together 1,900 scientists from 47 countries, advancing knowledge across a broad spectrum of mathematical disciplines, from pure mathematics to applied research across scientific disciplines.
	
	Impacted Research Communities - Extensive Benefits for the Broader Scientific Landscape Fields that could benefit directly or indirectly from investment in a national residential mathematical institute include:
	
	Mathematical research centres across Australia:
	
	• MATRIX support brings leading mathematical researchers from around the globe to Australia. Once in Australia, they often visit and collaborate with Australian researchers at various university departments and SMRI in Sydney alongside MATRIX workshops, benefitting the entire Australian research community.
	• Healthcare and Medicine
	  ○ Genomic data analysis
	  ○ Epidemiological forecasting
	• Computer Science
	  ○ Artificial intelligence and machine learning
	  ○ Quantum computing
	  ○ Algorithm design and analysis
	  ○ Cryptography and cybersecurity
	• Economics and Finance
	  ○ Financial modelling
	  ○ Risk assessment
	• Emerging Technologies

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	◦ Renewable energy systems integration • Engineering ◦ Aerospace engineering (flight dynamics, structural analysis) ◦ Electrical engineering (signal processing, control theory) ◦ Mechanical engineering (stress analysis, thermodynamics) ◦ Civil engineering (structural mechanics, earthquake engineering) ◦ Chemical engineering (reaction kinetics, transport phenomena) • Physical Sciences ◦ Theoretical physics (quantum mechanics, string theory, general relativity) ◦ Astrophysics and cosmology ◦ Materials science and solid-state physics ◦ Fluid dynamics and plasma physics ◦ Optics and photonics • Biological Sciences ◦ Computational biology ◦ Bioinformatics • Earth Sciences ◦ Climate modelling ◦ Geophysics ◦ Oceanography ◦ Meteorology ◦ Seismology • Chemistry ◦ Quantum chemistry ◦ Computational chemistry **Timeframe** - A step change Investment over 5 years MATRIX is proposing a phased approach that would require investment through 2030. This funding will provide MATRIX with the opportunity to significantly expand its operations, increase the number of research programs, and strengthen international collaborations with leading institutes. A significant portion of the funding will be dedicated to large-scale research initiatives that directly and indirectly support Australia's long-term national security and resilience.
127_Roadmap Survey_ Rowland Mosbergen	We have the ARDC that is more focused on Data and Research Infrastructure, yet we don't have a Research Software NRI capability that stands on its own to help others. ACCESS-NRI also has this software focus, but only in the one domain. We need something cross domain.

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	This would be a people capability, similar to ARDC, with the medium-term goals of raising capability across NCRIS, universities, and research institutes, many who are reinventing the wheel inhouse. A good example is the duplication of techincal architectures within the MRFF. Many projects get funded to "share" their "reusable" technical architectures yet many of these architectures are not flexible enough to handle different use cases as they are not looking across projects. I would advocate an establishment of a capability over the next 2 years with a small group that could then grow based on demand. ARDC has provided some reports on this: 1. https://ardc.edu.au/article/research-software-a-first-class-research-output/ 2. https://ardc.edu.au/article/nurturing-research-software-capability-in-australia/ 3. https://ardc.edu.au/article/6000-people-develop-and-maintain-research-software/
128_Roadmap Survey_ Christopher McErlean	A national NMR facility (perhaps a hub and spokes model) will support advances in many nationally critical areas of research including biomedical and food production. These technologies are an absolute requirement for all molecular research, increasingly out of the price range of research institutes and universities, but lack the glamour of being 'breakthrough' technology. They support research and discovery as a critical tool.
129_Roadmap Survey_ Angela Webster	No response to question 35 submitted.
130_Roadmap Survey_ Jeremy Mould	The nuclear physics and quantum computing communities need access to an underground laboratory free from the cosmic ray background. This has been developed by capital grants by the federal government and the Victorian government at the Stawell Underground Physics Laboratory in western Victoria. Operating costs need to be covered by NCRIS. The federal government, the Universities' and CSIRO's astronomy community have made a large investment in the Square Kilometre Array and a strategic partnership with the European Southern Observatory, world leading research facilities. ESO membership needs to be secured, and Australia's ability to build state of the art instrumentation for these facilities should be supported by NCRIS to get full value from the investment and to make world leading discoveries. These discoveries bring young people into science and engineering and make Australia a peak performer among our peers.
131_Roadmap Survey_ Steven Prawer	As above, I believe that we need a national prototyping facility. Furthermore, I would like to propose a radical model in which the facility takes an equity share/royalty which can eventually make the facility self funding.

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132_Roadmap Survey_ Paul Roe (QUT,JCU),Prof Susan Fuller (QUT) and Prof Lin Schwarzkopf (JCU)	**The Need** There is a need for a National EcoAcoustics Facility (NEAF). This would provide infrastructure and training for large scale acoustic fauna monitoring. Currently we have a poor understanding of faunal biodiversity across Australia; this facility will collate and share data enabling new research which was hitherto impossible, yet vital for Australia's future. Ecoacoustics uses sensors which continuously record sound to provide a direct and permanent record of the environment, of vocal fauna. Off the shelf recorders are available and AI tools for analysing sound recordings to find vocal species in recordings are now available. Together these enable scalable fauna monitoring which will transform our understanding of the environment in much the same way that remote sensing has enabled large scale vegetation monitoring. Large long duration acoustic recordings provide a new way to research and understand the effects of climate change, land use change, bush fires, threatened and invasive species, and to understand the effectiveness of environmental management actions and restorations, such data can also feed into green accounting mechanisms. Many organisations including all levels of government and NGOs are collecting ecoacoustics data for a variety of purposes. However, data is unavailable, not shared nor aggregated nor is it reusable, it is not FAIR. There is a need for infrastructure to store and analyse data, to provide a fauna observatory from all these datasets currently being collected, and there is a need for training and standardisation of data collection, analysis and interpretation. No commercial solutions exist. Through the ARDC we have built a platform for storing and analysing data (open Ecoacoustics https://openecoacoustics.org/), we have collected 1 Petabyte of data, and we have over 1800 users of our data. We have over 50 partners interested in contributing datasets, and we would like to grow our data collection to 10 Petabytes. Data is being collected for monitoring, we want to maximise its use and utility through aggregation and reuse, and to drive adoption of common collection protocols and FAIR data use, permitting data reuse and data aggregation to form a national observatory from existing data collections. In addition to traditional research and monitoring there are opportunities to partner with First Nations communities to provide communities with tools to monitor, understand and report on their land and to combine this with Indigenous knowledge. There are also opportunities for a facility to be used commercially by industry, mining, developers and farmers for environmental assessments, environmental auditing and green accounting schemes. This facility would extend and enhance an existing capacity, provide a much-needed repository of ecological data and enable new ways to understand our environment. It builds on existing projects including ARDC Open Ecoacoustics and an ARC LIEF project Australian Acoustic Observatory https://acousticobservatory.org/) The project team are international leaders in this area and have an existing large network of researchers and land managers who wish to partner, continue to and use such a facility. **The Proposed Infrastructure Capability**

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	The NEAF capability would comprise a platform and associated promotion, support, training and standardisation.
	
	Platform: ecoacoustics data is big and this is why existing data collectors are not making their datasets available online: one recorder can easily collect 2TB per annum. The existing open ecoacoustics projects already have in excess of 1 PD of data. The following figures represent estimates based on our partners needs:
	
	• Web servers to provide web frontend and web API interfaces to data
	• 10PD of hot data storage
	• HPC for data (call) analysis using AI deep learning tools (BirdNet and Google Perch)
	• Citizen science services for data validation
	• Raw data ingest facilities:
	    ○ Upload services – interfaces and APIs
	    ○ Manual data ingest from SD cards
	    ○ Streamed data ingest from sensors
	• Analysed data egest into downstream data services including:
	    ○ Data export to ALA, BDR and other biodiversity databases
	    ○ Data export to downstream processing services including Ecocommons and ARDC Planet interfaces
	    ○ TERN and other partner facilities
	    ○ Stakeholder web sites and reporting
	
	Promotion, support, training and standardisation: the facility would be promoted to data producers and data consumers, including using co-design to ensure users needs are met, production of support and training materials including face to face and online workshops (we have successfully done this in the past) and the development and adoption of standardised monitoring and data protocols.
	
	The Medium Term Goals
	
	The medium terms goals of the facility are to:
	
	• Collect, unite and share disparate data sets to create a fauna observatory (FAIR data), from state governments, Parks Australia, DCCEEW, Bush Heritage Australia, Australian Wildlife Conservancy, BirdLife Australia.
	• Analyse data to provide fauna call data for monitoring, modelling, reporting and research and to make the analysed data easily available for researchers and other users
	• Generate and curate long term monitoring datasets enabling understanding of long-term changes associated with environmental change
	• Development and adoption of standards and protocols for acoustic monitoring

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	• Development and provision of support and training materials **Impacted Research Communities** The following research communities would be impacted: • University researchers interested in biology, ecology, environmental monitoring, conservation management, ecoacoustics and computer science • Government and NGOs undertaking monitoring and research on their lands • ALA, TERN, ARDC • Public, schools, university students and citizen scientists • First Nations communities **The Timeframe** We propose to establish the facility in 2027 with an initial duration of 4 years
133_ Roadmap Survey_ Maximilien Desservettaz	No response to question 35 submitted.
134_Roadmap Survey_ Clare Murphy	The world urgently needs to slow the progression of climate change. To this end, Australia recently set emissions reduction targets to reach 43% of 2005 levels by 2030 and net zero by 2050[1]. Much of the focus of abatement strategies has been on reducing carbon dioxide emissions, since these have the greatest long-term impact on climate[2]. However, methane (CH_4) has a higher global warming potential (28–36 times that of carbon dioxide over a 100-year period[2]) and with its shorter atmospheric lifetime of ~12.4 years, provides the opportunity for emissions reductions to have a faster impact on global temperatures[3]. Thus, in October 2022, Australia joined the Global Methane Pledge - a voluntary commitment with 122 signatories, working collectively to reduce global methane emissions across all sectors by at least 30% below 2020 levels by 2030[4]. A significant barrier to progress is that our ability to estimate methane emissions has uncertainties that are often greater than reductions expected from the mitigation strategies being trialled[5]. It has been shown that inventory methods underestimate emissions from cattle by at least 33%[6] and from wastewater treatment plants by 50%[7] whilst over-estimating emissions from landfills by 30%[8]. At a current price of $35 per tonne this uncertainty represents a large financial risk to Australian businesses. Understanding anthropogenic emissions on a regional scale can be further complicated by natural emissions (such as those from bushfires and wetlands), which are poorly characterised and subject to potential positive feedback loops for climate warming[9, 10]. The crux of the problem is that currently Australia cannot meet its emission reduction goals without: 1. A better understanding of its current methane emissions

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	2. Better tools to validate the effectiveness of sectorial interventions and the veracity of emissions reductions claimed under abatement schemes. A roadmap has been proposed to address these issues: https://www.superpowerinstitute.com.au/work/national-emissions-monitoring-roadmap **REFERENCES** 1. Australian Government Department of Industry Science Energy and Resources. 2022.; 2. Intergovernmental Panel on Climate, C. 2023, Cambridge: Cambridge University Press. ; 3. Balcombe, P., et al., Environmental Science: Processes & Impacts, 2018. 20(10): p. 1323-1339. ; 4. The Hon Chris Bowen MP Minister for Climate Change and Energy, A.j.G.M. Pledge, Editor. 2022. 5. Saunois, M., et al., Earth Syst. Sci. Data, 2020. 12(3): p. 1561-1623. ; 6. Vechi, N.T., J. Mellqvist, and C. Scheutz, Agriculture, Ecosystems & Environment, 2022. 330: p. 107885. ; 7. Moore, D.P., et al., Environmental Science & Technology, 2023. 57(10): p. 4082-4090. ; 8. De la Cruz, F.B., et al., Environmental Science & Technology, 2016. 50(17): p. 9432-9441. 9. Peng, S., et al., Nature, 2022. 612(7940): p. 477-482. ; 10. Pitman, A.J., G.T. Narisma, and J. McAneney, Climatic Change, 2007. 84(3-4): p. 383-401.
135_Roadmap Survey_ University of Newcastle	No response to question 35 submitted.
136_Roadmap Survey_ Ross Wilkinson	No response to question 35 submitted.
137_Roadmap Survey_ Australian National Fabrication Facility Ltd	**Large concepts requires future looking strategies** The novel initiatives in the previous NRI roadmap offered great potential but lacked the necessary restructuring for viable delivery. Aspirational visions, such as those of the step-changes in the previous Roadmap, should be matched with longitudinal strategies including increased funding, timelines and talent development to match the scale of the vision. These step-changes may not always fit within existing NCRIS projects and so it is critical that they be funded separately from the Business as usual of the current envied system. Some of the new initiatives that have been advocated for by our community include; • Small scale manufacturing of compound semiconductors (pilot line flexifab capable of servicing numerous clients). While this could be considered a step beyond research infrastructure, it could well be considered 'development' infrastructure. 1-3 years • Clinical trial scale med-tech device manufacturing to move medtech companies towards larger private investment. 1-3 years

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	• Si28 sovereign manufacturing capability to support the development of Quantum technologies on shore. 2 years • Expansion of precision machining capabilities including for precision optics. DSTG have invested heavily in this area and we see this growing as more applications become available. Ongoing • Talent development for non-research roles in the industries being seeded by NRI investment. These include technician roles, technically literate business development and operations staff. Ongoing • Materials discovery, testing and qualification facilities to accelerate the introduction of new materials with specific functionalities. 3-5 years Details on these concepts can be provided as needed.
138_ Roadmap Survey_ Claus Christophersen	No response to question 35 submitted.
139_Roadmap Survey_ Stephen Garton	Culture is often overlooked as a vital area in social cohesion which underpins national resilience. The digital infrastructure needs of the HASS, Arts and Culture industries has been sadly neglected in government policy and the creation of research infrastructure. Researchers in these disciplines need well funding digital access to the collections of major museum and library institutions. Researchers in these areas are increasingly reliant on good digital data-base and web presentation tools and the lack of agreed data base platforms in these fields is undermining our capacity to tell our national stories to a wider public. We have been working closely with Sydney Informatics Hub (SIH) to solve some of these issues but have a national framework to make collections nationally available and tools for researchers in this field to share common resources and platforms is vital. Importantly many of the projects in these fields are designed to produce material that should be available to the wider community in perpetuity so attention to digital archiving and preservation of digital data is a sadly neglected part of our national infrastructure
140_Roadmap Survey_ Geoscience Australia	Building on the outcomes of the NCRIS-supported scoping study, there is a clear need for NRI that supports environmental prediction and forecasting – particularly in relation to terrestrial and coastal ecosystems for which there is much less support than for oceanic and atmospheric domains. The ability for the research community to support Australia's adaptation to the impacts of climate change under a range of scenarios, including for key industries such as agriculture and financial services, is critical but will depend on integration of efforts and capabilities across climate, landscape science, social science, and economic modelling disciplines. This will require a major 'step up' from current approaches which focus on monitoring the current and past state of the environment, shifting to an approach where the best available climate forecasts are integrated with deep understanding of the likely/probably evolutions in landscapes and ecosystems. This will require national investment and coordination, including support for the development of new infrastructure such as new datasets, new digital ecosystem models, and greater integration of climate projection products with other datasets. A robust national 'Digital Twin' of our lands and coasts that is 'climate smart' would be a cornerstone element. Careful consideration should be given to how to leverage (and not duplicate) Australian Government operational capabilities (such as those provided by the Bureau of Meteorology and Geoscience Australia) and complement them with NRI-targeted funding that fills gaps and supports integration.

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	Government, industry and private stakeholders are placing a greater reliance on Earth Observation data for a range of uses including environmental, commercial and defence. Each year, new remote sensors are launched by various international partners, which Australia benefits from through strategic partnerships, such as Landsat Next and the Copernicus Program. Funding a national data repository for science missions to complement the existing NCI hosted Copernicus Australasia Regional Data Hub and the future Indo-Pacific Data Hub would allow a greater focus on R&D missions and would allow for a greater number of datasets with greater data volumes to be exploited. The NRI-funded hub would ensure the datasets are analysis-ready, interoperable and accessible. Connecting the land and sea domains is integral to maintaining research capability where investment is required in the ground infrastructure (observing equipment), digital systems and architecture for data archiving and standardisation, as well as data dissemination. An example of this is the Coastal Research Infrastructure Initiative (yet to be funded).
141_Roadmap Survey_ Samuel Green	No response to question 35 submitted.
142_Roadmap Survey_ Jonathan Danon	Along with countless others across the country, I strongly support a new NCRIS for Magnetic Resonance (MR) in Australia. MR is an indispensable capability and a cornerstone of molecular/biomolecular/chemical/materials analysis with applications across quantum computing, chemical synthesis, environmental monitoring, natural product discovery, drug discovery and development, forensic and health studies, to name just a few. It is widely accepted that Australia's fragmented MR infrastucture currently lags far behind the US, Europe, and most of Asia. There is an urgent need for widespread maintenance and infrastructure upgrades. An NCRIS capability is the perfect medium through which this can be achieved, from economic, scientific, industrial, and commercial perspectives. Coordination of a national MR network and capability through NCRIS will enable to maintain, upgrade, and leverage existing MR infrastructure, provide access to researchers across the country, maximise return on investment, safeguard capability, and ensure that Australia’s research community can continue to produce world-leading scientific and/or industrial outcomes.
143_ Roadmap Survey_ Zoe Loh	Australia currently does not have a genuine national facility for measuring the essential climate variables in the atmosphere that the Global Climate Observing System identifies as fundamental and critical for climate adaptation and mitigation planning. CSIRO, in collaboration with the Australian Bureau of Meteorology and some universities undertakes some of this work, but it is currently inadequate to address the nation's needs in planning for the transition to net zero and adapting to the committed warming. A national scale, spatially distributed network of atmospheric observing stations, positioned to cover Australia's main ecosystem types and regions of large greenhouse gas emissions coupled to atmospheric modelling techniques could produce routine estimates of continental and regional scale greenhouse gas emissions at annual and monthly time resolution. As a priority, this would address CO2 and methane, but could also be leveraged to monitor nitrous oxide, and other climatically relevant species. Key to the success of this facility would be a central calibration facility and standardised quality assurance procedures along with a data

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	centre for processing and computing fluxes from the atmospheric data. I would expect that development of such infrastructure to take 5-7 years to scale up across the continent, with key new observational sites implemented within the first few years and a gradual scale up over time.
144_Roadmap Survey_ Australian Structural Biology Computing	**AI and HPC in Biomolecular Science** AI and HPC are transforming biomolecular science, with breakthroughs in structural biology enabling accurate protein modelling and de novo protein design. These advances are driving progress across medicine, biotechnology, agriculture, and engineering. As the field evolves toward integrative multi-omics and the development of powerful biological foundation models, robust computational infrastructure is rapidly becoming indispensable. Deep Learning style computing relies heavily on resource-intensive computing powered predominantly by NVIDIA GPUs which Australian HPC Infrastructure is currently ill equipped to handle. Australia's existing HPC resources fall far short of the demands posed by rapidly advancing biomolecular AI technologies. Currently Tier 1 and Tier 2 infrastructure can not adequately support even small-scale research, let alone the training of a single protein model. Sovereign capability remains limited, and commercial platforms are prohibitively expensive and often restrict access during peak demand. To safeguard strategic research and intellectual property, Australia must strengthen resilience against global market and policy fluctuations. Targeted investment in AI-capable HPC is therefore essential to maintain scientific competitiveness, accelerate biomolecular research, and foster meaningful translational and industry partnerships. Australia faces several infrastructure bottlenecks and should prioritize funding the following areas: • Computational Power: AI-driven structural biology requires significant GPU resources that are currently scarce in Australia. Many structural biology tools require hours of GPU use for a single inference. Investing in infrastructure that can be continually upgraded or expanded is crucial to keep pace with the rapid evolution of these technologies. • Fast Storage: Large-scale biological AI depends on vast datasets, making fast storage vital for efficiency. Rapid data access reduces the time GPUs sit idle, lowering costs and maximising hardware utilisation. This accelerates AI workflows and ensures more can be achieved with the same GPU resources. • Democratised Access: Limited availability of computing resources across institutions hinders collaboration and slows critical research progress, with only a few institutions able to access suitable hardware. This not only inflates costs for existing funded projects but also impedes the adoption and training of AI-driven methods in Australia, placing the nation at a global disadvantage. A coordinated national strategy integrating Tier 1 and Tier 2 infrastructure hubs will reduce duplication, streamline support, and optimise hardware utilisation. • Training: AI in structural biology has emerged rapidly, leaving many researchers unprepared. There is a pressing need for training in AI-driven modelling, data management, and computational workflows. Infrastructure availability is the first step, but hands-on practice is essential to develop expertise and drive innovation. Specialised tools and pipelines tailored to Australian needs will spur

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	partnerships with startups and industry, while distributed training pipelines and dedicated support teams will democratise adoption, future-proof national research capabilities, and maximise returns on infrastructure investment. Equipping a broad range of researchers with these skills will have far-reaching benefits, from designing climate-resilient crops to creating novel therapeutics for emerging pathogens. **Medium-Term Goals (2–5 Years)** • Build Sovereign Capability: Mitigate reliance on overseas providers by establishing local infrastructure that safeguards sensitive research and IP. • Accelerate Translational Research: Foster collaborations between academia, startups, and industry to develop next-generation therapeutics, agricultural solutions, and bioengineering applications. • Future-Proof National Research: Ensure that HPC capacity can scale with the advent of more advanced AI models (e.g., biological foundation models, integrative multi-omics). • Impacted Research Communities • Biological and Medical Sciences: From vaccine design, disease research and personalised medicine. • Agriculture and Environmental Studies: Breeding climate-resilient crops and managing ecological challenges. • Biotechnology and Engineering: Developing new enzymes, materials, and industrial processes. • Cross-Disciplinary Endeavours: Integrating AI expertise into bioinformatics, genomics, chemistry. **Timeframe for Establishment** Australia needs to begin upgrading its HPC capacity immediately to remain competitive. We already lag behind both Europe and the US and many countries in Asia in supporting biomolecular AI. Within three years, fundamental infrastructure upgrades should be in place, with five years as a horizon for more comprehensive adoption, training programs, and industry collaboration. AI and HPC are transforming structural biology and influencing a host of disciplines and industries, yet Australia’s infrastructure is falling behind. Enhancing computational capacity, data management, and workforce training is crucial for maintaining a competitive edge, bolster sovereign capability, protect intellectual property, and catalyse new partnerships. A well-coordinated national strategy will establish Australia as a global leader in AI-driven biomolecular science, and by strengthening our AI HPC capabilities over the next few years, Australia can secure a leadership position in AI-driven biomolecular science, delivering tangible benefits across academia, industry, and the broader economy, including pressing challenges in human health, agriculture, and biotechnology. Data from early adopters shows that this technology delivers a strong return on investment, highlighting its transformative impact and reinforcing the case for broader adoption. (see https://australian-structural-biology-computing.github.io/website/ for the more).
145_Roadmap Survey_ Open Access Australasia	No response to question 35 submitted.

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146_Roadmap Survey_ Hanshenh Chen	No response to question 35 submitted.
147_Roadmap Survey_ Mark Adams	In addition to its oft touted 'biodiversity crisis' (the extinction of named species), Australia has a largely-unacknowledged and far greater biodiversity predicament, one which can only be properly addressed by national-level collaboration and co-ordination. For many decades the nation has directed considerable resources into documenting (e.g. Fauna/Flora/Fungi/Algae/Zoological Catalogue of Australia series) and sharing biodiversity knowledge (e.g. the Atlas of Living Australia), plus identifying and protecting vulnerable species and habitats (e.g. via the Environment Protection and Biodiversity Conservation Act and the state wildlife agencies). The harsh reality behind this façade of 'best practice' is that much of this effort is wasteful and misguided, since we are largely ignorant of even the most fundamental knowledge required to intelligently undertake these endeavours i.e. an adequately-comprehensive inventory of our native species. In truth most of the nation's biodiversity remains 'dark' to us. To quote the Australian Biological Resources Study (ABRS 2025) ……. "Australia is one of only 17 mega-diverse countries in the world, with a rich and unique biodiversity. An estimated eight percent of the world's plants and animals are Australian, yet only a fraction of these species are known to science. It is estimated that 75 percent of Australia's biodiversity remains to be discovered and described." This so-called 'taxonomic impediment' is the nation's primary stumbling block to our ability to intelligently manage, conserve, and sensibly exploit our biological diversity (Environment Australia, 1998) and represents the nation's most serious biodiversity 'crisis'. Historically, most of the Australia's zoological and botanical collections have been held, cared for, and studied by the various state/territory-funded museums of natural history and herbaria. Unfortunately, many of these regionally-funded institutions have suffered declines in the numbers of the collection managers and researchers/curators who together have traditionally made up a significant proportion of the taxonomists working to discover and describe (name) our native species. Unfortunately, state-funded natural history museums and herbaria typically operate under multiple limitations that hinder their ability to work in the national interest. Often anomalously placed in inappropriate state government departments (SAM is in the Department for the Arts!), they are frequently pressured to focus on their own region (whereas most taxonomically-chaotic organismal groups occur across multiple states), are usually run by boards/trustees/departments that lack understanding of or interest in the national biodiversity crisis, have ongoing public gallery/outreach obligations that attract immediate community approval (whereas biodiversity discovery provides longer-term benefits that tend to remain 'hidden' to the community), and have great difficulty attracting outside funding for pure taxonomic research. To put the current biodiversity predicament in perspective, it will take over 1000 years to produce a moderately-comprehensive inventory of all of Australia's native species at the current rate of species description (e.g. 626 species named in 2022; ~320,000 species already

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	named (Chapman 2009), these being only ~25% of the estimated total number). In the attachment notes I have further explored the many inadequacies of our existing capability for biodiversity discovery, the reasons we need a substantial national investment in taxonomic research, and the relevance of molecular datasets and how to optimize their taxonomic value. The 2026 NRI roadmap offers an ideal opportunity to demonstrate we really are a ‘clever country’ by (a) publicly acknowledging the depth and consequences of Australia’s taxonomic impediment, and (b) including strategies and funding that prioritize biodiversity discovery into the future. I have included below nine specific recommendations on how to optimize any national investment in biodiversity discovery. 1. Properly fund the Australian Biological Resources Study (suggestion – $20 million annually, indexed for inflation) 2. Provide ring-fenced funding support for all state/territory Natural History Museums & Herbaria across all areas underpinning biodiversity discovery, namely collection care, facilitating researcher access to both tissue and voucher collections, carrying out and publishing taxonomic revisions, and undertaking field surveys to acquire taxonomic vouchers plus their associated frozen tissues 3. Nominate all Australian tissue collections as a national resource and provide infrastructure funding to maintain and replace ultra-cold freezers 4. Facilitate the networking of all state/territory Natural History Museums & Herbaria to minimize duplication of field collection and taxonomic effort, and to coordinate access to tissue collections 5. Undertake a contemporary survey of Australia’s taxonomic capacity to identify areas of major deficiency 6. Fund a specialized open access journal for the rapid publication of taxonomic revisions on Australia’s biota 7. Establish and fund a national commitment to discover and name all Australian species of vertebrate and flowering plant within the next decade 8. Include in that commitment targeted funding for comprehensive molecular datasets (e.g. SNPs) for all problematic genera within the above-mentioned groups, explicitly linked to a companion taxonomic revision 9. Liaise with the peak body groups ‘Society of Australian Systematic Biologists’ and ‘Taxonomy Australia’ to create programs for achieving the above-mentioned goals and to mentor a new generation of taxonomists **Cited** • ABRS (2025) https://www.dcceew.gov.au/science-research/abrs • Environment Australia (1998) https://www.dcceew.gov.au/science-research/abrs/publications/darwin • Chapman AD (2009) Numbers of Living Species in Australia and the World, 2nd edition. Report, ABRS, Canberra.

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148_ Roadmap Survey_ Caitlin Moore	Better investment in, and support for, research infrastructure operational staff. One of the biggest challenges we face in running RI is keeping skilled staff employed, especially when competing with more desirable contract conditions from industry. If we could offer better, mid-term job security, this problem could be mitigated.
149_Roadmap Survey_ Research & Prototype Foundry - The University of Sydney	No response to question 35 submitted.
150_Roadmap Survey_ National Drug Discovery Centre, WEHI	Australia's medical research sector consistently produces world-class discoveries, yet many fail to progress beyond early stages due to a lack of accessible translational infrastructure. This gap between fundamental research and clinical application represents a significant loss of potential health and economic benefits for the nation. We propose growing an enhanced nationwide network of interconnected translational research capabilities. This network would build upon existing facilities like the National Drug Discovery Centre (NDDC), MedChem Australia and the Queensland Drug Discovery Alliance (QDDA) and expand to create a comprehensive, accessible ecosystem for translational research. Key components would include high-throughput screening and fragment screening facilities, biophysical characterisation facilities, advanced computational infrastructure for AI-driven drug discovery, medicinal chemistry and lead optimisation laboratories, preclinical testing facilities, and regulatory affairs and clinical trial design support. These facilities would be strategically distributed across Australia to leverage regional expertise, with each site staffed by highly skilled specialists. **Medium-term Goals** 1. Accelerate the translation of at least ten promising Australian discoveries into clinical candidates within ten years 2. Attract increased international investment in Australian biotech and pharmaceutical sectors 3. Create a sustainable pipeline of skilled professionals in translational research **Impacted Research Communities** This infrastructure would benefit a wide range of research communities, including: • Academic researchers in life sciences and medicine • Medical Research Institutes • Biotechnology and pharmaceutical companies • Public health organizations

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	• Clinical researchers and healthcare providers We advocate for a phased establishment over 3-5 years, commencing with planning, and initial funding allocation. TIA would be an appropriate coordinating body for this initiative, given its established role in overseeing national research infrastructure and its expertise in facilitating collaborative research across the therapeutic development pipeline. **Long-term Funding and Accessibility** To ensure the success and sustainability of this initiative, we propose: 1. A dedicated long-term government funding mechanism with sufficient runway to establish sustainability (15+ years) 2. Merit-based access to facilities 3. Subsidised access for high-potential projects from academic and early-stage biotech sectors 4. Implementation of a revenue-sharing mechanism that ensures a portion of the commercial success derived from the network's resources is reinvested into the infrastructure. By investing in this enhanced translational research network, Australia can significantly improve its capacity to convert scientific discoveries into real-world health and economic benefits, positioning the nation as a global leader in medical innovation and pandemic preparedness.
151_Roadmap Survey_ Australian Genome Foundry at Macquarie University	Building large scale fermentation infrastructure (1000L and upwards) is too risky for traditional funding sources, so requires government intervention to de-risk these infrastructure ventures. Synthetic biology and biotechnology startup progress will be hindered (or will move overseas) without access to these shared facilities or de-risked options for funding these facilities.
152_Roadmap Survey_ Briardo Llorente	No response to question 35 submitted.
153_Roadmap Survey_ Tom Honeyman	Outcome 6 of the NDRI strategy (NDRI “maximised by openly available research software tools”) suggests that research software should be recognised as critical NDRI. Targeted investment in research software engineering capability (as proposed) will help to lift data intensive NDRI, but still leaves a gap in that broader aim of recognition and visibility, especially in areas not traditionally served by existing NDRI investment. And more broadly realised visibility and useability of software is still needed by Australian researchers (DOI: 10.5281/zenodo.7340033). A “Software Sustainability Institute” (following the UK, and now US equivalent) would provide a national-level capability for that broader aim of recognition, and to address the visibility, shaping and sustainability concerns where the production is distributed across the nation rather than in a specific domain. Software isn’t an domain or institution-bound activity. Such a change can only be achieved through

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	leadership and advocacy at a national level. The SSI in the UK runs advocacy/policy analysis, consultancy, community building and training activities as BAU, and hosts funded change activities as challenges are identified. They were critical in the maturation of the (separate but connected) research software engineering movement in the UK. They've been doing it for a decade and have given UK a world leading position in research software and research software engineering. I propose that a scoping study, conducted for the department as an early part of the roadmap. A suitable consultant with a good understanding of the Australia research software and NDRI landscape could investigate the viability of setting up a new capability to perform this function, as well as more fully articulate the desire for such a capability. Such a capability could host change activities. For instance, right now, in addition to their BAU, the UK SSI are running a fixed-period research software maintenance fund, and a specific program addressing software needs in the social sciences. Over 10 years, they've run a great variety of programs. In an Australian context, suitable change activities might include those given the ARDC's National Agenda for Research Software (mentioned in the NDRI Strategy, DOI: 10.5281/zenodo.4940273, which I was the primary author of). The draft Agenda (DOI: 10.5281/zenodo.4940274) contains more detail on specific activities, to which I would also add the following as potential change activities: • A mirror of Software Heritage (an archive of the world's open source software code) positioned next to Tier 1 HPC for research purposes. Software Heritage is a place that already preserves most of the openly developed research software produced in Australia, and is supported by UNESCO (https://www.unesco.org/en/articles/softwareheritageorg-unesco-and-inria-open-archive-digital-age). • Programs to assist research intensive organisations in better tracking of software used and created by their research staff. Possibilities include maturing policy and/or infrastructure. An approach taken in the US is establishing Open Source Program Offices (https://sloan.org/programs/digital-technology/ospo-loi). An OSPO for NCRIS might also be a possibility. • A research software infra-scope as proposed in DOI:10.5281/zenodo.8404846 (alongside several other suggestions to make software more visible). This is a publication monitoring capability to reveal the tools used in specific disciplines through mentions of software in papers. It can reveal commonly used tools and newly invented ones. A catalogue of software tools by discipline based on use rather than curation could be developed. • A recurrent survey of the size and nature of the workforce producing software for the benefit of researchers, repeating and improving on the one conducted in 2022 (DOI:10.5281/zenodo.6335998). Such detail may help to surface suitable targets for NDRI software engineering capabilities, and forms a measure for tracking change. • A cross-NDRI forum for careers in research software, and/or application of software engineering practices for research software infrastructure. Even a cross NCRIS visiting software fellows scheme to foster connections.

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	Such a capability would naturally benefit the domains where software production is highest, but which is under-represented as a target of NCRIS investment: Computer Science and Engineering, Mathematics and Statistics, Physics and Digital Humanities are domains with strengths in computational methods development. They are the more common by estimates of production of software arising from public research funding, but software is actually produced in every domain of research (DOI:10.5281/zenodo.10530615). A structural constraint makes support for this kind of software harder to surface when asking one research community to articulate support for a different research community: software produced these “method making” domains is used by researchers in other domains, and so is less readily recognised by software-using research communities as a need (it is just assumed to be available and supported). Because of this, a scoping study which seeks to gather measures of support between these communities, as well as a careful assessment of possible change activities that might underpin a new capability and a roadmap for establishment, would be a sensible first step for the Roadmap for an NDRI landscape that is maximising openly available software tools. And such a scoping activity can comfortably run in parallel to specific investments in software engineering capability to bolster existing NCRIS facilities, especially those that are more domain focussed.
154_Roadmap Survey_ TERN Australia	Despite the achievements and reputation of our environmental science researchers, our abilities to simulate ecosystem functions and predict how they might respond to future disturbances remain quite immature. This is an area of environmental science where all countries are struggling, mainly because it lies at the intersection of the biological, physical, chemical and data sciences, and few programs of sufficient scale exist to support such collaboration. To advance this area of science, Australia must find a way to engage scientists of diverse abilities using innovative digital approaches. The Environmental Futures Lab (EF-lab) is proposed as the catalyst for realising this ambition. It is anticipated EF-lab could receive project governance oversight from NEESFF - the National Earth and Environment Scientific Facilities Forum, providing incubation, training and translation services. In the ECRI space, EF-lab would sit alongside and complement ACCESS-NRI, which provides climate scenarios based on use of research infrastructure comprising coupled models. The community serviced by and contributing to EF-lab would be: • model developers working on best-practice multi-domain model development and integration to minimise uncertainties • field ecologists and theoreticians playing key roles in conceptualisation and validation activities to build and extend prediction capabilities • environmental planners and regulators guiding the work toward critical information gaps and prediction needs and thereby contributing to focused research questions • policy makers and researchers defining prediction parameters • policy and decision-makers seeking and developing solutions to complex questions • technical experts working on system-of-systems interoperability.

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	Examples of forecasting innovation outcomes are: 1. Predicting impacts of future fire regimes. 2. Predicting effects of interventions for preventing extinction of endangered species. 3. Predicting changes in vital soil nutrients and plant carbon in response to climate change. 4. Analysing interactions among climate change and the threatening processes of invasive species, fire regimes and habitat loss. 5. Predicting ecosystem change under cumulative impacts of development. Transformation of forecasts into a rigorous, scientific endeavour has only recently been made possible through: • observing capacity of operational satellites from which Australia acquires data streams • the long term national observing projects covering land, bedrock to atmosphere, coasts and oceans • ubiquitous and cost-efficient cloud computing and data storage • high-performance computing for modelling of complex, dynamic systems • machine learning and AI for mining of large quantities of data. Data and a range of analytic tools from existing NCRIS-enabled research infrastructure projects provide a low-risk foundation for building and operating the EF-lab. EF-lab is nevertheless a new capability because existing capabilities lack environmental prediction expertise, in either their own domain areas or synthesised across domains. They also lack delivery into new scales (the very large and very small) and incorporation of new processes, such as dynamic evolution, for addressing national challenges. The build stage for EF-lab would be 12 months during which time, governance, business processes, partner agreements, employment, data sharing agreements, licences, QA/QC systems, engagement plan, working groups and similar would be established alongside completion of arrangements for: a) Data access b) Data as a Service (DaaS) c) Modelling frameworks d) Client applications e) Community consultation
155_Roadmap Survey_ ACCESS-NRI	No response to question 35 submitted.
156_Roadmap Survey_ Cloud Business Transformation	Proposed National Infrastructure Capability: A Dedicated AI-Optimized Supercomputing Network 1. The Need

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	Australia's existing high-performance computing (HPC) systems—such as NCI's Gadi and Pawsey's Setonix—are world-class for traditional computational science. However, AI research and large-scale data analytics are expanding at such a rapid pace that these facilities will soon be insufficient to meet national demands. Complex domains (e.g., genomics, climate modeling, energy systems, defence analytics, advanced manufacturing) increasingly require AI-specific infrastructure featuring dense GPU/accelerator capacity and specialized data pipelines. Global competitors (e.g., the US, EU, China) are investing heavily in AI-focused supercomputers and moving toward exascale compute. Without a major national-level upgrade—tailored to AI and data-intensive workloads—Australian researchers and industry risk losing competitiveness, and the nation's sovereignty over critical technological capabilities could be compromised. 2. Proposed Infrastructure Capability We propose establishing a National AI-Optimized Supercomputing Network—a coordinated set of HPC facilities across Australia, specifically geared toward AI. This network would: • Scale Up GPU/Accelerator Resources • Provide a large, shared pool of next-generation GPU or specialized AI accelerators (e.g., H100/200 GPUs, TPUs, FPGAs) capable of training complex machine learning models, handling extensive simulation data, and performing near-real-time analytics. • Integrate Secure Data and Compute • Ensure end-to-end security and data sovereignty by locating infrastructure onshore, with advanced governance frameworks for sensitive data in areas such as health, defence, and Indigenous knowledge systems. • Adopt a Modular, Distributed Architecture • Link existing HPC sites (NCI, Pawsey, CSIRO clusters) and new specialized nodes, enabling flexible expansion and resilience. This modular design would also facilitate synergy with emerging technologies (quantum accelerators, neuromorphic chips) in the future. • Support Collaborative Tools and Training • Provide user-friendly AI development platforms, robust data-sharing protocols, and HPC training programs, so that both academia and industry can effectively use these high-end resources. 3. Medium-Term Goals Accelerate Research & Innovation (2–3 Years): • Enable large-scale AI initiatives—for instance, national language models, advanced climate projections, or multiomics-based personalized medicine—that currently exceed domestic compute capacity. Nurture cross-disciplinary collaborations via uniform data standards and HPC services.

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	Position Australia as a Global AI Leader (3–5 Years): • Host exascale-class or near-exascale compute specifically tuned for machine learning and data analytics, ensuring Australian researchers keep pace with international best. • Attract top AI talent globally by offering unique computational capabilities, thereby stimulating the local innovation ecosystem. Secure Sovereign Capability (5+ Years): • Safeguard national security interests and critical infrastructure by reducing reliance on foreign cloud providers for advanced AI training. • Provide consistent upgrade paths to remain at the forefront of HPC technology. 4. Impacted Research Communities • Health & Medical: Genomics, drug discovery, imaging, and personalized healthcare. • Environment & Climate: High-resolution climate modeling, disaster prediction, biodiversity genomics. • Energy & Resources: Mineral exploration, renewable integration, net-zero transition modeling. • Defence & National Security: Secure data processing, autonomous systems, threat intelligence. • Manufacturing & Industry: Robotics, generative design, supply-chain optimization. • Social Sciences & Humanities: Language preservation, large-scale data analysis of cultural and social dynamics. 5. Timeframe for Establishment • Immediate Planning (Within 12 Months): Finalize design parameters, governance models, and funding structure in coordination with existing HPC centers and stakeholders. • Phased Deployment (2–5 Years): Incrementally expand HPC nodes, add specialized GPU/accelerator clusters, and implement secure data exchange frameworks. • Continuous Upgrades (5+ Years): Plan for exascale or post-exascale expansions to maintain global competitiveness.
157_Roadmap Survey_ Andrew Klekociuk	New infrastructure is needed to adequately assess continent-scale atmospheric changes relevant to the environment, human health and national interests in water and food security. The priority needed infrastructure includes 1. A long-term fixed site in the western tropical region (e.g. an upgrade to previous facilities used by BoM at Gunn Point, Darwin, or a new site in Western Australia) to monitor pollutants from the northern hemisphere and to assist in verifying Australia’s greenhouse emissions; 2. Upgrade of Australia’s icebreaker RSV Nuyina to conduct long-term atmospheric measurements over the Southern Ocean, to monitor change relevant to the health of the Southern Ocean relevant to the climate, water and food security of Australia (as outlined in the Australian Antarctic Science Decadal Strategy 2025-

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	2035 https://www.antarctica.gov.au/site/assets/files/70227/australian_antarctic_science_decadal_strategy_2025-2035). Both of these facilities should be established within 5 years. The scale and type of infrastructure is beyond the scope of an individual research group or institute to fund and maintain, and requires coordination across government, research units and industry to successfully achieve.
159_Roadmap Survey_ National Imaging Facility	**Skin imaging** Australia is advancing the development of a National Targeted Skin Cancer Screening Program, with Commonwealth funding allocated for a roadmap. Given the country's high melanoma rates, significant healthcare burden, and the potential for groundbreaking research, integrating skin imaging into national research infrastructure presents a timely and necessary opportunity. A national skin imaging capability would enable the development of reliable, evidence-based solutions to transform early melanoma detection, leading to: • Improved early diagnosis, reducing mortality rates and alleviating the financial strain on the healthcare system. • Enhanced treatment testing, supporting pharmaceutical advancements and personalized medicine. • Standardized screening processes, ensuring equitable access to high-quality skin cancer detection across diverse populations. • Greater diagnostic accuracy, minimizing both underdiagnosis (missed melanomas) and overdiagnosis (unnecessary procedures). **Digital biobanking** Digital population biobanks integrate genetic, imaging, phenotypic, and health data across a population sample, offering researchers secure access under ethical and legal guidelines. The UK Biobank, which has collected anonymized data from 500,000 individuals since 2004, is a prime example of how large-scale, well-structured biobanking can drive breakthroughs in epidemiology, genomics, public health, clinical research, and personalized medicine. Australian researchers are major users of this data, yet no equivalent national resource exists locally. To address this gap, a staged approach could be taken. The first step is strengthening national coordination and standardization of biobanking data, including digital and physical biobanks. Currently, biobank collections across Australia operate in a fragmented manner, limiting discoverability and accessibility. A coordinated, community-driven strategy would streamline standards and practices, making existing datasets more accessible and reusable through a central digital platform. This would improve efficiency and create a foundation for a more comprehensive system. The second step is investing in a national prospective population biobank, similar to the UK Biobank, which would provide essential normative data to support medical and health research. Such a resource would enhance the productivity of existing studies while enabling new research that is currently unfeasible. A national digital biobank would be an important national research infrastructure and is well aligned to the NCRIS principles. The NCRIS Health Group, and other NCRIS partners, would provide existing capacity and capability

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	platforms to deliver this resource. An Australian national digital biobank would be an important data source for understanding unique Australian health challenges including those associated with a changing environment, indigenous health, and an ageing population.
160_Roadmap Survey_ Christopher Watson	Here I would refer the panel to the application submitted for the CoastRI capability given it is uncertain if this will obtain support in the short term future. There is support from diverse research communities around the need for this capability - if it doesn't get federal support in the coming budget, I would advocate strongly for reconsideration in future NRI deliberations.
161_Roadmap Survey_ Australian Plant Phenomics Network	Digital plant phenotyping, backed by automation, robotics and digital infrastructure can accelerate delivery of solutions to Australia's climate, food security, environmental protection and rural social challenges, including for indigenous knowledge systems. NCRIS recognised this in the 2021 Roadmap and 2023 funding rounds creating an initial national network of human and physical plant phenotyping infrastructure unique in the world. Developments in scientific thinking and sensor capability now offer opportunities to expand and/or focus on important sub-segments to further accelerate impact and delivery. **Expansion of Plant to Sensor Facilities** 'Plant to Sensor' phenotyping systems, such as The Plant Accelerator® at the University of Adelaide, provide high capacity 3-dimensional phenotyping of the plants unobtainable by other systems. As there is heavy demand for such systems, replication in other states would add capacity to meet expanding demand. Goal: Expand studies into the phenotype to genotype drivers of crop morphology accelerating new crop variety development and delivery. Impacted Research Communities: Academic researchers, Breeding companies. Timeframe: 2028-2033 **Specialised plant disease research phenotyping capability** With changing climates and management, crop diseases are growing in number and importance in Australia causing significant losses in yields and threatening food security. Breakthrough plant disease research requires compartmented, climate controlled and quarantine level facilities to cultivate, infect, assess and measure damage. Dedicated field machinery is also needed to avoid cross contamination with other trials. Goal: Address growing endemic and exotic crop disease threats by proactive accelerated phenotyping driven research. Impacted Research Communities: Crop pathologists, Breeding companies, Crop protection companies. Timeframe: 2028 - 2038

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	Enhance satellite-based phenotyping capabilities The number and resolution of Earth Observation (EO) satellites is rapidly increasing. By 2030, precision may rival some current ground-based sensors, increasing options for space-based phenotyping. Dedicated investment in tasking and acquisition of existing of Australian imagery plus building analytical pipelines will accelerate bridging between different scale. Medium Term Goal: Identify new means to measure crop signatures from space to provide farmers and researchers with new predictive tools and models at dramatically lower cost. Impacted Research Communities: Academic researchers, EO companies, breeding companies, farm advisors, farmers. Timeframe: 2028-2038 **Expand national root phenotyping capabilities** Roots are fundamental for nutrient, water and carbon storage efficacy yet root phenotyping remains challenging and under-developed. An integrated national root phenotyping facility should be developed by; a) Expansions of the existing Lysimeter Center at Charles Sturt University (CSU) to include all major national soil types. b) Expanding the medium scale Rhizobox systems at ANU and c) Exploit new remote technologies to boost field-based phenotyping. This will create a world-leading facility capable of studying continent-wide soil/plant interactions in a world leading infrastructure. Goal: Accelerate understanding of the link between above and below ground plant phenotypes in near real-world environments, update climate prediction models and strengthen soil management, health and conservation . Impacted Research Communities: Australia wide ag researchers, soil additive companies, fertilizers companies, IPPC researchers, crop modelers, farmers. Timeframe: 2028 – 2038 **Future climate facilities** To prepare farmer for future climates, it is necessary to mimic future climate and field conditions which can capture complex genotype x environment x inter-plant interactions and grow the larger numbers of plants necessary for breeding. Larger mesocosm greenhouses, including real soil substrates will enable the growth of crop plants in field like environments. Real world simulation facilities such as the EucFACE facility (https://eucface.hieresearch.org/) at UWS, or the AgFace (https://www.piccc.org.au/news/agface-research-news-new-phase) experiment should also be considered for investment.

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	Goal: Breed crops ready for future climates today. Impacted Research Communities: Academic researchers, breeding companies, farmer groups. Timeframe: 2028-2038 **Monitoring of climate gases in agricultural systems.** Green-house gases need to be monitored in Ag systems to confirm research outcomes and meet national reporting requirements. While conducted in extensive grazing environment via TERN and the Zero Net Emissions CRC, monitoring in cropping environment is limited. Based on current understanding, future monitoring must take into account the carbon balance across the crop and atmosphere and soil, as soil is the major long-term store of both carbon and nitrogen. New instrumentation offers ways to do this more efficiently and accurately. Goal: Provide accurate full cycle monitoring of climate gas across major Australian agro-ecological zones and help design management practices with both adapt and mitigate climate change. Impacted Research Communities: Government, Academic researchers, ZNE-CRC, IPPC international researchers. Timeframe: 2028-2050 **Monitoring of Biodiversity in Agriculture Systems.** Biodiversity health in Agriculture systems is increasingly being monitored, both to assess impact, seek mitigations and support remediation efforts. New photographic, acoustic and e-DNA techniques could be used to build monitor status and assess proposed strategies. Goal: To monitor biodiversity in major cropping environments to assess health and develop mitigation and remediation strategies. Impacted Research Communities: Academic, UN, Government Timeframe: 2028-2038
162_Roadmap Survey_ Australian Academy of Technological Sciences & Engineering	No response to question 35 submitted.
163_Roadmap Survey_ Charles Perkins Centre	I have emphasised a greater emphasis on basic research in Australia. One area I have observed to be under threat for example is research on model systems like flies, rodents and larger animals. Such research has been at the cornerstone of all major advances in the past but there is a now a view by some that it is no longer necessary. While the pace of discovery has increased over the past two decades we still have a long way to go before we can make a lasting impression on the health of Australians in a truly sustainable way. Now is not the time

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	to abandon investment in the very thing that has got us to where we are today. Sometimes we have to reward curiosity even if the immediate rewards are difficult to see.
164_Roadmap Survey_ Australian Mathematical Sciences Institute	**Case for a National Residential Research Institute for the Mathematical Sciences** Mathematical sciences drive innovation across all disciplines, delivering benefits through enhanced employability, job creation, economic mobility, productivity and global competitiveness. Fundamental research in mathematics underpins these applications, fostering breakthroughs that advance applied mathematics and related fields including AI, space science, quantum computing, cybersecurity, optimisation and environmental modelling (e.g., weather, finance, epidemics, and natural disasters). Despite their critical role in scientific discovery and technological advancement, Australia lags behind nations such as the United States, the United Kingdom and China, which have invested significantly in dedicated mathematical sciences research institutes. These institutes provide essential infrastructure for research, innovation and workforce development. To close this gap, AMSI proposes a National Residential Research Institute, with MATRIX ideally positioned to lead its development. MATRIX is a residential research institute that serves as a facilitator and incubator for emerging disciplines reliant on mathematical sciences, and key hub where academic and industry leaders collaborate to solve complex problems and drive innovation. Since 2016, MATRIX has hosted 88 research programs, attracting 2,100 scientists from 47 counties. However, it operates on limited funding, supported by five Australian universities and the Simons Foundation, with only one ARC LIEF grant providing national funding. Sustained national investment and dedicated research infrastructure are essential to maintain and expand its impact. The need for such an institute is clear. Both the Decadal Plan for Mathematical Sciences (2016-2025) and the Australian Academy of Technological Sciences and Engineering (ATSE) Pre-Budget Submission (2025-26) highlight the importance of strengthening Australia’s mathematical research capabilities. A MATRIX-led institute will: • Serve as a hub to connect academia, industry, and government • Drive collaborative research to address national challenges • Develop a highly skilled workforce to meet future demand. • Position Australia as a global leader in mathematical sciences. Funding will enable MATRIX to expand its operations, increase research programs and strengthen international collaborations. A significant portion of the investment will support large-scale research initiatives that address global challenges, enhancing Australia's role in solving critical scientific and technological issues. A National Residential Research Institute for the Mathematical Sciences will provide vital research capabilities across multiple sectors, driving innovation, industry collaboration, and economic growth. By advancing research and strengthening partnerships between

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	academia, industry and government, this investment will ensure Australia remains globally competitive and well-prepared for emerging challenges and opportunities.
165_Roadmap Survey_ Women in Mathematics Special Interest Group (WIMSIG)	**Identified need** Investment in research infrastructure is essential for all areas of science, including mathematics. The most effective infrastructure for developing mathematical expertise, solving critical problems and building collaborative networks is a national residential research institute for mathematics. This aligns with the NCRIS objective of strengthening Australia's research capabilities. **Proposed Infrastructure – A Residential National Research Institute for Mathematics** Research in mathematics primarily relies upon deep collaborative interactions, which are most effectively carried out in person. Unlike many other sciences, mathematics does not require large and expensive pieces of equipment. Globally, residential research institutes are recognised as crucial components of the research ecosystem in mathematics. The Isaac Newton Institute for Mathematical Sciences in the UK, founded 1992, is a prime example. In the US, the Simons Laufer Mathematical Sciences Institute (SLMath, founded 1982) and the Institute for Pure and Applied Mathematics (IPAM, founded 2000) are renowned for their contributions to advancing mathematical research. Canada has the Banff International Research Station for Mathematical Innovation and Discovery (BIRS, founded 2003), and the New Zealand Mathematics Research Institute was founded in 1995. In Australia's region, many well-funded mathematical research institutes have been established in recent years. China opened the Shanghai Institute for Mathematics and Interdisciplinary Sciences in early 2024, and the Beijing Institute of Mathematical Sciences and Applications was founded in 2021. Despite the essential foundational role of mathematics, dedicated government funding to support research infrastructure for mathematics in Australia remains absent. The urgent need for a sustainably-funded national institute for mathematics in Australia is identified in the Decadal Plan for the Mathematical Sciences (2016-2025) and reinforced by ATSE's Pre-Budget Submission 2025-6. WIMSIG highlights that a residential research institute in Australia has a key role to play in addressing the under-representation of women in mathematics. The programs of such an institute bring world-leading experts to Australia for deep collaborations. This is critically important to Australian researchers with caregiving responsibilities, who often cannot travel internationally, and so miss out on opportunities to participate in programs at overseas research institutes. Since women are more likely to be caregivers of both children and elderly parents, such restrictions on overseas travel are a long-term challenge for many women in mathematics. Further, for those women who are caring for children, residential institutes can and do support full participation in programs by providing on-site childcare. Repairing the leaky pipeline of women in mathematics requires robust support for students and early-career researchers. A national research institute is a key facilitator of career-building mentoring and collaboration between established researchers and those who are starting out. This includes activities targeted at women in mathematics, such as the "Connections for Women" program which runs at the

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	start of every semester at SLMath in the US, or collaborative workshops like "Women in Operator Algebras" at BIRS in Canada. The visibility of a national research institute with women actively involved in its strategic initiatives also encourages female school students to continue to engage in STEM disciplines. To build a secure and resilient Australia, we need to invest in the talents of our entire population. **Timeframe** Timeframe Dedicated funding for a national research institute in mathematics should commence in 2026. Australia is already far behind the rest of the world in this kind of investment and our security and resilience depend on catching up.
166_Roadmap Survey_ RMIT University	No response to question 35 submitted.
167_Roadmap Survey_ Language Data Commons of Australia (LDaCA)	Australia is a massively multilingual country, in one of the world's most linguistically diverse regions. More than a quarter of the world's languages are spoken in Australia and its region. However, while Australia's rich linguistic heritage is well documented, much of this data remains inaccessible or under-utilised due to barriers to accessing collections, as well as a lack of access to tools and skills for analysing that data at scale. The goal of the Language Data Commons of Australia (LDaCA) is to work collaboratively with researchers, communities and institutions to develop an integrated national infrastructure for analysing spoken, written, signed and multimodal text collections at scale in order to open up the social and economic possibilities of Australia's rich linguistic and cultural heritage for impactful research with significant benefits to the nation. LDaCA is making available valuable collections of national significance more findable, accessible, interoperable and reusable (FAIR) while adhering to CARE principles; developing the computational infrastructure and tools required to analyse language collections at scale; and increasing the awareness and capabilities of researchers in applying digital methods to language and text data. LDaCA was initiated in 2021 as a national infrastructure project that supports language work and language research through co-investment from the Australian Research Data Commons (ARDC). LDaCA is led by the University of Queensland (UQ) in partnership with AARNet, ANU, Batchelor Institute of Indigenous Tertiary Education, First Languages Australia, Queensland University of Technology, University of Melbourne, University of Sydney, and University of Western Australia. As a key focus is on Indigenous languages, LDaCA adheres to an Indigenous Data Governance framework developed in collaboration with ARDC and IDN. The first two phases of LDaCA (2021-2024: HIR001; 2024-2028: HIR024) have focused on: 1) Developing the social and technical foundations for a national, distributed archival repository for language and text data, including: (a) shared, collaborative data governance and standards framework; (b) shared data access, authentication and authorisation policies, procedures and processes; (c) shared technical infrastructure for curation and storage of language data; and(d) shared technical infrastructure for collection and annotation of language data. 2) Continuing to secure vulnerable and nationally significant collections of Aboriginal and Torres Strait Islander languages, Indigenous languages in Australia's Pacific region, (varieties of) Australian English and migrant languages, and sign languages of Australia and

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	its region. 3) Developing a national data portal for accessing and repurposing language and text data of significance to researchers and communities, both that is held in GLAM institutions, including libraries, archives and museums, as well as language and text collections held in other distributed archival repositories. 4) Establishing an integrated analytics environment for researchers to create fully described, reproducible research on written, spoken, signed and multimodal text in accordance with Open Science principles, and aligned with community expectations for research of practical benefit. 5) Providing training and develop resources for researchers and communities to support best practice in accessing, analysing and archiving language and text data in line with FAIR and CARE principles. Key existing components of the Language Data Commons of Australia (LDaCA) include: the PILARS protocols for sustainable research infrastructure, RO-Crate as an implementation-neutral approach to describing data, and the ONI data portal for making data available to human and machine agents with appropriate security controls for data capture and access, and LDaCA Analytics for language and text analysis, including the Australian Text Analytics Platform (ATAP) and the Language Technology and Data Analysis Lab (LADAL). These components of the LDaCA infrastructure have been purposefully designed to be maximally adaptable to a wide range of research disciplines across HASS and beyond. The goal of LDaCA in the next NCRIS Roadmap is to provide the technical architecture and collaborative blueprint for an integrated HASS NCRIS capability, and to contribute to the technical foundations of an Indigenous NCRIS capability in line with Indigenous Data Governance principles and community expectations. The LDaCA social and technical framework provides for the provision of key cross-cutting services for research with unstructured text data for HASS and Indigenous researchers and communities, including: 1) National Research Data Archival Repository 2) Unstructured Data Transformation and Repurposing 3) AI-Enabled Text Data Capture and Research Workflows 4) Text Analytics: Tools and Workbenches 5) Digital Methods Training and Research Support 6) Data and Infrastructure Governance From 2028-2032, LDaCA anticipates working in collaboration with other key partners to develop an integrated HASS NCRIS capability, as well as contributing to the establishment of an Indigenous NCRIS capability as appropriate. This will involve working strategically with other focus areas of the ARDC-supported HASS and Indigenous Research Data Commons and other relevant existing NCRIS capabilities in order to leverage existing and emerging relationships with key partners, including GLAM (e.g. AIATSIS, NSLA), community organisations (e.g. Language Centres), private industry (e.g. Amazon, Google), international research infrastructures (e.g. CLARIN, DARIAH), as well as relevant Government and NGO stakeholders. This will require a significant new investment that capitalises on investments to date in the

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	development of LDaCA and other focus areas of the HASS and Indigenous RDC.
168_ Roadmap Survey_ Sarah Brough	I have identified several requirements which come directly from the decadal plan for Australian astronomy 2026–2035 which is currently in the final stages of development following many rounds of Australian astronomy community consultation over the last 18 months prior to publication by the Australian Academy of Science mid-2025.
169_Roadmap Survey_ Phenomics Australia	**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

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	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

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	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.
170_Roadmap Survey_ Sarah Kirkpatrick	No response to question 35 submitted.
171_Roadmap Survey_ GLAM Peak	No response to question 35 submitted.
172_Roadmap Survey_ Isabel Ceron	**IDENTIFIED NEED AND PROPOSED CAPABILITY** There is a critical gap in Australia's research infrastructure ecosystem: a well-funded, well-governed bridge between researcher communities and NCRIS. Australia has dedicated funding streams for research (ARC) and research infrastructure (NCRIS), however opportunities to align their goals remain fragmented. The solution would not involve a new NCRIS facility, but a targeted funding stream to support decadal planning for research infrastructure. **CURRENT STATE** Currently, the function of aligning the two sectors is addressed through a variety of dispersed mechanisms: • National Science and Research Priorities. These are recognised in the NCRIS funding process as a criterion for funding allocation. While they effectively ensure that NCRIS investments align with government priorities, they do not fully address the need for direct engagement with researcher communities to understand their specific infrastructure needs. • Academies' Decadal Plans. These plans outline research directions but are not comprehensive across all disciplines. Only some decadal plans directly or comprehensively address research infrastructure needs (see examples at the end). NCRIS funding does not formally recognise Decadal Plans as a criterion for investment. • ARC funding process. The ARC process requires researchers to consider existing infrastructure before proposing new investments (this is great), but it lacks a formal mechanism to incorporate emerging infrastructure needs from ARC-supported research projects, meaning these needs are not systematically considered in NCRIS funding decisions. • Ad hoc consultations by NCRIS facilities. Some NCRIS facilities are attempting to bridge this gap by directly consulting researchers, but NCRIS are not structured as representative, community-based organisations. This approach risks reinforcing existing biases, overlooking disciplines and bypassing established processes and institutions, such as Academies, that are designed to provide sector-wide input.

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	• NCRIS 2026 Roadmap consultation. This very consultation is another attempt to bridge the research-infrastructure gap, which highlights the need for a more structured, systematic approach. **PROPOSED SOLUTION** The renewed emphasis of the NCRIS programme on user-focused infrastructure (NDRI Strategy) is commendable, but without a formal mechanism to connect the research and research infrastructure sectors, alignment remains ad hoc. Given the scale and long-term nature of infrastructure investments, ad hoc alignment is insufficient. A robust, comprehensive mechanism is required to create alignment between NCRIS and ARC priorities. The proposed solution is decadal research infrastructure planning. Rather than creating new NCRIS facilities, a dedicated funding stream could be established to support structured, discipline-spanning Decadal Planning for Research Infrastructure where it is already occurring (e.g. Academies). This funding should be allocated to: • Develop decadal plans for research infrastructure covering all domains • Engage established community-based research associations, ensuring representation for EMCRs and unaffiliated researchers • Integrate NCRIS facilities into the process to ensure that infrastructure perspectives are included • Collectively consider the infrastructure needs of ARC projects Finally, these decadal plans will need to be empowered by making their priorities a recognised funding criterion for NCRIS investment **MEDIUM-TERM GOALS & TIMEFRAME** • By release of the 2026 Roadmap: Include Decadal infrastructure planning among the criteria for NCRIS investment and allocate funding for their development. • Within 2 years: Publish the first round of infrastructure decadal plans. **IMPACTED RESEARCH COMMUNITIES** This initiative would benefit all research communities by ensuring that research infrastructure investments are demand-driven and strategically aligned, rather than fragmented or reactive. **EXEMPLARS:** • Decadal Plan for Social Science Research Infrastructure 2024-33 (Academy of the Social Sciences) • Decadal Plan for Australian Earth System Science 2024–2033 (Australian Academy of Science)
173_Roadmap Survey_ Australian Proteome	I propose enhancements to existing capabilities in the field of Glycobiology. I am a Senior Research Scientist at the Australian Proteome Analysis Facility (APAF) situated in Macquarie University, Sydney, NSW. APAF is a NCRIS funded analytical facility functioning under

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Analysis Facility (APAF)	Bioplatforms Australia. I take care of Glycomics and Glycoproteomics in APAF and I work with Prof. Nicole Packer who is one of the founding members and currently is its Academic Lead. I graduated my PhD in 2023 from the Institute for Biomedicine and Glycomics, Griffith University, QLD. Glycobiology is the study of complex carbohydrates which exist as glycoproteins, glycolipids, proteoglycans, free oligosaccharides found in human and other mammalian milk, etc. Glycosylation is involved in almost every cellular activity such as communication, pathogen adhesion, cell death, replication etc. There is strong evidence of dysregulated glycosylation during healthy and diseases conditions. The field has gained extraordinary momentum over the last decade especially in the analytical domain with famous mass spectrometry-based "Proteomics" researcher inclining towards studying glycoproteins. Top pharma companies have invested in the glycan analysis since at least 50% of the drugs available today are glycosylated and these sugars play an important role in drug potency. The Noble Prize for Chemistry (2022) was awarded to Prof. Carolyn Bertozzi from Stanford University for her work on visualising glycans in living cells using click chemistry. The importance of glycobiology has been recognised worldwide both in industrial and academic space due to its tremendous scope for transitional science. According to the Canadian Glycomics Network (GlycoNet https://canadianglycomics.ca/), 5 out of the top 10 selling drugs in the world are glycosylated and have generated a combined revenue of USD $58 billion in 2020 alone. By 2028, the global market for glycosylated drugs is set to reach USD $257 billion. Europe, Canada and Japan (http://www.jcgg.jp/index_e.html) have already started investing heavily on the glycobiology market. The recent report published by CarboMet (European Carbohydrate Network) outlays a roadmap for glycoscience in Europe for 2030 (https://glycopedia.eu/IMG/pdf/glyco_2030_a_roadmap_for_glycoscience_in_europe). Medium term goal: A strong limitation in glycobiology is the complexity of studying glycoconjugates and lack of trained personal to handle costly analytical instruments such as mass spectrometers, downstream data analysis etc. There is a strong need for establishing a state-of-the-art "Australian Glycomics Research and Translation Network" to galvanise extraordinary talents in glycobiology spread across different states of our country. Glycobiologists in Australia are spread out as plant glycobiologists, bacterial glycobiologists and researchers focussing on glycans in humans and other mammalian model organisms. However, the analytical techniques used by different groups of researchers are the same and is slightly modified according to their samples. There is a strong need for knowledge transfer among the researchers as a first step to break free of the prevalent notion that "studying sugars is difficult". Easy access of analytical techniques could make way for larger community of researchers to include glycobiology in their research especially in multi-omics projects. Impacted research communities: Investing in glycobiology based infrastructure is highly valuable in research focussing on diagnostics, therapeutics, quality control in drug manufacturing, cancer research, precision medicine for allergy such as red-meat allergy, rheumatoid arthritis, plant biotechnology, sea weeds-based therapeutics, to name a few. Establishing this network could bring together analytical experts provide a one stop solution for training emerging scientists and technical experts. This network could bridge the gap between industry and academia by providing expert advice to industries. A Glycomics foundry can be included for easing the research needs of glycobiology based startups.

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174_Roadmap Survey_ EMBL Australia	**Pilot program / leveraging existing collaborations** EMBL Australia is highly motivated to help shape Australia's NRI workforce. We are working on 'AusRISE', a pilot program focused on developing a highly skilled NRI workforce that is globally connected and supported by robust career recognition and accreditation frameworks. A conceptually solid proposal has been developed and is currently circulating with potential collaborators for a second round of input from existing NCRIS capabilities, Australian research institutions and global delivery partners. AusRISE will leverage international blueprints and experience to support NRI skills development at multiple levels. The pilot program is focused on talent development across three streams, investing in human capabilities and transferable skills that enable the NRI workforce to collaborate, innovate and co-create opportunities both nationally and internationally. • AusRISE Leaders: for established RI leaders, senior researchers / managers • AusRISE Fellows: for emerging RI scientists / engineers with deep tech knowledge and interest in service provision to support research (postdocs level) • AusRISE Next Gen: life science students from across Australia (PhD students) Collectively, the AusRISE community and their support networks will leverage the investment into national RI to future-proof Australia's digital RI ecosystem. The successful implementation of AusRISE will integrate workforce development efforts and lead to multi-faceted outcomes, including international knowledge exchange, talent attraction, training blueprints, innovative digital RI technologies and champions for ongoing NRI workforce development. **Expected outcomes** AusRISE aims to launch a network of globally connected RI scientists and provide a valuable testbed for future career pathways and tailored RI training frameworks in Australia. Its implementation across diverse career levels aims to create a strong and integrated talent pipeline, well-equipped to tackle current and future technological and societal challenges. Short- and medium-term outcomes (3-4 years) will include: • Australia's first RI Fellowship scheme, providing a concept and testbed for scalable NRI skills development • Recruitment of top talent into specialised NRI domains • New digital technologies / methods developed by AusRISE Fellows at their respective hosts • Activation of an integrated and globally connected network of established NRI leaders, emerging talent and life science students interested in digital RI careers.

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	Long- term outcomes (5+ years): • Critical insights, templates and learnings to inform a national RI career recognition and accreditation framework • RI scientists equipped to embark on a variety of career pathways across academia and industry • Curated content that could be turned into 'NCRIS micro-credentials' • An opportunity to showcase Australia's NRI capability on the global stage **Approach** • Highly collaborative and complementary to other initiatives such as Technicians Commitment: • User-centric and contextualised to the Australian research and innovation system • Scalable and transferable frameworks • Reciprocal and consolidated effort to global knowledge management of RI operations, capacity building and policy development **Stewardship** EMBL and EMBL Australia are well positioned to provide stewardship for AusRISE. With the mandate of maximising Australia's associate membership to EMBL in Europe, EMBL Australia has a track record of international talent recruitment, research collaboration and training delivery, and is deeply networked into leading Universities and medical research institutes across Australia, evident in the EMBL Australia Partner Laboratory Network. Locally, EMBL Australia formally joined the NCRIS Health Group in 2024 and currently works in close collaboration with its members (BPA, NIF, TIA, Phenomics Australia, PHRN) as well as as other NCRIS capabilities including Microscopy Australia and ANSTO. Internationally, AusRISE will leverage EMBL's experience and demonstrated success in developing RI competencies for scientists (e.g. ARISE) and co-developing tailored capacity strengthening projects for different regions (e.g. CABANA, a project that accelerated the implementation of data-driven biology in Latin America through sustainable capacity-building focused on three challenges – communicable disease, sustainable food production, and protection of biodiversity). https://competency.ebi.ac.uk/framework/arise/0.5 https://www.embl.org/training/arise2/ https://cabana.online/ About EMBL Australia EMBL Australia is a national life science capability with a vision to build the next generation of Australian life science leaders. We attract talented scientists and provide training and long-term support for emerging research and technology leaders to build their careers at

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	Australia's top universities and medical research institutes. https://www.emblaustralia.org/about/embl-australia-partner-laboratory-network/ https://www.emblaustralia.org/events-speakers/ EMBL Australia is a partner of the European Molecular Biology Laboratory (EMBL). We work towards better integration and participation of national scientific communities into EMBL science, infrastructure and training programs. https://www.emblaustralia.org/infrastructure/access-embl-scientific-services/ Monash University is the lead agent for EMBL Australia and hosts the EMBL Australia Secretariat. EMBL Australia is part of the NCRIS Health Group. https://www.emblaustralia.org/infrastructure/ncris-health-group/ https://www.emblaustralia.org/wp-content/uploads/2024/10/Approved_NCRIS-Health-Group-flyer-1-1.pdf
175_Roadmap Survey_ Carole Jackson	My comments here are as a private consultant working with AAL and ANU for future Gravitational Wave opportunities. I am sure ANU and AAL will respond here with the scale of NRI that they will wish to have included.
176_Roadmap Survey_ Macquarie University	Macquarie University's researchers suggest two domains for new capabilities and their infrastructure requirements, as follows: **Artificial Intelligence** Large language models (LLMs) are a rapidly growing branch of Generative AI technologies that are transforming many areas and are of special interest in language and linguistic research. Most leading LLMs developed by private industry are made available in a limited capacity as black-box technologies: very useful for many applications but limited as research tools because of restrictions on how they can be accessed. LLMs are very large-scale technologies that need to be developed and trained with enormous amounts of data. The type and scale of resources required to deploy these technologies as open-source research tools exceed the capabilities of most universities and research centres but could be developed on a national scale with the right kind of infrastructure. Open-source independent LLMs would offer tremendous advantages to researchers not currently available through proprietary systems and would be a very valuable asset to the Australian research community, across a host of disciplines. Other new AI capabilities, or capabilities to be enhanced, include: • Access to frontier models in AI platforms, as these are expensive for universities. • Next-generation capability set and talent pipeline such as AI scientists and AI engineers to enable AI4Science and AI4Tech. • In general, Macquarie's researchers consider many facets of AI to be an emerging research trend with critical infrastructure

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	requirements: AI for science (AI4Science), such as AI for medicine, AI for biology, AI for human science. Also, AI for technologies (AI4Tech), such as AI4Finance, AI4Bio, AI4Health, AI4Care, AI4Arts, AI4City, AI4Transport, AI4Agriculture, AI4Security, etc. **Glycoscience** Glycoscience and its analysis is increasingly recognised as crucially important in many aspects of health and disease, environment and sustainability. See Glyco 2030: A Roadmap for Glycoscience in Europe https://euroglyco.com/ .To enable this glycoscience to occur, new mass spectrometric, array, modelling and enzyme technologies are proliferating in the literature , indicating that these capabilities are essentials for research advance and innovation across many projects in many research areas.
177_Roadmap Survey_ AustLII Foundation Limited	The current 2021 Roadmap does not identify specific non-STEM initiatives such as legal research infrastructure that should qualify for investment under the NRI principles. It is submitted that Law should be explicitly recognised as a research infrastructure priority. In a society based on the rule of law, citizens must have the right to be able to access the law for free. Citizens are bound by the law and have private and public rights under the law, and so for the rule of law to be effective they must be able to know what the law is, and what it means. Free access to legal information is a human right. AustLII provides free access to public legal information to everyone, irrespective of their means. This supports the effective functioning of the rule of law and provides essential legal information that is necessary for all Australians. The legal system underpins all aspects of the Australian economy and society. Improved access to the law and increased capacity to research and understand it will impact upon: the Australian economy, the social structures and well-being of all Australians, and Australian responses to critical national and international challenges. In one sense 'the law' constitutes an entity distinct from other research domains, being neither STEM nor HASS. Because of the authoritative status of primary legal information infrastructure (legislation, case law, treaties, etc.) the law is essential to the operation of all other aspects of the economy and society, and effective and efficient access to the law, by means as sophisticated as possible should constitute a significant part of the NRI Strategic Framework. National investment in legal research infrastructure will help to maximise the contributions of the research and development system to foster innovation, economic development, national security, social wellbeing and environmental sustainability. Legal Information, as critical national research infrastructure, supports and enables effective translation of research outcomes into law and policy for the benefit of Australia, including provision of an essential sovereign capability. Providing free and anonymous access to the law eliminates barriers for those undertaking research. In advocating for the recognition of Law as a National Research Infrastructure priority it is suggested that this would add a new dimension to NRI and that it would assist the research ecosystem to drive innovation, develop the digital economy, and facilitate world leading research by underpinning the structures that enable civil society and democratic government. It ensures that the legal system operates effectively and efficiently, supports access to justice and helps to enable the rule of law for Australia and internationally.

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	Australia already has a world leading and globally significant legal research infrastructure that should be incorporated into the NRI and funded under NCRIS – the Australasian Legal Information Institute (AustLII), operated by the AustLII Foundation Limited. AustLII is critically important to Australia, supporting the operation of the legal system, ensuring access to justice, providing critical research infrastructure, supporting good public policy, the economy and society and helping to promote Australia's international leadership. AustLII should be funded as National Research Infrastructure because it supports all the NRI Principles and meets the criteria outlined in the NRI Investment Principles. (see attached document for details)
178_Roadmap Survey_ Monash University	To position Australia as a global leader in drug discovery, med tech, and advanced manufacturing, it is essential to develop sovereign capabilities that drive innovation and commercialisation at scale. Continued investment in research infrastructure is key to building the strength and capacity needed to attract partnerships, leverage funding, and foster economic growth. By establishing advanced research networks and facilities in these areas, Australia can enhance its capabilities in emerging technologies, drive breakthroughs in health and manufacturing, and ensure that innovations are rapidly translated into real-world applications. Strengthening these NRIs will not only support scientific advancements but also position Australia to respond to critical global challenges and emerging industries. **Advanced Manufacturing** Advanced Materials Manufacturing Research Infrastructure Network (AMM-RIN): Structural materials are essential for load-bearing capabilities, biomedical materials are crucial for implants, and functional materials enable energy conversion, sensing, and advanced manufacturing solutions. However, Australia faces significant challenges in developing and scaling these materials. Addressing these challenges can be achieved through the establishment of the AMM-RIN as a hub and spoke national model, focusing on the following key areas: • Discovery: Advances in automated materials discovery systems, coupled with large language models (LLMs), present an opportunity to accelerate the discovery of functional and structural material candidates, processed through digital twin models. • Feedstocks: There is a limited ability to scale new engineered materials from laboratory-scale to intermediate kg-to-ton levels, which is essential for commercialisation. Transforming these materials into useful form factors for advanced manufacturing, such as additive manufacturing, is a critical next step. • Advanced Manufacturing: Developing world-class facilities that support various advanced manufacturing processes is a national opportunity. These facilities would foster coordination, reduce fragmentation, and address the current limitations in TRLs. • Testing and Characterisation: There remains a critical gap in assessing the performance, fatigue, and stability of materials under real-world conditions, including in-operandum, controlled, and extreme environments, as well as accelerated testing for larger components or fully functional technologies. • X-ray Characterisation Hub: Australia's local lab-based X-ray facilities, equipped with highly complementary techniques to those offered at national facilities, are well-positioned to enhance national capabilities through closer collaboration and coordination.

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	With targeted investment in technical expertise, research staff, and infrastructure, these facilities could evolve into a national X-ray Characterisation and Technology Hub, serving as a critical hub for X-ray technology R&D (e.g., fabrication, characterisation, and prototyping of energy materials, high-tech materials, and devices). The centre would fill a critical gap in in-situ and specialised X-ray techniques, particularly for reactive diffraction and scattering experiments, which are not currently available at scale. **Drug Discovery, Development and Medtech** Advanced spatial transcriptomics: Spatial transcriptomics platforms, such as 10x Genomics Xenium, enable researchers to map gene expression within tissue with unparalleled molecular, cellular, and spatial imaging data. This is transformative for biomarker discovery, disease profiling, and advancing precision medicine. To support drug discovery and development, Australia needs enhanced computational infrastructure, particularly GPU-based supercomputing capabilities, to manage, integrate, and interpret complex multi-omic datasets efficiently. Digital biobanking: Digital population biobanks integrate genetic, imaging, phenotypic, and health data from broad population samples, giving researchers secure access under strict ethical guidelines. The UK Biobank has demonstrated how well-structured biobanks drive breakthroughs in epidemiology, genomics, public health, clinical research, and personalized medicine. Although Australian researchers rely heavily on this data, no equivalent national resource exists. National coordination and standardisation of biobanking data—both digital and physical—are essential. Fragmented collections hinder access, so a community-driven strategy with common standards and a centralized digital platform is needed. Establishing a national prospective population biobank, similar to the UK Biobank, will provide essential data for medical and health research. National clinical registry: Clinical registries track epidemiology, clinical practice, and outcomes, providing vital benchmarking data for hospitals, clinicians, and policymakers. This supports continuous improvement and reduces low-value care. However, existing registries often suffer from insufficient funding, institutional support, and policy recognition, limiting their potential. A long-term commitment to funding, stronger institutional backing, and formal policy recognition is required, with participation in key clinical registries becoming a standard practice for clinicians and healthcare providers. Skin imaging: Australia is making strides in establishing a National Targeted Skin Cancer Screening Program, with Commonwealth funding allocated for a strategic roadmap. With the country’s high rates of melanoma and its significant healthcare burden, integrating skin imaging into the nation's medtech infrastructure is both timely and crucial. A national skin imaging capability would facilitate the development of reliable, evidence-based solutions for early melanoma detection, improving early diagnosis, testing of treatments, standardized screening, and diagnostic accuracy in clinical settings.
179_Roadmap Survey_ National Imaging Facility Museums Special Interest	In the next 5-10 years, Australia will remain at the front line of accelerating global climate change and environmental degradation, requiring biodiversity monitoring and mitigation efforts to retain ecosystem services and quality of life for our increasing populations. As the repositories of primary biodiversity information, Australian fauna and flora collections – such as museums and natural history

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Group	collections - play a key role in this process. Our biodiversity collections increasingly rely on digital imaging to expand the detail and public availability of their data, using Australia's excellent imaging infrastructure. Computed Tomography (CT), micro-CT, laser/structured light surface scanning, or photogrammetry are now standard tools to digitise museum objects, producing accurate, easily shared specimen representations that are otherwise locked up in collections. In the case of tomographic data, 3D images can even add previously inaccessible information on a specimen's internal structure. 3D imaging represents a step change in Australian biodiversity research through its potential to make critical biodiversity data available to the scientific community. Well curated, updated and accessible 3D datasets are paramount in accurate identification of biodiversity, including invasive species, new or endangered species, contraband natural history objects (e.g., fossils) and assessment of heritage objects (e.g. archaeology). However, this potential cannot be realised without appropriate infrastructure. Unfortunately, critical resourcing shortages currently prevent the sector from developing infrastructures that realise the potential of 3D imaging. Instead, many collections do not control their own data, despite the accelerating growth in 3D-imaging based research. Terabytes of imaging data from disparate, short-term funded initiatives sit on inaccessible hard drives, often in the collections themselves, or on unsuitable storage solutions (e.g., Dropbox). In many cases, researchers use informal ad-hoc permissions to publish 3D data. For example, the US-based MorphoSource platform hosts thousands of 3D object images from Australian natural history collections, but only a fraction of these is controlled by the collections from which they were acquired. As government funding is the chief funding source of these images, the opportunity and economic cost to collections and Australian science is immense. However, an excellent example of how this can work are the well-supported digitisation strategies in the CSIRO National Research Collection of Australia, which has benefitted from substantial investment into data migration, infrastructure and online sharing of images. In a submission to the Academy of Science [1], the National Imaging Museums Special Interest Group outlined the areas in which urgent support is required to mobilise existing and appropriately manage future data, with the following priorities: • Nationally based, centrally supported digital storage infrastructure • Equitably distributed data and metadata curation capacity • Support for well-developed frontline data management • A national Copyright and IP policy framework • Structures to help prioritise and provide equitable access As mostly state-governed institutions historically designed for archival of physical items, Australia's biodiversity collections are neither designed, equipped, nor funded to address such a tremendous emergent task. However, Australia's excellent research infrastructure provides most components for a successful national 3D imaging framework for biodiversity collections (as well as others, like cultural heritage collections). These include

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	• Potential national storage solutions e.g. through NECTAR; • Entities specifically catering to requirements of data curation, platforming, management and coordination, such as the Australian Research Data Commons and National Imaging Facility; • Existing IP and copyright expertise; and • Clear existing federal guidelines for Public Data Policy (e.g., [2]) We therefore call for sustained investment into the priority areas identified above over the next 5-10 years. This would allow the sector to harness existing capabilities to catch up with the digital age, and develop future-proof infrastructure that maximises the use of Australian 3D biodiversity collections. A preferred approach would be through a community of practice to ensure sustainability, and safeguard against obsolescence. This would involve a period of stakeholder consultation to develop implementation frameworks followed by technical implementation (e.g., storage allocation, platform design and deployment, and legal development) and a well-funded adoption initiative (e.g., resourcing of collections to adopt solutions and staff training). [1] Weisbecker V, Fisher N, Goscinski W, Kench P, Keogh S, Melville J, Patalwala D, Peachey T, Rampe M, and Tatarnic N (2023) National Imaging Facility Museums Special Interest Group - Submission to the AAS Accessing Australia's Research Collections stakeholder consultation. Zenodo. doi: https://doi.org/10.5281/zenodo.10776122. [2] Australian Government Department of Finance (2015) Public Data Policy Statement. http://www.dpmc.gov.au/resource-centre/data/australian-government-public-data-policy-statement National Imaging Facility Museums Special Interest Group Assoc. Prof. Vera Weisbecker (Flinders University) Dr Alice Clement (Flinders University) Nicole Fisher (CSIRO National Research Collection of Australia) Dr Scott Hocknull (Queensland Museum) Prof. Scott Keogh (Australian National University) Dr Jane Melville AM (Museums Victoria) Diana Patalwala (University of Western Australia/National Imaging Facility) Thomas Peachey (Australian Museum) Michael Rampe (Macquarie University)

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	Dr Nik Tatarnic (Western Australian Museum) Assoc. Prof. Laura Wilson (Australian National University)
180_Roadmap Survey_ Ray Langenfelds	The views expressed on an individual level in this submission relate to more detailed documents on similar subject matter prepared by 1) CSIRO - Atmospheric Composition and Chemistry Group for DISR's National Science Priorities Conversation Starter in April 2023; accessible at https://consult.industry.gov.au/sciencepriorities1/survey/list and 2) The Superpower Institute as a National Emissions Monitoring Roadmap (NEMR) in November 2023; accessible at https://www.superpowerinstitute.com.au/work/national-emissions-monitoring-roadmap The NEMR document, in particular, provides details of proposed national GHG observing system infrastructure.
181_Roadmap Survey_ Gwenaelle Proust	**Vision and Rationale** The Australian Additive Manufacturing Research Hub (AAMRH) will establish a nationally coordinated, multi-institutional research infrastructure that supports cutting-edge additive manufacturing (AM) research across metals, ceramics, and polymers, covering the entire AM workflow from design, feedstock, manufacturing, heat treatment, surface finishing, machining. AM is revolutionising the manufacturing industry in the fields of aerospace, biomedical, defence, oil and gas, new energy tech and mining, and Australia must develop world-class research capabilities to remain at the forefront of innovation. The National Collaborative Research Infrastructure Strategy (NCRIS) provides an ideal funding framework to support the salaries of highly skilled technical staff required to operate and maintain advanced AM platforms. Furthermore, universities face increasing challenges in funding the capital-intensive equipment and consumables that underpin AM, making an NCRIS-supported network particularly attractive. **Strategic Objectives** • Establish a nationally distributed network of AM facilities, enabling universities to develop areas of specialisation while maintaining a coordinated approach. • Provide researchers and industry partners with access to cutting-edge AM equipment, digital workflows, and advanced characterisation tools. • Support training, skills development, and workforce pipelines to advance Australia's AM expertise. • Foster cross-institutional and international collaborations, leveraging shared infrastructure and expertise. • Strengthen industry engagement to facilitate technology translation and commercialisation. **Benefits** A National AM Research Hub would strengthen Australia’s manufacturing independence, economic resilience, and global leadership in

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	advanced technology. It would drive innovation, job creation, and sustainability, ensuring Australia is at the forefront of the next industrial revolution. It would accelerate AM research & development by facilitating collaboration between universities, industry, and government and supporting cutting-edge research in sustainable materials. It will allow the education and training of Future Engineers & Scientists and boosting Australia's global competitiveness. **Time frame** Many universities have already build some laboratories in the area of advanced manufacturing and therefore there is already some capability that will enable the creation of such capability. This is a long term capability and we will need to adpat with time as progress is made in technology. We need to focus our efforts to support the Australian manufacturing industry. This new NCRIS could be put in place in less than a year given the teams already in place in Australia and their desire to work together to make a difference.
182_ Roadmap Survey_ Peter Innis	No response to question 35 submitted.
183_Roadmap Survey_ MortarCAPS Higher Learning Data Standard	Research administration data is highly fragmented across institutions, funding bodies, and government agencies, making it difficult to track research activity, collaborations, and outcomes over time. The absence of a unified persistent identifier (PID) framework creates inefficiencies in data management, limits interoperability between systems, and restricts the ability of researchers and policymakers to generate insights from national research data. A national PID scheme, developed in collaboration between MortarCAPS Higher Learning Data Standard and the Australian Research Data Commons (ARDC), would provide a structured and interoperable framework to link research administration data at scale. This initiative would enhance data integrity, reduce duplication, and improve the long-term usability of research metadata, driving greater efficiency and impact in research funding, collaboration, and policy decision-making. **Proposed PID Infrastructure Capability** A national research administration PID scheme would: • Establish Unique Identifiers Across the Research Ecosystem • Implement persistent identifiers for researchers, research projects, funding grants, institutional affiliations, and datasets to enable seamless tracking and interoperability. • Align with global PID systems such as ORCID (researchers), DOI (datasets and publications), RAiD (research activities), and ROR (institutional affiliations) while extending their application to research administration records. • Enhance Data Interoperability and Linkage

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	• Create a nationally consistent data structure for research administration that connects funding data, institutional records, and research outputs. • Enable automatic reconciliation of research activity across multiple agencies, institutions, and jurisdictions, reducing administrative burden. • Support AI-Driven Research and Policy Analysis • Improve machine-readability of research administration data, enabling AI-driven insights into funding impact, researcher mobility, and collaboration networks. • Support advanced analytics for tracking research productivity, interdisciplinarity, and global engagement. • Reduce Administrative Overhead and Increase Efficiency • Automate compliance reporting for funding agencies and institutions, reducing manual data reconciliation efforts. • Improve tracking of research career pathways by linking researcher mobility, funding, and publication records over time. **Medium-Term Goals (3–5 Years)** Phase 1 – Infrastructure Design & Pilot Implementation (Years 1–2) • Define a national PID framework aligned with existing global standards (e.g., ORCID, DOI, ROR, RAiD). • Establish technical protocols for integrating PIDs into research administration systems. • Pilot PID adoption within a subset of Australian universities and funding bodies. Phase 2 – National Adoption & Interoperability Expansion (Years 3–5) • Scale implementation across all major research institutions, funding bodies, and government agencies. • Develop automated research impact assessment tools leveraging linked PID data. • Integrate with international research infrastructure (e.g., UKRI, SSHRC Canada). Phase 3 – Global Research Collaboration & Policy Alignment (Year 5+) • Enable cross-border research data interoperability between Australia, Canada, and the UK. • Develop policy frameworks for long-term governance and sustainability of the PID system. • Enhance predictive analytics capabilities to inform national research priorities and funding strategies. **Impacted Research Communities** • Research Administrators & Funding Bodies: Streamlined data management, enhanced reporting, and reduced duplication of effort. • Higher Education Institutions: Improved tracking of research outputs, funding impact, and institutional performance. • Policy Analysts & Government Agencies: Data-driven decision-making on research investment and national innovation strategies.

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	• Data Science & AI Researchers: Enhanced datasets for modelling research networks, collaboration trends, and funding impact. **Timeframe for Establishment** A national research administration PID scheme could be piloted within 12–18 months, with full-scale national adoption targeted within five years. This aligns with ARDC's National Persistent Identifier Strategy, supporting a cohesive, efficient, and research-driven national data infrastructure. By investing in a PID-enabled research administration framework, Australia would establish itself as a leader in interoperable, AI-ready research data, setting a precedent for global best practices in research management and policy.
184_ Roadmap Survey_ Australasian Biospecimen Network Association (ABNA)	Given the national interest in advancing medical products, defence research, and public health, there is a clear need for a new NRI capability dedicated to the strategic development and expansion of biobanks and biological models. The proposed capability should include: 1. National Biobank Approach – An integrated, scalable system to collect, store, and manage biological samples from diverse populations across Australia is essential. This infrastructure should be designed to accommodate the growing needs of precision medicine, genomic research, and public health surveillance. A unified national approach, with clear guidelines on ethics and governance, would significantly enhance this effort. Specifically, a coordinated framework for how ethics committees address biobanks across Australia is needed to ensure consistency, transparency, and trust in the handling of sensitive biological data. Establishing these ethical and governance guidelines would foster collaboration, streamline processes, and ensure that biobanks are managed in accordance with the highest standards of integrity and public accountability. 2. Enhanced Data Infrastructure – Biobanks must be integrated with advanced data management platforms that allow for big data analysis, genomic sequencing, and longitudinal data tracking. These platforms should enable researchers to efficiently access and query large datasets to drive discovery. 3. Research Capacity Expansion – The development of biological models, including organoids, cell lines, and animal models, will be crucial in facilitating therapeutic development and clinical trials. National investment is needed to scale the production and distribution of these models to meet future research demands. 4. Support for Interdisciplinary Research – Biobanks should be integrated with other critical research infrastructure to support interdisciplinary collaborations across fields such as environmental science, neuroscience, and infectious disease research. 5. Workforce Development for Biobankers - Investment in training programs, career pathways, and upskilling initiatives to ensure a skilled workforce capable of managing high-throughput automation, implementing novel technologies/techniques, data science, and regulatory compliance in biobanking. The timeframe for establishing this capability is urgent—within the next 3-5 years, given the rapidly evolving landscape of biomedical research. This infrastructure will serve not only as a foundation for advancing Australian research excellence but also as a key contributor

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	to global health innovation.
185_Roadmap Survey_ Institute for Social Science Research	There are several broader issues surrounding data infrastructure that require future funding and action, including expanding and developing new research infrastructure capabilities. The below comments address some of these broader needs, seen from the disciplinary point of view of the social sciences, but carrying relevance for other research disciplines. **Data discovery in a world full of data** The production and availability of data are rapidly expanding. Within the field of social sciences, the recently published Decadal Plan for Social Science Research infrastructure from the Academy of the Social Sciences in Australia identifies improved data discoverability as one of the key needs for the sector. Numerous data discovery tools have emerged, offering a range of functionalities. However, most of these tools provide only a snapshot view—presenting a selection of information and links compiled at a specific point in time, with occasional updates. Such tools struggle to keep up with the accelerating speed at which new data are generated and made available. By the time they are released, they may already be outdated. This issue applies not only to new data collections and sources but also to the information these tools provide about existing datasets. Without a robust maintenance model, content and links are unlikely to be sufficiently updated. Additionally, many tools lack comprehensiveness, either in the range of data they capture or in the richness of the metadata they provide, while point-in-time nature of these snapshots also contributes to the lack of comprehensiveness. There is therefore a strong case for investing in technology that enables researchers across multiple disciplinary areas to explore the existence, availability, and characteristics of existing data in real time. In the context of the social sciences, this includes providing subject area experts with the data, metadata, and practical information necessary to produce research without having to become experts in state or Commonwealth administrative data systems. Developing such technology will require national infrastructure funding. The Social Science Research Infrastructure Network (SSRIN) project offers a starting point for such an endeavour within the social sciences through its Activity Stream on improving discoverability of public sector social science data. Continued funding would facilitate an automation of the discoverability process implemented in the Activity Stream, and allow for expansion beyond the social sciences. Such dedicated funding could be used more broadly to connect the various NCRIS-funded data discoverability tools and initiatives, ensuring inter-operability and facilitating multidisciplinary collaborations. **Continued data integration initiatives** With the proliferation of data there will be an ongoing need for data integration into the foreseeable future. Within the social sciences context, large-scale data integration initiatives have been implemented by various government agencies – usually statistical agencies, health departments and associated health research units. Other, often smaller-scale, data integration projects, whether of a more strategic or one-off-application basis will have been executed in academia, private business and public service. These potentially numerous data

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	integrations, remain largely hidden from the public domain. Data integration is still a very under-researched field. It poses methodological issues that are often not well understood by social researchers. Data linkage agencies are commonly constrained in understanding the limitations of their work due to their unfamiliarity with some of the source data. Further national investments in data integration are urgently needed to: a) Support better research into, and communication of the quality issues associated with data integration processes, especially repercussions for population representation and uncertainty in estimates. b) Develop good-practice data integration guidelines that target the large data linkage providers as well as the many smaller-scale linkage providers including individual researchers who link data rather ad-hoc for their work. c) To develop training programs in data linkage that teach good practice principles of linking data, and treating arising quality issues. d) To develop online tools and associated administrative models for its use that allows researchers to conduct ad-hoc data integration using their data. The Social Science Research Infrastructure Network (SSRIN) project offers some first steps in this direction in the context of social sciences, through its Activity Stream on improving integrated data usability. Working in close collaboration with the Australian Bureau of Statistics (ABS), this activity will deliver a series of key enhancements to some of the key data assets administered by the ABS and the associated documentation. This involves setting up the technical infrastructure and introducing a set of processes for improved delivery of supporting information. **Infrastructure Needs for Policy and Program Evaluation** Evaluation plays an increasingly critical role in guiding public investment in Australia; thus, ensuring adequate infrastructure for high-quality, system-wide policy assessment is essential for evidence-informed decision-making. Timely access to high-quality, linked administrative data will improve evaluation of large-scale health and social policies and facilitate the development of data-driven decision tools to enable dynamic policy adaptation and simulation based on real-world evidence. In addition, infrastructure that enables real-time data integration will provide opportunities to complement periodic evaluations (the current status quo) with real-time monitoring and feedback loops to allow for timely adjustments to policy and program implementation. This requires investment in digital platforms and data-sharing agreements across sectors and jurisdictions.
186_Roadmap Survey_ Gregory Warr	Both the ACNS and NDF are Landmark rather than National infrastructure facilities insofar as each is one of a small number of such international facilities around the world that house complementary instruments, techniques and expertise. ACNS's suite of instrumentation and the associated expertise of its instrument scientists serves an international as well as the Australian science community through collaborations as well as direct merit-based access applications (user community). Informed decisions about

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	future new and upgraded replacement instrumentation (beamlines) at the ACNS will be more effective if both ACNS scientists and the Australian user community are able to access new and state of the art beamlines not currently available in Australia at comparable facilities around the world (e.g. Oak Ridge National Laboratory, US; Rutherford-Appleton Laboratory UK, Institut Laue-Langevin, France, J-PARC, Japan). Such access is already merit-based through grants of instrument time by facilities, but travel costs can prevent researchers, especially early- and mid- career researchers, from utilising access granted to these facilities, or simply discourage application. Prior to the establishment of ACNS and the operation of OPAL at ANSTO, the Access to Major Facilities Program funded travel for such purposes. It was a critical element in the establishment of an informed community of researchers able to contribute to the design, construction and operation of each new tranche of beamlines, and to take best advantage of the ACNS's facilities. Future developments at ACNS will benefit greatly from a similarly informed and experienced user community, including the next generation of researchers. The NDF provides critical support to experiments at the ACNS through bespoke deuteration of chemical compounds for research that are not commercially available. It is a leader among an international network of such facilities with expertise in biological and chemical deuteration technologies.
188_Roadmap Survey_ The University of Adelaide	National Hubs in South Australia for critical sector South Australia's unique assets offer the opportunity for new NRI capabilities in critical sectors: to evolve necessary infrastructure for net-zero energy, biosecurity, defence & space. A national-scale investment will unify fragmented efforts across the nation. Climate change & geopolitical shifts require scalable solutions in energy & metallurgy (e.g. green iron & metals), agriculture (net-zero, biosecurity), defence (quantum materials, directed energy), & space (ISRU, lunar/Martian geotech). **Proposed Capability** hubs should include: 1. a net-zero energy/green metals catalyst in Whyalla; 2. an agriculture catalyst with co-localised climate chambers & plant phenotyping, imaging & biosecurity (including GMO entomology facilities); 3. semiconductor & quantum materials facilities for defence, USPL & sovereign alloys; 4. an ISRU & geotech lab for lunar/Martian construction & farming for Space. These are all underpinned by nation leading AI-driven platforms for optimisation. **Medium-Term Goals** Over 5-10 years: 1. enhance net-zero energy, climate-resilient farming & biosecurity by 25%;

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	2. develop sovereign quantum materials & USPL for defence; 3. pioneer lunar/Martian ISRU technologies; 4. position Australia as a global exporter of resilience technology. **Impacted Communities** Agricultural scientists, entomologists, defence engineers, space researchers & industry (e.g. BHP, CSIRO) will benefit. Facilities and universities (including regional campuses) & SMEs will drive interdisciplinary innovation at scale through these hubs. **Timeframe** Launch in 2025-2027—funding in 2025, pilot by 2027, full-scale by 2030—aligning with climate & defence priorities. **Context** South Australia's net-zero energy/green metals catalyst/hub would build on Whyalla's green iron investment and be inspired by Germany's Fraunhofer model, requiring national-scale coordination to bridge research-to-market gaps, ensuring leadership in agriculture, defence & space resilience. Other hubs could be modelled on the example below, of what hubs such as this, could look like: **A National Industry Catapult for Green Iron and Green Metals** The global race to net-zero emissions requires radical innovation in carbon-intensive industries like steel & metals production - key contributors to Australia's economy & global CO2 output. A compelling case exists for a new NRI capability—a "Green Metals Catapult"—to drive the development of green iron & low-carbon metals. Modelled on Germany's industrial prowess or the UK's Catapult network, this would meet the urgent need for novel, scalable production capacity, requiring national-level investment beyond the reach of fragmented research efforts. **The Need** Steel & metals production accounts for ~7-9% of global CO2 emissions, largely from coal-reliant blast furnaces. Green iron, produced via hydrogen-based direct reduction (H2-DRI) & green metals (e.g. low-carbon aluminium, copper) hinge on cost-competitive, scalable tech. Challenges include high energy costs, limited renewable integration & nascent supply chains. Australia's research landscape—split across SMEs, academia & industry—lacks the heft to bridge lab breakthroughs to industrial reality. A national capability is critical to unify efforts, de-risk innovation & hit 2030 decarbonisation targets, aligning with global frameworks like the EU Green Deal. **Proposed Infrastructure Capability** The Green Metals Catapult would be a collaborative hub featuring: (1) an H2-DRI pilot plant to refine green iron processes; (2) renewable energy labs for low-carbon smelting (e.g., solar-powered plasma furnaces); (3) a circularity centre to boost scrap recycling; (4) a digital twin platform with AI for real-time optimisation; (5) an innovation arm to translate research into industry growth. Inspired by the UK's High-

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	Value Manufacturing Catapult & Germany's Fraunhofer Institutes, it would link academia, industry & government, accelerating tech deployment. Facilities would test emerging methods like microwave-assisted reduction & bio-char substitution, leveraging Australia's renewable & mineral strengths. **Medium-Term Goals** Over 5-10 years, the Catapult aims to: (1) slash green iron costs by 20-30% via efficiency & scale; (2) create a retrofit blueprint for existing plants; (3) set green metals certification standards; (4) establish Australia as a global exporter of green tech. These align with the EU's Carbon Border Adjustment Mechanism (CBAM) & UK net-zero goals, boosting competitiveness in a carbon-priced world. **Impacted Research Communities** This would unite materials scientists (e.g. developing low-carbon alloys), engineers (e.g. advancing hydrogen electrolysis), energy experts (e.g. integrating tidal/solar power), & economists (e.g. assessing market fit). It would engage top universities (e.g. Adelaide, UNSW, Imperial College), national labs (e.g. CSIRO, UK's NPL) & firms like BHP & Rio Tinto. SMEs would gain access to shared resources, amplifying innovation. **Timeframe** Launch within 2-3 years (2025-2027): funding/site selection in 2025, pilot operations by 2027, full scale by 2030. This syncs with climate deadlines & builds on initiatives like Australia's Whyalla investment (over AUD$1B) & Germany's Hydrogen Strategy. **Justification and Context** The scale—mirroring Germany's €9B hydrogen push or the UK's £1B Catapult network—demands national investment. Reports like the UK's "Net Zero Strategy" (2021) & Germany's "National Hydrogen Strategy" (2020) highlight centralised infrastructure's role in crossing the research-to-market "valley of death." **Conclusion** Only a national effort can deliver the cross-domain coordination & funding needed, enhance existing efforts and secure Australia's industrial future in a dynamic geo-political global security situation across hubs for critical sectors.
189_Roadmap Survey_ Academy of the Social Sciences in Australia	**An Australian Research Infrastructure Ecosystem for the Social Sciences (ARIESS)** Between 2022 and 2024, the Academy of the Social Sciences in Australia worked with partners the ARC Centre of Excellence for Children and Families over the Life Course, the ARC Centre of Excellence in Population Ageing Research, the ARC Centre of Excellence for Automated Decision-Making and Society, the Institute for Social Science Research at the University of Queensland, and the ANU Centre for Social Research and Methods to engage with a broad cross-section of Australia's social science research community in a co-design process

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	to establish common ground on research infrastructure needs and priorities for the future. The result is the Decadal Plan for Social Science Research Infrastructure: 2024-33. Launched in April 2024, this plan outlines three high-level goals, nine priority action areas, and five decision-making principles that represent the consensus view of hundreds of individuals and organisations involved in the sector in Australia. The central element of the plan is a vision for a new, coordinated Australian Research Infrastructure Ecosystem for the Social Sciences–ARIESS–that will: • engage and mobilise key stakeholders from the research, government, community and business sectors in the design, implementation and review of new social science infrastructure initiative • take decisive steps to embed Indigenous Data Take decisive steps to embed Indigenous Data Governance (IDG), Indigenous Data Sovereignty (IDS) and Indigenous Cultural and Intellectual Property (ICIP) goals and aspirations across the ARIESS, in line with the Maiam nayri Wingara Principles and Australia's National Agreement on Closing the Gap. • Establish mechanisms for sectoral cooperation at the national level, to collectively develop or acquire strategic data and analytics assets necessary to tackle urgent national challenges. • Formulate a comprehensive and coordinated sectoral response to Artificial Intelligence and other emerging technologies, across the various components of the ARIESS. The specific actions identified as requirements by the sector are listed in the Decadal Plan document. Amont other priorities, these actions include: • Working with government and research stakeholders to develop national standards for social science research data and metadata, incorporating IDGov and IDSov principles and a suite of social science research vocabularies to promote data linkage • Working with partners to develop a suite of national training datasets and test environments • Working across the humanities, arts and social science sectors, and the galleries, libraries, archives and museums (GLAM) sector to prioritise and support digitization of physical records and other high-value research assets • Promoting and guiding the development of necessary national storage and computational capabilities for secure handling of sensitive data. The ARIESS model is supported by a broad cross-section of the social science research community, including those from government, industry, the community sector and existing national research infrastructure capabilities (in particular, ARDC, PHRN and AURIN). With co-investment from partners matching Federal Government funding, it is envisaged that a new ARIESS capability would engage in a 10-year workplan to support and enable transformative changes across the research ecosystem in ways that enable higher quality research outputs that will be directly beneficial to policy makers, businesses, community organisations and broader society.

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	Discrete investment in Indigenous Research Infrastructure In addition to the ARIESS model outlined here, there is a clear requirement for investment in national-scale research infrastructure to support Indigenous research and Indigenous researchers, as well as those non-Indigenous researchers from HASS and other disciplines who work directly with Aboriginal and Torres Strait Islander people and communities, and with Indigenous data. The Academy recommends that this new infrastructure capability should be built on the successful Improving Indigenous Research Capabilities program supported since 2022 by the ARDC.
190_Roadmap Survey_ Rohan Glover	**The Need:** Determining the age of Australia's groundwater is crucial for developing a national sustainable groundwater management plan. Groundwater hydrologists rely on using chemical tracers to infer the age and movement of water in aquifers and their rate of replenishment. The measurement of these tracers is a critical input into the development of groundwater models that are relied upon by government and industry to support decisions on the sustainable use of groundwater. Existing, age tracers such as 14C and 36Cl are important tools. However, because they are chemically active, they are often affected by complex chemical interactions or unknown input parameters. The properties of the noble tracers make them ideal for groundwater investigations. They are chemically inert and have relatively simple transport processes, making them the most reliable and effective method for age-dating of groundwater. They more reliably predict the aquifer age and movement of water and replenishment rate when compared to conventional tracers. They can be used to compliment and add value to other tracers like 14C and 36Cl by providing calibration, improving their reliability. If Australia wants to develop trusted models of groundwater to support solutions to National Challenges including transitioning to a net zero future and protecting and restoring its environment, Australia needs access to a world class noble gas facility. It will support the Groundwater Strategic Framework 2016-2026 and the new National Water Agreement. **The Infrastructure Capability:** The CSIRO and The University of Adelaide, with the support of AuScope, have built a globally unique facility that can measure the amount of stable noble gases (He, Ne, Ar, Kr, Xe), radioactive noble gas isotopes (85Kr, 81Kr, 39Ar), and tritium (3H) at ultra-low levels in water. • The long-lived radioactive noble gases 85Kr, 39Ar, and 81Kr are emerging as three of the best groundwater age tracers because they are chemically inert making them more reliable and they can be used to estimate water age over large timescales: from modern water (less than 50 years; 85Kr), water of several hundred years (39Ar) to really old water of several hundred thousand years (81Kr). These isotopes are measured using the newly developed quantum technology Atom Trap Trace Analysis at the University of Adelaide. • Stable noble gas isotopes and tritium via in-growth are measured at CSIRO's Environmental Tracer Lab via stable noble gas mass

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	spectrometry. Noble gas isotopes stand out as amongst the most reliable due to their chemical inertness, well constrained source and sink mechanisms, and uniform global distribution. Helium-4 is the most reliable indicator of old groundwater. There is limited capacity globally for measuring this combination of noble gases. The combined stable and radioactive noble gas and tritium facility based on noble gas mass spectrometry is entirely unique in the world. There is also concern about using some foreign facilities for geopolitical reasons. As radioactive noble gas tracers become more widely used globally, sending radioactive tracers overseas for analysis takes up to a year to be processed: this is a clear barrier to uptake by industry. **Medium Term Goals:** Building on the $10M invested in these facilities to date, we propose the establishment of a National Noble Gas Facility for Groundwater (NNGFG) linked to AuScope under NCRIS to accelerate the delivery of real-world groundwater solutions, support groundwater research and enable the sustainable growth of the minerals, energy, and food industries in Australia. The NNGFG will be a national collaboration hub for groundwater research that will strengthen AuScope and NCRIS research initiatives including: Coastal Research Infrastructure; AuScope's Downward Looking Telescope; Earth Composition and Evolution; Environment & Climate; and Simulation, Analysis and Modelling activities. NNGFG will also leverage and add value to Auscope's AusGeochem database. The NNGFG will provide services at competitive prices and turn-around times delivering better groundwater outcomes for Australia. The information will enhance our research efforts, increase industry confidence in potential mineral exploration areas or food production regions relying on groundwater for irrigation. Together with Auscope, the Heavy Ion Accelerator Facility, ANU, and ANSTO, we will explore the development a cross-NCRIS collaboration to support a national groundwater isotope capability including the stable and radioactive noble gases, tritium, carbon-14, and chlorine-36. **Impacted Research Communities:** The user community will include organisations in government responsible for groundwater management; academics whose research involves the understanding of groundwater systems, contaminant transport, groundwater flow and recharge; and industry such as the energy and agriculture sectors that are users of groundwater. Over the past year our team has conducted over 19 presentations to end-users across government academia and received 13 letters of support. The proposed facility is aligned with the United Nations Sustainable Development Goals: Clean Water and Sanitation for All (Goal 6) through sustainable management of groundwater, while the management of our groundwater resources is crucial for building Resilient Infrastructure and Industrial Development (Goal 9), Sustainable Cities and Communities (Goal 11) and ensuring Sustainable Consumption and Production Patterns (Goal 12). **Timeframe:**

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	Currently, the stable noble gas facility at the CSIRO Adelaide Waite Campus is operational and providing measurement of hundreds of samples per year. The Atom Trap Trace Analysis facility at the University of Adelaide is measuring radiokrypton and is currently being upgraded to measure hundreds of krypton samples per year by mid-2026 and argon-39 by 2028. A third facility, the CSIRO TRItium Facility by Ingrowth (TRIFIN), will become operational by 2026.
191_Roadmap Survey_ Curtin University	Long-term resourcing for high-quality research software has been highlighted globally as a missing, but key requirement for the success of the entire research ecosystem. Furthermore, numerous reports have highlighted that this is a specialist domain requiring dedicated research software engineers working alongside domain experts to achieve the best and longest lasting returns on national research infrastructure investment. Countries like the Netherlands and UK have already invested in national research software centers such as the eScience Centre in Delft, (https://www.esciencecenter.nl/) and the Software Sustainability Institute which is distributed across three universities (Edinburgh, Manchester, Southhampton: https://www.software.ac.uk/) and more recently the German government has approved the creation of FutuRSI - a service organization for research software engineering with distributed teams in 5 institutions. All of these organisations provide a pool of research software engineers and data scientists that can be deployed via merit allocation to assist researchers nationally to create and maintain high-quality research software using the best possible practices. In Australia there have been smaller scale efforts to provide research software support including the Curtin Institute for Data Science which provides domain agnostic research software engineering and data science to research, academia and government, the Queensland Cyber Infrastructure Foundation (QCIF) which provides primarily digital infrastructure capabilities for research, industry & government but includes a software offering, the domain-specific Astronomy Data and Compute Service (ADACS) program operated by Curtin, Swinburne and Macquarie university on behalf of Astronomy Australia Limited, and the Australian Space Data Analysis Facility (ASDAF) operated by Curtin which provided research software to the Australian Space sector nationally. QCIF and ADACS are NCRIS funded but not at a national scale, ASDAF was nationally funded by Department of Industry Science and Resources (DISR) but only for 3 years before needing to move to a commercial model. It is clear there is a need for long-term funding for a distributed National Software Centre to provide merit allocated access to pools of research software engineers to maximize the return on investment in both research and research infrastructure in Australia. A distributed model as in the UK and Germany, similar to the structure of an ARC Centre of Excellence, combining the existing expertise across the country would be ideal. As we advance towards an era of unprecedented growth driven by AI and quantum computing, there is an urgent need for research infrastructure that supports a sustainable and intelligent future. This demands the development of highly energy-efficient, federated AI-optimized computing clusters capable of handling big data processing, deep learning models, and real-time simulations while minimizing environmental impact. By leveraging federated learning, this new infrastructure will comply with stringent data protection regulations, including patient privacy frameworks, thereby reducing risks while maintaining research scalability. Future research into synthetic biology and climate change modeling may also benefit in the long term from locally trained models, decreasing potential bias in their respective fields. To ensure AI scalability and security, the establishment of a dedicated NCRIS node may be warranted. These energy-efficient clusters will be essential for critical applications in health and national security, providing a highly secure, sustainable, and future-ready

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	computational framework for advanced research and innovation.
192_Roadmap Survey_ Australasian Radiopharmaceutical Trials Network	No response to question 35 submitted.
193_Roadmap Survey_ Laure Martin	The IMS1280 large geometry-SIMS (LG-SIMS) was commissioned in 2010 as a "flagship" instrument, led by the NCRIS funded Australian Microscopy and Microanalysis Research Facility (now Microscopy Australia). This $7M investment received funding from federal (AuScope and Microscopy Australia – $3M), state ($2.5M) and institutional ($1.5M) sources. This cutting-edge mass spectrometer is designed for the in-situ analysis of isotope concentrations in solid samples with high precision and has a fundamental role in geosciences (geochronology and stable isotope geochemistry) and nuclear forensic research. LG-SIMS analyses come at the end of a complex characterisation workflow involving optical and electron microscopy, X-ray technologies and others depending on the scientific problem. LG-SIMS results often lead to new scientific questions necessitating further nano-scale characterisation using Transmitted Electron Microscopy (TEM) or nanoSIMS. This correlative, multimodal approach can transform the research landscape in many scientific disciplines, offering opportunities for innovation and new discovery. However, the instrument hosted at UWA will be obsolete in 2028, as annouced by its manufacturer CAMECA. Given the excellent reputation of the laboratory worldwide, the current emergence of a new stream of research at UWA, and Australia-wide, on nuclear forensic research and the vibrant geoscience research communities at UWA, CSIRO, GSWA, and in Australia, there is a real need in the continuation and upgrade of the LG-SIMS facility at UWA. Between the vast number of geoscience applications and UWA's specialisation in nuclear forensics, there is a real demand for replacing the LG-SIMS at UWA. The loss or retention of LG-SIMS at UWA has several ramifications that are outlined below. • Loss of highly sought-after experts in geochemistry, nuclear forensics, and the SIMS technique. • Loss of the impactful UWA research outcomes and programs in geosciences and critical mineral research from an unparalleled technology for isotope analyses. Loss of an essential component in many geoscience research workflows (ICP-MS, EM, microprobe). • Loss of an important and unique Australian contribution to global nuclear safety and its ability to support research in nuclear safeguards.
194_Roadmap Survey_ Australian Cancer Research	The ACEMID project believes the inclusion of skin imaging capability in the NRI is overdue, particularly considering recent Commonwealth

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Foundation Australian Centre of Excellence in Melanoma Imaging & Diagnosis	government funding to develop a roadmap for a national targeted skin cancer screening program. Investment in national skin imaging capability would enable the development of reliable and evidence-based solutions to transform the early detection of melanoma and skin cancer, including improved early diagnosis, greater diagnostic accuracy, and standardised screening processes, enhanced by machine learning and intelligent support systems, for improved patient outcomes and optimal utilisation of health care resources. Skin imaging capability would also provide additional benefit outside of skin cancer/melanoma, resulting in positive impacts on the burden of other dermatological conditions and skin disease more broadly.
195_Roadmap Survey_ Population Health Research Network	Australian Biobank The need Successive NRI Roadmaps have highlighted the need for a national approach to biobanking but this has not resulted in any progress. A national approach to biobanking is critical in the health and medical research area. Meanwhile several developed national, most notably the UK, have invested in biobanks which have provided a major boost to health and medical research and delivered significant impact on medical product development and health outcomes improvement. The proposed infrastructure A federated, inclusive infrastructure is proposed that leverages existing NRI and institutional capabilities is proposed. It will incorporate genomics, other omics, imaging, clinical and population data. Key components include a platform to support data discovery, access and advanced analytics. Good governance including strong stakeholder engagement will be critical to success Medium term goals Operationalise the Australian Biobank (Health and Medical) platform by 2029. Impacted research communities Most health and medical research communities will benefit from the Australian Biobank including those looking at common health conditions such as cancer, cardiovascular, respiratory and mental health, and those involved with rare diseases. The Biobank will also support researchers involved in medical product development, clinical trials, precision medicine, infectious diseases and population health. Timeframe The need is urgent. Interested groups including the NCRIS Health Group and the Collections Working Group are working collaboratively to progress the Australian Biobank and have well thought through, spade-ready plans. Integrated Clinical Data The need Health and medical researchers around Australia are seeking greater access to clinical data. Major Australian health and medical research funders continue to invest heavily in infrastructure to collect clinical data but this may duplicate existing data collection processes. Digital clinical data is becoming more readily available as electronic health records systems are implemented by health service providers across Australia. There is a critical need for this data to be captured, linked/ integrated with Australia's rich linked health data assets and made available in privacy preserving ways for ground-breaking health and medical research. This infrastructure would support the work done by state and national clinical quality registries and may reduce the need for aspects of siloed clinical registries. The proposed infrastructure The new infrastructure will build on the existing PHRN data linkage infrastructure. Every jurisdiction in Australian has its core health and human services data linked via a PHRN-supported data linkage unit and researchers access linked data through these systems. Regional and state-wide clinical data will be incorporated into the linkage systems. Good

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	governance including stakeholder engagement will be a critical component of this infrastructure. Medium term goals Incorporate key clinical data including pathology and imaging into Australia's population-based data linkage systems by 2030. Impacted research communities Most health and medical research communities will benefit from more systematic access to linked clinical data. This includes researchers investigating common health conditions such as cancer, cardiovascular disease, respiratory and mental health, and those involved with rare diseases. The integrated clinical data will also support researchers involved in medical product development, clinical trials, precision medicine, infectious diseases, evidence-based care and population health. Timeframe With appropriate investments, key clinical data including pathology and imaging can be incorporated into Australia's population-based data linkage systems by 2030. PHRN has already piloted incorporation of pathology data into the linkage systems and several jurisdictions are well advanced in a state-wide approach to collection of clinical data from public hospitals and other components of the public health system. Some regional research centres also have excellent, functional clinical data repositories which could be included in a national harmonised system.
196_Roadmap Survey_ Australasian Fluid Mechanics Society	Fluid mechanics – the science and engineering of fluids in motion or at rest, whether they are gases, liquids, slurries, granules or mixtures of these – is crucial to address all major challenges faced by society in the 21st century. The energy transition via an intensification of wind, solar, pumped hydro and wave resources, and the production, storage and use of alternative liquid/gaseous fuels like hydrogen, will only be possible with a large and coordinated national research effort. Bio- and med-tech advances, Australia's vast coastal and marine natural resources, prediction and modelling of weather and climate change and its mitigation, our air- and sea-based defence, and the development of a self-sufficient space industry, all rely on the understanding and manipulation of fluid flows. The Australasian Fluid Mechanics Society (AFMS), representing the fluid and thermal science research and practitioner community in Australia (and New Zealand) commissioned and published a report "Riding the Wave: the value of Fluid Mechanics to Australasia" in Dec 2024 (see: https://www.afms.org.au/docs/AFMS_Riding_the_Wave). It outlines the importance to the current economy of fluid mechanics to Australasia, providing an estimate of a contribution of $34B/year to the economy. Much of this current contribution comes from major drivers of Australia's current economy – oil and gas (28.3%), and resource engineering (15.4%). Oil and gas may reduce as a proportion of fuel use in the future, but the importance of petrochemicals will certainly remain crucial, and the efficiency of oil and gas extraction and processing with be paramount. Mineral resources will continue to be a pillar of the Australian economy, and this industry needs rapid and coordinated research on fluid flow phenomena (extraction, transport, separation, etc.) to decarbonise at the rate required for Australia to meet its net zero by 2050 ambition. We propose this research must be done in Australia, with the joint support of Australian government and industry. This joint effort must be underpinned by large-scale and dedicated facilities in aero- and hydro-dynamics. While smaller, two other industries stand out as areas where fluid mechanics is already making a significant economic contribution in the AFMS report – life science and pharmaceutical diagnostics (4.2%) and renewable power (6.8%). These two industries are at the forefront of

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	critical challenges facing Australia in the coming 5-10 years. New, dedicated facilities including fluid flow measurement and diagnostic equipment is required to boost both of these burgeoning areas domestically. We propose that Australia desperately needs: • (1 – 2 years) A consortium or similar, bringing together the various aero- and hydro-dynamics facilities across the country to drastically boost the capacity of domestic industry to develop and innovate in the fluids space. The primary impacted research communities are those in aerodynamics, aerospace, hydrodynamics, wind engineering, transport, and defence. • (3 – 5 years) The consortium to be supported by the establishment of new, large-scale experimental air and water testing facilities – e.g., wind tunnels, deep water facilities, and wave flumes. • (3 – 5 years) The supplementation of large-scale facilities with cutting-edge measurement and diagnostic equipment that can be deployed at a range of scales, to measure and image flows from atmospheric, to sea- and air-craft, to sub-mm biological flows, to micro- and nano-scale fluidics. The research and development communities impacted by this would be vast; as well as those suggested above, fluids-based research across scales could be boosted and this underpins a huge number of fields which include: aerospace, mechanical and civil engineering; marine and atmospheric science; weather and climate; biomedical, physiological and biological science; advanced manufacturing. • (3 – 5 years) Dedicated high-performance computational facilities for fluid mechanics research incorporating flow simulation, advanced data science for the analysis of the huge spatially- and temporally-varying data sets generated by experimental flow measurement and simulation, and associated data and flow visualisation. These facilities need associated software – with the technical and human resources for software development - and technical staff available on an on-going basis. This would benefit all the research communities previously suggested, as well as those in data science and computational mechanics. The major capabilities that this infrastructure would add are: • Physical and computational modelling and measurement of flows at a scale required to study air flows ranging in speeds from almost zero (e.g., urban wind environments) to hypersonic (e.g., space re-entry and defence applications) • The study of water flows of large scale and depth • The measurement, simulation and processing of data from flows in complex geometries and of complex fluids such as those encountered in biomedical and food processing applications. • A knowledge transfer between current fluid researchers across fields via collaboration on dedicated and centrally funded equipment • A rapid development of education and training in advanced measurement and computational techniques to provide the human capital required by Australian industry to boost sovereign capacity. A primary motivation for this infrastructure is to rapidly increase the capacity of Australian industry by:

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	• providing the base of world-leading facilities for conducting fluid based research locally • providing ready access to Australia's excellent expertise in fluid mechanics that is not currently adequately leveraged. The aforementioned AFMS report states most fluid mechanics research in Australia is currently funded via public sources such as the ARC; we propose the focussed and dedicated facilities suggested here would instead attract significant industry investment in R&D.
197_Roadmap Survey_ Australian Research Data Commons	**The Need for Engineering Research Support in NCRIS:** Despite the critical role heavy engineering research plays in driving innovation and industrial growth, NCRIS currently lacks dedicated support for engineering researchers. This gap affects a broad spectrum of fields, including manufacturing (FoR 4014), energy (FoR 4008), recycling (FoR 4019) and materials science (FoR 4016). Notably, 21% of Australia's R&D expenditure goes to manufacturing, which lacks supporting digital research infrastructure (https://tinyurl.com/3rfa7tt7). Engineering research underpins efforts to reach net-zero and build a secure, resilient nation—two of the 2024 National Science and Research Priorities. Furthermore, the 2021 National Research Infrastructure Roadmap identified several challenges still unsupported: Resources Technology and Critical Minerals Processing (FoR 4019), Recycling and Clean Energy (FoR 4016, 4019), and Frontier Technologies and Modern Manufacturing (FoR 4008, 4009, 4014). Without dedicated digital infrastructure, Australia will fall behind in sustainability, economic competitiveness and innovation. ARDC proposes to establish an Engineering Research Data Commons (Engineering RDC) to support national engineering research through secure access, sharing and use of engineering data. This capability will integrate existing datasets, enable secure and efficient data sharing, and support advanced modelling and simulation. By facilitating data interoperability across universities, research institutions, SMEs and heavy industries, the RDC will accelerate research translation, foster collaboration and drive innovation. Secure data sharing and interoperability are essential to translate research into real-world applications. A key function will be developing data standards and governance frameworks, ensuring research outputs can be effectively used by industry. **Case Study–The Role of Data Standardisation in Carbon Capture Reporting:** Data standardisation is critical to ensuring trust, transparency and credibility in industrial reporting and regulatory compliance. For example, in the concrete industry, carbon capture and storage within concrete products is an emerging decarbonisation strategy. Producers are increasingly required to report on the amount of CO_2 captured and stored during production. Without standardised data formats and verification frameworks, inconsistencies in reporting arise, creating loopholes that can be exploited. Some companies, including international operators working under different regulatory regimes, may satisfy Australian compliance requirements without demonstrating equivalent environmental outcomes. Robust data standards address this risk by ensuring that emissions data is consistent, verifiable and comparable. These standards can be embedded in companies' data capture and reporting processes, while also enabling regulators to independently verify claims and uphold the integrity of emissions reduction efforts. This supports fair competition, builds confidence in industry reporting, and reinforces Australia's climate commitments.

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	About the Engineering RDC: This initiative will establish a federated and secure data infrastructure connecting diverse engineering research domains. The immediate priority will be to map and integrate existing datasets, addressing critical gaps in research areas such as sustainable manufacturing, energy transition technologies and resource efficiency. The capability will focus on developing AI-driven tools and digital twin technologies to enhance modelling, simulation and predictive analytics in engineering applications. A major milestone will be demonstrating the practical benefits of data sharing and interoperability, showcasing how enhanced access to engineering data can accelerate industrial innovation, optimise resource utilisation and support national sustainability goals. Given the breadth of engineering research, it is important to recognise its pervasiveness across sectors, the rapid pace of technological progress and the evolving nature of national priorities. Accordingly, initial efforts must be focused, and priorities refined as the initiative develops, guided by ongoing consultation with stakeholders. ARDC has used its Translational Research Data Challenges (TRDC) program for short (2–3 year) mission-driven initiatives to build digital infrastructure and foster collaboration across sectors to tackle specific problems, e.g. Bushfires TRDC. In alignment with current national priorities and ARDC research, this construct will be applied to the energy sector before 2028. This pilot will serve as a model for scaling to an Engineering RDC. The Engineering RDC will benefit a wide range of research communities and industry sectors, particularly those engaged in advanced manufacturing, clean energy technologies and circular economy solutions. Researchers working in materials engineering, robotics, AI-driven industrial automation and sustainable resource processing will gain access to a robust data ecosystem that enhances their ability to develop and test innovative solutions. Additionally, industries focused on battery development, hydrogen production, waste recycling and smart infrastructure will benefit from improved data accessibility, enabling them to collaborate more effectively with researchers to address pressing technological challenges. Given the urgency of addressing Australia's engineering research data needs, it is recommended that this capability be established within the next five years. The Engineering RDC will be the backbone of engineering research and the transition to net zero in Australia, ensuring that researchers and industry partners have the tools they need to drive sustainable, technology-led growth for the nation. By investing in a dedicated Engineering Research Data Commons, Australia can position itself as a global leader in engineering-driven innovation, supporting economic resilience and national priorities.
198_Roadmap Survey_ Felipe Kremer	There are significant challenges ahead. Novel materials will play an important role in realizing net zero, in exploring our natural resources, in achieving faster communications. This will not only the maintenance of existing personal and equipment as well as the acquisition of microscopes with higher resolution, faster detection systems and integration with the national computational infrastructure to be able to deal with the large data to be analyzed.

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199_Roadmap Survey_ The Australian Wine Research Institute (AWRI)	**A case for enhanced or new NRI capability:** Modular fermentation facilities to bridge the gap between laboratory-based systems for R&D and large scale production facilities. **Background:** Fermentation is a green manufacturing technology that uses yeast and other microorganisms to produce a range of valuable products, from pharmaceuticals and foods to biofuels, enzymes and fine chemicals. While some companies have been manufacturing fermentation-based products for over three decades, in recent years, ‘precision fermentation’ has attracted global attention and investment in the production of food ingredients used in vegan dairy and meat alternatives, aroma compounds, lipids and proteins. The biomass fermentation industry has seen a rapid diversification in microbial species, production methods and consumer products. From 2013 to 2022, the average global investment in fermentation-derived products tripled, and the number of commercially producing companies increased from seven to 136. To support translation of research and realise long-term growth, contract manufacturing organisations (CMOs) and innovation in technical capabilities play a crucial role in alleviating manufacturing capacity constraints, especially for early-stage companies working with precision or liquid-biomass fermentation. However, the limited availability of CMOs and fermenter capacity across all stages of development remains a challenge. To address this gap, there is a case for creating modular fermentation facilities, together with ready access to down-stream processing technologies, to bridge the gap between laboratory-based systems for R&D and large scale production facilities. These would connect with existing Bioplatforms Australia and Metabolomics Australia capabilities to enable monitoring of fermentation processes and products. In addition, brownfield development and retrofitting existing equipment have the potential to reduce up-front capital expenditure by more than 70 percent and significantly shorten construction lead times. However, no blueprints are available for retrofitting the equipment involved, especially fermenters traditionally used for anaerobic wine production. In this context it’s worth noting that a large volume of fermentation capacity across Australian wineries is currently underutilised, proving an opportunity for developing diversified fermentation infrastructure and capability.
200_Roadmap Survey_ Sydney Informatics Hub, Core Research Facility, Office of PVC-RI, The University of Sydney	We identify a critical need for new national capability that bridges the gap between traditional HPC infrastructure and emerging AI-driven research requirements. 1. Australian Research Computing. Aligned. (UNSW submission to which we are a signatory). A new coordinating capability comprising: a. Australian Research Computing Advisory Panel (ARCAP) • Coordinate national compute strategy across all tiers

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	• Develop comprehensive vision for research computing • Guide investment priorities and technology adoption • Ensure alignment between facilities and research needs • Coordinate workforce development and training b. Australian Tier 2 Network (AT2N) • Network of institutional HPC facilities • Standardized metrics and best practices • Support for emerging compute paradigms • Co-location with research instruments • Cross-institutional resource sharing 2. A dedicated facility supporting AI-driven research across all applied research domains and working directly with each existing NRI facility: • Large-scale GPU computing resources • Interactive computing environments • AI model deployment, configuration, user interface and fine-tuning for applied science uses, targeting maximum user base and acceleration of other research domains • Secure processing environments • Integration with existing NRIs 3. National Research Data Platform (NRDP). An integrated platform providing: • AI-assisted data labelling • Secure data repositories • Domain-specific tools • FAIR/CARE compliance support • Cross-domain data integration 4. Trusted Research Environments on ARDC Nectar. Secure computing environments for sensitive data: • Solve a national problem once, nationally. • Standardized governance frameworks • Domain-specific workflows • Integration with national compute • Cross-institutional collaboration This structured approach would enable coordinated development of national research infrastructure while ensuring alignment with research needs and efficient resource utilization. The combination of these capabilities would position Australia competitively in the global

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	research landscape while maintaining appropriate governance and security standards.
201_Roadmap Survey_ UNSW Sydney	Quantum Device Testbed Network – new UNSW advocates for the inception of a new NCRIS capability centred around quantum information technologies, the National Quantum Device Testbed Network in collaboration with colleagues in Queensland and Victoria. While Australia has established national networks using NCRIS infrastructure for the fabrication of quantum devices and materials (ANFF) and their visualization (Microscopy Australia), there is currently no equivalent national infrastructure for testing and operating these quantum devices and materials. The new Quantum Device Testbed Network would address this gap by providing essential national infrastructure to support quantum technologies research and development. It would offer quantum start-ups access to state-of-the-art facilities and expertise that would otherwise be cost-prohibitive and time-consuming to develop independently. The network would provide access to industry-friendly laboratories equipped with cryogenic quantum device measurement platforms, confocal systems with interferometry and single-photon detectors, quantum sensing labs, computing and quantum computing resources. Additionally, a Training Hub would be established to upskill Australia's workforce in this critical field. This would also provide the infrastructure to support workforce training initiatives by the recently funded Quantum Australia and FLiQC (Future leaders in Quantum Computing) training centres. Leveraging world-leading quantum expertise at UNSW, including the $3 million investment in the quantum industry lab from UNSW/ARC LIEF, as well as comprehensive device fabrication (ANFF) and materials and device imaging and physical characterization (MWAC) capabilities at UNSW, this initiative would also include nodes in Melbourne (University of Melbourne) and Brisbane (University of Southern Queensland), and potentially UWA and ANU. Importantly, this initiative aligns with the step-change and priority areas identified in the 2021 roadmap, including research translation infrastructure and the National Research Infrastructure Workforce, and the research theme of Frontier Technologies and Modern Manufacturing. Infrastructure on Australia's East Coast to support preclinical (animal) research (new under Phenomics Australia) The vulnerability of medical research using laboratory animals to supply shortages was highlighted over the past three years during a time of transition of the Western Australia government supported ARC to commercial management. Animal strains and services that were nationally available have been severely limited or not yet fully established during this time, delaying or preventing research outcomes. Shortages of supply and infrastructure support for animal species have also hampered research established in models other than rodents (aquatic species, guinea pigs). UNSW recognises the urgent national need to complement and support infrastructure for supply of laboratory animals in Western Australia by expanding capabilities on the east coast. This capability gap was also recognised in the 2021 Roadmap but not taken further. New infrastructure could come under Phenomics Australia and build on existing capabilities currently focusing on mice to possibly include:

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	• Improved supply of rats at a high health status • Provision of rat reproductive services such as timed mating, rederivation, cryoarchiving • Coordination of supply of infrequently used species or strains for research which are not commercially viable (ie guinea pigs, low-demand rodent strains) • Capability for import, quarantine and distribution of aquatic species in Australia **Functional and Structural Materials Manufacturing (FASMM) Network (new)** UNSW supports the creation of the Functional and Structural Materials Manufacturing (FASMM) network led by Monash University. The FASMM network would encompass manufacturing, testing, and characterization capabilities to establish the necessary workflows for translating early-stage research. It would be specifically focussed on technology readiness level 3-5 infrastructure, with a view to scale and accelerate translation in a nationally coordinated way. These capabilities would include metal and functional materials processing, additive manufacturing and printing, as well as mechanical, in-operandum, and extreme environment testing. **Digital Biobanking (new under NIF)** We support NIFs proposal to make much better use of research data, reducing fragmentation and improving integration, discoverability and analysis. The NCRIS Health Group, and other NCRIS partners, would provide existing capacity and capability platforms to deliver this resource.
202_Roadmap Survey_ Victorian Cancer Biobank Consortium	**Proposal: Establishing a National Agency for Biobanking Coordination** A national agency is essential to facilitate standardisation, visibility, and cross-institutional collaboration for biobanking infrastructure. This initiative should focus on: 1. Digital Infrastructure with AI Integration: AI-driven tools for data integration, metadata cataloguing, and sample accessibility will enhance research efficiency and scalability. 2. Expanding Public and Private Partnerships: Engagement with industry, government agencies, and biobanking networks can provide sustainable funding and research expansion opportunities. This would also include further leveraging with other NCRIS initiatives (e.g. biodiversity collections). 3. Developing a Unified Biobanking Governance Strategy: National policies for ethical, legal, and social frameworks will ensure standardised/harmonised access and compliance across biobanks. 4. Enhancing Researcher and Public Awareness: Visibility campaigns and educational outreach will promote the significance of biobanking and encourage broader utilisation. 5. Creating National Health Collections at Scale: Leveraging existing biobanking infrastructure (e.g. Victorian Cancer Biobank) to build comprehensive national specimen collections addressing key health priorities. For example, UK Biobank showcase the great impact

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	of samples and data generated from 500,000 donors recruited across the country. Internationally, model like BBMRI-ERIC in Europe has demonstrated the benefits of coordinated national biobank infrastructure. The impacted research communities include those who conduct research in (but not limited to): • Rare diseases (e.g. rare and low survival cancers) research – collective resources of human samples is critical for research in this area to achieve equality in health outcomes • Precision medicine and translational research • Clinical research and trials • Public health and infectious disease research • Life science and biotechnology companies Economic and Health Benefits: Recently, the Victorian Cancer Biobank (VCB) demonstrates the economic value of biobanks, with an estimated Return of Investment (ROI) of $1.59 for every dollar invested. Establishing a national biobanking infrastructure will unlock greater potential for research impact and economic return.
203_ Roadmap Survey_ Southern Ocean Sea Level monitoring network	No response to question 35 submitted.
204_Roadmap Survey_ Adrienne Nicotra	No response to question 35 submitted.
205_Roadmap Survey_Science and Technology Australia	Please see STA's separate response.
206_Roadmap Survey Response_ Meena Mikhael	No response to question 35 submitted.
207_Roadmap Survey_ Research Software Engineers, Australia & New Zealand (RSE-AUNZ)	There is a need for a national research software capability that: • operates across all research domains, drawing inspiration from the UK's Software Sustainability Institute or the US's Chan-Zuckerberg Initiative Essential Open-Source for Science program (CZI-EOSS) • provides shared infrastructure, frameworks, and utility libraries to support research software development. • offers policy advocacy, training, advice, and capability-building at a national level.

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	• ensures sustainability and governance beyond individual institutions or short-term grants. • where appropriate, directly support the maintenance and sustainable development of critical pieces of existing, mature research software, where individual institutions or short term grants fail to meet the community's needs Medium-term goals would include: • providing trusted advice/consultancy/knowledge sharing to all key NCRIS facilities • providing a capability-building program for researchers across domains and researchers in multidisciplinary projects - this is modelled on the success of ADACS, MDAP, and RCP in their capability-building programs • providing training across domains for researchers to improve their digital skills such as programming, problem-solving, and choosing software/information system architectures. • providing national advice through online drop-in sessions to bridge the gap between introductory tutorials and the ability to write and maintain sustainable research software. • providing the service and capabilities of a national Open Source Program Office (OSPO) That will include but not be limited to the feedback of legal compliance issues and risk management of open source research software. • foster a collaborative community connecting researchers who code with software engineers in research, facilitating the exchange of ideas and best practices. • develop a scheme to identify and support critical pieces of open-source research software. Such a scheme should focus on sustainable development practices for existing, well-established research software and should include but not be limited to bug fixes, improving software engineering processes such as automated testing, improving documentation, or community management. The scheme could be modelled after successful approaches from the private sector and philanthropic organisations, such as CZI-EOSS or Google's Summer of Code program
208_Roadmap Survey_ Social Science Research infrastructure Network (SSRIN)	There are several broader issues surrounding data infrastructure that require future funding and action, including expanding and developing new research infrastructure capabilities. The below comments address some of these broader needs, seen from the disciplinary point of view of the social sciences, but carrying relevance for other research disciplines. **Data discovery in a world full of data** The production and availability of data are rapidly expanding. Within the field of social sciences, the recently published Decadal Plan for Social Science Research infrastructure from the Academy of the Social Sciences in Australia identifies improved data discoverability as one of the key needs for the sector. Numerous data discovery tools have emerged, offering a range of functionalities. However, most of these tools provide only a snapshot view—presenting a selection of information and links compiled at a specific point in time, with occasional updates.

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	Such tools struggle to keep up with the accelerating speed at which new data are generated and made available. By the time they are released, they may already be outdated. This issue applies not only to new data collections and sources but also to the information these tools provide about existing datasets. Without a robust maintenance model, content and links are unlikely to be sufficiently updated. Additionally, many tools lack comprehensiveness, either in the range of data they capture or in the richness of the metadata they provide, while point-in-time nature of these snapshots also contributes to the lack of comprehensiveness There is therefore a strong case for investing in technology that enables researchers across multiple disciplinary areas to explore the existence, availability, and characteristics of existing data in real time. In the context of the social sciences, this includes providing subject area experts with the data, metadata, and practical information necessary to produce research without having to become experts in state or Commonwealth administrative data systems. Developing such technology will require national infrastructure funding. The Social Science Research Infrastructure Network (SSRIN) project offers a starting point for such an endeavour within the social sciences through its Activity Stream on improving discoverability of public sector social science data. Continued funding would facilitate an automation of the discoverability process implemented in the Activity Stream, and allow for expansion beyond the social sciences. Such dedicated funding could be used more broadly to connect the various NCRIS-funded data discoverability tools and initiatives, ensuring inter-operability and facilitating multidisciplinary collaborations. **Continued data integration initiatives** With the proliferation of data there will be an ongoing need for data integration into the foreseeable future. Within the social sciences context, large-scale data integration initiatives have been implemented by various government agencies – usually statistical agencies, health departments and associated health research units. Other, often smaller-scale, data integration projects, whether of a more strategic or one-off-application basis will have been executed in academia, private business and public service. These potentially numerous data integrations, remain largely hidden from the public domain. Data integration is still a very under-researched field. It poses methodological issues that are often not well understood by social researchers. Data linkage agencies are commonly constrained in understanding the limitations of their work due to their unfamiliarity with some of the source data. Further national investments in data integration are urgently needed to: a) Support better research into, and communication of the quality issues associated with data integration processes, especially repercussions for population representation and uncertainty in estimates. b) Develop good-practice data integration guidelines that target the large data linkage providers as well as the many smaller-scale linkage providers including individual researchers who link data rather ad-hoc for their work. c) To develop training programs in data linkage that teach good practice principles of linking data, and treating arising quality issues. d) To develop online tools and associated administrative models for its use that allows researchers to conduct ad-hoc data

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	integration using their data. The Social Science Research Infrastructure Network (SSRIN) project offers some first steps in this direction in the context of social sciences, through its Activity Stream on improving integrated data usability. Working in close collaboration with the Australian Bureau of Statistics (ABS), this activity will deliver a series of key enhancements to some of the key data assets administered by the ABS and the associated documentation. This involves setting up the technical infrastructure and introducing a set of processes for improved delivery of supporting information. **Infrastructure Needs for Policy and Program Evaluation** Evaluation plays an increasingly critical role in guiding public investment in Australia; thus, ensuring adequate infrastructure for high-quality, system-wide policy assessment is essential for evidence-informed decision-making. Timely access to high-quality, linked administrative data will improve evaluation of large-scale health and social policies and facilitate the development of data-driven decision tools to enable dynamic policy adaptation and simulation based on real-world evidence. In addition, infrastructure that enables real-time data integration will provide opportunities to complement periodic evaluations (the current status quo) with real-time monitoring and feedback loops to allow for timely adjustments to policy and program implementation. This requires investment in digital platforms and data-sharing agreements across sectors and jurisdictions.
209_Roadmap Survey_ Collections Working Group	**Need for New Biobanking Infrastructure** Through successive Research Infrastructure Roadmaps, Australia's research community has identified a growing need for a national co-ordination of biobanks and research collections, Millions of health samples are stored in Australian biobanks, yet most collections remain fragmented and siloed within different institutions. Australia needs a centralized, well-coordinated effort with national leadership to integrate existing collections such that they can be accessed by more researchers, to support to biomedical, precision medicine, and environmental health research. A co-ordinated national approach for collections and biobanks would also enable more comprehensive research studies, by consolidating existing and new biological samples with linked genomic, phenotypic and clinical data, to drive future breakthroughs in medicine and public health. **Proposed Infrastructure Capability** The proposed national infrastructure would act as a centralized platform for existing and future biobanks, to allow research and industry access to more biological samples with associated genomic, phenotypic, environmental and preanalytical data. This infrastructure would: • Integrate samples and data from multiple biobanks across research fields and institutions, ensuring that more samples and data are accessible for scaled research efforts by more research users. • Improve research capacity for drug discovery, precision medicine, public health, and responses to climate change, through comprehensive, unified datasets that facilitate research translation.

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	• Create comprehensive longitudinal datasets by progressively adding new samples and data, enabling studies on chronic diseases, treatment efficacy and side effects, and environmental impacts on health and disease. • Provide a responsive network of biobanking capabilities that could be rapidly and effectively realigned to new or emerging research priority areas. National biobank infrastructure would maximize the use of critical new sample and data collections that will be required to address new health challenges. • Create synergies with complementary NRI capabilities, by providing scaled access to samples and data that can be analysed by other NRI. 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 research breadth and depth and ensure that past investments in biospecimen and data collection can be reutilized for new research. **Impacted Research Communities** • Applied genomics and precision medicine research will benefit from comprehensive collections of biospecimens with annotated genetic and environmental data, allowing the validation of predictions from in silico research powered by AI, and enabling the development of personalized health strategies for Australian populations. • Public health research will benefit from scaled, more representative health datasets for studying disease prevention, risk factors, and health outcomes across Australia's diverse populations. • Environmental researchers will benefit from access to more comprehensive biospecimen and data cohorts linked with environmental exposure data, enabling the study of environmental change on human and animal health and biodiversity.
210_Roadmap Survey_Australian Academy of the Humanities	What's missing from the current ecosystem and what do we need in next Roadmap? In summary: 1. Indigenous Research Capability: a ten-year vision, building on the successes of the Indigenous Data Capability program led by Professor Marcia Langton. This is a case for scaling an existing project (currently funded through the HASS & I RDC). 2. National research collections infrastructure capability: a new research-led agenda, bringing together Indigenous knowledge, sciences and humanities, taking full advantage of AI. This is a new capability, it does not yet exist. 3. Integration and coordination capability across HASS and for structured collaboration across NCRIS and wider system to leverage investment. This is a new capability, it does not yet exist. To focus on: a) National workforce capability strategy for HASS b) Multi-pronged AI capability for HASS c) Data capture (digitisation) capability. d) Repository infrastructure for high value collections - STEM also has this problem; a 'joined up' discussion about future proofing is needed. Australia's sovereign data in the humanities is at risk.

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	1. Indigenous Research Capability. [NSRP Priority 3] We support the proposal from the Improving Indigenous Research Capabilities (IIRC) project, led by Professor Marcia Langton AO FASSA through the HASS & I RDC for a stand-alone NCRIS capability as follows: "Aboriginal and Torres Strait Islander Research Data Commons: “A new National Research Infrastructure (NRI) capability focusing on scaling up the Improving Indigenous Research Capabilities (IIRC) project is critical for recognising, securely storing and effectively and appropriately utilising the wealth of Aboriginal and Torres Strait Islander data for research, policy-making, and cultural preservation. … To support Indigenous data governance, protect cultural heritage, and integrate Indigenous knowledge into research, significant investment in long-term research infrastructure is required. This includes dedicated resources for managing, protecting, and sharing Indigenous data to facilitate large-scale research, policy development, and community-driven initiatives. Such investment is essential to meet growing demands for digital infrastructure, data security, cultural protocols, and supporting Aboriginal and Torres Strait Islander communities to maintain control over their knowledge.” Leads: IIRC/Marcia Langton, with a 4-year establishment period. 2. National Research Collections Infrastructure Capability. [NSRP Priorities 3 and 5] Australia struggles with its national story and contested histories - an ongoing problem for government and communities. Existing science infrastructure will not solve this. We lack an authoritative, non-partisan, evidence base - the cultural and social research infrastructure that would equip HASS researchers (40% of the workforce) to construct the elements of our complex national identity in an evidentiary way. We need to connect the research data (locked away collecting institutions) so that it can be used by researchers to better understand and share the Australian story. This is imperative to matters of national identity and social cohesion. Leads: Profs Andrea Whitcomb, Gaye Sculthorpe, Alistair Paterson propose: An ‘Australian Collections Commons’ building to a ‘A Cultural Atlas of Australia. Their model for a national research collections infrastructure (connecting up existing assets) brings together Indigenous Knowledges, science and cultural research, using purpose-built AI. It partners with GLAM and international exemplars. The program of work would harness existing infrastructure, relationships and expertise within the HASS & I RDC. 3. Integration and Coordination Capability across HASS. This is a vital, underpinning capability to capitalise on existing investments and leverage wider R&D landscape. There is value in convening for HASS writ large, and then developing targeted strategies for sub-sectors, themes and cohorts i.e. humanities, qualitative research, ECRs, etc. A national workforce strategy to build HASS capability: • Humanities face workforce challenges: lack of national succession planning; loss of ECR talent, as well as senior leadership; challenges ‘mainstreaming’ data enabled research. The opportunity cost we are currently experiencing, to build national capability, cannot be underestimated.

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	• Better data management driven by disciplines is needed, including data standards and protocols, management frameworks, digital and data literacy capability, research training in digital methods.
	• There are very significant skills gap in EMCRs and MCRs' capacity to make full use of RDI already developed, also more generally in computational humanities. This reflects the piecemeal and fragmentary development of RI across HASS through ad hoc project funding without ongoing programmatic support or strategic framing.
	
	New AI infrastructure investment is needed
	
	• Proof of concept cases to significantly extend the use of AI in HASS NRI:
	  ○ Building AI pipelines for projects working with textual data and sovereign LLMs. Leads: Profs James Smithies, Katherine Bode. Part of broader agenda for HASS to access high quality data and infrastructure for building sovereign LLMs.
	  ○ Digital research platforms to interrogate flows of information in the AI age. Leads: Profs Julian Thomas, Jean Burgess. Underway through a second phase of ARDC HASS & I RDC investment - the Australian Internet Observatory (AIO). We refer the Department to the AIO's separate submission, which sets out an agenda 2028-2033 to meet the digital transformation challenge at scale
	  ○ The AI enabled data analysis & aggregation proposed in the national collections model (above) can leapfrog the classification issues that silo our knowledge systems (science, museum, archive etc) by using AI to describe things, as they are, not by disciplinary or collection specific metadata standards.
	• For AI to truly deliver, data needs to be digitised.

211_Roadmap Survey_Australian Creative Histories and Futures	Cultural Data and Digitisation Need There is now broad agreement from researchers in the arts – whether they are located in industry, universities, government agencies, or not-for-profit organisations – that Australia needs to increase its investment in cultural data and digitisation. On arts, creative and cultural data, the sector has been described as "nascent and emerging," "dispersed," "uneven," "fragile" and "ad hoc" (AAH 2022, 1-3) as well as "broad yet fragmented" (Fensham et al 2024, 15), and suffering from significant "gaps" (Brook et al 2022, 4). In an important joint submission to the Office of the Arts about its cultural policy Revive, Creative Australia (then the Australia Council for the Arts), A New Approach, Macquarie University, QUT, and RMIT observed several needs, including the "need for core cultural and creative industries data" as well as the "need for a centralised hub for coordinating, drawing together and providing access to and guidance on … [cultural] data sets from the ABS and other sources … [I]n addition to custodianship of core data sets, this body should also help to guide the development and the conduct of data collections" (Brook et al, pp.3-6). Similarly, in their submission, colleagues from the Australian Cultural Data Engine – an ARC LIEF funded project – recommended a national cultural data research laboratory (Fensham et al 2022, p.3). On digitisation, the NRI Roadmap 2021 already identified the need for a national capability that would provide standards and guidelines for digitisation, give advice on preservation, risk, copyright and licensing, and connect researchers, organisations and digitisation vendors (pp. 70-71). Substantial efforts are underway on both fronts. The Australian Creative Histories and Futures (ACHF) was established in 2024 with

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	investment from the Australian Research Data Commons, as part of the HASS & Indigenous Research Data Commons and funded under the National Collaborative Research Infrastructure Strategy. Led by UNSW Sydney, Phase 1 involves Flinders University, Creative Australia, and ACMI (formerly the Australian Centre for the Moving Image). Several industry partners and universities have signalled their interest in joining the project at its midpoint in 2026. There are also digitisation efforts underway across the country, including for example the Digitisation Centre of Western Australia and the Australian Emulation Network, both of which were also enabled under the ARC LIEF scheme. Individually these projects are impressive, but were they supported by significant national research infrastructure they could become so much more. The cultural data and digitisation need is not Australia's alone. Terras et al describe a global "patchwork of small to large scale content, held in different locations, formats and under different reuse licenses, with different institutional approaches to risk, public engagement and entrepreneurship" (2021, 11). Given et al note that "while cultural data initiatives are growing in number, globally, they lack a cohesive, sustainable, and healthy ecosystem to enable collaboration and sharing cross related contexts" (2024, 2). Internationally, there are several relevant projects underway. In the UK, the Centre for Cultural Value has embarked on a new project on cultural data, which they envisage as a step towards a National Cultural Data Observatory. In the US, the Equitable Arts Infrastructure project is deploying data as part of its efforts to address "cultural, economic, and racial equity in the performing arts sector." In Canada, The Arts Impact Project: Understanding the Arts' Civic Impact in the Data-Driven Economy is also just starting. Once again, it is possible for individual researchers in Australia to collaborate with these international projects, but substantial national research infrastructure could anchor, augment and accelerate these efforts. Infrastructure Capability: Australian Centre for Cultural Data and Digitisation In line with international efforts, and in response to Australia's own needs, the NRI Roadmap should consider a capability in Cultural Data and Digitisation. This could be done either as a standalone capability or as part of a broader HASS NCRIS Capability. **Goals** In Phase 1 (2024-28), the Australian Creative Histories aims to: • Secure existing data assets by strengthening their technical, financial and social architectures; • Facilitate interoperability between these data assets as well as knowledge exchange between their associated research and industry communities; • Develop Indigenous data governance, reparative description, and accessibility principles for the cultural data sector, in line with FAIR and CARE principles; • Upskill sector stakeholders in cultural data management and analysis. These, in addition to the tasks outlined in NDI Roadmap 2021 for a digitisation capability, could form the foundational goals for an NCRIS

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	capability. **Research Communities** The research community associated with arts, creative and cultural data is broader than most. It includes: researchers in universities; researchers, analysts and policy makers in government agencies; arts organisations manage their own archival and data holdings; and artists themselves. **Timeframe** The ACHF is in Phase 1. However, it builds on the seven previous LIEF grants that have enabled AusStage: The Australian Live Performance Database, and the four LIEF grants that enabled the Design & Art Australia Online database as well as the 50 years of data held by Creative Australia. There are also, as mentioned, multiple digitisation efforts underway. In 2021, the NDI roadmap already identified the emerging importance on the creative arts and humanities; in 2023, the Revive cultural policy's articulated Pillar 4 Strong Cultural Infrastructure. In 2026, we should acknowledge that the sector is ready for a significant investment in dedicated infrastructure for cultural data and digitisation.
212_Roadmap Survey_ Australian and New Zealand International Scientific Drilling Consortium	The examples provided in this submission demonstrate the important role for subsurface sampling NRI in tightening constraints on the pace of past climate change and establishing environmental baselines, facilitating resource discovery, understanding offshore fresh groundwater aquifers before they are exploited, and in allowing a full appreciation of the mechanisms controlling natural hazards that may impact the Australian coastline. To maintain this ability to acquire subsurface samples, it is critical for NRI to facilitate long-term Australian membership in international research infrastructure initiatives like the International Ocean Discovery Program and the International Continental Scientific Drilling Program. Whilst Australia currently has NRI that provides membership into international subsurface sampling programs (i.e. the Australian and New Zealand International Scientific Drilling Consortium, funded by ARC LIEF to 2024 and by NCRIS from 2024 to mid-2027), there is a need to expand this NRI to support greater continuity in funding and to provide international partners with longer-term planning certainty for projects that can take up to 10 years to implement. In addition, research infrastructure for subsurface sampling, particularly in the ocean, is expensive (US$20 million or more per expedition). These costs are steadily increasing and Australian NRI needs to be funded at levels commensurate with international partner expectations. Additionally, access to a well-equipped, modern and capable research vessel fleet is essential for collecting the seabed data and samples that guide efforts to pin down the ideal locations at which to target acquisition of the subseafloor samples that allow thousand- or million-year time-series datasets to be established. Given the size of Australia's maritime jurisdiction, our research vessel fleet should include: an expanded, multi-vessel Marine National Facility that increases the at-sea time available for science and training; a modernised coastal research vessel fleet available for studies of the entire Australian continental shelf; and an additional Antarctic ice breaker that is free from

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	resupply constraints and available for meaningful science to be undertaken in the polar region, a region that is particularly important because it arguably holds the key to understanding the implications of future climate change. An expanded and fully capable research vessel fleet also positions Australia to be a direct contributor to international research infrastructure initiatives. For example, an ice breaker dedicated to science would allow Australia to provide a much sought-after platform for rapidly advancing seabed drilling infrastructure. An infrastructure contribution of this nature would position Australia as a leader in international efforts for land-to-sea drilling initiatives that combine million-year ice core drilling initiatives with offshore scientific drilling to collect samples that more thoroughly constrain the history of Antarctic ice sheet stability. Given that the Australian coastline stands to be most affected by, among other impacts, sea level rise resulting from melting ice sheets and expanding oceans, damage to infrastructure from natural hazards, and ecosystem harm through potential exploitation of subseafloor groundwater resources, there is considerable benefit in a combined NRI focus on the coastal zone. Considerable momentum has built in this space in recent years through planning for the CoastRI initiative. Future NRI would be wise to build on this start to establish CoastRI as a long-term initiative that will help build community resilience, protect and restore ecosystems, and provide a platform for elevating Aboriginal and Torres Strait Islander knowledge systems. With new NCRIS-supported opportunities for Australian-led subsurface and subseafloor sampling in partnership with international scientific drilling programs (both marine and terrestrial), Australia's NRI should also include a vision for a national research core and sample repository. This repository would not only ensure that subsurface samples are well curated and perpetually accessible, without need for duplication, but would also potentially provide a means for Aboriginal and Torres Islander peoples to maintain access and oversight of materials collected on Country.
213_Roadmap Survey_ Monash Centre for Electron Microscopy (MCEM), Monash University	As a major node of NCRIS-funded Microscopy Australia and constituting national infrastructure, the Monash Centre for Electron Microscopy has enabled critical research in ALL the challenge areas and 4 out of 5 priority areas listed above. This research has taken place at the national level, involving cross-national teams, with translation to industry. Key capabilities for driving further advances in those priority areas and beyond must include both nationally significant instrumentation, highly specialist expertise plus an environment providing "supporting/feeder" instrumentation. In more detail: **Nationally-significant Instrumentation:** 1. Atomic-scale, ultra low-dose imaging, in three dimensions, of delicate materials (essential for nearly all materials). Electron microscopy currently can provide atomic-scale structural information in two dimensions, but routine access to the third will require new technology (fast, sensitive detectors and electronics). This will benefit all fields mentioned above. 2. Atomic-scale, ultra-low dose imaging of light elements such as lithium (essential for characterising materials as diverse as membranes for lithium extraction, solar-cells and ultra-high-strength lightweight alloys for transportation).

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	3. Single-atom sensitivity for the identification of all chemical elements. This will benefit all fields mentioned above. 4. Atomic-scale imaging of dynamic processes (essential for characterizing the evolution of materials under different conditions). This will require microscopes with much higher vacuum than currently available and significantly faster detectors. This will benefit all fields mentioned above. 5. Ultrahigh energy resolution (<5meV) with atomic spatial resolution for the measurement of materials electronic and optical properties in the microscope, for correlation with structure and chemistry at the atomic scale. This will particularly benefit Challenge Areas 3-8. 6. Atomic-scale characterization of materials at temperatures down to liquid helium, for example for the study of quantum materials and some beam-sensitive materials. This will particularly benefit Challenge Areas 4,6 and 8. 7. Field-free transmission electron microscopy, enabling magnetic materials to be characterized at much greater spatial resolution than currently possible now. This will benefit Challenge Areas 1, 3-8. Some of these capabilities, at least in part, are already available outside of Australia (Instrumentation Capabilities 4, 7). Rapid technological advances in electron microscopy hardware and computational methods are taking place now that offer the prospect of Instrumentation Capabilities 1-3, 5 and 6 becoming a reality within the next 3 to 5 years. This will enable the development of new materials and devices for health, the environment, energy, mineral extraction…etc. Such advances must be enabled at the national infrastructure level so they can be accessed by all Australian researchers and benefit Australian society and industry. **Expertise:** Without expert staff to run complex cutting-edge instrumentation, such instrumentation cannot be utilised to its full capability, if at all. The “human capability” is as critical as the instrumentation, and it is something that must be developed alongside it, as new technology becomes available and is improved locally. Owing to its complexity, such instrumentation can take several years to generate research outputs. It is therefore essential for expert staff to have sustained tenure, that lasts at least as long as the lifetime of the instrument (typically 10 years or more). Supporting/feeder infrastructure; Nationally-significant instrumentation also needs to be housed within an environment that provides the requisite supporting infrastructure, such as a stable building, specimen preparation equipment, inert specimen transfer and feeder instruments for preliminary or supporting experiments.
214_Roadmap Survey_ South Australian Museum	We recommend the establishment of a dedicated National Collections Infrastructure Program. This initiative would strategically target Australia’s critical infrastructure gaps in taxonomy, biodiversity documentation, and conservation. Key elements would include upgrading physical collection storage facilities to safeguard specimens from climate-related risks; expanding genomic, genetic, and molecular research capabilities within museums; and significantly investing in workforce capacity by creating new positions and training programs, including dedicated roles for Indigenous knowledge holders. Medium-term goals would involve comprehensive digitisation of priority

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	collections (type specimens, threatened species, culturally significant objects), substantial growth in the trained taxonomic workforce, and expanded molecular research capabilities. Establishment of this new capability within the next 2–3 years, achieving full operation by 2030, is essential to support Australia's commitment to zero extinctions, address the urgent taxonomic impediment, and enhance national resilience in biodiversity conservation and environmental management.
215_Roadmap Survey_ Stephen Rintoul	Risk of rapid sea level rise from instability of the Antarctic Ice Sheet: the need for an observing system on the continental shelf of Antarctica Australia is uniquely exposed to sea level rise, with half a million coastal properties already uninsurable due to high flood risk. The rate of global sea rise has more than doubled over the past 30 years as a result of ice sheet melt and continues to accelerate. As sea level rises, the risk of coastal flooding will increase, with today's 1 in 100 year floods anticipated to occur weekly by 2100 on parts of Australia's most populated coastlines. The largest, and most uncertain, contribution to future sea level rise is the Antarctic Ice Sheet. Melt of the Antarctic ice sheet may also drive tipping points in ocean circulation, with projections of a 40% slowdown of the deep overturning circulation by 2050, reducing the ocean's ability to store heat and carbon and providing a positive feedback on climate change. The vulnerability of the Antarctic Ice Sheet is largely determined by the surrounding ocean: ocean heat melts ice shelves, which results in more rapid drainage of Antarctic ice to the sea, raising sea level. And yet, we have no observing system in place to observe the ocean on the Antarctic continental shelf, and some critical locations have never been sampled. Ocean observations on the continental shelf of Antarctica have been challenging because the region is remote and often covered with heavy sea ice. However, recent advances in autonomous instrumentation mean that it is now possible to collect the sustained, year-round observations needed to assess the vulnerability of the Antarctic Ice Sheet and its contribution to sea level rise. Pilot deployments have demonstrated that autonomous profiling floats provide a feasible and cost-effective way to sample the Antarctic shelf, including beneath sea ice and ice shelves. To enable reliable and useful projections of future sea level rise, investment in observations on the Antarctic continental shelf is essential. The critical research infrastructure required is a mix of platforms that can deliver sustained, year-round observations of water properties and circulation on the Antarctic continental shelf. Profiling floats will provide the backbone of such an observing system. Recent deployments have shown floats to be robust and cost-effective autonomous instruments that can be deployed by both ship and aircraft. Instruments moored to the seafloor or ice will be used in particularly critical locations (e.g. in warm water inflows to ice shelf cavities). The proposed observing system would complement existing satellite missions. The medium term goal is to establish observing systems at the ice shelf and glacier systems in the Australian sector of Antarctica that are most likely to contribute to future sea level rise (Totten, Denman and Cook). Within 5 years, the observations will be used to provide the first assessment of ice sheet vulnerability based on observations from this part of Antarctica. Longer-term goals include expanding the

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	spatial coverage of the observing system to other areas of the Antarctic continental shelf. Research communities that will benefit from the proposed infrastructure investment include climate scientists, sea level researchers, oceanographers, glaciologists, ice sheet modellers, earth system modellers, Antarctic marine ecologists, experts on flood risk, and climate adaptation researchers. **Timeframe** • Year 1: broad consultation to complete observing system design; seek international co-ivestment; seek support for deployments • Year 2: Deploy profiling floats near Totten and Denman glaciers; data publicly available immediately after transmission by satellite • Year 3: Expand float observing system to other parts of the continental shelf and to use of other platforms • Year 4: Initial synthesis of multi-year data sets to identify parts of Antarctic most exposed to ocean heat • Year 5: Assessment of vulnerability of the East Antarctic Ice SEnd users of the research enabled by the investment in an East Antarctic Shelf Observing System will include government and community leaders who need to plan for how to adapt to rising sea levels. At present, the timing of sea level exceeding a given threshold is highly uncertain. This makes it difficult to plan. Sea level rise puts at risk infrastructure with multi-decadal lifetimes (e.g. roads, airports, schools, hospitals, factories). Given that the cost of defending just the largest coastal cities from rising sea level has been estimated to exceed $1 trillion a year by 2070, the remaining large uncertainty in how much and how fast sea level will rise means there is substantial risk of maladaptation. For low-lying island states, a critical question is when critical thresholds will be passed that threaten their viability. An ocean observing system on Antarctica's continental shelves is an essential part of delivering to end users the information they need to respond effectively to future risks.
216_ Roadmap Survey_ School of Science, Edith Cowan University	No response to question 35 submitted.
217_Roadmap Survey_ Commonwealth Scientific and Industrial Research Organisation (CSIRO)	In situ ocean observing is limited by the ability to make comprehensive observations due to remoteness, and the sheer scale of the ocean environment. A significant information gap in the deep ocean and under ice exists, along with the need for improved seabed mapping globally. Many of these challenges will be tackled by the rapid expansion and uptake of unmanned semi-autonomous and autonomous systems, supported by dedicated manned research infrastructure such as RV Investigator and a coastal vessel fleet. **Proposed Infrastructure Capability** To address the significant challenges posed by the ocean environment and enhance regional and global-scale research, the following infrastructure capabilities are proposed, currently all of which require secure funding and/or a commitment to develop to scale: 1. Development of Autonomous Platforms: Investment in more affordable, modular, capable, and easier-to-maintain autonomous

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	systems. These platforms should be able to operate in various ocean conditions and provide comprehensive data on parameters such as salinity, temperature, nitrate, pressure, oxygen, and biomass. Creative new types of platforms and compact, low-power sensors to expand autonomous observations and augment existing marine research delivery options. 2. Connectivity: Continued expansion of mobile network capabilities and satellite connectivity to ensure reliable communication with Marine Autonomous Vehicles (MAVs), enabling real-time data transmission and remote control. 3. Integration of AI and Machine Learning: Development of the application of AI and machine learning for navigation, collision avoidance, and route optimization. These technologies will help adapt to changing conditions and optimize their operations for maximum efficiency. 4. Support for Research Vessels: Develop pathways for testing and trialling new technologies on existing platforms such as RV Investigator to support the transition to more autonomous operations and extending the reach the autonomous systems can have. **Medium-Term Goals** To achieve the proposed infrastructure capabilities, the following medium-term goals are proposed: 1. Regulatory Framework: • Overcome regulatory constraints to ensure the safe deployment of MAVs. This includes developing standards and guidelines for the design, operation, and maintenance of autonomous platforms, as well as addressing legal and liability issues. 2. Adoption of Autonomous Vessels: • Increase the use of semi-autonomous and fully autonomous vessels for research projects with funding support for existing dedicated resources within an integrated coastal and blue water research vessel fleet. This will enhance the scope and efficiency of marine research, allowing scientists to collect more data over larger areas and longer periods. • Further development of Remotely operated Unmanned Underwater Vehicles (UUVs, Unmanned Surface Vehicles (USVs), Autonomous Surface Vehicles (ASVs) and Autonomous Underwater Vehicles (AUVs) supported by manned, dedicated platforms such as RV Investigator, will allow more temporal and spatial coverage of measurements through extension of range and near real time control. 3. Hybrid Vessels: • Develop vessels that combine traditional crewed operations with autonomous capabilities to deliver flexible and efficient approach to research, allowing for incorporation of fully autonomous operations. 4. Data Portals: • Link the observing network to data portals that can be accessed by multiple users. This will ensure that the data collected by autonomous platforms is widely available and useful for various research communities, facilitating collaboration and knowledge sharing. **Impacted Research Communities**

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	The proposed infrastructure capabilities and medium-term goals will impact a wide range of research communities, including: 1. Marine Scientists: Enhanced capabilities for collecting comprehensive oceanographic data will support marine scientists in studying ocean processes, ecosystems, and climate change. 2. Environmental Researchers: Improved data on ocean conditions will aid environmental researchers in understanding and mitigating the impacts of human activities on marine environments. 3. Climate Scientists: Access to more comprehensive and accurate ocean data will help climate scientists model and predict climate change and its effects on global weather patterns. 4. Maritime Security Experts: Autonomous surveillance and patrolling capabilities will support maritime security experts in monitoring and protecting ocean areas from illegal activities. 5. Technology Developers: The development and deployment of advanced autonomous platforms and sensors will provide opportunities for technology developers to innovate and create new solutions for oceanographic research. **Timeframe for Establishment** The proposed infrastructure capabilities and medium-term goals are to be achieved within the following timeframe: 1. By 2030: Achieve widespread adoption of semi-autonomous vessels, with the necessary infrastructure and regulations in place to support their operation. This will involve significant investment in research and development, as well as collaboration between industry, government, and academia. 2. By 2040: Integrate fully autonomous vessels significantly into the maritime industry, enhancing the efficiency and scope of marine research. This will require continued investment in technology development, as well as efforts to address regulatory and operational challenges. 3. By 2050: Achieve full-scale deployment of MAVs, alongside green research vessels to contribute to net-zero emissions and creating a digitally connected maritime network. Marine science operations require a mix of autonomy and “green” manned research vessels, as there are activities on research vessels that will likely never be replaced. This process will involve the widespread adoption of advanced technologies, and the development of new business models and operational practices.
218_Roadmap Survey_Microscopy Australia	Microscopy Australia’s researcher consultations revealed two major needs: an uplift in core capabilities, and a new focus on advanced optical microscopy. **Uplift in core capabilities** Structural knowledge is the thread that weaves through all knowledge creation. It underpins innovation, validates models, and unlocks new perspectives. At Microscopy Australia, we empower researchers to see and understand the world at its most fundamental levels—whether it's mapping atomic arrangements in next-generation quantum devices, developing sustainable biomaterials, understanding

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	antimicrobial resistance or tracing the origins of critical minerals for green technologies. By mastering matter at the atomic and molecular scale, we drive breakthroughs that reduce energy and resource consumption, accelerate medical advances, and shape the future of materials science. Our facilities and expertise provide the foundation for tomorrow's discoveries. Our consultations of over 200 researchers indicated two core needs: new instruments and more staff. Access to essential microscopes is currently at risk as 60-80% of the microscopes across Microscopy Australia are expected to reach end-of-life by 2030. Without significant investment and careful planning at a national scale there will be significant bottlenecks resulting in unacceptable delays and efficiency reductions in in research training and grant outcomes. **Molecular-scale light microscopy:** In 2023 the Advanced Imaging Center at HHMI Janelia, published a review: "Imagining the future of optical microscopy: everything, everywhere, all at once". This paper sets out the advances needed to see into living cells; anything, anywhere and anytime. These will allow researchers to see sub-cellular molecular movements, actions and processes – critical to tackling many of the world greatest health challenges. The review identifies significant advances as: light sheet microscopy, super-resolution microscopy (Nobel Prize 2014), label-free microscopy, and machine-learning-controlled and adaptive microscopy. With increasingly constrained resources, Australia must develop a national strategy to ensure life science researchers can access world-class light microscopes, data analysis tools and expertise. In 2007, Microscopy Australia, was tasked to provide coordinated open access to advanced microscopes and highly sensitive microanalytical tools and expertise. This has focussed largely on electron microscopes. The 2016 Roadmap identified an uplift for microscopy and this resulted in expansion into Victoria, but kept the focus on electron microscopes, partly due to their significant cost, $3-8 million. Numerous international examples exist, including HHNI Janaelia (USA) and EMBL (Europe), where significant expertise has been coordinated and harnessed in advanced light microscopy to unlock new knowledge in life sciences and enable biomedical innovation. Recent advances now position advanced optical microscopes alongside electron microscopes as a critical, nationally significant area of research infrastructure, needed to enable our many world-leading biomedical researchers. From the Strategic Examination of R&D discussion paper, Australia's citations for biomedical and clinical sciences is 200% above the world average, indicating Australia's significant research strength in these areas. Advanced optical microscopes have now reached nano-scale resolution and are capable of tracking large numbers of molecules simultaneously and observing their rapid movements. Many new and complementary super-resolution techniques are emerging to tackle different demands in biomedical research. These highly complex technologies enable researchers to observe biological processes in real time in live cells providing vital insights for health and agricultural outcomes. This requires significant expertise for sample preparation, microscope operation and training, data acquisition and analysis. Open access to a nationally significant suite of advanced optical microscopes is a substantial capability gap requiring national coordination.

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	This need was clearly identified by Australian researchers in the 2021 NRI roadmap survey. When asked which NRI capabilities they would use more of in coming years, they identified microscopes and imaging (a term used interchangeably with microscopy in life sciences) as 2 of the top 4 needs. Imaging was also identified as the second highest emerging need, with live-cell imaging – one of the light microscopy techniques described above – highlighted in the survey summary. Despite this clear identification of the need for microscopy, there was no investment in light microscopy over the last roadmap period, and extremely limited investment in all other microscopy and micro-scale imaging techniques, just 1.8% of the total funding pool, despite being identified the highest area of need after HPC/data storage. Delivering national research infrastructure coordination in light microscopy, could be efficiently achieved by expanding Microscopy Australia's scope to include advanced light microscopy, in line with current European and USA strategies. This will ensure the best outcomes for nationally coordinated advanced light microscope technologies and their use in correlative and multi-modal approaches. Microscopy Australia is working with members of the NCRIS Health Group, on synergies and opportunities in light microscopy. This emphasises why the whole NRI ecosystem is critical and must be supported. Many Microscopy Australia users also use other NCRIS facilities (MicroAU has been jointly acknowledged in papers with 18 NCRIS projects). There is clearly a need to accelerate support for potential biomedical advances that build on Australia's strengths. This, combined with the expertise and coordinated approach to training and machine learning tools that Microscopy Australia provides, will increase knowledge generation in health, medical and life sciences.
219_Roadmap Survey_ Emily Kahl	A major gap in the current National Research Infrastructure is the lack of support for research software development, especially maintenance of existing, mature computational tools. The lack of a pathway for sustainable research software development has substantially hindered Australian researchers' capabilities in this field and results in important development work being abandoned once short-term funding runs out. There are successful schemes for sustainable research software development overseas which could serve as a potential model for this, including the Software Sustainability Institute in the United Kingdom, as well as the Chan-Zuckerberg Initiative's "Essential Open Source Software for Science" in the United States. Building such a capability at the national level would establish Australian sovereign capacity in research software, especially in the emerging fields of machine learning and artificial intelligence (as applied to science), where currently Australian researchers are almost entirely reliant on software developed overseas. To meet the needs of the computational science community, such a body should: • Operate across all digital research domains in Australia, including both traditionally software-heavy fields like theoretical and computational chemistry, and emerging data-driven fields such as computational biology, • Provide policy advice and advocacy for research software in Australia, • Provide training and upskilling for researchers and students in both fundamental software, engineering skills and in emerging technologies such as AI and machine learning • Coordinate with universities, the private sector and NCRIS facilities such as NCI, Pawsey, ARDC and ACCESS-NRI to ensure a

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	cohesive national strategy around research software and sustainability, • Where possible, directly support the maintenance, governance and sustainable development of critical pieces of research software in such cases where existing schemes fail to meet the community's needs. Medium-term goals would be: • Provide training to researchers and capability-building programs in research software engineering practices, especially in emerging fields such as AI and ML for which there is limited institutional knowledge among research organisations, • Provide legal advice to research software developers, such as software licensing and compliance issues, as well as advice on sustainable governance practices, - Provide expertise and communication on research software policies and priorities across institutions in the university and research infrastructure sectors • Develop a scheme to identify and support critical pieces of open-source research software. Such a scheme should focus on sustainable development practices for existing, well-established research software and should include but not be limited to bug fixes, improving software engineering processes such as automated testing, improving documentation, or community management. The scheme could be modelled after successful approaches from the private sector and philanthropic organisations, such as CZI-EOSS or Google's Summer of Code program.
220_ Roadmap Survey_ Glenda Wardle	Australia needs investment in research collaboration infrastructure similar to the National Science Foundation in the US which has funded the highly impactful National Center for Ecological Analysis and Synthesis (NCEAS) for many years.
221_Roadmap Survey_ Metabolomics Australia (AWRI Node)	The rapid advancement of mass spectrometry, nuclear magnetic resonance, metabolomics, multi-omics, bioinformatics, and data science is reshaping the research and industry landscape. A critical gap exists in training and workforce development, which threatens the effective translation of these technologies into industry applications. While skilled graduates have foundational exposure to these advanced technologies, they often lack hands-on experience with mass spectrometry and metabolomics in industry-driven service environments. This results in a steep learning curve when transitioning from academia to industry, where the demand for professionals proficient in omics-based diagnostics, analytical workflows, and data interpretation is growing. To address this, existing NRI capabilities could be enhanced through a national training framework that integrates cutting-edge omics technologies with industry-driven service models. This initiative would bridge the gap between academic training and workforce readiness, equipping students with the skills needed to contribute to food safety, environmental monitoring, precision agriculture, and biomedical innovation. A coordinated national effort would enable research infrastructure to play a greater role in workforce development, ensuring Australia remains competitive in global research and innovation. Over the next 5 to 10 years, national investment is required to establish structured training pipelines, including internships, industry placements, and advanced hands-on training within existing NRI-funded facilities. This will accelerate knowledge transfer, support

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	emerging research fields, and create a sustainable talent pipeline that aligns with national priorities in technology-driven agriculture, health, and environmental sciences.
222_ Roadmap Survey_ Australian National University	1. Tier 1 compute capability: The widespread movement in the current NDRI Strategy to include Tier 2 compute and data systems within the NCRIS framework, seeing Tier 2 and 3 as a 'gap', needs to be refuted. The most efficient way to achieve the goal for an integrated system of all levels of computing is to provide Tier 2 and 3 systems is within an integrated Tier 1 HPCD capability. 2. Space testing As the Australian space industry grows, the demand for space-testing services such as those for electronic components, novel radiation shielding materials and radiation-resistant plants increases correspondingly. Australian infrastructure is not meeting demand and international facilities have multi-year wait times and prohibitively high user charges. We have a particular gap in our translation research infrastructure, namely the ability to produce heavy ion beams with energies of 100 MeV/nucleon or greater (10-20 times higher than currently available). Establishing a nationally coordinated framework for space testing infrastructure leveraging the National Space Qualification Network is a sensible first step in developing an effective framework 3. Developing a research vessel fleet Access to a well-equipped, modern and capable research vessel fleet is essential for collecting the seabed data and samples that guide efforts to pin down the ideal locations at which to target acquisition of the subseafloor samples that allow thousand- or million-year time-series to be established. A research vessel fleet should include a Marine National Facility that maximises at-sea time for science and training, an accessible and modernised coastal research vessel fleet, and an Antarctic ice breaker – or ideally ice breakers. 4. Developing CoastRI There is considerable benefit in a combined NRI focus on the coastal zone. Considerable momentum has built in this space in recent years through planning for the CoastRI initiative. Future NRI would be wise to build on this start to establish CoastRI as a long-term initiative that will help build community resilience, protect and restore ecosystems, and provide a platform for elevating Aboriginal and Torres Strait Islander knowledge systems. 5. Collections Discussions around a consolidated approach to collections, called out in the 2021 Roadmap, has stalled (from the University's perspective). Partly this may be to do with different notions of what types of collections are in scope. There are three critical pieces that each need their own response.

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	a) Biobanks b) Indigenous Ancestors and Cultural Materials requires a national consolidated approach c) ALA and related natural collections 6. Strengthening biological models and biobanks as national research infrastructure Australia requires concerted national leadership for the strategic development and delivery of biological models as research infrastructure. The sector is more fragile than in the past roadmap. There is a significant national opportunity of supporting non-animal modelling infrastructure (requires a concerted national infrastructure response. 7. Sustaining and uplifting investment in Advanced Microscopy Cutting-edge microscopy and microanalytical tools underpin broad science disciplines, from medical, soft matter, plant, materials, agricultural and geological sciences, to address Australia’s future research and industry needs. A significant uplift in advanced microscopy is urgently required across the country. The continuation of long-term investment (10+ years) without interruption or stagnation in national research infrastructure, such as Microscopy Australia, is critical to ensure continuous high-level support for all Australian researchers at all career stages. 8. Uplifting digital Humanities and Social Sciences sapabilities Targeted investments in digital infrastructure is essential to support high-impact HASS research. We suggest the following opportunities: • Development of a HASS research software engineering (RSE) workforce. • Funding for the development of local and national HASS research infrastructure. • Guidelines for peer review and quality assessment of digital research outputs, from grant bid to end of life. • Investment in digital methods training for HASS researchers. • Recommended technical patterns for the design, development, and maintenance of HASS research outputs. • Publication of a high-level national architecture and roadmap for HASS-specific research infrastructure. • Better alignment with GLAM sector technical investments and planning. • National access to GPU for open source model inferencing. • National access to compute for cultural heritage digitisation, and development of vector stores and digital twins. • Greater emphasis on cross-sectoral investment in Heritage Science • Greater emphasis on cross-sectoral investment in the creative industries. • Stable and Long-Term Funding for NCRIS The 5-year funding periods of the current NCRIS decadal funding horizon lead to inevitable 'funding cliffs' that have stunted service

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	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. 9. Workforce Development A diverse, knowledgeable, and flexible workforce will be the main driver of success for ANU research infrastructure. As a sector we must do more to attract, retain and give job certainty to our expert workforce that underpins research. Universities are to different extents offering novel pathways such as specialist classification streams to address this, but more can be achieved in a joined-up national way.
223_Roadmap Survey_ Australian Internet Observatory	In recent years a new wave of digital transformation has seen a new generation of platforms, devices and AI capabilities impacting almost every aspect of social and economic life. The pace and scale of this change is only set to continue over the next decade presenting a wide range of challenges which will require new tools, skills and training for social science, arts and humanities (HASS) research. To achieve national research priorities and address the benefits and harms of digital technologies we need investment in research infrastructure to meet this new digital transformation challenge. Observability of digital platforms, services and smart devices is critical to our capacity to research, regulate and manage digital technologies for national benefit - to address research priorities such as health and wellbeing, community resilience and natural disasters, misinformation and social cohesion, scams, manipulation and cybersecurity, and much more. We therefore need to invest in the kinds of research infrastructure needed for HASS and Indigenous researchers, as well as the wider research community to address the digital transformation challenges of the next decade. Infrastructure capability: an expanded Australian Internet Observatory To support research in a rapidly changing and dynamic field, we need to build on and expand the capabilities of the Australian Internet Observatory and other HASS capabilities. This includes capabilities to collect, analyse, and interpret the rapidly expanding range of data from new digital services, networks and devices. New visualisation tools that can work with Generative AI and digital simlations, develop open standards and data governance for digital public infrastructure and uplift the next generation of social science and humanities researchers in digital research methods and emerging technologies. The digital transformation challenge requires investment in an expanded Australian Internet Observatory (AIO) as critical HASS NRI, focussing on 5 key areas: Data collection and auditing tools:

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	Digital platforms, services and smart devices Development of automated, adaptive data collection tools for digital platforms and services, smart data and Internet of Things (IoT) Expanded forms of crowdsourcing and data donation tools to provide access to a wide range of digital systems for auditing at scale Web scraping and API-based tools for data collection from established and emerging digital platforms, services and smart devices. GenAI and ML Research Infrastructure Domain-specific LLMs for Australian contexts, including models trained on local datasets relevant to law, health, and media studies and tools for fine-tuning open-source generative models tailored for research in HASS Secure, institutionally managed AI systems that support text, image, audio, and video synthesis for research while ensuring privacy and compliance. Visualisations, Simulation Environments and Digital Twins Researchers need a range of tools to visualise and analyse data and new technologies are opening up innovations for data analysis from digital and social data that are unprecedented. Sandbox environments that simulate platform interactions to determine algorithmic and social drivers of misinformation spread, and rigorous and independent testing of platform effects. Digital Twins for observing and analysing platforms and communication ecosystems to model the impact of regulatory interventions. A range of synthetic data and interactive visualisation tools are also required to provide insights into large scale systems and connect data across disciplines and related NRI facilities. Digital Public Infrastructure (DPI): Systems and Standards DPI is an emerging concept being adopted around the world which involves networked open technology standards built for public interest, governance frameworks and a multisector community of participants working to drive innovation in the operations of public goods. AIO's DPI program aims to: Build the capacity of all actors to implement, innovate, scale, and lead digital transformation, ensuring digital sovereignty and a thriving local digital ecosystem. Develop systems and standards for AIO and related DPI to enable data portability and interoperability which is a fundamental precondition for service delivery, credential verification, security, data privacy and data sharing in areas of social security, health, education, travel, and

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	finance. Training and Translation Research translation and engagement: A whole-of-society approach is essential for inclusive digital transformation. Governments, the private sector, civil society, academia, and individuals must have access to tools and research findings to support policy development and regulation, digital inclusion and new social and economic innovations. Expanding the skills and capabilities of the next generation of HASS researchers to understand and work with new tools and methods is critical if we are to address the digital transformation challenge. The AIO program will develop specialised training for uplift across HASS disciplines. Research communities AIO Phase 1 is being developed and led by RMIT University in partnership with Queensland University of Technology, The University of Queensland, The University of Melbourne, Swinburne University of Technology and Deakin University. An expanded AIO will look to develop new partnerships including with facilities such as the International Digital Policy Observatory at University of Sydney and the Australian Data Archive. AIO Phase 2 will continue to work closely with the wider research infrastructure sector, particularly the ARDC, AURIN, HASS and Indigenous NRI facilities, as well as Health and Environment facilities to develop interoperable, integrated and collaborative data and technology solutions.
224_ Roadmap Survey_ University of New England	Expanded methane (and other GHG) measurement facilities for ruminants to test genetics and feed supplements' impact on livestock to reduce climate impact of agriculture in Australia and with wider use internationally. Facilities enable comparison of different feed supplement's, pastures and their impact on reducing methane and other GHG, as well as the genetic traits of lines and breeds and differences between individual animals' emissions. Australia (at UNE) already has a large facility (Beef and Sheep) in world terms, however needs expanding to accommodate research and industry need.
225_ Roadmap Survey_ Collections as National Infrastructure Network	As our answers to the previous questions indicate, the CaNI network across the university and GLAM sector has identified the need for a new national research infrastructure for the collections in the GLAM sector – one that breaks disciplinary silos, is able to connect collections that are multi-modal in nature and across institutions. As others have argued, Australia's collections are foundational to our society. Collections of natural science, archival records, historical and Indigenous materials reveal Australia's deep past and our human histories, preserve lost worlds and capture the nation's memories. As such they are critical infrastructure [1]. They allow us to address planetary survival, arrest loss of biological and cultural knowledge, and create new understandings of who we are. Our current collections infrastructure, however, is not fit for purpose. This infrastructure is

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	divided by geography, discipline, culture, jurisdiction and material classification (e.g. object, natural specimen, document, artwork, born-digital item). Consequently, collections remain 'siloed' by institutions, professional routines, protocols and knowledge systems that were formed in the Enlightenment and embed the traces of colonial knowledge [4]. Disciplinary architectures built on distinctions between nature and culture, science and humanities are no longer fit for current needs. They cannot adequately include Indigenous knowledge, fail to address colonial legacies, and inhibit efforts to draw on Australia's rich past to address the problems of the future [5]. **Who is this important for?** Communities cannot discover material relevant to their history or region. The problem is particularly urgent for Indigenous communities: senior Indigenous knowledge holders may pass without being able to interpret information in collections, leading to irreversible knowledge loss. Although attempts have been made to connect social and cultural collections, these efforts remain isolated and vulnerable. The lessons learned are localised and the digital platforms rely on aging technologies [6] which are not user friendly and do not allow for natural queries [7]. Consequently, Australia's collections infrastructure does not support an ability to elicit relationships between collection objects, people, ecology and Country. While some collections have been catalogued, with data and images digitised and placed online, the existence of different metadata standards limits connections between collections across disciplines and at scale. This creates barriers to generating new forms of transdisciplinary knowledge and centering the user. Researchers and the public struggle to interlink archival, library and museum collections and connect these to specific people, places and events. Public access to these knowledge resources then, is limited – not by interest or public will but by arcane institutional arrangements and difficulties in navigating current data governance requirements, especially in relation to the use of Indigenous Knowledge [8]. A new digital research infrastructure could help to overcome these problems. While the long term need is to develop an interdisciplinary capability able to connect platforms such as ALA and TROVE with what we are calling an Atlas of Cultural Australia (ACA), the most immediate need is to enable the vast repository of knowledge held within the social and cultural collections within Australia's GLAM sector as TROVE and ALA already exist. Developing a prototype for how an ACA could be built, working across the multi-modal nature of these collections, their distribution over multiple institutions, and addressing the capacity building needs of the sector to engage in this work and that of researchers to use it to address pressing questions needs a step by step process. As long as the long term vision is agreed upon with the national roadmap, there is no reason why a step by step strategy to achieve the joint goals of building an ACA and eventually linking it to both the ALA and TROVE cannot be achieved. It might also be possible to connect such efforts to other national research infrastructure projects such as LDaCA. Our initial take would be to break this work down into the following steps: 1. Undertake a world-wide survey of initiatives elsewhere, ensuring Australia can be at the forefront of building digital research infrastructure for collections and doing so in a way that meets our needs as a settler colonial society by putting Indigenous Knowledge and Peoples at the centre of the endeavour. Doing so will require us to think in interdisciplinary ways.

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	2. Develop the social and technical foundations for a national, distributed digital platform to connect metadata on social and cultural collections across institutions and HASS and creative arts disciplines, including Indigenous Knowledge. 3. Do so with attention to the need to make these records accessible to speakers of Aboriginal and Torres Strait Islander languages, Indigenous languages in Australia's Pacific region, varieties of Australian English and migrant languages or at least to capture their languages when they are present in the archive. 4. Develop the appropriate governance protocols building on work done in the Indigenous ARDC. 5. Develop an Australian Collections Commons where tools and research into how to build digital research infrastructure for collections and how to use it can me made accessible to all researchers.
226_ Roadmap Survey_ David Etheridge	The case for an integrated atmospheric composition observing network has consistently been advocated by the main atmospheric and climate research organisations across Australia over the past 5 years with support from collaborators in our region and across the planet. As well as addressing the growing research and policy demands that an enhanced atmospheric composition monitoring network could answer, it is clear that there would be significant operational efficiencies, continuity of monitoring as well as the versatility to focus on regions and research questions that emerge. The concept reached broad community support with a proposal to NCRIS* through AuScope in 2019/20 which was unsuccessful. Workshops and discussions continue across the research community. To fulfil the needs outlined earlier, quantum increases in the number of observing stations, the capacity of a central development and calibration facility and enhancements in a data management centre would be needed. These would be enabled by the rapid improvements in commercially-available monitoring instruments that are fit for purpose. Installations (monitoring locations, compounds and frequency) would be guided by network design, with examples for Australia already available (see Ziehn et al.). A timeframe of several years to reach the goals outlined above, depending on the resources made available, should be expected. *AuScope Atmosphere Lead authors: David Etheridge (CSIRO), Zoe Loh (CSIRO), Robyn Schofield (University of Melbourne) Collaborators: University of Wollongong (Nicholas Jones), AAD (Andrew Klekociuk), ANSTO (Alastair Williams), BoM (Peter May) Ziehn, T., Law, R. M., Rayner, P. J., and Roff, G.: Designing optimal greenhouse gas monitoring networks for Australia, Geosci. Instrum. Method. Data Syst., 5, 1–15, https://doi.org/10.5194/gi-5-1-2016, 2016.
227_ Roadmap Survey_ Melita Keywood	A National Atmospheric Composition network The gaseous and particulate composition of the atmosphere determines our climate, UV radiation exposure and air quality. Management of the emissions that affect the levels of greenhouse gases, ozone depleting gases, and other active constituents is one of the most important yet demanding national and global challenges. Australia is exposed to the risks of

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	these atmospheric changes through their impacts on the environment and because the mitigation of their emissions will lead to local and global readjustments in sectors such as energy and agriculture. A comprehensive observational capability is required to understand the causes of the emissions, to track the efficacy of mitigation measures, and to avoid unwanted consequences of action. The atmosphere is the main interconnector between the emission sources, such as earth resources, industry and agriculture, and where they are removed, mainly by chemical reactions in the atmosphere or uptake by the ocean and land surfaces. The atmosphere is therefore a crucial sphere of the geosciences and monitoring its chemical changes provides the basis to track emissions and to determine their fate and their impacts. Despite this the atmosphere is not represented in the NRI facility network. As a signatory to the Paris Agreement, Australia has committed to the global effort to reduce greenhouse gas (GHG) emissions to Net Zero emissions by 2050. A national facility for spatially distributed observations of atmospheric composition will directly contribute to Australia's Net Zero ambitions, and guide appropriate climate adaptation. The need for this nationally co-ordinated atmospheric composition network has been recently raised in The decadal plan for Earth System Science: https://www.science.org.au/files/userfiles/support/reports-and-plans/2024/decadal-plan-earth-system-science-2024-33 and in the Climate Change Authority Report 2023 2023 Annual Progress Report https://www.climatechangeauthority.gov.au/sites/default/files/documents/2023-11/2023 AnnualProgressReport_0 and the atmospheric composition research community AUSTRAL - Australia's Urban Supersite neTwork for Research on Air quaLity. The University of Melbourne. Poster. https://doi.org/10.26188/28605209
228_Roadmap Survey_ OHBM Australia	Nationwide biobanking of imaging data to support data sharing and reuse. This would require a storage and access architecture as well as governance support.
229_Roadmap Survey_ ARC Centre of Excellence for Automated Decision-Making + Society	ADM+S supports the enhancement and expansion of existing ARDC HASS & Indigenous Research Data Commons facilities. The Australian Internet Observatory in particular plays a notable role in giving researchers unprecedented levels of observability of the interactions between Australians and digital platforms. There is now an opportunity extend the capabilities of the AIO to encompass the rapidly growing environment of digital devices and services, from media platforms to health apps, connected vehicles and smart devices. We see five key areas for the second phase investment in AIO. Data collection and auditing tools: Digital platforms, services and smart devices Development of automated, adaptive data collection tools for digital platforms and services, smart data and Internet of Things (IoT) Expanded forms of crowdsourcing and data donation tools to provide access to a wide range of digital systems for auditing at scale Web

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	scraping and API-based tools for data collection from established and emerging digital platforms, services and smart devices. GenAI and ML Research Infrastructure Domain-specific LLMs for Australian contexts, including models trained on local datasets relevant to law, health, and media studies and tools for fine-tuning open-source generative models tailored for research in HASS Secure, institutionally managed AI systems that support text, image, audio, and video synthesis for research while ensuring privacy and compliance. Visualisations, Simulation Environments and Digital Twins Researchers need a range of tools to visualise and analyse data and new technologies are opening up innovations for data analysis from digital and social data that are unprecedented. Sandbox environments that simulate platform interactions to determine algorithmic and social drivers of misinformation spread, and rigorous and independent testing of platform effects. Digital Twins for observing and analysing platforms and communication ecosystems to model the impact of regulatory interventions. A range of synthetic data and interactive visualisation tools are also required to provide insights into large scale systems and connect data across disciplines and related NRI facilities. Digital Public Infrastructure (DPI): Systems and Standards DPI is an emerging concept being adopted around the world which involves networked open technology standards built for public interest, governance frameworks and a multisector community of participants working to drive innovation in the operations of public goods. AIO's DPI program aims to: Build the capacity of all actors to implement, innovate, scale, and lead digital transformation, ensuring digital sovereignty and a thriving local digital ecosystem. Develop systems and standards for AIO and related DPI to enable data portability and interoperability which is a fundamental precondition for service delivery, credential verification, security, data privacy and data sharing in areas of social security, health, education, travel, and finance. Training and Translation Research translation and engagement: A whole-of-society approach is essential for inclusive digital transformation. Governments, the private sector, civil society, academia, and individuals must have access to tools and research findings to support policy development and regulation, digital inclusion and new social and economic innovations. Expanding the skills and capabilities of the next generation of HASS researchers to understand and work with new tools and methods is critical if we are to address the digital transformation challenge. The AIO program will develop specialised training for uplift across HASS disciplines and researchers across sectors and for the Research Software Engineers that work with them. **Research communities** For ADM+S AIO demonstrates the importance of NRI investment. AIO has enabled us to make ADM+S developed tools and methods available for a substantially larger research community, both inside and outside universities. We are already seeing rapid take up of the tools AIO Phase 1 provides. The Australian Internet Observatory is an initiative of the ARC Centre of Excellence for Automated Decision-Making + Society (ADM+S) in

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	collaboration with researchers and research centres, university partners and organisations across Australia and internationally. The AIO was established in 2024 with investment from the Australian Research Data Commons (ARDC) as part of the HASS & Indigenous Research Data Commons and funded under the National Collaborative Infrastructure Strategy (NCRIS). Phase 1 is being developed and led by RMIT University in partnership with Queensland University of Technology, The University of Queensland, The University of Melbourne, Swinburne University of Technology and Deakin University. An expanded AIO will look to develop new partnerships including with facilities such as the International Digital Policy Observatory at University of Sydney and the Australian Data Archive. AIO Phase 2 will continue to work closely with the wider research infrastructure sector, particularly the ARDC, AURIN, HASS and Indigenous NRI facilities, as well as Health and Environment facilities to develop interoperable, integrated and collaborative data and technology solutions. Phase 2 will also build on and extend partnerships internationally including collaboration with Smart Data Research UK, Data Donation Europe and the Internet Observatory in the US.
230_Roadmap Survey_ Busselton Population Medical Research Institute Inc	The need National investment in longitudinal biospecimen management and tracking is essential to allow readily available specimen and its associated data to support real-time research. A national network will also reduce duplication, increase efficiency, quality and collaborations. Investing in biobank infrastructure will ultimately attract more funding, both nationally and internationally, thereby enhancing innovation-driven economic growth. Urgency of action: • Immediate government and institutional recognition of biobanks as a national research priority, with dedicated funding commitment. • Implementing regulatory frameworks to sustain and protect biobank resource with a plan in establishing a fully integrated National virtual (data) and physical (biospecimen) biobank network. • Establishing Australia as a global leader by collaborating and participating in international biobanking consortia, positioning Australia as a global research hub. The future of research across multiple disciplines relies on the urgent advancement of a strong biobanking model. Biobank is essential but their development remains a long-standing unmet national priority. Australia will risk falling behind in the global research landscape without proper investment or strategic support and establishment of a strong national biobanking network.
231_Roadmap Survey_ Charles Sturt University	**New Capability Proposal: National Soil and Plant Research Centre** Australia's agricultural productivity, environmental sustainability, and climate resilience are underpinned by the health and function of its diverse soils. Yet, there is no nationally coordinated research infrastructure dedicated to systematically studying soil-plant interactions across Australia's varied agro-ecological zones. Current infrastructure, including the CSU Rhizolysimeter, provides an important foundation but is limited in scale—restricted to two soil types from the Wagga region. This presents a significant gap in addressing national research,

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	industry, and policy priorities. To address this, we propose the establishment of a National Soil and Plant Research Centre at Charles Sturt University (CSU), developed in collaboration with the Australian Plant Phenomics Network (APPN). Located in a key regional hub, this centre will position Australia at the forefront of soil and plant science by delivering nationally relevant datasets, innovative research capabilities, and wide-reaching benefits across agricultural, environmental, and policy sectors, while also strengthening research and development opportunities in regional Australia. **Proposed Infrastructure Capability** 1. Expansion of Rhizolysimeter Infrastructure • Expansion from two to six agronomically significant soil types, representing 80% of Australia's productive cropping soils. • Focus on crop root physiology at the cropping scale, bridging controlled environment and field-based research. • The proposed centre will focus on crop root physiology at the cropping scale, rather than individual plants, effectively bridging the gap between controlled environment research and field-based studies. 2. Controlled Environment Phenotyping Facility • Glasshouses over lysimeter bays for controlled temperature, humidity, light, and CO_2. • Simulation of climate scenarios and plant responses. • Integration with above- and below-ground phenotyping platforms. 3. Advanced Monitoring and Sensor Integration • Deployment of leading-edge root imaging sensors (e.g., minirhizotrons and advanced optical systems) to non-invasively monitor root architecture and dynamics in situ. • Integration of new lysimetry technologies including advanced soil moisture and nutrient sensors for real-time monitoring. Establishment of a comprehensive root phenotyping and soil hydrology network linking above- and below-ground sensor systems. • Integration with APPN's phenotyping and data platforms, with the APPN central data team leading efforts to ensure national interoperability. 4. Public Engagement, Education, and Outreach Facilities • Interactive spaces to showcase soil and plant research to students, industry stakeholders, policymakers, and the wider community. • Supports STEM education, agricultural extension, and public awareness of sustainable soil management. **Medium-Term Goals (2028–2038)**

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	• Enable research into plant-soil interactions across key soil types. • Provide integrated datasets to inform soil carbon sequestration, nutrient management, and climate-smart agriculture. • Drive innovation in crop breeding and sustainable land management. • Support predictive modelling of soil-plant-water dynamics. • Reduce cost and complexity of multi-region trials, increasing corporate R&D investment. • Strengthen Australia's global leadership through international collaborations. • Foster long-term collaboration across research, industry, government, and Indigenous communities. **Impacted Research Communities** • Agricultural Scientists, Soil Scientists, Plant Breeders • Climate, Environmental, and Data Scientists • Industry Stakeholders, Policymakers, Indigenous Land Managers • Educators, Students, Community Stakeholders **Timeframe for Establishment** • Infrastructure planning, stakeholder consultation, and lysimeter expansion. Expansion from CSU's existing facility expedites establishment. • Construction of glasshouses and installation of monitoring technologies. • Development of public engagement facilities. • Integration of datasets and establishment of research programs and collaborations. • Establishment timeframe: 2028 to 2038. **Strategic Justification** Crop-scale lysimetry bridges the gap between single-plant controlled environment research and field-scale research, providing a platform to study root physiology and soil-plant interactions under real-world conditions. No existing facility systematically studies plant-soil interactions across six of Australia's most productive soil types. Integrating advanced phenotyping, leading-edge sensors, and a national soil hydrology network, the centre aligns with: • Australia's net-zero transition. • National food security by improving drought and nutrient resilience. • Restoration of soil health, biodiversity, and landscape resilience. • Collaboration with Indigenous communities on land management and native foods.

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	• Public education and workforce development to build agricultural and environmental capacity. This nationally coordinated infrastructure cannot be realised through fragmented or institution-level investments. It requires strategic, long-term commitment at the national level to deliver benefits across Australia's research, industry, policy, and community sectors.
232_Roadmap Survey Response_ PIRL-SAHMRI	No response to question 35 submitted.
233_Roadmap Survey_ AustLit, at the University of Queensland	AustLit, a bio-bibliographical database and research platform of Australian storytelling meets the definition of National Research Infrastructure and needs to be recognised as such. It is a nationally significant asset storing invaluable data developed over twenty-five years, it serves a broad research community and both supports and hosts leading-edge research in Australian literary studies. The most enduring digital humanities project in Australia, AustLit has enabled radical new understanding of the Australian literary field since the database's inception. AustLit began as a consortium and is now housed at UQ, but it is not infrastructure that can be sustained by any single institution at an institutional level, so it is not infrastructure at an institutional level. AustLit is funded via subscription and its most significant subscriber is the CAUL (Council of Australian University Libraries) consortia, which subscribes on behalf of Australian tertiary institutions. The National Library of Australia and the NSLA (National State Libraries Australasia) are also key subscribers. Through these arrangements, AustLit remains accessible to researchers and community members across the country. AustLit also has a significant international subscriber base including, for example, The British Library, as well as university library subscribers and scholarly associations in the UK, the US, Canada, Europe, China, Japan and India making it a significant international asset as well. It is much loved and well utilised. In 2024, for example, it had almost 2,000,000 page views. AustLit uses the widely shared and mature data model FRBR (Functional Requirements of Bibliographic Records), an entity-relationship model developed by IFLA (International Federation of Library Associations and Institutions). AustLit was, in 2001, the world's first large-scale implementation of FRBR, although many international library systems, including the Library of Congress and WorldCat, have retroactively implemented FRBR. The database architecture was custom-built to implement the model. Each of AustLit's over 1,000,000 work records and 200,000 agent records have been manually indexed by AustLit's data specialists over decades as data expands and grows. The potential of AI-enhanced data enrichment to improve the quality of records is promising and this work is beginning, including from the content operations team at Clarivate. (See Elizabeth York, David Hanegbi & Tamar Ganor, 2024, Enriching Bibliographic Records Using AI – A Pilot by Ex Libris, Internet Reference Services Quarterly, 28:3, 287-291, DOI: 10.1080/10875301.2024.2361871). At the moment, AustLit has no capacity to even begin to explore this potential, and there is an opportunity to expand and participate in this project with a range of partners across the sector with national-level investment which will benefit researchers across multiple disciplines in the humanities and beyond, libraries, database custodians, and content providers across the country and the globe.

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234_ Roadmap Survey_ SmartCrete CRC	Transition to net-zero for heavy industry will, to some extent, require carbon capture technology. Globally, carbon capture technology is progressing with advancements in both capture effectiveness and reduction in price. Australia's efforts in this space are somewhat siloed and would benefit from a coordinated national approach. At the commercial scale great progress in carbon capture and utilisation is being achieved by Australian company MCi Carbon, and research efforts are being supported across a range of Australian universities through various decarbonisation initiatives. https://mcicarbon.com/
235_ Roadmap Survey_ Australian Proteome Analysis Facility, Macquarie University	Bioinformatics Training and Career Development: • Bioinformatics is a highly sought-after skillset across all biological fields due to the rapid development of technologies that generate data at an increasing pace. Processing, analyzing, and interpreting this data requires many years of specialized training. Training individuals with a broad range of skills needed for diverse multi-omics projects is challenging. Bioinformatics spans multiple disciplines, including biology, computer science, and statistics, but traditional university degrees typically focus on only one of these areas. Specialized training, often at the master's or PhD level, is necessary to achieve the rigorous output required for many research projects. Support for Core Bioinformaticians: • In Australia and globally, there is an imbalance between the limited supply of bioinformaticians and the high demand for their skills. This is exacerbated by the fact that bioinformaticians possess data science skills that are highly sought after by the data science industry, which offers competitive remuneration, well-defined career development pathways, and job security. • Core bioinformaticians often handle a high volume of work while needing to stay updated with new and emerging technologies. They are expected to work with data from new technologies as they become commonplace. Traditional training for new technologies typically occurs during the master's or PhD phase. Without well-developed and accessible training courses, core bioinformaticians may struggle to find structured and guided training to learn and adapt to these new technologies. Structured, publicly available, and open-sourced courses would be more efficient than self-teaching. • There is little recognition or accreditation for self-training, unlike mature careers with well-developed professional development resources, such as Chartered Accountants who have professional training courses and formally recognized certificates. • Bioinformatics as a career is relatively new and lacks a well-defined career pathway. Early-career bioinformaticians often face short-term contracts with little long-term security. Mid-career bioinformaticians, including professional bioinformaticians, may find their career progression plateauing, with little guidance on how to advance. Training for Domain Experts Requiring Bioinformatics Capabilities: • There is a lack of training resources for individuals traditionally trained in areas related to bioinformatics (e.g., biologists, computational scientists, software developers, and statisticians) who need bioinformatics capabilities for their research.

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	• Galaxy Australia, Australian BioCommons, and Bioplatforms Australia provide training, but not in all required fields. Genomics and transcriptomics, with a large group of practitioners in Australia, are better supported for training non-core bioinformaticians. However, support is limited for -omics areas with fewer practitioners (e.g., proteomics, metabolomics). Advocacy for Training Resources: • We advocate for more full-time equivalent (FTE) resources to support bioinformaticians nationwide in areas with fewer practitioners, such as proteomics and metabolomics. Efforts should support the development of individuals involved in multi-omics, cross-disciplinary, and multi-modal projects. • We advocate for working groups to help define career development pathways for bioinformaticians at all levels, particularly mid-career bioinformaticians, where career pathways are not well-defined. • We advocate for resources to develop bioinformatics training and foster a "community of practice" with the mission of training and up-skilling core bioinformaticians, researchers, and practitioners who wish to gain bioinformatics capabilities. Training courses should be developed, accredited, or peer-reviewed, and the up-skilling undertaken by participants should be recognized nationally and preferably internationally. Emerging Technologies: • The field is increasingly moving towards deep learning and large language models (LLMs). It is crucial to understand how these emerging technologies can be utilized for multi-omics, multi-modal, and cross-disciplinary research. These AI tools should be accessible and open source. • We advocate for substantial investment from the government and co-investment from industry to create a critical mass of inter-linked and systems-level data for training AI, machine learning, and large language models (LLMs). These datasets should be open source, open access, and adhere to the FAIR data principles—Findable, Accessible, Interoperable, and Reusable. Additionally, all raw data, associated experimental metadata, and cohort clinical metadata should be made available. • There needs to be continuity planning around the phased and continual analysis of this dataset of national importance. Potential Applications of Emerging AI Technologies: • Reducing Drug Development Time and Resources: AI technologies can streamline the drug development process, reducing the time and resources required. • Integrating Multi-omics and Multi-modal Datasets: AI can help integrate diverse datasets to model cells, organisms, or large clinical cohorts. This integration can lead to accurate predictions, potentially bypassing the need for animal research and testing, and guiding large-cohort studies with precise predictions. Privacy and Ethics:

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	• There are important questions about privacy, ethics and safety of using AI and LLMs. Advocacy for LLM Development: • We advocate for the development of an LLM specifically aimed at augmenting multi-omics, multi-modal, and cross-disciplinary research projects. This LLM would ideally provide best practices for various types of -omics analyses, covering areas such as medicine and health informatics, agricultural biology, and environmental biology. Ideally, these LLM should be open-source and open access, with seamless usage by researchers.
236_Roadmap Survey_National Open Science Task Force	**Urgent need to improve open science infrastructure** Australia has considerable expertise in Open Science and investments in infrastructure including NCRIS, funded by the Australian government. NCRIS (and organisations supported by NCRIS) do not have a specific mandate that enables Open Science. Facilities can be and are used to support research investigations, however, the products are not necessarily open. This situation could be significantly improved if NCRIS, and Australia as a whole, implemented a National Open Science Action Plan that guides the investment of resources to improve the openness of the knowledge infrastructure in line with international best practice. **The encroachment of big publishing into the university sector** There is an urgent need for Australia to regain control over its research outputs and information about its research, both of which are increasingly being captured into a small number of very powerful companies. The largest of these are Clarivate and RELX. RELX is the parent company of Elsevier and 40% of revenue comes from databases and tools according to the 2022 RELX annual report. The encroachment of big publishing into the university research infrastructure includes offering publication and data 'repositories' as part of the research management suite that do not provide capabilities and features necessary for open access services, resulting in institutions migrating community/open-source repositories into sub-optimal commercially owned ones. Australian dependency on multi-national publishers is not reducing, this market is fast consolidating with the top 20 largest publishers controlling 83% of the corpus in 2022. The former Chief Scientist of Australia, Dr Foley, argued that publisher paywalls have a negative impact on innovation and on SME enterprises - in particular (Chief Scientist's Advice on Open Science, 2023, 8). In 2024, 56% of Australian publications remained closed access (COKI, 2025). Models identified for redressing this include a consideration of rights retention (Addendum to advice on open access models: unlocking knowledge for national benefit (2023, 2). Additionally, NCRIS should support rights retention to help shift institutional practice, which, combined with investment in a national repository, would reduce the risk of multinational publishers setting the terms of engagement with our publicly funded research outputs. **Developing a migration road map to a national repository** Currently Australia has repository infrastructure at institutional level, rather than at a national level. There have been several attempts to

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	identify the nature of our repository network. The ARDC has compiled a list of data repository software and DMP tools. CAUL undertook a review of Repository Infrastructure in 2018. A list of open repositories on OA Australasia's website doesn't list the platforms on which they are based. Repository and research reporting software is often commercial and owned by a few companies – Clarivate, Elsevier/RELX and Digital Science (whose parent company is Springer Nature). It is clear that essential research infrastructure for our publicly funded research is being pulled into a very small number of commercial hands. There is an urgent need for a clear understanding of the extent of the commercial take-over of our national publicly funded research outputs and scholarly infrastructure. **The proposed infrastructure capability** 1. NCRIS, and Australia as a whole, implement a National Open Science Action Plan. 2. A central repository based on an open-source platform (such as DSpace) 3. A cross-walk capability to link existing functional repositories in institutions and academic organisations into the central repository 1. A National Open Science Action Plan National reporting on the UNESCO Recommendation on Open Science is significantly impeded by lack of relevant sector knowledge and co-ordination. This reduces the utility of reporting as a mechanism to improve national performance. NCRIS should review organisations that have used an NCRIS capability, assessed in line with the UNESCO Recommendations. 2. A central repository based on an open-source platform (such as DSpace) that can be used by researchers without access to an appropriate institutional or subject based repository to make their research openly available. 3. A cross-walk capability to link metadata from existing functional repositories in institutions and academic organisations into the central repository The purpose of the central repository is to develop an openly collection of all research outputs generated by Australian researchers. This repository provides a location for those researchers and institutions without access to a functional open access repository. It prevents the unnecessary duplication of resourcing at individual institutions to develop repositories. **Impacted research communities** All Australian researchers and their institutions would benefit from the above proposals. **The timeframe over which you advocate its establishment** Australia is an outlier in co-ordinating our national engagement with Open Science, with the heavy lifting done by voluntary organisations and committed individuals. This situation is sub-optimal. Immediate attention to this problem is required.

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	It is anticipated that the development of a central repository and the associated cross walks could be at proof-of-concept stage within 18 months to two years. The subsequent roll out including policy development and advocacy work would take a further three years to be fully operational and adopted nationally. NOST members would welcome a meeting with NCRIS to discuss these issues further.
237_Roadmap Survey_Humanities, Arts and Social Sciences Faculty, The University of Queensland	For the last 8 years, The University of Queensland (UQ) Humanities, Arts and Social Sciences (HASS) Faculty has been actively engaged in the HASS and Indigenous Research Data Commons (HASS&I RDC), as a result of ongoing NCRIS investment, strong partnerships, and university co-contributions. Investment across key focus areas has accelerated the impact of HASS and Indigenous research to deliver long-term, enduring national digital research infrastructure and improve its overall national coordination of, access to, and analysis of, large data corpus and physical and digital collections using tools such as digitisation, computational, aggregation and interpretation platforms. UQ HASS has engaged in all activity areas of the HASS&I RDC, contributing key leadership roles in the Language Data Commons of Australia, the Social Science Research Infrastructure Network, and the Australian Internet Observatory. There is also strong commitment of UQ researchers concerning the Improving Indigenous Research Capability, the Community Data Lab and the Australian Creative Histories and Futures Project. UQ social research science researchers in the Science Faculty are also shaping research infrastructure development with the NCRIS AURIN Facility with the intent to establish a UQ node of AURIN. National HASS research infrastructure through ARDC, AURIN and government, community and industry partners is approaching a standalone capability. Australia's Learned Academies for Social Sciences and Humanities are critical players, mobilising research communities and coordinated research infrastructure planning, with UQ researchers being integrally involved in these large national initiatives. UQ researchers have also led the development of the Academy of Social Sciences Decadal Plan for Research Infrastructure, which establishes the 10 year roadmap for the development of national social science research infrastructure. HASS leadership of research infrastructure supporting Indigenous research capability provides a model for sector wide leadership across the "NCRIS family" as a recommendation in the 2026 Roadmap. Our maturity as a sector extends to the establishment of an integrated standalone HASS NCRIS capability. This would work strategically across the HASS&I RDC and establish collaborations and promote interoperability to other NCRIS capabilities (e.g. AURIN, TERN, PHRN). It would also contribute to the establishment of the Indigenous NCRIS capability, and leverage government and non-government partnerships, international research infrastructure, private industry organisations, GLAM, and community associations. A new HASS NCRIS capability would support research and researchers addressing national science and research priorities, but, this will require new investment to: • enhance current focus areas of the HASS&I RDC; • build capability including further linkage between Government (e.g. ABS) and non-government research infrastructure with

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	relevant NCRIS capabilities (e.g. ARDC, PHRN); and • develop new infrastructures through Improving Indigenous Research Capabilities (IIRC), the Australian Creative and Historical Futures (ACHF), the Social Sciences Research Infrastructure Network (SSRIN), and Language Data Commons of Australia (LDaCA). In generative AI, the Australian Internet Observatory, SSRIN, and LDACA are already shaping tools and technologies to build sovereign capability and shape national sovereign capability, by testing offline capabilities to work in controlled environments and pressure test generative AI tools and AI-augmented research workflows. This work expands demand for high performance computing (HPC), training and support, and workforce development. Digital infrastructure plus AI technologies, generative AI and large language models (LLMs) will move us from statistical and computational analytics and empirics towards models, synthetic populations, and simulation. As well as analysing existing cultures, societies, social systems, structures, institutions and behaviours, we will be able to simulate and model these entities. The critical capabilities for this are local and national sovereign AI models built and trained on appropriate data for Australia. We also need secure offsite test environments to ensure cybersecurity, and support social licence, public and community acceptance, especially as we build models and synthetic data from increasingly rich digital traces of real human populations in time and space. In the future, understanding underlying social, cultural, and economic structures and how they shape policy, institutional design, behaviour change, and adoption will require different types of data – in terms of human behaviour, diverse languages, social interactions, cultural collections, community outreach, institutional and government assets – at different scales. Australian HASS researchers need to work at scale to stay internationally competitive but Australia also has the research infrastructure foundations for global leadership in HASS, with the right investment and planning. All fields and disciplines will need to consider social licence, community and social engagement and community involvement. HASS can lead this. ATSI governance models and ATSI knowledge systems are also pivotal across fields and priority areas. HASS can lead this too.
238_Roadmap Survey_ The University of Sydney	Australia's scientific landscape thrives on collaboration, yet lacks a unified national facility for Nuclear Magnetic Resonance (NMR), a cornerstone of modern research. NMR unlocks molecular insights critical to chemistry, materials science, and biomedicine—from drug design to renewable energy materials. The Australian NMR community is a powerhouse, boasting world-class expertise, cutting-edge applications, and a proven track record of innovation across universities and institutes. This community is primed to unite, ready to partner in a cohesive network mirroring the success of Microscopy Australia (MA). MA's model—linking dispersed facilities into a shared, accessible resource—has amplified impact through collaboration, training, and infrastructure optimization. A similar trial or pilot for NMR would suit this community well, leveraging existing strengths, enhancing access to high-field instruments, and fostering cross-disciplinary breakthroughs. A national NMR facility is overdue—now is the time to build it. A national facility for modern manufacturing, focused on additive manufacturing (AM), would boost Australia's innovation and economy. AM's ability to create complex, low-waste products—like aerospace parts or custom implants—demands advanced infrastructure: high-precision printers, materials labs, and pilot plants. Linking universities, CSIRO, and industry in a Microscopy Australia-style network, would democratise access, drive R&D in 3 and 4D printing and bioprinting, and attract investment. It supports net zero goals with localised,

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	sustainable production, enhancing resilience and jobs. Australia's AM community is ready—a national facility would leverage significant recent existing investment in the higher education sector and beyond. The Stawell Underground Physics Laboratory (SUPL) merits consideration as National Research Infrastructure (NRI) for its unique potential to advance diverse fields. Located 1 km underground, SUPL's low-radiation environment is ideal for dark matter detection, quantum physics experiments, and neutrino studies. Beyond physics, it can support biology—probing radiation effects on life—and geoscience, like seismic monitoring. As NRI, SUPL would unite researchers, enhance Australia's global standing, and drive breakthroughs across disciplines. NCRIS has bolstered Australia's research by funding staff (many of whom are necessarily PhD-trained) to operate our research facilities, partnering with users to maximise impact. This human infrastructure is vital. In new facilities such as those mentioned above, or in existing research facilities, these staff will integrate AI, scale our tech, navigate clinical trials, and sustain collaborations and partnerships. Continued investment in these skilled professionals ensures all facilities remain cutting-edge, driving innovation and research excellence. The human resources are the most important component of NCRIS.
239_Roadmap Survey_ Australian Antarctic Division	No response to question 35 submitted.
240_Roadmap Survey_ Kazuki Mita	No response to question 35 submitted.
241_ Roadmap Survey_ Stewart Campbell	Nuclear science is an increasingly relevant topic for consideration with the potential AUKUS development and exploration of nuclear power stations. Establishment of at least two nuclear physics Schools in two universities should be established in close collaboration with ANSTO. Potential universities include UNSW, ANU and Melbourne University.
242_Roadmap Survey_ Beatriz Pena-Molino	While the impacts of a changing ocean in Australia are felt directly at our coasts, the drivers of these changes are broad and reach far beyond our EEZ. The cost of maintaining climate relevant ocean observations increases exponentially the further we move from the coast. Under the current level of investment, IMOS has limited capability to maintain the existing near shore infrastructure and expand observations from the tropics to the pole, across the Pacific, Indian and Southern Oceans where the engine of our weather and climate is. This expansion will be critical to fill in existing spatial gaps (noting for large portions of the oceans around Australia is imposible to determine if conditions are changing, as there is no knowledge of what the "normal" conditions are), incorporate more biogeochemical and ecological observations with the more traditional and easier to measure physical parameters, and deliver data at sufficient spatial and temporal resolution to make it relevant to stakeholders and decision makers.
243_Roadmap Survey_ Yun	No response to question 35 submitted.

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244_Roadmap Survey_ Bradley Moggridge	There is growing evidence to indicate that conservation (water, climate and ecosystem) outcomes improve, and well-being is enhanced, when legislative and policy settings are equitable, supportive and designed to recognise knowledge by empowering environmental stewardship of Indigenous peoples and local communities. https://public-health.uq.edu.au/ipcc-voices
245_Roadmap Survey_ Genomics WA	Our NRI facilities have experienced and skilled staff who are capable of providing high level training to enhance STEM skills. For genomics such trainings also require access to latest instruments. Adding a second function to NRI capabilities as advanced training centres will require little investment but deliver a huge impact. This will enable upskilling of local workforce to build capacity and capability within Australia to meet our needs.
246_Roadmap Survey Response_ Division of Plant Sciences, Research School of Biology, Australian National University	Related to the comments on need for the plant/environment/agricultural capabilities nationally in Australia, there are two main areas that need strong long term support to enable the kind of changes needed for the Australian agricultural sector to move forward and remain competitive: 1. Expansion of the Australian Plant Phenomics Network: the current network has only been expanded recently with 7 of APPN's 9 nodes currently being set up. Significant research outcomes will require a minimum of 5 year's additional funding to fully deliver significant outcome to Oz Ag and repay investment. 2. There is a need to strengthen staff training and expertise in the data analytics and modelling area, including use of AI for analysing more and more complex datasets from multiple phenotyping platforms. There needs to be an investment in trained staff as much as in the infrastructure itself. 3. The APPN is lacking activities in Tasmania, parts of Victoria and in northern tropical regions. As these areas are diverse in terrain and crop/native plant cover, infrastructure and analysis tools would have to be adapted. 4. There is a need for a national facility to monitor below ground phenotypes, e.g. in an expanded Lysimeter facility or large scale rhizobox monitoring facility with digital phenotyping tools. This is important because of the growing recognition that traits such as root architecture, root metabolites and the root-soil microbiome are important drivers of aboveground productivity. 5. Australia is facing increased crop and native plant disease pressure that requires remote monitoring, e.g. through spectral features reflected from leaves that are indicative of disease development. 6. Scaling from field robotics to drones to satellites would be an essential expansion of our capabilities in Australia. Again, this requires large scale national infrastructure, including software development, staff training, ongoing support and data analytics tools. Equally, there is a greater need for a well supported network of microscopy facilities that would allow high throughout phenotyping of traits at a cellular level, e.g. anatomical and cell-level morphological trait detection in plants, detection of fluorescent signatures from

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	tissues as indicators of disease or stress from climate change. Increased capability to enable correlative and multimodal microscopy solutions for more complete, multiscale and integrated data from samples across the discipline spectrum, especially in the agriculture sciences. New developments in more integrated systems would enhance our ability to capture these types of data, and then to provide support for analysis of these complex data sets. We are currently lacking the infrastructure as well as trained staff to develop data analysis pipelines.
247_Roadmap Survey Response_ Himanshu Joshi	This project we are embarking upon aims to revolutionise the diagnosis of rare diseases by leveraging RNA sequencing (RNAseq) to uncover and interpret complex splicing variants, a frequent yet under appreciated cause of disease. By integrating bioinformatics and high-performance computing (HPC), we intend to build a comprehensive, publicly accessible dataset of splicing patterns across diverse tissue types and conditions. This dataset will serve as a critical resource for the identification and characterisation of splicing abnormalities, facilitating accurate diagnosis of previously undiagnosed cases. Our approach combines our bespoke RNAseq analysis pipelines adapted to run in an HPC environment, enabling the alignment and processing of large-scale RNASeq datasets s. This publicly available resource will enable clinicians and researchers to decode splicing-related mechanisms, paving the way for personalised medicine and improved therapeutic strategies for rare disease patients worldwide. tr The majority of workflows we currently use involve alignment of RNASeq (Short and Long read) and post alignment analysis. At present, the workflows are based on snakemake, but we plan on migrating to Nextflow. A goal is to transition to singularity to ease software maintenance and reproducibility. This project is intended to continue over the next 4~5 years and will involve and aims to build a national pipeline Year 1: Establish governance, Set up computational infrastructure Year 2: Continue diagnostic services, perform cost evaluations, benchmark research methods, expand computational resources Year 3: Implement advanced diagnostics and research into RNA therapeutics, refine computational analytics, Year 4: Analyse trial results, and disseminate findings widely. Facilitating this requires compute and storage including: • Bucket (S3 like) storage to store raw sequencing files (but backup and long term archival) • Compute for running batch workflows • Disk storage connected to Compute nodes to store transient data • Container services for orchestration of Docker / singularity containers • 64+ CPU cores • 15 Tb for storage of raw sequencing data (30 Gb per sample x 500 samples over 2 years)

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	• 6 Tb for storage of aligned files including associated metadata
248_Roadmap Survey_ Edward Doddridge	No response to question 35 submitted.
249_Roadmap Survey_ Rebecca Montsion	No response to question 35 submitted.
250_Roadmap Survey_ The National Sea Simulator. the Australian Institute of Marine Science	No response to question 35 submitted.
251_Roadmap Survey_ Rose Franco	Proteomic and transcriptomic analyses of mixed culture systems for additive manufacturing of cell and gene therapies.
252_Roadmap Survey_ Cath Moore	Australia is poised to be of global importance in ensuring there is good global diversity in genomic data sets utilised for clinical trials and drug discovery. We must ensure that we have the appropriate genomics capability and capacity to capitalise on those opportunities. This requires the genomic research infrastructure established using NCRIS funding to be set up to perform genomic testing under NATA 15189 regulatory conditions (clinical accreditation). Currently, there is only one such facility in Australia (AGRF), and the cost of maintaining the required clinical accreditation has been borne entirely by that facility. As the volume of research work requiring clinical accreditation grows (it has grown 100% in the past 3 years) funding support will be required. For example, a common issue for most laboratories with clinical accreditation (eg public and private pathology labs) is having a fit for purpose laboratory information management system (LIMS). LIMS is the infrastructure that orchestrates and tracks the movement of samples and data in and out of the laboratory and analysis processes and is critical to ensuring compliance with the regulatory requirement of processing clinical samples. To upgrade LIMS cost ~$2M, and currently NCRIS does not recognise this as "infrastructure" and so does not provide support. Establishing dedicated infrastructure for clinical research will equip Australia to play a role in the global drive to utilise genomics to positively impact community health. It will attract global pharmaceutical companies to conduct their clinical trials and drug discovery work here, it will enhance opportunities for Australian researchers to be engaged in global health and research initiatives, and this in turn will provide life saving opportunities for Australian people to have access to clinical trials to improve health outcomes. With clinical accreditation, these research facilities can also support public and private pathology laboratories when required. By labs like AGRF providing more cost-effective genomic sequencing, with faster sample to data turnaround times, pathology labs can focus on the critical task of analysing and reporting of the data, and interpretation of those results to inform the patient's diagnosis and treatment plan. As clinical genomics becomes increasingly entrenched in our health systems, this model offers a path to provide equitable access to

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	testing, at the lowest cost, with States providing the resources to ensure that data is effectively interpreted and
253_Roadmap Survey_ Bioplatforms Australia Ltd	No response to question 35 submitted.
255_Roadmap Survey_ Indigenous Data Network	Proposed infrastructure capability: Aboriginal and Torres Strait Islander Research Data Commons (ATSIRDC) Indigenous research data is located across all academic disciplines, including health and medicine, environmental science and ecology, social sciences, law and policy, arts and humanities, education and technology and innovation. Given its breadth, it is inherently interdisciplinary and intersects with all research communities across Australia. A new National Research Infrastructure (NRI) capability focusing on scaling up the Indigenous Data Network's ARDC HASS&I 'Improving Indigenous Research Capabilities (IIRC)' project is critical for recognising, securely storing and effectively and appropriately utilising the wealth of Aboriginal and Torres Strait Islander data for research, policy-making, and cultural preservation. Led by Distinguished Professor Marcia Langton, a descendant of the Yiman and Bidjara nations, The IIRC project is a critical initiative aiming to build the capacity of Indigenous research data communities by developing and improving access to secure, culturally appropriate data management tools and platforms that enable more effective management, sharing and protection of Indigenous data in alignment with Indigenous data governance principles. The project has made significant advances to foster collaboration between Indigenous communities, researchers and other Indigenous data custodians, providing essential training, resources, and tools to strengthen Indigenous participation in research. Despite its achievements, the IIRC project lacks the scale and investment required to address the extensive needs of Indigenous data communities across Australia. To support Indigenous data governance, protect cultural heritage, and integrate Indigenous knowledge into research, significant investment in long-term research infrastructure is required. This includes dedicated resources for managing, protecting, and sharing Indigenous data to facilitate large-scale research, policy development, and community-driven initiatives. Such investment is essential to meet growing demands for digital infrastructure, data security, cultural protocols, and supporting Aboriginal and Torres Strait Islander communities to maintain control over their knowledge. To appropriately scale the IIRC project to a new NRI capability would require four years, enabling collaboration across disciplines and Indigenous data communities, testing and iterative development. This timeframe would support the development and implementation of a data commons that is robust, secure and capable of embedding Indigenous data governance whilst promoting Aboriginal and Torres Strait Islander self-determination and cultural integrity. Professor Langton and the Indigenous Data Network would be pleased to elaborate on our survey responses and offer further advice to the Department of Education.

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256_Roadmap Survey_ Damien Cleary	Advanced pilot-scale gas fermentation test facility which has the capacity to develop high-efficiency microbial systems for the production of high value products as well as bulk commodities from one carbon emissions (CO_2, CO, CH_4). Which includes infrastructure for Metabolomics and metabolic engineering to analyse metabolites targeted through metabolic engineering. A research hub to facilitate collaborative and contract research projects.
257_Roadmap Survey_ Science & Technology Australia	No response to question 35 submitted.
258_ Roadmap Survey_ Peng group at AIBN	No response to question 35 submitted.
259_Roadmap Survey_Advanced Instrumentation Technology Centre, Australian National University	The missing capability is a mechanism to ensure a sustainable high technology research engineering work force. This investment need not necessarily be direct funding support of any individual university research groups. Rather via a strong strategic focus on enabling engagement with national and international initiatives through stable baseline funding for research instrumentation projects pursued by the Astralis consortium is required. This would ensure excellence in science productivity while securing the skilled workforce, ensuring they are available at short notice to address programs aligned with national priorities as they arise. The uncertainty around the availability of such funding inhibits engagement with major international initiatives and holds back investment in people and emerging technologies.
260_Roadmap Survey_ Haxby Hefford	No response to question 35 submitted.
261_Roadmap Survey_Zero-Error Systems Pte. Ltd. Singapore	No response to question 35 submitted.
262_Roadmap Survey_ Mengwei He	No response to question 35 submitted.
263_Roadmap Survey_ Pawsey Supercomputing Research Centre (Pawsey)	The need In recent years there has been greater convergence between artificial intelligence (AI) and high performance computing (HPC). Cutting-edge HPC systems, such as Setonix, increasingly serve dual roles: running traditional scientific simulations and training or deploying AI models. Likewise, AI research at scale now relies on HPC-class infrastructure (multi-GPU clusters, supercomputers) to train massive neural networks. Examples of this work at Pawsey include:

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	• Traumatic Brain Injury: https://pawsey.org.au/case_studies/traumatic-brain-injury-predictions/ • AI to support clinician to provide better care: Harnessing AI for Health with WA Supercomputers (businessnews.com.au) **Medium-term goals** • Maintain performance and scaling demand of Australian research. • Move Australia towards increasingly GPU dominated offerings to take advantage of the efficiencies of that technology while moving Australin into the AI and exascale regime. • Expand access to AI architectures through an extension of the NCMAS scheme for AI. • Enhance the research outputs of Australian researchers through AI and accelerated computing to drive the next era of scientific discovery. **Impacted research communities** Enhancing AI and accelerated compute architectures is critical for multiple research communities including climate/weather modelling, astrophysics, and molecular dynamics, and particularly in emerging fields such as machine learning, large language models, and data-intensive simulations. **Timeframe for establishment** Australia's HPC offerings (such as Pawsey's Setonix) have an existing strong foundation on which to enhance and expand the GPU-accelerated HPC systems available to Australian researchers. An enhanced offering could be established within a short timeframe.
264_Roadmap Survey_ Optus	No response to question 35 submitted.
265_Roadmap Survey_ Denys Villa Gomez	No response to question 35 submitted.
266_Roadmap Survey_ The University of Queensland	Mechanisms to support new activities The five-year timescales of each iteration of the NRI Roadmap do not always allow for responsiveness when considering emergent NCRIS activities that may best serve the national interest. Under the current model, the same list of projects have acquired recurrent funding, which has been a necessary mechanism to provide ongoing support to the vital RI that has been established under the NRI initiative. However, there is a gap when it comes to new research infrastructure needs and opportunities, particularly those that cannot be meaningfully linked to an existing NCRIS project. What is the pathway through which new NCRIS projects are identified and supported? A case study provided by Professor Joseph Grotowski, Head of UQ's School of Mathematics and Physics, is illustrative. Professor Grotowski references the benefits of the establishment of a national residential mathematics research institute. A nascent form of such an institute

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	exists currently in MATRIX, a research facility currently under the aegis of the University of Melbourne. MATRIX currently fosters world class mathematics research and collaboration which has already had significant impact on the national research priorities, including 'building a secure and resilient nation.' The facility currently serves as an incubator and facilitator for the fields of AI, cybersecurity, space research, quantum research, and forecasting (weather, finance, health and natural disasters). Internationally, there has been growing investment in this style of mathematics research infrastructure, such as in the United States, China, the UK and Japan. MATRIX has previously received an ARC LIEF grant and also receives US-based funding along with contributions from other higher education providers. It has the potential for immediate establishment as an NCRIS project and scale up of service delivery. Specific research infrastructure funding relating to a mathematics research institute has been out-of-scope for past NRI Roadmaps as this facility does not align with existing NCRIS projects. UQ would welcome a move to open new pathways to establishment of NCRIS projects under the 2026 NRI Roadmap.
267_Roadmap Survey_Advanced Navigation	Australia's space industry is a close-knit and rapidly evolving ecosystem. At Advanced Navigation, we believe that collaboration between industry, academia, and government will be the defining factor in ensuring the long-term success and global competitiveness of our sector. Supporting each other—through shared infrastructure, expertise, and innovation pipelines—will be essential to unlocking commercially viable outcomes and strengthening local manufacturing. Advanced Navigation is at the forefront of Australia's space technology landscape. Our inertial navigation systems and advanced sensors are used in space missions globally, and we are deeply invested in building sovereign capabilities here at home. We have directly benefited from access to space qualification infrastructure, including facilities within the National Space Qualification Network (NSQN), such as the National Space Test Facility (NSTF) and ANSTO. These capabilities are critical in ensuring that high-performance space hardware can be qualified locally, quickly, and cost-effectively. We fully support the inclusion and continued investment in NSQN as part of the 2026 NRI Roadmap. Strengthening this network will ensure Australian innovations don't face delays or additional costs due to offshore qualification, helping our industry stay globally competitive while supporting domestic supply chains and advanced manufacturing. We encourage the Roadmap team to continue prioritising initiatives that enable strong collaboration between research institutions and commercial partners, and to ensure these capabilities are maintained and upgraded to meet the needs of future space missions.
268_Roadmap Survey_ Matthew Bailes	Gravitational wave detectors are the ultimate quantum level detector. Partnering with other countries to develop these facilities either on shore or remotely builds cutting-edge expertise in this critical domain. It also attracts our best and brightest minds to science and technology.
269_Roadmap Survey_	No response to question 35 submitted.

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Rafael Hernandez	
270_Roadmap Survey_Centre for Gravitational Astrophysics, ANU	We are proposing that a new NRI Capability be targeted to gravitational wave physical system developments. The medium term goal is to secure and grow Australia's R&D and impact in the global network of GW Observatories, create more IP in the key areas as identified earlier. This discipline nurtures adaptable, skilled graduates who diffuse into industry and defence, and can be shown to be working in front line technology areas. This NRI capability needs to be secured from Jan 2026, for 10 years to allow Australia to cement its leadership and develop a potential case for larger participation in the global GW network.
271_Roadmap Survey_ Monash University	Monash University is strongly supportive of a new NCRIS capability centred on the characterization of materials and devices for quantum information technologies, in order to support the growth of research and development in quantum technologies in Australia. We envision an extensive network of facilities which would include Monash University as well as synergistic capabilities at other universities as well as ANSTO and ANFF laboratories. Such a facility would complement the existing NCRIS capability in nanofabrication (ANFF) and imaging (Microscopy Australia). The Quantum Device Testbed Network would address a gap in quantum science in Australia: novel quantum materials and devices require novel characterization tools to verify and benchmark their quantum properties, often using specialized advanced techniques currently not available in a user facility environment in Australia. We envision that the Quantum Device Testbed Network would include advanced quantum characterization tools available at Monash University such as ultra-low-temperature, high magnetic field scanning tunnelling microscopy, ultra-low temperature cryogenic electrical measurements, and broadband (THz to visible) ultrafast pump-probe spectroscopy, to probe quantum properties at the atomic scale and extreme conditions (temperatures as low as 100 mK, magnetic field up to 14 T). The Quantum Device Testbed Network would leverage substantial investment in quantum research infrastructure at Monash and the surrounding precinct, including the $175M New Horizons Centre which includes laboratory space with exquisite control of vibration and temperature, and >$6M investment in equipment including three ultra-high-vacuum STMs, ultra-low temperature cryostats, ultra-fast optical probes from THz to visible, and van der Waals heterostructure fabrication. The Integrated Quantum Materials Foundry would also take advantage of the existing integration of Monash facilities with each other and with ANSTO Australian Synchrotron. For example, samples may be exchanged in ultra-high vacuum to integrate MBE growth, scanning tunnelling microscopy, and angle-resolved photoemission spectroscopy on the same sample without exposing to ambient. Such a facility would allow Australian quantum industry access to state-of-the-art custom quantum characterization tools which form the basis of new quantum technologies. This aligns well with the 2021 roadmap goals of providing research translation infrastructure and the National Research Infrastructure Workforce, under the theme of Frontier Technologies and Modern Manufacturing.
272_Roadmap Survey_ The University of Western	Research communities would benefit from a National Quantum Device Testbed both in the short- and long-terms. Quantum sensing devices and startups already exist, and communications are coming online. Quantum computing is looking more and more like a medium-

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Australia	term reality. For Australian researchers to capitalise on this emerging sector, we must fast track the testing and proofing required to take products out of the labs and into the market. Easing access for researchers to translate their work into commercial products will also open new avenues and career pathways for young researchers, enhancing the reputation of the field and creating a feedback mechanism whereby observed success leads to stronger talent pipelines. It should be the dream of any STEM undergraduate or PhD student that their research can change the world and have a positive impact on the daily lives of Australians.
273_ Roadmap Survey_ The Astralis Instrumentation Consortium	n/a
274_Roadmap Survey_ Zhuoqi Xiao	No response to question 35 submitted.
275_Roadmap Survey_ Virginia Kilborn	An emerging requirement is for an Underground Physics laboratory which will enable cutting-edge science such as experiements to detect dark matter, quantum technologies testing, defence applications, and radio-biology. The Stawell Underground Physics Laboratory (SUPL) is currently installing first experiments, and will be a growing research infrastructure asset over the coming years.
276_Roadmap Survey_ Australian Government DCCEEW	Australia requires access to high-performance computational and data storage capabilities to support the development and delivery of climate projections for public good science in the national interest. Climate projections in Australia already represent the largest current use of Australia's HPCD but the existing system is not sufficient to meet the needs. Australia's current HPCD system for projections science is centred around the Tier 1 National Computing Infrastructure (NCI), with computations and data largely performed on the supercomputer Gadi. The service life of this computer is coming to an end in 2025 and it will not be able to support the ongoing climate projections needs for Australia. An urgent refresh of HPCD is required to support immediate needs such as data storage for the current models, hosting of international reference datasets, and to feed the next wave of artificial intelligence / machine learning (AI/ML) and data-driven science. To provide the best information base for climate-related decisions requires a plausible range of likely climate futures which in turn requires many model runs to generate. Producing these runs at a resolution that is relevant for decision making calls for significant high performance computing resources and associated data storage. Without adequate investment in this infrastructure, and the people to develop and run the models, we risk not being able to inform decisions in response to climate change and protecting our natural and built environments, economy and people. In order to maintain an efficient and effective climate projections modelling capability that is able to support future demands requires: • A strategic framework or roadmap to provide the vision for a HPCD system and steps to implement that vision. This would encompass hardware; software, data and the people required to develop, provide input to and support that system.

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	• A single integrated HPCD system (i.e. Tier 1 or 0 facility). This will avoid Australia falling behind by:
	  ◦ Supporting collaboration and enable sharing of data, analysis techniques, knowledge and information both within Australia and internationally with peer climate and weather centres.
	  ◦ Enabling production of an ensemble of models that create a range of plausible futures and massive storage of associated data.
	  ◦ Supporting publication processes and provenance to trusted data sources (e.g., Australian observations and simulation results).
	• Staff with hybrid scientific and technical skills that can harness new technologies and capabilities, to ensure strategic infrastructure is fit-for-purpose into the future
	• Software that integrates the technology and data, and the people that develop this.
	• Communities of climate experts to maintain and grow our sovereign projections science capability and support the multi-institutional and cross-domain learnings.

277_Roadmap Survey_ Cellular Agriculture Australia	CAA submits that the 2026 NRI Roadmap should nominate biomanufacturing as underpinning the bioeconomy, as a new NRI capability. This would build on the recognition in the 2021 NRI Roadmap of the importance of the bioeconomy in the Synthetic Biology research theme, which stated "The resulting research-innovation pipeline is also set to create new, disruptive bioindustries that will ensure future prosperity by underpinning a strong and sustainable bioeconomy that supports Australian net zero strategies and targets." (p 85) CAA also submits that the biomanufacturing of ingredients and food products should be one of the priority bioindustries looking forward. **The Need** Publicly funded and accessible infrastructure to support research and development is a key requirement to advance the Australian bioeconomy. CAA's focus is food as a new bioindustry, and so provides the following information on the needs of the cellular agriculture sector. While private investment in cellular agriculture globally has grown over recent years, public research in the sector is disproportionately underfunded. As a result, scientific discoveries and breakthroughs are locked up in incumbent private companies, which widens the so-called "valley of death" between basic research and research translation for product commercialisation. This makes it increasingly difficult for new start-ups to enter the sector and, paradoxically, hinders innovation. In addition, the lack of objective academics and rigorous peer-reviewed research in these new technologies makes it more difficult to build consumer trust. Fundamentally, the need can be defined as: Pilot and demonstration infrastructure and associated upstream and downstream processing linked to research programs to optimise bioprocesses production systems etc. which could lead to up to a 50% reduction in unit costs Research to underpin the redesign of bioreactors that are designed and optimised specifically for food production. This has the potential to support process optimisation whilst also driving down capital investment requirements as the sector scales. Process optimisation and tech transfer capabilities to other

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	bioindustries such as fuel, fibre etc. Multi-use and modular facility design to facilitate the range of manufacturing technologies being developed in Australia **The proposed infrastructure capability** While current synthetic biology infrastructure exists, it is not at a scale required, nor is it designed for food production. Currently, cellular agriculture research must be undertaken in bioreactor infrastructure that is not fit-for-purpose, creating cost inefficiencies and imperfect outcomes. The key immediate research infrastructure required to develop, prototype and scale the manufacture of cultivated meat and precision fermentation products includes: Research infrastructure consisting of 25L - 2000L fit-for-purpose bioreactors is required. This allows upstream and downstream processing that can be customised to mimic the process at scale allowing optimisation of the standard operating processes and equipment that will be used at scale. Without this step, there is little way to know if production can be replicated in large fermentation tanks that perform in different environments and at different optimal conditions. Microbial strains - the development of microbial strains that have been developed with media formulations and demonstrated at scale is where research infrastructure will play a key role. Cell line repositories - existing cell lines are often proprietary and difficult to obtain, creating a high barrier to entry for researchers and companies. Ensuring these cell lines have been developed with media formulations and demonstrated at scale is where research infrastructure will play a key role. Scaffold databases - scaffolds made from biomaterials fit for human consumption have been used in the development of structured meats like steak or fish fillets. However, most existing scaffolds are made from human-derived proteins and used for regenerative medicine purposes. Whether these scaffolds can continue to underpin cultivated meat production requires more research. The cellular agriculture sector also requires a research uplift in HASS disciplines and resulting infrastructure. In order to translate research into real-world applications, research that supports regulatory frameworks and approaches, the development of global safety standards for new foods, and determining consumer attitudes to new foods is critical. **The medium- term goals** Infrastructure that can support the development of new bioindustries, including food, fibres, materials, chemicals and fuels. Specifically, the following impact could be realised: • Scale existing laboratory research capability to better prepare for commercial-scale production processes • Enable product testing, economic viability assessment, and customer prototyping within research environments

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	• Retain Australian companies and projects within the country, supported by fit-for-purpose research infrastructure • Attract foreign direct investment in the biomanufacturing sector • Position Australia as a top global destination for cellular agriculture research This, in turn would translate to the following: • Create jobs and export opportunities • Enhance supply chain resilience and adaptability • Support Australia's circularity and environmental goals **Impacted research communities** Those research communities serving food in the bioeconomy include: • Synthetic Biology • Cell and tissue biology • Microbiology • Food (nutrition)science • Food science (product formulation) • Food regulation • Plant science • Agricultural science • Bioprocess engineering • Mechanical engineering (infrastructure design) **Timeframe** This infrastructure can be supporting innovation in 1-3 years
278_Roadmap Survey_ James Buttenshaw	No response to question 35 submitted.
279_Roadmap Survey_ ARC Centre for Excellence in Gravitatonal Wave Discovery (OzGrav)	Gravitational wave (GW) detection, particularly by the US LIGO detector, is rapidly transforming observational astronomy; a field of research to which Australia has made significant contributions over many decades and has resulted in the training of numerous young STEM scientists, many of whom have then been employed by Australian industry and IT companies. Previous LIEF funding has facilitated Australian membership of the iconic LIGO Project, which provided timely access to detector

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	development and observational data. While this membership has resulted in some new research in multi-messenger astronomy, novel photonic and quantum technologies for the LIGO detectors, we have been unable to optimise and fully exploit our contributions or to bid for delivery of more significant subsystems or instrumentation due to the uncertain nature of LIEF funding. The Current exposure draft of the next Decadal Plan for Astronomy notes: The design and development of an Australian gravitational wave pathfinder is a key priority to lay the foundations to future construction and operation of a full next-generation southern hemisphere gravitational wave detector hosted by Australia. Such a project should engage international partners to bring significant investment for construction of an international facility on Australian soil. This would require, however, a significant change to the way in which the current membership of the LIGO GW detectors is prosecuted. Without this change, it will not possible to train and grow the required Australian workforce - both technical and IT - and local technical industrial capability, or to optimise and fully exploit our world-leading contributions to the US LIGO detectors, or the European Advanced Virgo and Japanese KAGRA detectors, en route to the construction of the Australian detector.
280_ Roadmap Survey_ The Australian National University (ANU)	Proposal for Recognition of the National Space Qualification Network (NSQN) as a New National Research Infrastructure Capability Identified Need: • Australia's space sector is entering a period of rapid growth, underpinned by frontier technologies in satellite design, space-based sensing, radiation-hardened semiconductors, and in-space servicing. However, one of the most significant and persistent gaps in the ecosystem is the lack of nationally coordinated, industry-accessible space qualification infrastructure. Testing and qualifying components for space—whether for launch, in-orbit operation, or reentry—is essential for ensuring mission success and reliability, but access to relevant infrastructure remains fragmented and underfunded. • Currently, Australian companies often rely on overseas facilities to conduct some of environmental and most of radiation qualification, leading to increased cost, extended timeframes, and dependency on foreign infrastructure. This undermines sovereign capability, slows the translation of R&D into commercial outcomes, and limits Australia's competitiveness in the global space and semiconductor markets. Proposed Infrastructure Capability: We propose that the National Space Qualification Network (NSQN) be formally recognized and supported as a dedicated national research infrastructure platform. NSQN is an existing, functioning framework that integrates critical infrastructure nodes across the country, and is poised to become a one-stop-shop for space qualification services. NSQN also offers a research translation-focused operating model, actively bridging research infrastructure and industry needs. In doing so, it fills a critical gap in Australia's innovation system by lowering barriers to space hardware qualification and making

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	national facilities accessible to SMEs, startups, and multinational companies alike. To meet emerging needs, this proposal also includes enhancements to existing infrastructure within NSQN, particularly: • Expansion of environmental testing capacity at the National Space Testing Facility, including Larger vibration facility, the instrumentation needed to run EMI/EMC testing, a solar simulator for Wombat XL. • Upgrades to the Heavy Ion Accelerator Facility (HIAF) to deliver 100 MeV/nucleon heavy ion beams, aligning with JEDEC and ECSS standards required for radiation qualification of advanced semiconductors. • Upgrades to laser testing facility at UOW to expand cutting edge laser testing capabilities to align with evolving new space ecosystem. • Cross-facility coordination tools to improve accessibility and service delivery. Impacted Research Communities: • Space and aerospace engineering researchers working on small satellites, propulsion systems, reentry systems, and in-orbit manufacturing • Semiconductor and microelectronics R&D teams developing radiation-tolerant or radiation-hardened components for LEO and deep-space use • Advanced materials scientists studying the impact of space environments on coatings, composites, and structures • National security and defence programs, where radiation-hardened, space-grade electronics are mission critical Call to Action: • NSQN is an established, functioning, and highly impactful network that delivers on the intent of national research infrastructure: to enable world-class research and innovation, drive industry engagement, and support sovereign capability. It responds to a clearly identified and growing need, aligns with multiple national priorities (space, defence, semiconductors, advanced manufacturing), and is supported by research, government, and industry stakeholders. • Recognizing NSQN in the 2026 NRI Roadmap—and investing in the necessary upgrades to its core facilities—will ensure that Australia can develop, test, and qualify frontier space technologies onshore, build global partnerships, and lead in emerging areas of advanced space and electronics manufacturing.
281_Roadmap Survey_ Deloitte	The National Space Qualification Network (NSQN) is crucial for advancing Australia's growing space industry, serving as a central hub for space qualification. It offers accessible, distributed testing infrastructure across Australia, enabling researchers and enterprises to qualify spacecraft, payloads, and components domestically, thus reducing reliance on costly overseas facilities. As the sector expands, the fragmented access to testing infrastructure presents significant challenges for companies developing satellites and technologies. The NSQN provides timely access to essential capabilities, mitigating delays, costs, and inefficiencies in preparing

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	hardware for launch. This is critical for Australian commercial space organisations to develop capability in time to meet global market demand, otherwise our industry will be too slow and outpaced by other nations. The NSQN integrates leading national testing facilities into a cohesive framework, delivering essential services such as thermal vacuum, vibration, pyroshock, EMI/EMC, and radiation effects testing. Over the past five years, 22 spacecraft have successfully undergone qualification through NSQN-affiliated facilities, highlighting its pivotal role in facilitating space missions. This network links industry stakeholders with specialized testing expertise nationwide, ensuring a smooth transition from R&D to launch-ready products. While these capabilities are highly relevant to the space sector, there is a significant opportunity for technology transfer, allowing these advanced technologies to be leveraged in testing across various industries. Sectors such as defence, biotechnology, automotive, and aerial systems can greatly benefit from these innovations. fostering cross-industry collaboration, these cutting-edge technologies can drive innovation, improve efficiency, and unlock new market opportunities beyond the space domain. However, without formal recognition in the National Research Infrastructure (NRI) Roadmap, the NSQN's ability to support growth, enhance facilities, and maintain world-class services is at risk. Future investment is vital for expanding capabilities, particularly in upgrading facilities like the National Space Test Facility (NSTF), the Heavy Ion Accelerator Facility (HIAF), and ANSTO. These improvements are crucial for Australian companies to maintain competitiveness globally. To position Australia as a leader in space technology, we recommend that the NSQN receive formal acknowledgment and support through the NRI Roadmap initiative. Such backing will ensure ongoing access to high-quality, cost-effective infrastructure, fostering innovation and reinforcing Australia's standing in the global space economy.
282_Roadmap Survey_ James Ryall, Thom Dixon and Jason Whitfield	**Background** Biomanufacturing involves leveraging biological systems to produce chemicals, food ingredients, materials, and more. Unlike clinical biomanufacturing (low-volume, high-value), non-clinical biomanufacturing focuses on high-volume, low-value products. Australia has demonstrated potential in this space, with companies like Cauldron Ferm (one of the largest CMOs in the Southern Hemisphere) and Vow (the only company currently selling cultivated meat to consumers). Technologies of interest include cell-based cultivation, precision fermentation, molecular farming, cell-free processes, and algae farming. **The Challenge / Gap** The main challenge identified is the missing link in the biomanufacturing slipstream: the transition from laboratory scale to commercial tech transfer and scale-up. While Australia excels in early-stage research and development (TRL 1-4), there is a significant gap in accessible infrastructure and commercial/regulatory support for scaling up production from 1-10 litres to over 500L. This gap hinders critical product testing, economic viability assessment, and customer prototyping, limiting companies' ability to raise investment or forcing companies to seek opportunities offshore or halt projects altogether.

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	The Ask (Biomanufacturing Hub) The proposal is to establish a centralized biomanufacturing hub that provides access to critical end-to-end production and process infrastructure for key biomanufacturing technologies. This hub would include: • Upstream processing facilities (1L-1000L scale bioreactors for each major production technology) • Downstream processing capabilities for purification and product isolation of major product classes • Process optimization and tech transfer capabilities • Multi-use and modular facility design to facilitate the range of manufacturing technologies being developed in Australia • [Desirable] Co-located regulatory support for OGTR, TGA, FSANZ. The hub would be designed to support various biomanufacturing technologies, including precision fermentation, cell-based cultivation, cell-free systems, and algae farming. **The Impact** The establishment of a biomanufacturing hub would have several significant impacts: • Bridge the gap between laboratory research and commercial-scale production • Enable product testing, economic viability assessment, and customer prototyping • Retain Australian companies and projects within the country • Attract foreign direct investment in the biomanufacturing sector • Position Australia as a top global destination for scale-up and pilot work • Create jobs and export opportunities • Enhance supply chain resilience and adaptability • Support Australia's circularity and environmental goals **Summary and Next Steps** The document proposes the establishment of a centralized biomanufacturing hub as a critical step in advancing Australia's biomanufacturing sector. To realize this vision and address the identified gaps, the following immediate steps are recommended: • Establish the Australian BioFutures Council to oversee and coordinate the development of the biomanufacturing sector, with a primary focus on creating the proposed biomanufacturing hub. • Charge the BioFutures Council with the following responsibilities: • Develop a comprehensive plan for the biomanufacturing hub, including infrastructure requirements, funding strategies, and operational models.

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	• Create sub-committees for talent development, feedstock sourcing, infrastructure planning, and international partnerships, all of which will contribute to the hub's success. • Seek funding for both the Council's operations and the initial phases of the biomanufacturing hub project. • Align existing programs and initiatives (such as state and federal programs such as QLD biofutures and NSW BAFI) with the Council's work to maximize efficiency and avoid duplication of efforts. Task the BioFutures Council with developing a specific biomanufacturing plan within the next year, which should include: • Detailed proposals for the biomanufacturing hub's design and implementation. • Strategies for attracting investment and partnerships for the hub. • Plans for integrating the hub into the broader Australian biomanufacturing ecosystem. • Initiate discussions with key stakeholders, including government agencies, academic institutions, and industry partners, to gather support and resources for the biomanufacturing hub project. • Begin preliminary work on regulatory frameworks and approval processes that will be necessary for the hub's operation, particularly in areas such as GM technologies and novel biomanufactured products. By focusing the BioFutures Council's efforts on developing the biomanufacturing hub, Australia can take a significant step towards becoming a world leader in the biomanufacturing revolution. This approach will capitalize on the country's natural advantages, address the critical gap in scale-up infrastructure, and serve Australia's national interests by creating jobs, enhancing supply chain resilience, and supporting environmental goals
283_ Roadmap Survey_ CSIRO	Research infrastructure plays a critical role in scientific advancement, adapting new technologies, and delivering on Australia's science ambitions. National level investment for new capabilities, and enhancements to existing capabilities, will elevate Australia's research and development to be ready to tackle current and emerging scientific inquiries. Below are some capability gaps that could be supported to elevate the national research infrastructure. Enhanced capabilities: • Enhancing High Performance Compute (HPC) Capacity: CSIRO welcomes the aspiration in the Draft Recommended NDRI Investment Plan to develop an integrated Australian HPC capability and notes that increased investment in this area is foreshadowed. • Artificial Intelligence (AI) and Machine Learning (ML): A digital infrastructure for hosting AI foundation models will attract new capability to Australia, leveraging on existing NRI investments in data access and compute, such as ACCESS-NRI, ARDC, and Pawsey. Data and Storage: CSIRO supports the 2021 NDRI Roadmap's call for system-wide enhancements to data storage and networking infrastructure.

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	• A dedicated radio transient monitoring array in the southern hemisphere: The Academy of Science Decadal Plan for Australian Astronomy (2016-2025) highlights an opportunity to amplify impact in the Square Kilometre Array (SKA) area, through small strategic investments. CSIRO welcomes the opportunity to discuss this with the NCRIS team. New capabilities: • Atmospheric Composition NRI: The Global Climate Observing system (GCOS) defines the Essential Climate Variables (ECVs) that are fundamental for national climate adaptation and mitigation planning. Currently, national research infrastructures deliver land ECVs via the Terrestrial Ecosystem Research Network (TERN) and for ocean ECVs via the Integrated Marine Observing System (IMOS). There is not currently an NCRIS facility that delivers ECVs for atmospheric composition. • Earth Observation (EO) Infrastructure: CSIRO affirms the need to support development of advanced Earth observation capabilities, as identified in the 2021 NRI Roadmap. Utilisation of earth observation data can be further applied to a broad range of science and research applications. CSIRO notes the emerging trend towards monitoring water quality. • National satellite data calibration and validation capabilities: Australia is internationally recognised for its satellite EO calibration and validation (cal/val) capabilities, spread across various organisations, including NCRIS facilities (e.g. TERN, IMOS, AuScope), government agencies (e.g. CSIRO, Geoscience Australia, Bureau of Meteorology) and universities. However, there is no central facility for accessing all cal/val datasets and expertise.
284_Roadmap Survey_ Jueming Bing	• In-situ GIWAX (GIWAX) • Travel support to national infrastructure and national facilities • 100 tesla pulsed magnet • Physical deposition clusters with in-situ characterisations (ALD, Sputter, CVD) • Scanning Tunnelling Microscopy (s-TEM) • Benchtop AFM/SEM accessible in more local labs • Solar cell certification national facility
285_Roadmap Survey_ Melbourne Initiative for Quantum Technology (MIQT), University of Melbourne	Quantum Device Testbed Network Australia's world-leading developments in quantum computing, quantum sensing and quantum technologies development has been made possible by the nanofabrication resources that have been developed within the NCRIS Australian National Fabrication Facility, quantum device fabrication capabilities through the NCRIS Heavy Ion Accelerator platform, visualisation capabilities through Microscopy Australia and device and materials modelling capabilities through access to high performance computing infrastructure. However, to maintain this international competitiveness there is now a need for quantum measurement and related capabilities to be developed as a national NCRIS platform to support the near-term and growing future needs of researchers and technology start-ups in this fast developing field that is projected to have enormous societal impact and commercial potential in the

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	coming decades. UoM strongly supports development of a new NCRIS capability to underpin and support the growth of quantum information technologies research and development in Australia. A national Quantum Device Testbed Network would provide essential quantum measurement, analysis and quantum device modelling and test facilities to help support and facilitate growth of quantum technologies capabilities and industries in Australia. The Quantum Device Testbed Network would complement the activities and capabilities of the existing NCRIS platforms for device fabrication, The Australian National Fabrication Facility (ANFF), the Heavy Ion Accelerator Platform with quantum device fabrication capabilities, and f Microscopy Australia that provides visualisation capabilities at the nanoscale. There is enormous scope for growth in quantum information technologies development in Australia but there is currently no national infrastructure providing support for quantum measurement, modelling and quantum device testing. The Quantum Device Testbed Network would provide this necessary support helping to accelerate Australia's international standing and competitiveness in quantum technologies and industries. Through network partnerships with UoM, RMIT, UNSW, University of Southern Queensland, and potentially University of Western Australia and the Australian National University, the Quantum Device Testbed Network would offer quantum technologies researchers and industries access to the quantum measurement, analysis and modelling resources that will accelerate their research and technology transfer needs and which would otherwise be cost-prohibitive and time-consuming to develop independently. The network resources would include cryogenic quantum device measurement platforms, confocal systems with interferometry and single-photon detectors, quantum sensing labs, computing and quantum computing resources and the associated expertise to facilitate user access. In parallel there would be scope to develop a Training Hub to provide a conduit for Australia's workforce to upskill in this critical field. UoM has provided very strong support for quantum computing and quantum technologies related research since its inception as a field of research. The University recognizes that the growing ecosystem of quantum technologies research in Australia cannot be adequately supported by individual facilities at this stage of its development and there is a strong need to develop a national approach. Development of a national Quantum Device Testbed Network strongly aligns with identification of step-change and priority areas as discussed in the 2021 roadmap, including research translation infrastructure and the National Research Infrastructure Workforce, and the research theme of Frontier Technologies and Modern Manufacturing.
286_Roadmap Survey_ Murdoch Children's Research Institute	Generation Australia: Unlocking the full potential of Australia's child and parent cohorts to help build Australia's research infrastructure Generation Australia is anchored by GenV and ORIGINS, two of Australia's newest, largest longitudinal child and parent cohorts with 60,000 consented and engaged families (comprising 145,000 individuals - children and their parents). Uniquely designed to test interventions at scale, these existing cohorts have a representative population which dramatically accelerates research translation. Generation Australia offers a cost-effective way to harness the power of population cohort data with existing research and investment in data linkage to accelerate research and policy outcomes and impact, benefiting researchers and government using these national assets. To deliver on this, Australia's two most internationally renowned and respected children's health research institutes, The Murdoch

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	Children's Research Institute and The Kids Research Institute Australia are joining forces to provide $100 million of in-kind existing investment from government, philanthropy and the institutes themselves toward the establishment of Generation Australia. With Commonwealth investment, Generation Australia can deliver on the NCRIS roadmap for Data Collections. Population genomic mapping is becoming cheaper and more sensitive; it allows researchers to compare diseases across the diversity of Australia's population, fast track diagnosis and personalise medicine. GenV has consent, biobanking, survey information and a cohort representing Australia's diversity. Population cohorts like GenV are ready to value add to population-based OMICS by exploring the interaction between genes and the environment. For example, how does microplastics or the microbiome impact the physical and mental health and wellbeing of children and their parents. Using population cohorts like GenV takes genomics to the next level of application. Leveraging Generation Australia, the National Health and Medical Research Council, Medical Research Future Fund and the Australian Research Council will be able to fund more research projects with greater efficiency, and lower risk profiles as researchers can access existing participants, biosamples and data linkage infrastructure. The WA Busselton Health Study found that using established cohorts delivered a social return on investment of $3.20 for every $1 invested (Commissioned report, unpublished). Cost savings can also be found by investing in better and more equitable policy and services, resulting in savings to government in the immediate -medium term and from having healthier children and adults in the longer term. Consented cohorts, designed for observation and trials, are national research infrastructure collections and assets. Unlike the UK and USA, there is no sustained research infrastructure funding for cohorts in Australia. It would be mutually beneficial to sustain and use these cohorts via the NCRIS; it also aligns to the NCRIS 2026 Roadmap to develop a national approach to collections, including longitudinal and biobank records. Generation Australia is ready to deliver the missing piece of Australia's research infrastructure.
287_Roadmap Survey _ Astronomy Australia	No response to question 35 submitted.
288_Roadmap Survey_Franco Milko Impellizzeri	New technology and research findings require collaboration between national administrative and university institutions to facilitate the adoption and translation of new technology and research findings, along with a shift in culture in research from group thinking and quantity to innovation and quality. Efficiency and control is also needed, and this requires an open science approach, greater collaboration and better governance and control. Infrastructure: • Digital repositories and data sharing platforms • Secure data systems • Infrastructure for open research software and code

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	• Independent groups of experts • Policy and governance structures • Supporting processes • Oversight bodies are needed, i.e., national or state research integrity committees and a national-level body to oversee and promote research integrity and quality, and to review institutional processes.