Australian Government

Australia's draft National Science and Research Priorities

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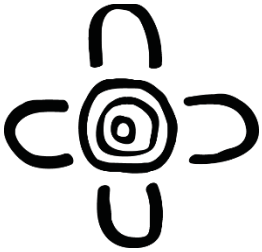
Contents



Acknowledgement of Country

Our department recognises the First Peoples of this Nation and their ongoing cultural and spiritual connections to the lands, waters, seas, skies, and communities.

We Acknowledge First Nations Peoples as the Traditional Custodians and Lore Keepers of the oldest living culture and pay respects to their Elders past and present. We extend that respect to all First Nations Peoples.

Introduction

Australia is a powerhouse of science and research. Our record of discovery and achievement is large in proportion to our population size. Aboriginal and Torres Strait Islander peoples have an unbroken connection to the lands and waters of Australia, with 65,000 years of deep knowledge that is unique in the world. Our multicultural diversity, geopolitical stability and world-class education sector make us attractive science and research partners.

On 22 September 2022, the Australian Government committed to revitalise Australia's science policy framework: the 2015 National Science and Research Priorities and 2017 National Science Statement.

Australia's Chief Scientist, Dr Cathy Foley AO PSM, was asked to lead the national conversation on behalf of the government to inform this work. The 2015 priorities and 2017 statement were developed before events like the global pandemic, accelerating climate change impacts and rapidly emerging new technologies. We need a new framework to reflect our current and future needs and recognise where complementary knowledge systems can work together.

Throughout the national conversation, participants noted how important science and research are to Australia's future economic prosperity. They believe science and research need to serve the challenges we face and drive new industries that foster secure, well-paying jobs.

Australians consistently identified four key priorities that cut across traditional discipline and sector boundaries. These are:

- Ensuring a net zero future and protecting Australia's biodiversity
- Supporting healthy and thriving communities
- Enabling a productive and innovative economy
- Building a stronger, more resilient nation.

These draft priorities set out the 'what' and 'why' for Australia's science and research efforts over the next decade. They reflect input from a wide range of people and organisations engaged in Australian science and research. We want to know how we can further improve the draft priorities and how organisations and governments should implement them. Your feedback will help us continue to develop and refine the priorities in ways that support their implementation.

Your feedback will also inform the National Science Statement. This statement will set out the government's vision for Australian science and reflect the updated priorities.

Considering the Terms of Reference

The revitalised National Science and Research Priorities:

- reflect pressing challenges and opportunities facing Australia
- align with government priorities such as the National Reconstruction Fund, Universities Accord process, Critical Minerals Strategy and Pathway to Diversity in STEM Review
- reflect Australia's competitive and comparative advantages including strengths in science and research, natural resources, and unique cultures
- will inform and help align government decision-making and investment into the future
- provide greater certainty and focus for investment, including by industry.

The revitalisation's Terms of Reference flagged three potential priorities including:

- action on climate change
- elevating and recognising First Nations knowledge systems and perspectives on science
- harnessing emerging technologies.

Feedback supported these potential priorities. Aboriginal and Torres Strait Islander peoples asked that First Nations knowledge and knowledge systems be reflected throughout the priorities, rather than as a standalone area. This document identifies some areas of First Nations knowledge and knowledge

systems as a starting point. Further discussion and partnership with First Nations communities is needed to ensure their expertise is integrated respectfully and where appropriate.

Consultation questions

1. The draft priorities intend to identify specific challenges facing the country that will require multidisciplinary and multisector efforts to address. Do they achieve this objective? How can we improve them?

2. Feedback stressed the need to work in partnership with First Nations people to embed First Nations knowledge and knowledge systems in the way we address national challenges. How might governments and the science and research sector best work with First Nations people to achieve this objective?

3. The draft priorities provide a range of critical research paths. How could we refine these research paths, for example, to address immediate challenges?

4. How would you implement the priorities in your organisation or setting? What mechanisms would support implementation?

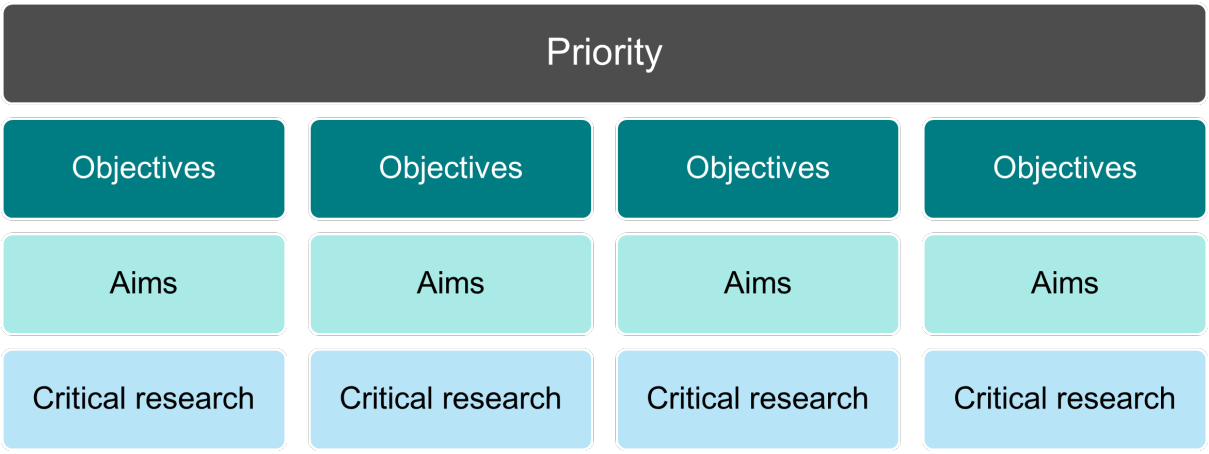
5. The National Science Statement will explain the role our science systems will play in delivering the priorities and maximising the benefits from science for Australia. How can the following best support the priorities:

    a. Science agencies
    b. Science infrastructure
    c. Australian government science programs
    d. Domestic and international science relationships.

Structuring the priorities

There are four overarching priorities, each with a set of objectives, aims, and proposed critical research paths.

Figure 1. Structure of the National Science and Research Priorities



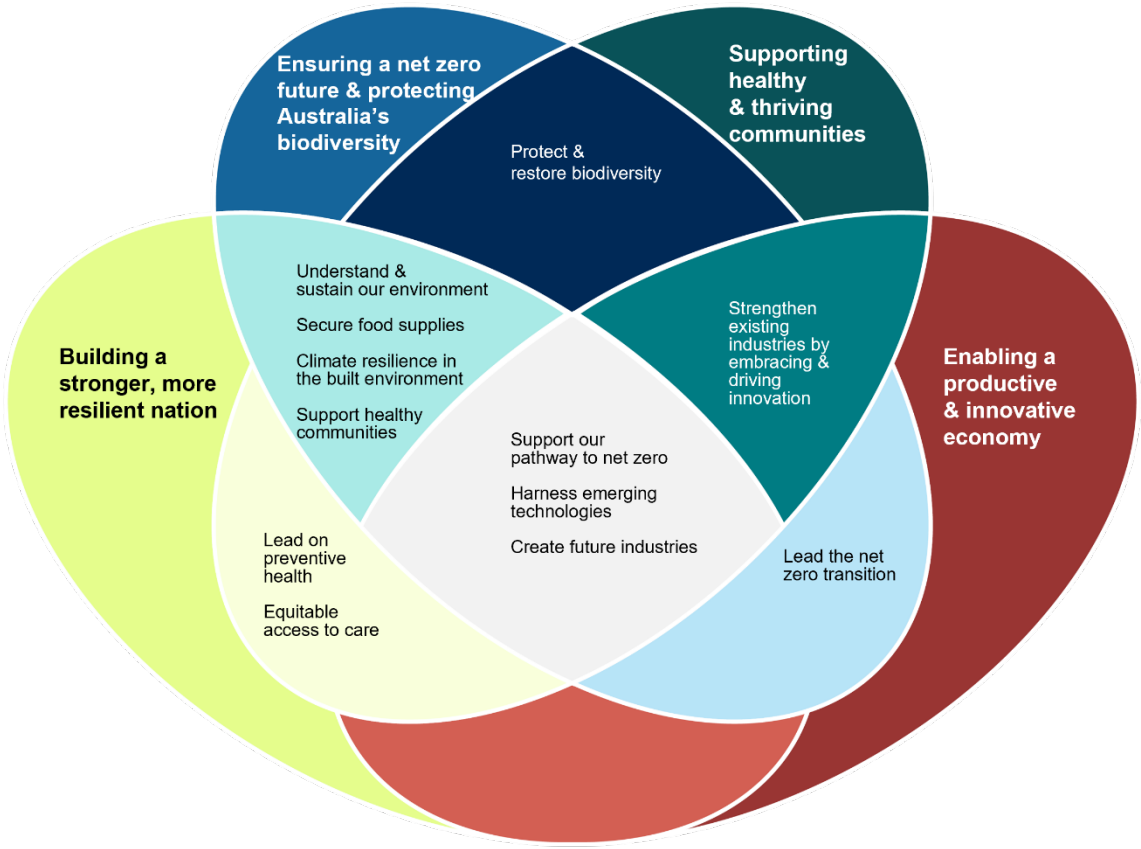
The priorities intend to be enduring. The objectives and aims have a time horizon of ten years and the research questions have a time horizon of 5-10 years (Figure 2, below).

Figure 2. High-level priorities and objectives

The priorities and their parts closely connect and deliberately overlap (Figure 3, below).

They are challenge-based and aim to focus multidisciplinary and multisector efforts in science and research. You can provide feedback on further changes to the priorities to ensure they achieve these goals.

Figure 3. Indicative overlap of the priorities and objectives



Draft priorities

Priority 1: Ensuring a net zero future and protecting Australia's biodiversity

What we heard

Throughout the national conversation, Australians raised climate change as the most significant challenge facing the planet and the country. We are already feeling acute effects in Australia and our region.

In this enormous challenge, Australians identified that science and research are critical to understanding and preventing future climate change. They will also equip us to deal with changes already underway. Australians strongly recognised the importance of First Nations knowledge and knowledge systems in solving this challenge. This included unlocking their potential to make significant improvements to our environmental stewardship through genuine and appropriate partnership.

Feedback also identified a need to ensure emissions reduction efforts maximise associated economic and environmental opportunities and manage competing uses of land, air, sky, and sea.

Objectives

Australia's science and research will develop and deploy the next generation of technologies and practices to mitigate the effects of climate change. These will put us on track to meet and exceed our net zero emissions targets.

We will work alongside Aboriginal and Torres Strait Islander peoples to protect and restore terrestrial and marine ecosystems for environmental and human wellbeing benefits.

Our objectives:

- Support our pathway to net zero
- Understand and sustain our environment
- Protect and restore biodiversity.

Aims

- Australia will **reduce emissions** at scale by developing emissions reduction and removal technologies that support restoring our environments *(Support our pathway to net zero).*
- Australia will understand likely **future conditions and risks for our climate and environment** and draw on complementary knowledge systems to address and mitigate climate change impacts *(Understand and sustain our environment).*
- Australia will **protect habitats and biodiversity** by applying, maintaining, and sustaining Indigenous knowledge and knowledge systems to improve environmental stewardship *(Protect and restore biodiversity).*
- Australia will **protect and restore marine, freshwater, and terrestrial habitats, and their biodiversity** by managing them sustainably as holistic systems *(Protect and restore biodiversity).*

Critical research

These critical areas of research will help achieve our aims:

- Carbon sources and sinks by soils, vegetation, coasts, and oceans in Australia and neighbouring regions and practical opportunities for managing natural carbon drawdown.
- Future climate conditions in Australia, our neighbouring regions and Antarctica, including tipping points, shifting weather patterns, extreme events and sea level rise.
- Indigenous approaches to environmental stewardship across Australia's diverse habitats.
- Improved forms of data collection, monitoring and analysis to support environmental and climate-related decision making.
- Sustainable use of freshwater and ocean resources for food, industry, and environmental and community health.
- Marine environment response to a changing climate and other human influences, and its impacts on future climate change, biodiversity and communities in Australia and neighbouring regions.
- Prediction of habitat and biodiversity change and ways to reverse declining biodiversity.
- Technological solutions for removing carbon dioxide from the atmosphere at the scale required to achieve and exceed net zero goals.

Priority 2: Supporting healthy and thriving communities

What we heard

Australians saw science and research playing a central role not just treating sickness but also increasing wellbeing. Feedback noted our health is closely linked to climate and environmental health, and climate change is negatively impacting it[1] *(Ensuring a net zero future and protecting Australia's biodiversity)*.

We heard that Australians recognise that Indigenous concepts of holistic health and wellbeing – the connections between healthy Country and healthy communities – can deliver benefits to all Australians.

Feedback also highlighted challenges like:

- equitable access to healthcare, wherever someone is based
- caring for an ageing population and people's desire to live in their own home for longer
- intersecting effects of disability and poor health on overall wellbeing
- preventing disease
- reducing rates of chronic conditions
- improving mental health
- collecting and curating data to support better wellbeing outcomes.

Australia's expertise in healthcare tools and emerging technologies can also further our economic and wellbeing goals *(Enabling a productive and innovative economy).*

Objectives

Australia's science and research will support healthy, thriving communities by improving physical, mental, and social wellbeing indicators in all corners of the country and at all stages of life.

We will be leaders in preventive health, empowering people to make choices in their care. Each Australian will be able to access the services and support they need. We will be leaders in fit-for-purpose data collection and access and trust to improve health and wellbeing.

Our objectives:

- Lead on preventive health
- Support healthy communities
- Ensure equitable access to care.

Aims

- Australia's science and research will **improve the physical, mental, and social wellbeing of all Australians** by developing and adopting integrative, holistic approaches for health and disability *(Lead on preventive health).*
- Australia's science and research will **understand the diverse and unique social and environment drivers of health and wellbeing in Australian communities** *(Support healthy communities).*
- Australians will have **healthy brains and improved mental health** throughout life *(Support healthy communities).*

[1] Lawrence, J., B. Mackey, F. Chiew, M.J. Costello, K. Hennessy, N. Lansbury, U.B. Nidumolu, G. Pecl, L. Rickards, N. Tapper, A. Woodward, and A. Wreford, 2022: Australasia. In: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 1581–1688, doi:10.1017/9781009325844.013.

- Australia's science and research will develop and adopt tools and approaches to **improve access to health and wellbeing services** for all Australians. These will be appropriate for peoples' backgrounds and circumstances *(Ensure equitable access to care).*

Critical research

These critical areas of research will help achieve our aims:

- Technologies and techniques that will enable an affordable, inclusive, culturally appropriate, and integrated preventive health system for Australia – one that drives positive behaviour changes and leverages fit-for-purpose data and connections to Country, community, and built and natural environments.
- Mechanisms of brain function and repair and how to address deterioration of brain function.
- Social and environmental drivers of ill health and poor mental health and the techniques and practices we can apply to enhance the wellbeing of all Australians at scale.

Priority 3: Enabling a productive and innovative economy

What we heard

In the national conversation, Australians identified the transition to net zero and low emissions technologies as a huge opportunity and challenge for Australia and the globe. These and other shifts, like our growing care and support economy and geopolitical uncertainty, will shape our future productivity.

Australian businesses told us they could see how advances in technology, the digital world and materials science could transform areas like waste management, defence and healthcare. They could help us achieve our environmental and resilience goals. But it was also clear there are barriers holding back Australian invention, development, and adoption, like research translation challenges and accessing a skilled workforce.

Aboriginal and Torres Strait Islander peoples recognise the potential in these opportunities. But they are calling for:

- stronger partnerships with knowledge holders
- protections for cultural and intellectual property
- stronger data access and governance to support decision making.

As a mid-sized economy, Australia does not have the scale or population to do everything. International partnerships will be important. The pace of change is accelerating, and Australians expect us to be ready to seize the opportunities on the horizon.

Objectives

Australia's science and research will help build a more complex and productive economy. It will do this by adding greater value to our natural mineral endowments and translating the knowledge our research generates at sufficient scale to achieve our environmental, wellbeing, and resilience ambitions.

We will ensure our small to medium-sized enterprises can take advantage of research breakthroughs. Aboriginal and Torres Strait Islander peoples will be able to capitalise on their knowledge and expertise and take advantage of emerging technologies in ways that best suit their communities.

Our objectives:

- Lead the transition to net zero
- Harness emerging technologies at scale
- Strengthen existing industries by embracing and driving innovation
- Create future industries.

Aims

- As part of the transition to a net zero economy, Australia's science and research will develop novel low and zero emissions technologies. This includes new ways to **increase value-add in critical minerals and exports,** embrace low environmental footprints and develop **circular economy** approaches *(Leading the transition to net zero).*
- Australia will build new industries and accelerate productivity by having **sovereign knowledge** and **access to develop and harness impactful emerging technologies**, particularly AI, quantum, robotics, and biotechnology *(Harness emerging technologies at scale. Create future industries).*

- **Australian businesses will engage in more research and development** increasing our global competitiveness *(Strengthen existing industries by embracing and driving innovation. Create future industries).*

Critical research

These critical areas of research will help achieve our aims:

- Materials and technologies to develop a secure, affordable, and diverse low emission energy industry for Australia and the Indo-Pacific.
- New and more efficient renewable energy generation and storage.
- Materials and technologies to advance our economy in a sustainable manner and at scale.
- Decarbonisation technologies for hard to abate processes and activities.
- Australia's transition to a circular economy amid geopolitical, climate and supply chain uncertainty, noting the scale needed and short timeframe.
- Causes of Australia's slow productivity growth and strategies to address them.
- Understanding the impacts of climate change on Australia's future productivity and our key markets.

Priority 4: Building a stronger, more resilient nation

What we heard

Throughout the national conversation, people told us they value Australia's civil and safe society. However, there are complex threats to our democratic values and safety that affect us as individuals, communities, and a nation.

People were concerned about the impacts of misinformation and disinformation. They wanted to understand how to manage the technologies that facilitate its spread. They also told us they want to be able to adapt to changes around them by learning and applying critical thinking and new knowledge and skills throughout their lives.

Australians were also concerned about the compounding effects of climate change and geopolitical instability on crises that impact key parts of our economy, safety, and way of life *(Ensuring a net zero future and protecting Australia's biodiversity. Supporting healthy and thriving communities. Enabling a productive and innovative economy)*.

Objectives

Australian communities will be resilient to disruption from natural and human-induced shocks. Our science and research system will provide tools and knowledge that underpin a resilient and informed society.

Our objectives:

- Support resilient communities
- Secure food supplies
- Build climate resilience in our built environment.

Aims

- Australian science and research will **support communities to develop the skills, tools and systems that can strengthen Australia's democratic resilience and enhance trust** *(Support resilient communities).*
- Australian science and research will **increase the climate-resilience, value, trustworthiness, sustainability, and health benefits of our food products** by developing new approaches and technologies for their production *(Secure food supplies).*
- Australian science and research will develop and apply new technologies and techniques for cities and towns to **prepare for and adapt to the impacts of climate change** *(Support resilient communities, Build climate resilience in our built environment).*

Critical research

These critical areas of research will help us achieve our aims:

- Cognitive and social causes of engagement with misinformation and disinformation.
- Technologies, teaching tools and systems to support community engagement with information and learning at different stages of our lives.
- Food safety and security for future Australian conditions and markets.
- Housing and built environments that support climate resilience in Australia and our region by creating new designs, technologies, materials, and construction techniques.

Guiding principles

The draft priorities align with seven principles the government set to guide the development of the National Science and Research Priorities and the National Science Statement.

Be community-informed – The first phase of the national conversation received 313 written submissions from individuals and organisations. Australia's Chief Scientist held more than 30 roundtables across the country and online, engaging with community, research, and industry sectors. 23 further workshops helped us to refine the draft priorities.

Be ambitious and purpose-driven – The priorities identify the key challenges and opportunities Australia will face now and into the coming decades. They signal to industry and the research sector the direction we will need to take over the coming decade to deliver meaningful impact on these community-informed priorities.

Be evidence-based – Community input through the national conversation, expert advice, and existing government priorities informed the draft priorities.

Be enduring and responsive – We intend the priorities to be enduring. The objectives and aims have a time horizon of ten years and the critical research has a time horizon of 5–10 years.

Be relevant – A review of the priorities is proposed every five years to monitor progress and adjust where needed to maintain their relevance or harness new opportunities.

Be focused – The four priorities reflect major societal domains that present the most significant challenges and opportunities. The objectives and aims identify more defined areas within the priorities. The final level identifies the key knowledge gaps that need to be addressed for maximum impact and societal benefit.

Inform investments – The priorities will be used to help guide government policy direction and investment in science and research but will not be the only means of doing this.

Measuring progress and adjusting the priorities

We will measure progress on the aims and impact of the priorities through:

- a set of metrics informed by the government's Measuring What Matters Framework
- other existing metrics, where possible.

The government will review the priorities at five-year intervals to assess progress and ensure they remain relevant to Australia's needs.

Thank you

The research sector, industry, not-for-profits, communities, and government organisations have contributed more than 1,200 hours to shape and refine the draft priorities in workshops and meetings. This does not count the time devoted to considering and writing submissions and other feedback.

Our department would like to thank everyone who has engaged in the national conversation so far, from written submissions to roundtables and workshops. Thank you for telling us about the biggest challenges and opportunities science and research can help address.

Appendix 1 – Consultation and alignment

Consultation to date

Australia's Chief Scientist Dr Cathy Foley has been leading a national conversation to inform the draft priorities and statement. This involved speaking with more than 600 people and receiving more than 300 written submissions from individuals and organisations.

The first round of public consultation began in February 2023. It involved an online consultation process and roundtables online and around the country. We asked Australians about our greatest challenges that science and research could address and the opportunities we should seize. We also invited comment on our strengths, capability and capacity, and what science and research Australia needs to be the nation we want to be.

Between 6 March and 14 April, Dr Foley hosted 26 roundtables with 316 participants from science and research organisations, state, territory and Australian governments, higher education, industry, and the community. Roundtables were in all capital cities as well as Townsville, Orange, Albury-Wodonga and Geraldton.

Following the first round of public consultation, we further refined the draft priorities and tested them with a broad cross-section of society. This included researchers, state, territory and Australian government organisations, industry, and not-for-profits.

In all, 67 roundtables and workshops were held with over 1,200 hours of time contributed by participants. Six roundtables and workshops were held with a specific focus on Aboriginal and Torres Strait Islander peoples' perspectives on science and research.

Written submissions

In the first round of public consultation, we received 313 written submissions. The following list includes respondents whose submissions are publicly available on our department's website.

- Academy of the Social Sciences in Australia
- Angela Moles
- Anna Guillan AM
- Anna Peeters, Deakin University
- ANSTO
- Anthony Thomas
- ANU Institute for Climate, Energy & Disaster Solutions
- ARC Centre of Excellence for Automated Decision-Making and Society (ADM+S)
- ARC ITTC DARE director R.W. Vervoort
- ASMR (Australian Society for Medical Research)
- Associate Professor Jon Mason
- Associate Professor Judith Fisher, Institute of Agriculture University of Western Australia and Curtin University
- Association for Interdisciplinary Meta-Research and Open Science (AIMOS)
- Association for the Battery Recycling Industry (ABRI)
- Association of Australian Medical Research Institutes
- Association of Mining and Exploration Companies (AMEC)
- Astronomical Society of Australia
- Astronomy Australia Limited
- AuScope Ltd
- Australasian Cities Research Network (ACRN)
- Australian Academy of Science
- Australian Academy of Technological Sciences & Engineering

- Australian Academy of the Humanities
- Australian Citizen Science Association
- Australian Council of Deans of Science
- Australian Council of Recycling
- Australian Earth System Simulator (ACCESS-NRI)
- Australian Institute of Food Science & Technology Ltd
- Australian Institute of Geoscientists
- Australian Institute of Marine Science
- Australian Land Conservation Alliance
- Australian Marine Sciences Association
- Australian Maths Trust
- Australian Meteorological and Oceanographic Society
- Australian National University
- Australian Research Data Commons
- Australian Science Innovations
- Australian Space Agency
- B. J. Moggridge
- Balz Kamber
- BehaviourWorks Australia
- Ben Blackburn Racing
- BioMelbourne Network
- Bob Wong
- Briony Moran
- Bruce McKellar
- Business Council for Sustainable Development Australia
- Cathy Oke
- Cellular Agriculture Australia
- Centre for Data Science
- Centre for Entrepreneurial Agri-Technology
- Centre for New Industry at Per Capita
- Chris Norman
- Climate Action Network Australia
- Climate and Health Alliance (CAHA)
- Cobi Calyx
- Commissioner for Children and Young People SA
- Conservation Genomics in Action working group
- Cooperative Research Australia
- Craig Parsey
- CropLife Australia
- Cruxes Innovation
- CSI–O - Atmospheric Composition and Chemistry Group
- Danny Kingsley
- Danny Samson
- Deimos Space Resources
- Department of Defence
- Department of Mathematics and Statistics, University of Western Australia
- Desert Knowledge Australia
- Dr Bob Webb
- Dr Georgia Ward-Fear
- Dr Gregory Harper
- Dr Johanna Nalau
- Dr Mohammad Taha (they/them)
- Dr Peter Birks
- Early- and Mid-Career Researcher Forum

- Ecological Society of Australia (ESA)
- Edward Obbard et al, UNSW
- Edward Obbard, Patrick Burr, Elizabeth Williams, Michael Preuss
- Elsevier
- Engineers Australia
- Farzad Khosrow
- Fight Parkinson's
- Fisheries Research and Development Corporation
- Flinders University
- Food Frontier
- Food Safety Information Council
- Food Standards Australia New Zealand
- Francesco Mancini
- Future Battery Industries Cooperative Research Centre
- Future Energy Exports Cooperative Research Centre (FEnEx CRC)
- GeneEthics
- Geoscience Australia
- Graeme Pearman
- Graham Macdonald
- Group submission on Quantum Sensing and Fundamental Physics
- Indigenous Carbon Industry Network
- Indrani Mukherjee
- Innovative Research Universities
- Inspiring Australia State & Territory Networks
- Institution of Chemical Engineers (IChemE)
- Invertebrates Australia
- Jamie Vandenberg
- Jason Evans
- Jemma Mayall
- John Hewson (chair) and Julian Cribb (member), Council for the Human Future
- John Hine
- Joh’ O'Donnell
- Jonathan Tyler
- Jordan Esh
- JS Caley
- Keith Tayler
- Kieran Parker
- Kingston AI Group
- La Trobe University
- Lalu Heriyanto
- Leigh Dayton PhD
- Leukaemia Foundation
- Libby Hepburn
- M. Marshall
- Mackenzie Yandell
- Mathematics Education Research Group of Australasia
- Matt King
- Matthew England
- Medicines Australia
- Melissa Pitman
- Michael Bull
- Monash University
- Nicholas Kirk

- NITRO-Oceania (Network of Leaders of Interdisciplinary and Transdisciplinary Research Organisations in the Oceania region)
- Ocean Decade Australia
- Office of the Great Barrier Reef
- Oliver Roberts
- Philip Batterham
- Prof Brian P. Schmidt
- Prof Fabienne Mackay
- Professor Barry Judd, Pro Vice Chancellor Indigenous, University of Melbourne
- Professor Karen Vella
- Professor Ken Baldwin - Chair, Australian Hydrogen Research Conference 2023
- Professor Marcus Foth
- Professor Toby Walsh FAA
- Regional Universities Network
- Reproductive Health Australia
- Reproductive Health Australia
- Research Office, Faculty of Engineering and Information Technology, University of Melbourne
- Research School of Physics, ANU
- rob lorimer
- Royal Australian Chemical Institute
- Royal Zoological Society of NSW
- Sanofi
- Science & Technology Australia
- Scitech
- SMRI (Sydney Mathematical Research Institute)
- Sonya Robinson
- Sonya Tadrowski
- Steven Prawer
- Tanya Dodgen
- The Australian Academy of Health and Medical Sciences
- The Australian National Centre for the Public Awareness of Science
- The National Youth Science Forum
- The Royal Society of Victoria
- The Western Australian Biodiversity Science Institute
- Thomas O'Neil
- University of Canberra
- University of Melbourne
- University of Newcastle
- University of Queensland
- University of Southern Queensland
- Virginia Barbour
- Voret Castillo
- Water Services Association of Australia and Water Research Australia
- Wenhua Yu
- Wesley Ward, The Comms Doctor
- Western Sydney University
- Wilderness Society

Alignment with government priorities

In addition to extensive consultation, the draft priorities have been informed by a range of other government work including:

- National Reconstruction Fund
- National Quantum Strategy
- List of Critical Technologies in the National Interest
- National Robotics Strategy
- National Battery Strategy
- Supporting responsible AI
- Critical Minerals Strategy 2023-2030
- Industry Growth Program
- CSIRO Missions
- Net Zero Economy Taskforce
- Circular Economy 2030
- Nature Positive Plan
- National Research Infrastructure Roadmap
- Threatened Species Action Plan 2022–2032
- Medical Research Future Fund – 2nd 10-year investment plan
- NHMRC research priorities
- National Health and Climate Strategy
- Defence Strategic Review
- National Resilience Taskforce
- Strengthening Democracy Taskforce
- National Skills Agreement
- Fee Free TAFE
- Jobs and Skills Australia
- Australian Universities Accord process
- Measuring What Matters
- Employment White Paper process
- Intergenerational Report
- Pathway to Diversity in STEM Review

Appendix 2 – Background

This background paper outlines how other nations set science and research priorities.

What can science and research priorities look like?

Structure

Science and research priorities are typically structured in one of the following ways:

- **Missions or challenge-based:** for example, reaching Net Zero emissions, putting a man on the moon.
- **Broad thematic priorities:** for example, environment, health, or industry sectors.
- **Intermediate topic level:** for example, water quality, physical activity. These can be related to broad thematic priorities, and are often implied (for example, in a health organisation's strategy).
- **Specific research questions:** for example, what are the most effective strategies for increasing fruit and vegetable intake among school children? These may sit under intermediate topic level priorities.
- **Systems-focused:** for example, how can we increase diffusion in innovation, STEM skills, enabling technologies, and shared research infrastructure.

Scope

The scope of science and research priorities are typically shaped by one or more of the following:

- **geography,** for example, national, state, region, bilateral partnership
- **institution,** for example, CSIRO's research priorities, Department of Defence research priorities
- **population group,** for example, Indigenous people; older people; children and younger people; people who are LGBTQIA+ culturally and linguistically diverse people; and migrant and refugee people
- **setting**, for example, rural and remote areas, schools
- **research types**, for example, intervention research, health economic research
- **issues**, for example, health equity, health systems access, emerging threats to health, social determinants of health
- **infrastructure-linked,** for example, ANSTO's research priorities; CERN research priorities, National Research Infrastructure roadmaps.

How do other countries set science and research priorities?

Many countries do not separate science and research priorities from broader innovation aims, or from the outcomes they are seeking for their economy and society.

Governments can express priorities *explicitly* in strategies, statements, and roadmaps. They can also express priorities *implicitly* through institutional structures, funding streams, government procurement, industrial subsidies, and other organisational frameworks. Internationally, explicit priorities are mostly developed alongside funding programs or announcements. Most countries express their priorities through a mix of explicit and implicit means.

In many countries, multiple organisations are involved in setting explicit science and research priorities, including research councils, funding agencies and universities. A ministry generally leads

development of explicit national priorities. They will often collaborate with other relevant ministries and agencies and conduct significant stakeholder and community engagement.

Strategies for identifying priorities

Governments and organisations often use several strategies to identify priority areas, including:

- **Strengths.** Priorities focus on existing strengths in a research system or economy.
- **Weaknesses or opportunities**. A similar model to the strengths-based model. The focus is on areas of a country's science and research system or economy that need development or co-ordination to become competitive and productive.
- **Highest-priority challenges.** This approach works with goal/challenge/mission-oriented prioritisation. Priorities are based on values and goals and identify high-priority challenges for research organisations and businesses to address with practical solutions.
- **Marginal gain.** Identifying the areas where investment will result in the highest returns (note that these returns do not need to be financial), within a particular period. Often the opportunity cost of pursuing one investment priority over another is also considered.
- **Potential for impact.** This approach considers the expected magnitude of the impact and feasibility of carrying out research. It includes technical, economic, political, socio-cultural, and ethical aspects.

Most science and research strategies include priorities based on several of these approaches.

International examples of national science and research priorities

The examples below are a summary of the types of priorities adopted by other countries. Most have structured their science and research priorities along the lines we highlight in this paper:

- mission or challenge-based
- broad thematic
- intermediate topic level
- specific research questions
- systems-focused priorities.

Canada

The Canada Research Coordinating Committee (CRCC) advances federal research priorities and coordinates policies and programs of Canada's research funding agencies and the Canada Foundation for Innovation. The priorities were informed by a public consultation in 2018. The New Frontiers in Research Fund has 3 streams that support specific goals. The fund also has flexibility to launch special calls targeted to support emerging research as needed.

The CRCC 2022 priorities below are examples of national, systems-focused priorities:

- equity, diversity, and inclusion
- Indigenous research and reconciliation
- early career researchers
- interdisciplinary, international, high-risk/high-reward, rapid-response research
- international cooperation
- COVID-19 response and recovery
- research training.

The Advisory Panel on the Federal Research Support System advised the Government of Canada on modernising the system supporting academic research. In addition to its core recommendations on

research governance, the panel identified 5 'enablers of research excellence' to position Canadian science and research to address complex challenges[2]:

- research infrastructure and a new paradigm for major research facilities
- connecting research and innovation
- strengthening equity, diversity, and inclusion
- Indigenous research talent
- supporting francophone research.

China

China has a centralised, top-down (central government to provincial governments) system of R&D programs centred on 5- to 10-year plans for science and technology. China uses a range of priority types including mission-driven priorities and identifying priority areas of science to meet the country's strategic priorities. The process for identifying priorities includes consultation with experts from academia, government, and industry. The outcomes of the consultations feed into several large, multi-year funding programs.

The areas from the Five-Year Plan below are examples of broad thematic priorities.

> "Efforts will focus on aerospace, biotech, neuroscience, artificial intelligence, quantum computing, and semiconductors, where the country expects to become a global leader in the longer term."
>
> From the Asian Development Bank's translation of the 14th Five-Year Plan for the People's Republic of China, 2021[3].

European Union

European Union science priorities are closely tied to the Horizon funding programs, most recently Horizon Europe[4]. The priorities link to the science and research priorities of Member States. Strategic plans inform the priorities and include public consultation, as well as extensive engagement with Member States and the European Parliament. The Strategic Plan sets out Horizon Europe's policy priorities and expected impacts.

Horizon Europe's funding is divided into 3 pillars:

- Excellent Science
- Global Challenges and European Economic Competitiveness
- Innovative Europe.

The main thematic or topic-based priorities are outlined under pillar 2, which has more than 50% of the budget. Detailed biennial work programs with targeted funding calls sit under 6 specific clusters (Health, Climate, Energy, Mobility etc.). The work programs are developed in consultation with Member States. A new mission-driven stream has recently been adopted in pillar 2, in addition to the clusters.

This extract from the strategic plan below shows examples of mission or challenge-based priorities.

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[2] Advisory Panel on the Federal Research Support System, 2023. Report of the Advisory Panel on the Federal Research Support System. Access at: https://ised-isde.canada.ca/site/panel-federal-research-support/en/report-advisory-panel-federal-research-support-system

[3] Asian Development Bank (2021). The 14th Five-Year Plan of the People's Republic of China —Fostering High-Quality Development. Accessed at https://www.adb.org/sites/default/files/publication/705886/14th-five-year-plan-high-quality-development-prc.pdf

[4] Horizon Europe is the EU's key funding program for research and innovation. It will run from 2021-2027, with a total budget of €95.5 billion. Accessed at: https://op.europa.eu/en/web/eu-law-and-publications/publication-detail/-/publication/93de16a0-821d-11eb-9ac9-01aa75ed71a1

> "The first Strategic Plan sets out the key strategic orientations for the targeting of investments in the programme's first four years.
>
> 1. promoting an open strategic autonomy by leading the development of key digital, enabling and emerging technologies, sectors and value chains to accelerate and steer the digital and green transitions through human-centred technologies and innovations
>
> 2. restoring Europe's ecosystems and biodiversity, and managing sustainably natural resources to ensure food security and a clean and healthy environment
>
> 3. making Europe the first digitally enabled circular, climate-neutral and sustainable economy through the transformation of its mobility, energy, construction and production systems
>
> 4. creating a more resilient, inclusive and democratic European society, prepared and responsive to threats and disasters, addressing inequalities and providing high-quality health care, and empowering all citizens to act in the green and digital transitions"
>
> European Commission, Horizon Europe: Strategic Plan, 2022[5]

> "The most anticipated change in Horizon Europe is the introduction of heavily financed, high-priority 'missions'. About €4.5 billion is earmarked for five areas: climate change; cancer; oceans and other bodies of water; smart cities; and soil and food."
>
> Nature commentary, Feb 2021[6]

Citizens were engaged in the design of these missions.

> "Citizens have been involved in the co-design of missions, and the Commission is committed to engage them throughout the missions' lifecycle, such as participating in projects and assessing the missions' results. This co-creation is not limited to consultation, but it broadly refers to building close relations through listening, giving feedback and taking action. In addition, social innovation and citizens' science have enormous potential to contribute to achieving mission objectives."
>
> European Commission, EU missions Q&A, 2021[7]

[5] European Commission (2022). Strategic plan: What Horizon Europe's Strategic Plan is and how it is developed. The second Horizon Europe Strategic Plan 2025-2027. Accessed at: https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/strategic-plan_en

[6] Schiermeier (2021, February 25). How Europe's €100-billion science fund will shape 7 years of research. Accessed at: https://www.nature.com/articles/d41586-021-00496-z

[7] European Commission (2021, September 29). Questions and answers: EU missions. Accessed at: https://ec.europa.eu/commission/presscorner/detail/en/qanda_21_4748

Germany

Germany is currently developing its future strategy for research and innovation[8] to replace the earlier High-Tech Strategies[9]. Germany has regularly updated its strategy since its first release in 2006. In the draft strategy, Germany continues to identify both system-level (for example, turning new knowledge into innovations) and topic-based priorities (for example, exploring space and seas and using them sustainably).

An October 2022 OECD review of Germany's Innovation Policy[10] highlighted Germany's large, autonomous, and well-resourced network of research organisations and universities. Germany's federated system adds to its decentralised science, research, and innovation governance. However, changes to the High-Tech Strategies since 2006 show a move towards more coordinated governance and prioritisation. They also show an increasing emphasis on missions and societal challenges.

Japan

Japan has published successive 5-year Basic Plans for science and technology based on the Science and Technology Basic Law enacted in 1995. The Council for Science and Technology Innovation (CSTI) prepares the Basic Plans. The current 6th Basic Plan (2021-2025) aims to realise "Society 5.0", a "super-smart society" where digital technologies from the fourth industrial revolution are integrated into everyday life. Society 5.0 aims to strengthen economic development and help Japan overcome its social challenges, such as an ageing population. Quantitative research by the National Institute of Science and Technology Policy and international benchmarking by the Centre for R&D Strategy informs the science, technology, and innovation priorities. The Japan Science and Technology Agency (JST) provides funding for implementing the national science and innovation priorities.

New Zealand

New Zealand is currently undertaking a multi-year reform process focused on the future of New Zealand's research, science and innovation system.

Part of the process was the development of a white paper. The Te Ara Paerangi Future Pathways White Paper 2022 presents a high-level vision for New Zealand's public Research Science and Innovation (RSI) system. It includes key policy directions and actions, and a roadmap to implement the reform program. It builds a framework based on societal objectives, supported by the main policy directions.

The 4 societal objectives are:

- Te Hanga Anamata Hou - Creating New Futures
- Te Uara i Ō Mātou Tāngata - Valuing Our People
- Te Hanga i te Kakama o te Pūnaha - Building System Agility
- Te Tāmau i Te Tiriti - Embedding Te Tiriti

These objectives shape policy directions. One of the policy directions is establishing of national research priorities. Other main policy directions are advancing Māori aspirations in the RSI system and investing in Māori knowledge.

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[8] German Government (2023, February 8). Zukunftsstrategie Forschung und Innovation. Accessed at: https://www.bmbf.de/bmbf/de/forschung/zukunftsstrategie/zukunftsstrategie_node.html#:~:text=Mit%20der%20Zukunftsstrategie%20wird%20die,die%20eigene%20Wirtschaftskraft%20zu%20gew%C3%A4hrleisten

[9] German Government (2022). High-tech Strategy 2025. Accessed at: https://www.bmbf.de/bmbf/en/research/hightech-and-innovation/high-tech-strategy-2025/high-tech-strategy-2025.html

[10] OECD (2022). OECD Reviews of Innovation Policy: Germany 2022. Building Agility for Successful Transitions. Accessed at: https://www.oecd-ilibrary.org/science-and-technology/oecd-reviews-of-innovation-policy-germany-2022_50b32331-en#:~:text=The%20OECD%20Review%20of%20Innovation,and%20Climate%20Action%2C%20BMWK

Thailand

Thailand's innovation policy is structured by challenge or mission-based, thematic, systems-focused, and industry or sector-based priorities. The priorities are organised by setting, geography, and issues. The Thai Government's Thailand 4.0 strategy, which aims to address economic challenges, shows overlapping examples of these approaches. Its aim is to transition the Thai economy to high-technology, high-value added industries, while growing the economy in an inclusive and sustainable way.

The strategy includes several time-bound goals under high-level aims. These aims include economic prosperity, social well-being, raising human values, and environmental protection. It also identifies the main industries for improvement or development, areas for transformation, and priority technologies for innovation. There is a consistent focus on skills and human capital, including improving the quality and global competitiveness of Thai universities. The fourth 'agenda' of the strategy sets out region-based goals.[11]

The Thai Ministry of Higher Education, Science, Research and Education (MHESI) work is structured around missions to:

- Develop 'smart citizens'
- Create and develop knowledge – to lead to a 'value-based economy'
- Build innovation – support Thailand in becoming an 'innovation nation'
- Reinvent universities – encouraging universities as agents of change, improving university quality/global competitiveness, and producing highly skilled workers in the Thailand 4.0 important industries.[12]

The United Kingdom

Mechanisms for setting priorities in the United Kingdom are mostly implicit organisational approaches, such as the structure of the research councils, and co-ordinating strategies (for example, industrial strategies). Many funding decisions shaping priorities are developed in consultation with research communities. They are based on areas of existing research strength and are determined by policy priorities. For example, the Industrial Strategy Challenge Fund aimed at research with an industry link.

On 6 March 2023, the UK government released its UK Science and Technology Framework. The framework sets out the UK Government's strategic vision to achieve its 2030 goal of becoming the most innovative economy in the world.

It outlines 10 key actions to support its vision and centres on:

- Identifying, pursuing, and achieving strategic advantage in the technologies that are most critical to achieving UK objectives and build UK global leadership. The 5 critical technologies the framework identify to build UK strategic advantage include AI, engineering biology, quantum technologies, future telecommunications, and semiconductors.
- Showcasing the UK's science and technology strengths and ambitions at home and abroad to attract talent and investment and boost global influence.
- Boosting private and public investment in research and development for economic growth and better productivity.
- Building on the UK's talent and skills base.
- Financing innovative science and technology start-ups and companies.
- Capitalising on the UK government's buying power to boost innovation and growth through public sector procurement.

[11] Royal Thai Embassy, Washington D.C. (n.d.) Thailand 4.0. Accessed at: https://thaiembdc.org/thailand-4-0-2/
[12] Australian Department of Education, Skills and Employment (2021) Higher Education Policy Update: Thailand. Accessed at: https://www.education.gov.au/international-education-engagement/resources/thailand-education-policy-update-higher-education-sector

- Shaping the global science and technology landscape through strategic international engagement, diplomacy, and partnerships.
- Ensuring researchers have access to the best physical and digital infrastructure for R&D that attracts talent, investment, and discoveries.
- Leveraging post Brexit opportunities to create world leading pro-innovation regulation and influence global technical standards.
- Creating a pro-innovation culture throughout the UK's public sector to improve public service delivery.

The United States

Identifying priorities in the United States is focused on thematic and systems aims, along with industry or sector-based prioritisation. Agencies and researchers conducting fundamental research inform the science priority setting. However, recently there has also been significant top-down influence, particularly from the Executive Office of the President[13]. The Executive Office is informed by the White House Office of Science and Technology Policy and co-ordination between federal departments on a set of broad thematic science priorities.

> "In the FY 2023 Budget, agencies should balance priorities to ensure that resources are allocated for agency-specific, mission-driven R&D, including fundamental research, while at the same time focusing resources, where appropriate, on the following multi-agency R&D activities that cannot be addressed solely by a single agency:
>
> - Pandemic readiness and prevention.
> - Tackling climate change
>   - Climate science
>   - Innovation in clean-energy technologies and infrastructure
>   - Climate adaptation and resilience
>   - Nature-based climate solutions for mitigation and adaptation
>   - Monitoring and measurement
> - Catalyze research and innovation in critical and emerging technologies
> - Innovation for equity
> - National security and economic resilience."
>
> Executive Office of the President, Memorandum for the Heads of Executive Departments and Agencies, 2021[14]

[13] The Executive Office of the President (EOP) comprises the offices and agencies that support the work of the president at the centre of the executive branch of the United States federal government.
[14] Executive Office of the President (2021). Memorandum for the Heads of Executive Departments and Agencies. Accessed at: https://www.whitehouse.gov/wp-content/uploads/2021/07/M-21-32-Multi-Agency-Research-and-Development-Prioirties-for-FY-2023-Budget-.pdf

Significant investment in critical technologies supporting important areas of science like semiconductors, biotechnologies, and quantum demonstrates sector-based prioritisation. There is also strong emphasis on supporting space science and exploration to encourage both scientific discovery and advanced manufacturing capacity.