Actuaries Institute.

Transformations too big to ignore

Anna-Maria Arabia
Chief Executive
The Australian Academy of Science
June 2025

Presented at the 2025 All Actuaries Summit

The Australian Academy of Science

Actuaries Institute.

The home of science

Actuaries Institute.

We bring evidence to decision making

THE ACADEMY WAY

- Independent
- Evidence-based
- Non-partisan
- Reliable
- Respectful of knowledge sources

Convene scientific experts

Shape the science system

Translate the vast knowledge of our Fellowship and the research community so it is fit for purpose for:

- Parliaments
- Classrooms
- Board rooms
- Newsrooms
- Public square

Actuaries Institute.

Australian Academy of Science

"Science without policy is science. Policy without science is gambling."

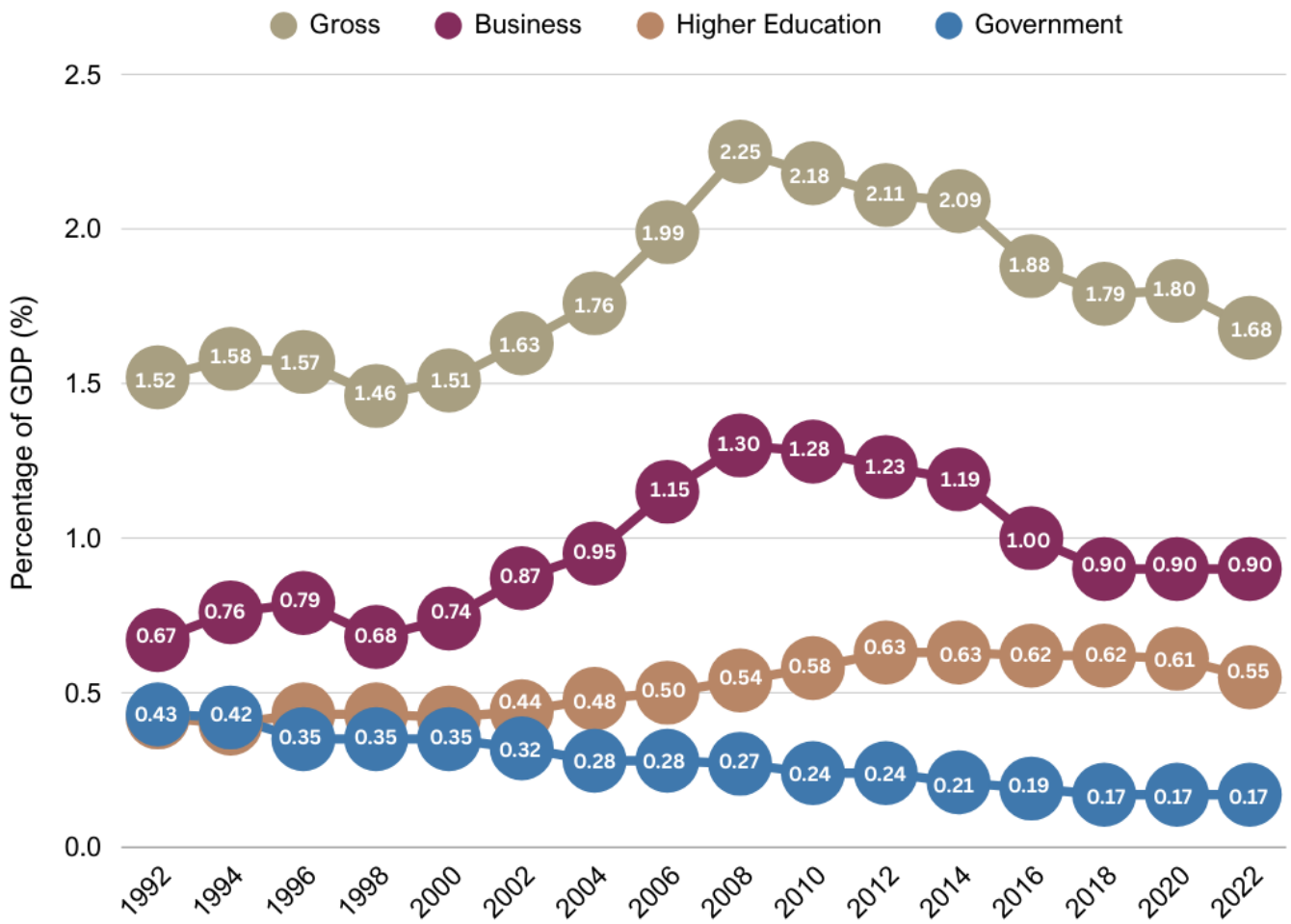
Science

- Generates knowledge for public good
- Deepens understanding of natural world and ourselves
- Fosters solutions for economic growth, productivity, national security, health, quality of life, democratic institutions, and environment
- Creates jobs
- Drives innovation and progress
- Source of soft (hard?) power and diplomacy

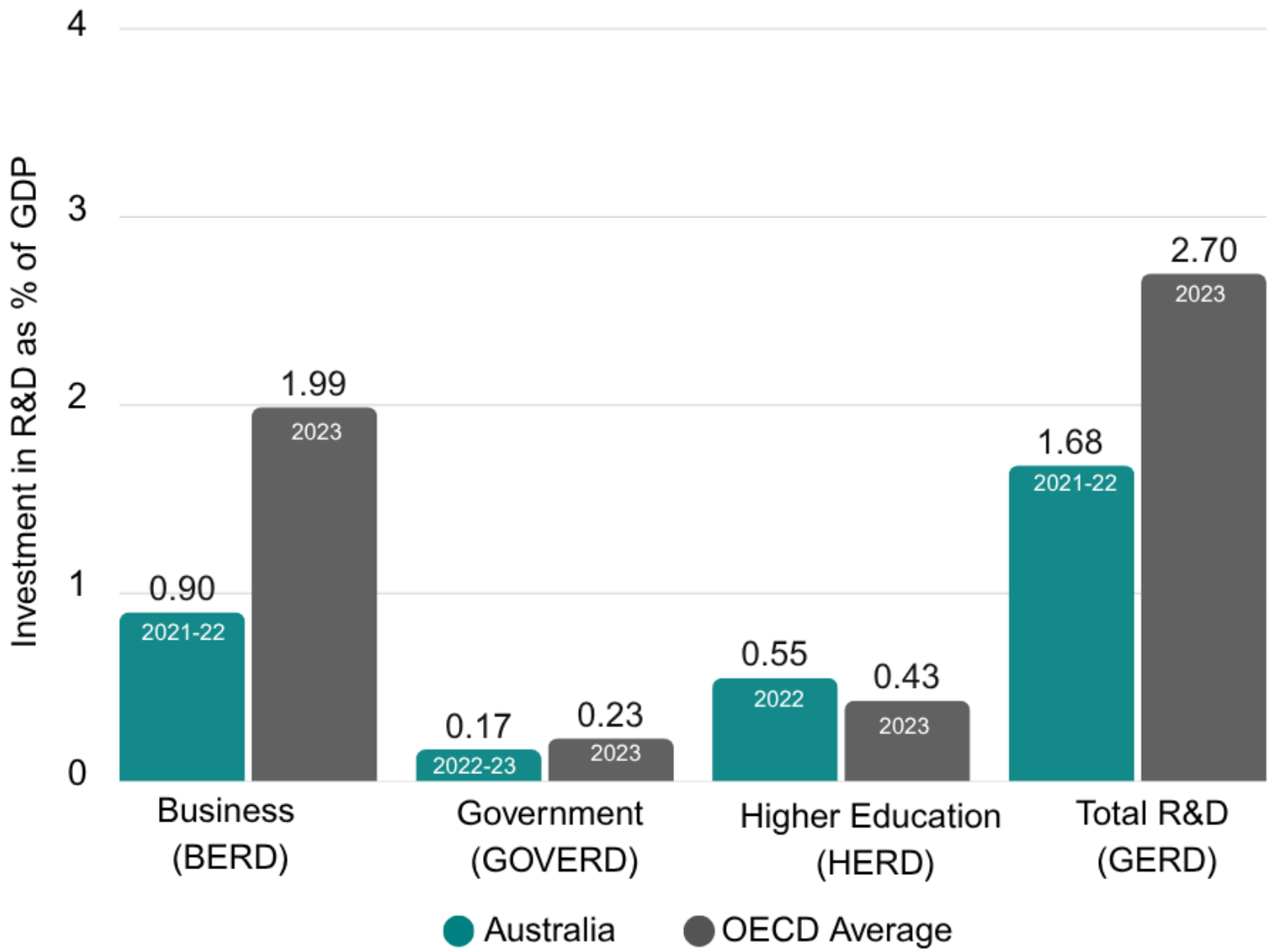
- **A national strategic capability, right?**

Actuaries Institute.

Over the last decade, the percentage of Australia's GDP spent on R&D has fallen



R&D expenditure as a % of GDP (1992-2022)

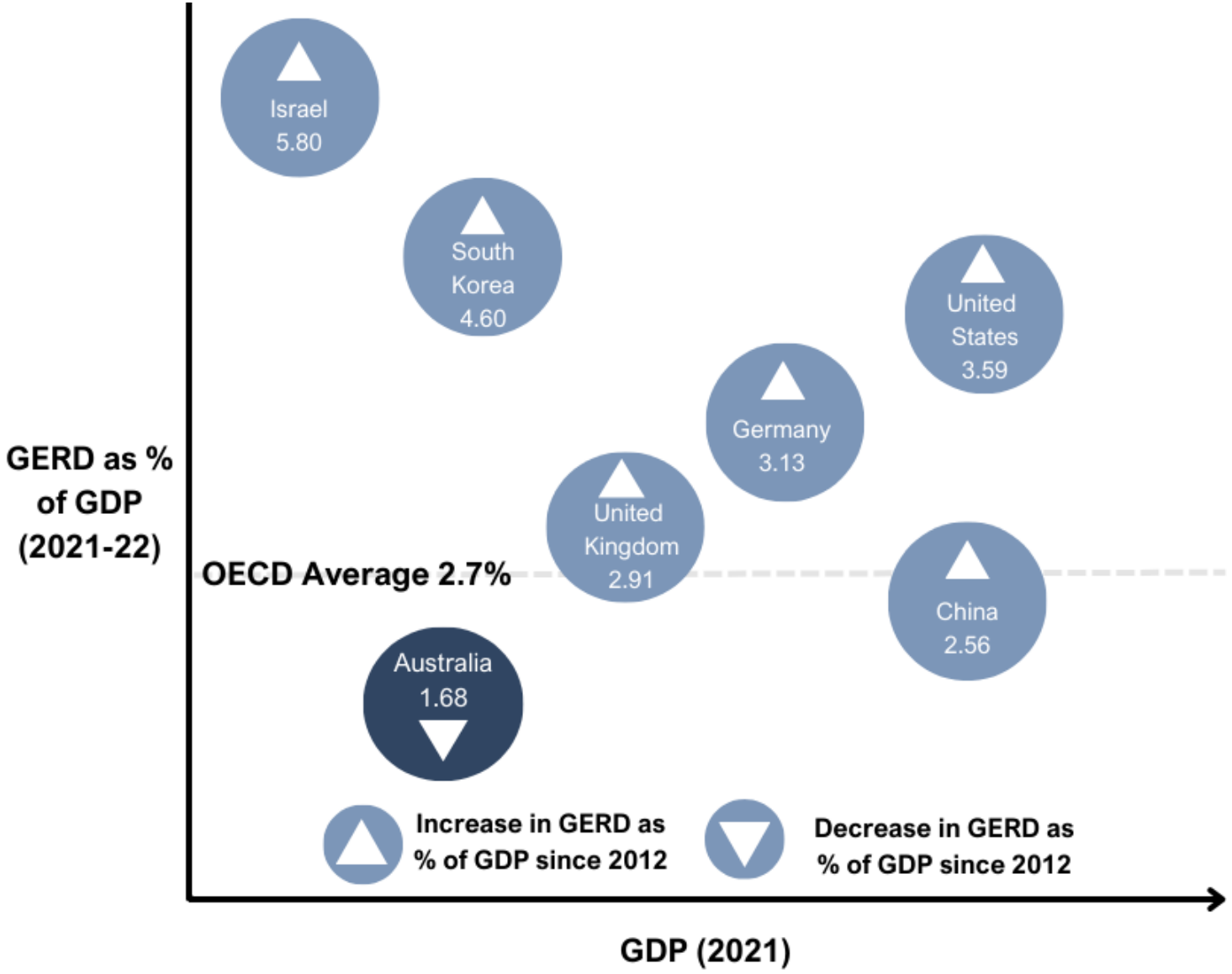


Australia's investment compared to the OECD average.

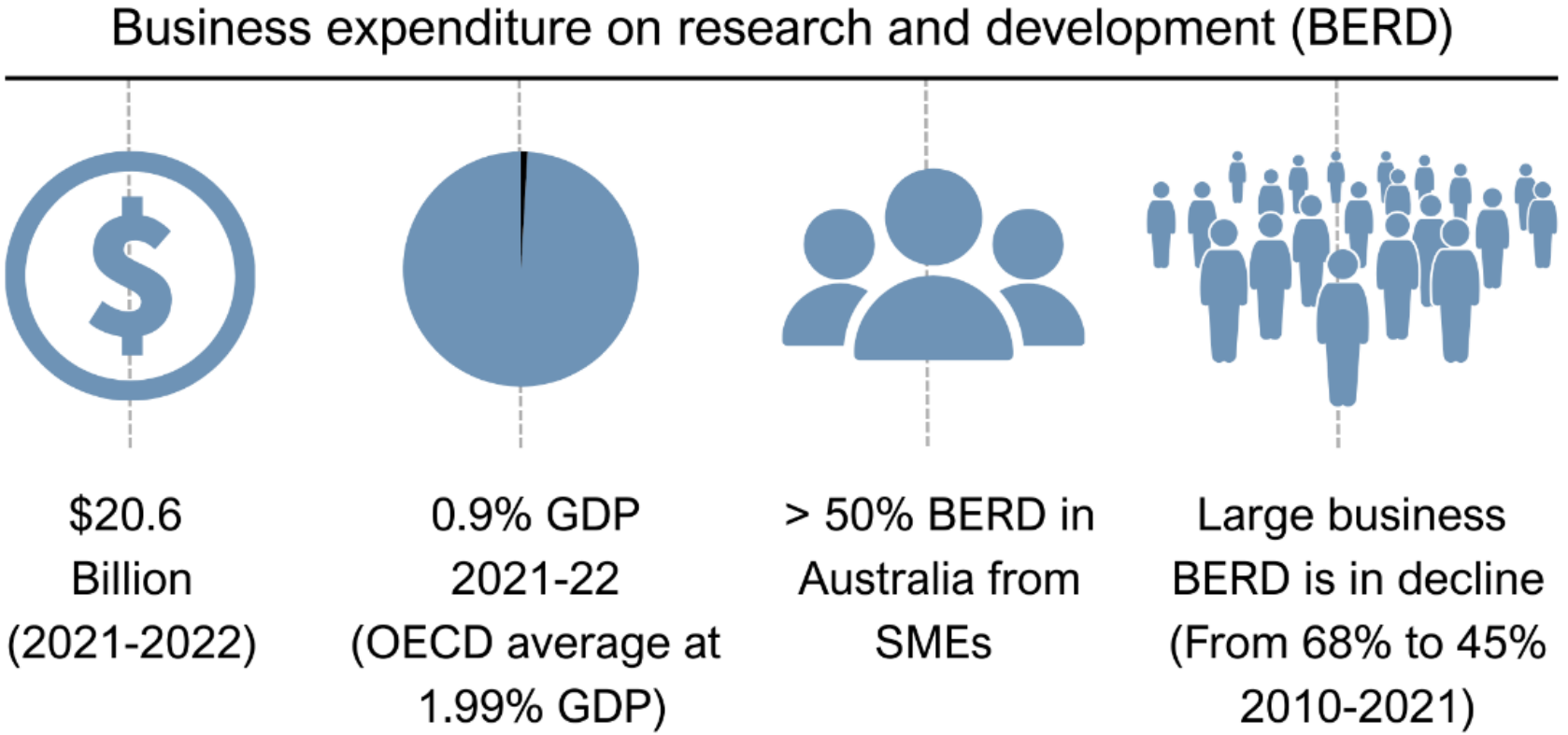
Source: OECD Main Science and Technology Indicators; Australian Bureau of Statistics

Actuaries Institute.

Australia's research intensity compared to other countries (2021-22)



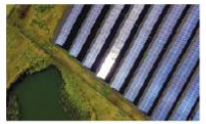
- Australia's R&D intensity has fallen.
- Australia's services and resource-focused economy is one of the least differentiated in the world (93rd).
- Australia's productivity growth has slowed since the mid-2010s
- Australia's public investment has shifted steadily toward near-term translation and commercialisation, eroding the foundational research base that fuels long-term impact.
- Weakens the pipeline of discovery and opportunity to innovate



Business Expenditure on R&D in Australia

Yet, our national ambitions rely on R&D

The Priority Areas Declaration outlines the 7 key sectors as shown below:



Renewables and low emission technologies

Products related to renewable energy, decarbonisation, energy efficiency and waste reduction, recovery and recycling.

Enabling capabilities

Products and technologies that support the advancement of Australia's industrial capability.

Defence capability

Products that are wholly or primarily for use in or in connection with defence.

Transport

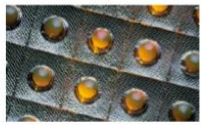
Vehicles and parts for aircraft, road vehicles, rail vehicles and ships. Products and components used in infrastructure.

Value-add in resources

Activities and capabilities that generate products with more value from Australia's mining industry and resource base.

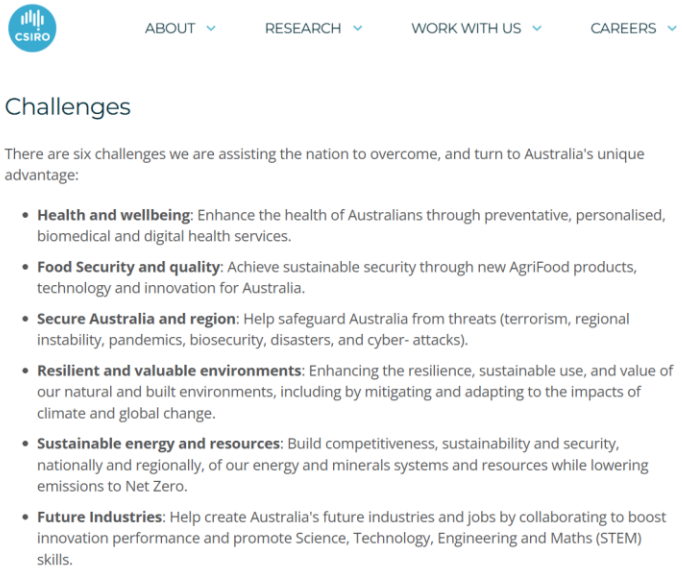
Value-add in agriculture, forestry and fisheries

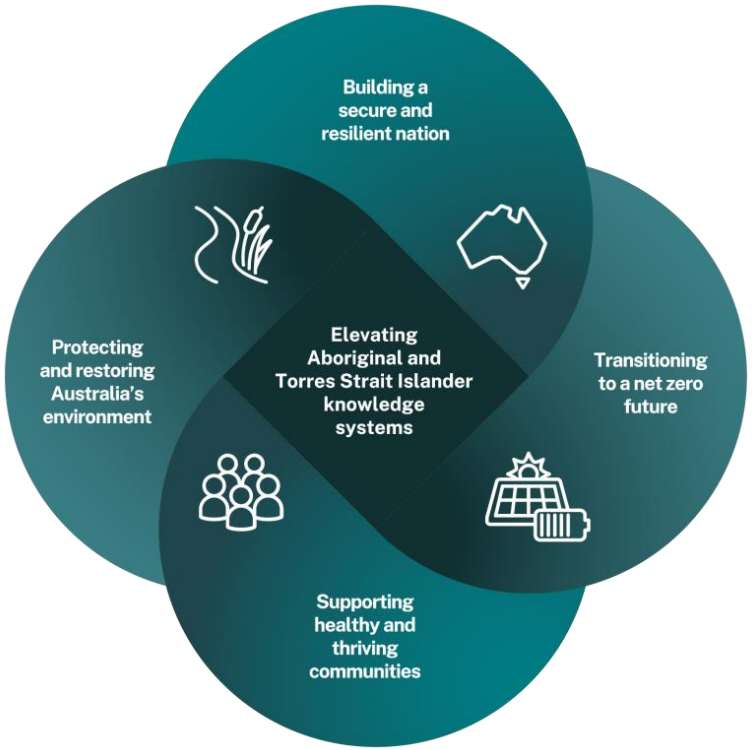
Activities and capabilities that generate products with more value from Australia's primary industries.



Medical science

Products for therapeutic use.





Actuaries Institute.

More money needed, but where to spend it?

Business Council says Australia needs to boost R&D Investment

1 January 2025

The Business Council is calling for an overhaul of Australia's research and development expenditure threshold to help make Australia a more competitive place for investment and the commercialisation of new products. Business Council Chief Executive Bran Black said private sector...

1 September 2023

Set a 3% R&D target and double the dollars for discoveries

AUSTRALIA 13 MAR 2024

Science groups reiterate calls for 3% R&D spending target

By Jenny Sinclair in Melbourne

Share

GROUP OF EIGHT AUSTRALIA

Australia's Research and Development (R&D) Intensity:

A Decadal Roadmap to 3% of GDP

Group of Eight (Go8) Universities Report to the Australian Government

Does the science capability we have match the science we need to meet our national ambitions?

Actuaries Institute.

Australian Academy of Science

AUSTRALIAN SCIENCE, AUSTRALIA'S FUTURE

SCIENCE 2035

5 major forces impacting the Australian economy:

1. Population ageing
2. Technological and digital transformation
3. Climate change and the net zero transition
4. Rising demand for care and support services
5. Geopolitical risk and fragmentation

Actuaries Institute.

Technological transformation

Demographic change

Climate change, decarbonisation and the environment

Actuaries Institute.

Compiled public + requested data across government

Education
and training

Workforce
and skills

Activities
and outputs

Expenditure
and funding

Challenge
specific data

Data gaps we filled (qualitative and quantitative analysis

DEMAND FOR SCIENCE

PREDICTING FUTURE
WORKFORCE

Select field of research

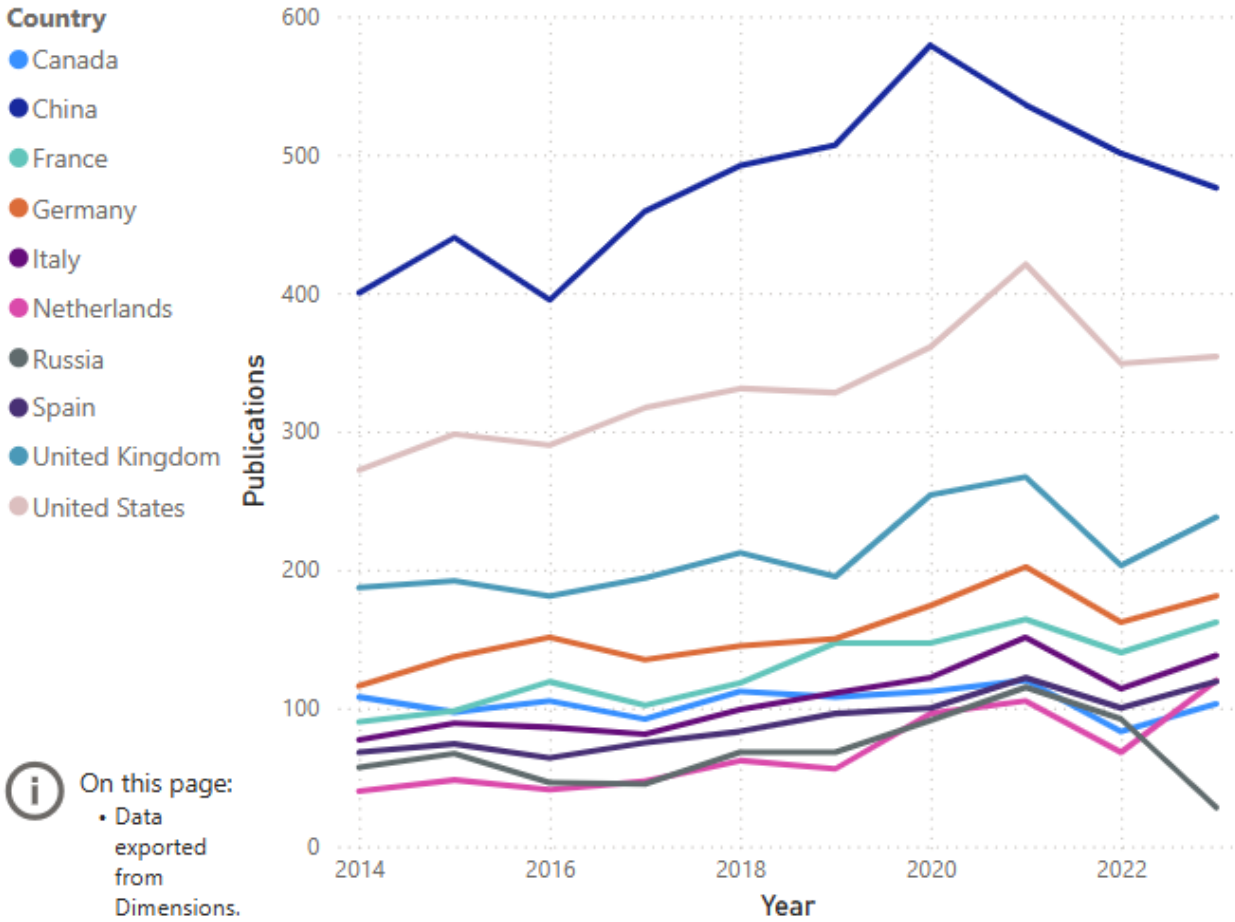
Agricultural, Veterinary and F... | Biomedical and Clinical Sciences | Earth Sciences | Environmental Sciences | Information and Computing Scien... | Physical Sciences

Biological Sciences | Chemical Sciences | Engineering | Health Sciences | **Mathematical Sciences** | Psychology

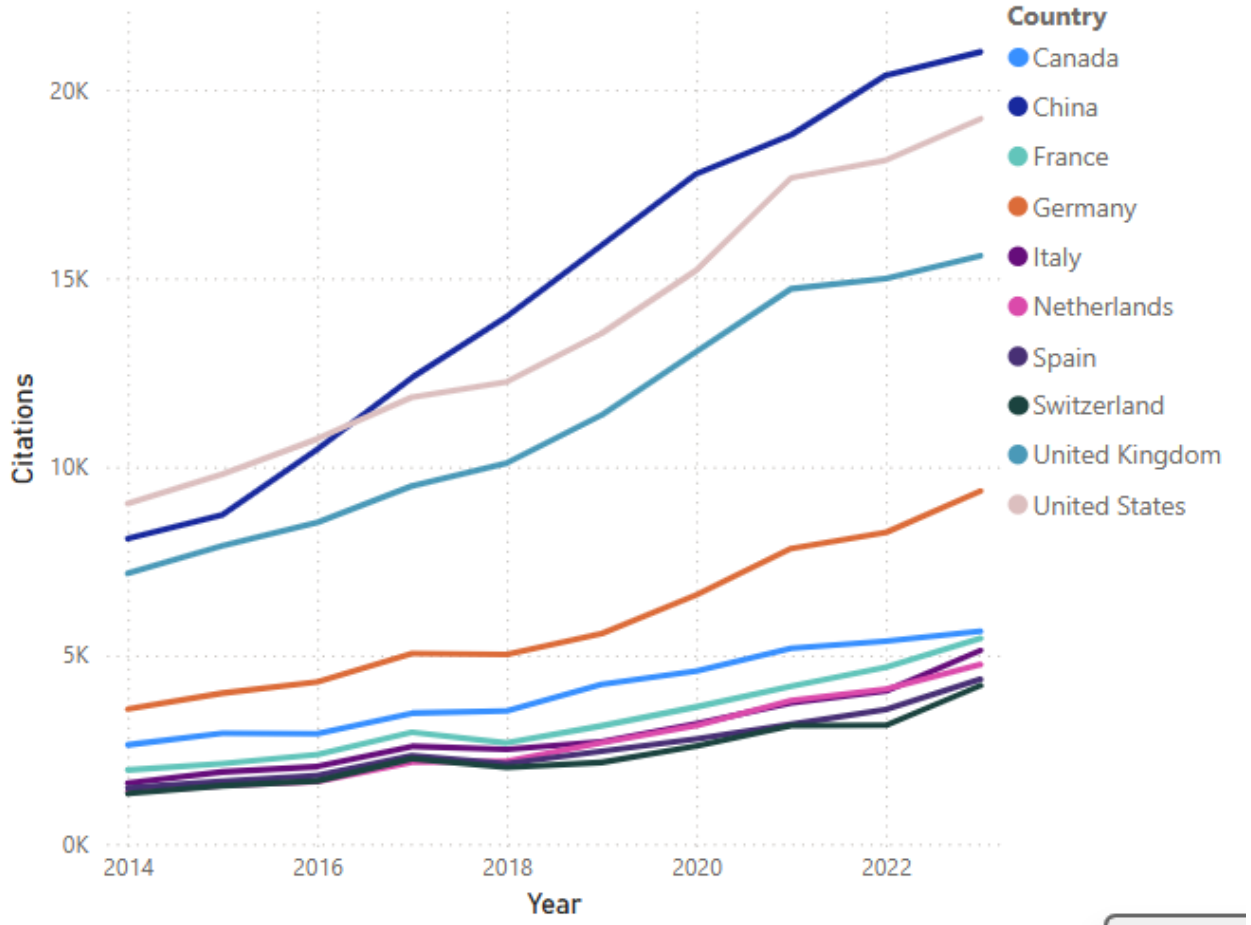
Select year

2014 – 2023

Publications with Australia's top 10 collaborators in selected field and time period

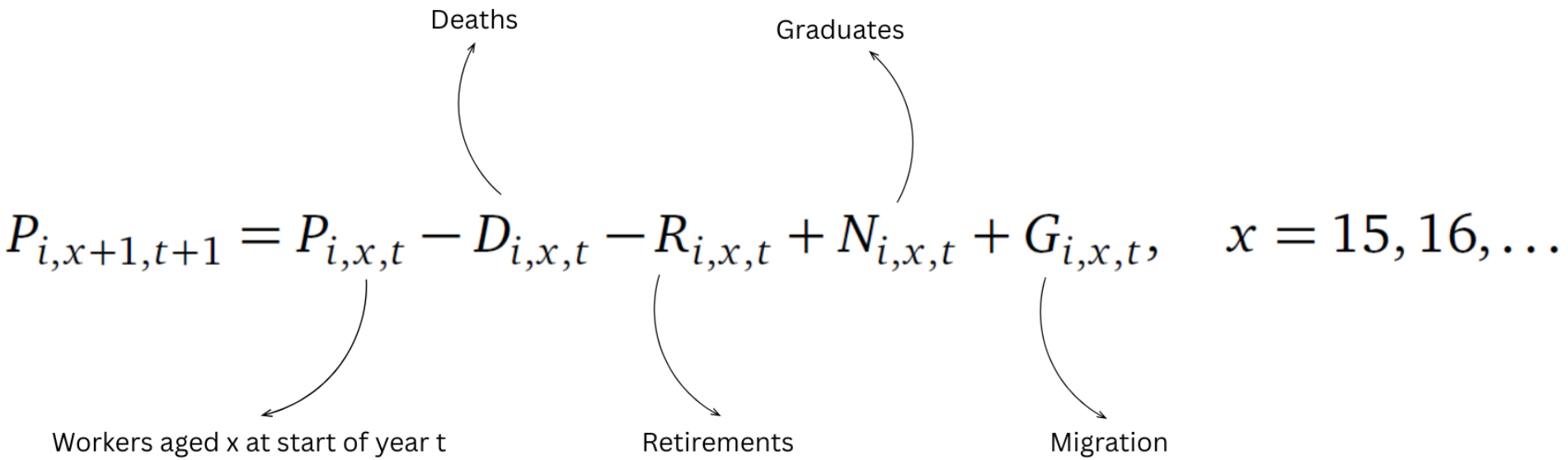


Citations with Australia's top ten collaborators in selected field and time period



On this page:
- Data exported from Dimensions.

The future working population in science



Actuaries Institute.

Future population forecasts

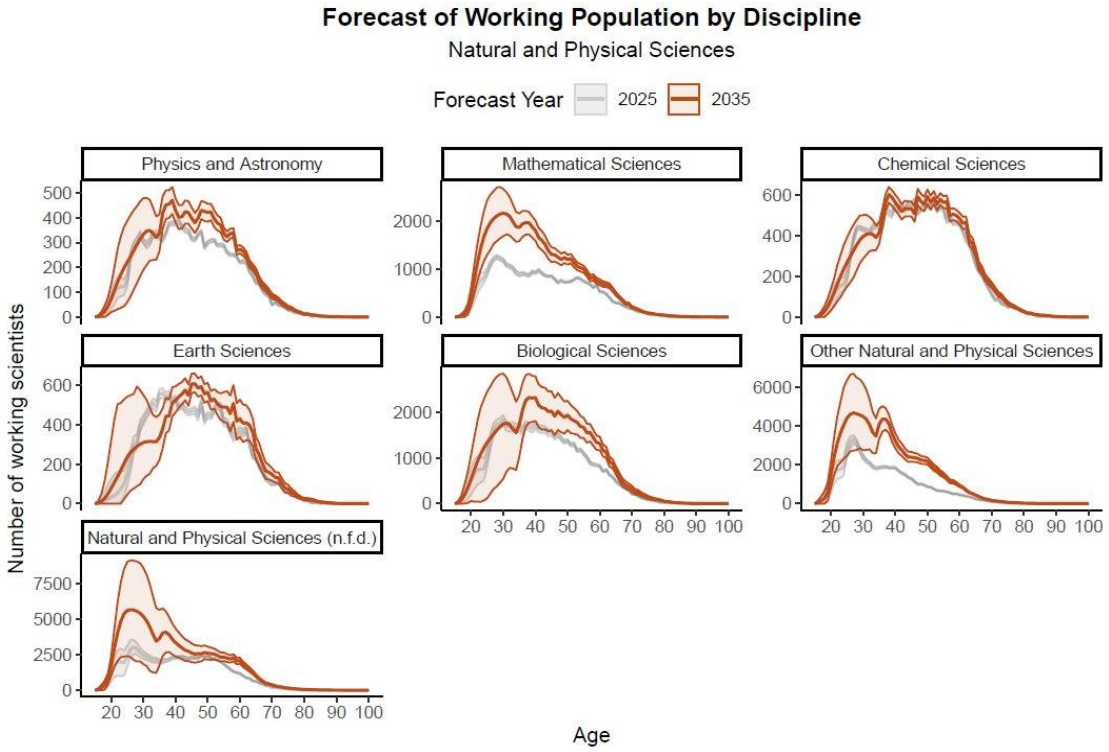


Figure 23: *Projected age distribution of the working population in 2025 and 2035 across scientific disciplines. The shaded regions represent the 90% prediction intervals, and the solid lines indicate the mean estimates for each year.*

Physics and astronomy – Ageing workforce

Mathematical sciences –Expansive workforce

Chemical sciences – Stationary workforce

Earth sciences – Ageing workforce

Biological sciences – Ageing workforce

Other natural and physical sciences – Expansive workforce

Natural and physical science – Ageing workforce

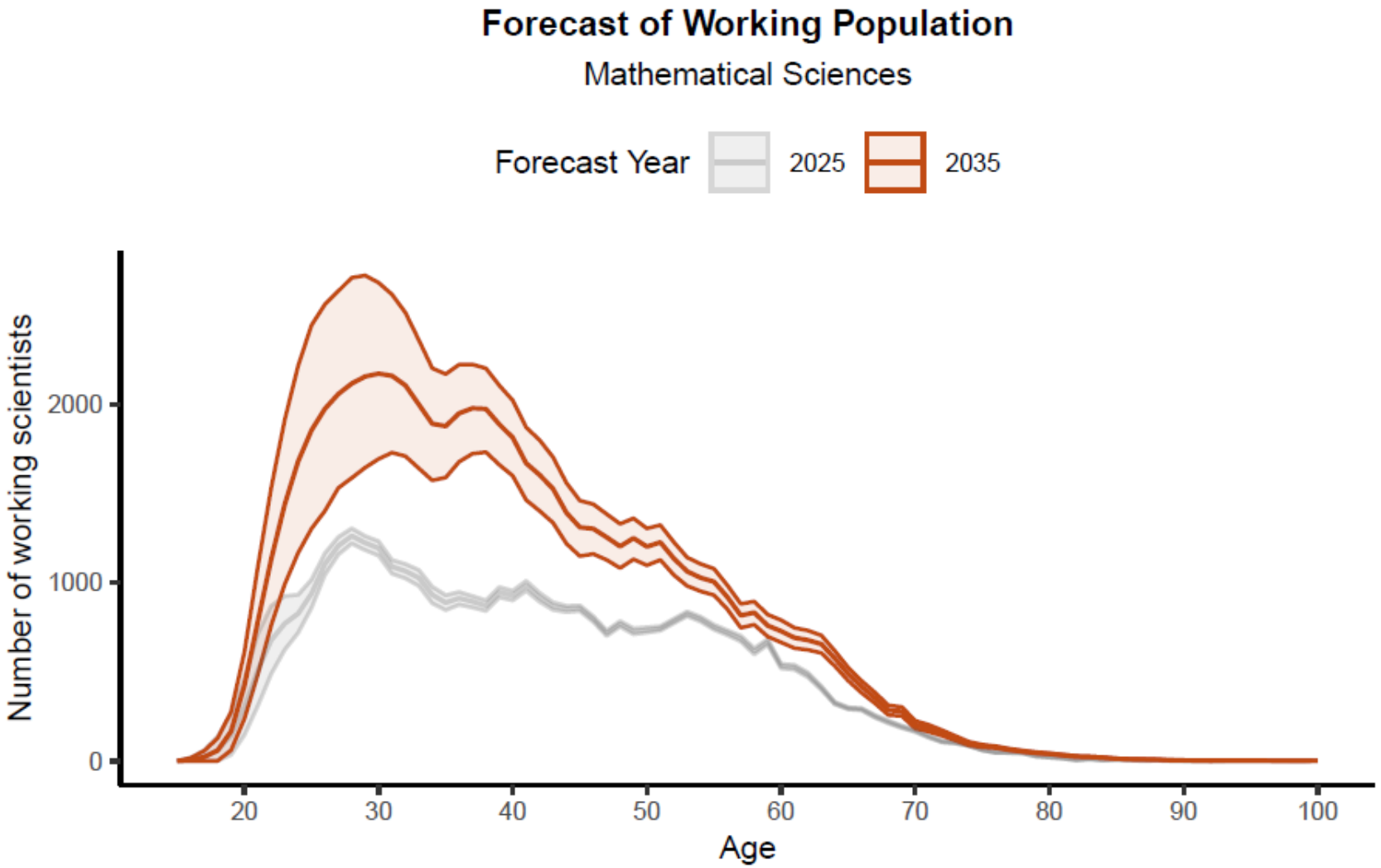


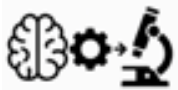
Figure 34: *Forecasted age distribution of the working population for Mathematical Sciences in 2025 and 2035, comparing changes over 10 years. Shaded areas represent 90% prediction intervals.*

Demand for science capability

Data science capability is essential to almost all areas of science given the increasingly data-intensive nature of research. Data science capability will help us maximise use of technologies such as high-performance computing, artificial intelligence and remote sensing. Data science also helps businesses understand and use their data for innovation.

Statistical analysis is a foundational capability that enables us to make sense of data, find patterns and make decisions. Statistical analysis helps answer questions about Australia's changing population, understand climate risks, develop algorithms for machine learning and identify trends in health data.

Modelling capability is essential to a range of scientific fields to understand, predict and explore complex systems. Developing and understanding local and global models helps us understand and make decisions in areas such as climate change and extreme weather, public health, biosecurity and quantum computing.



Artificial intelligence (AI) is shaping the practice of science and transforming industries. Over the next decade, Australia will need expertise in artificial intelligence to enable the responsible development and adoption of AI tools.

Climate science provides the fundamental knowledge that Australia needs to understand climate risks to our economy, businesses and environment. Knowledge from climate science informs predictions and projections that enable us to anticipate and respond to the impacts of climate change.

Agricultural science will support precision agriculture, agriculture sector adaptation to climate change and innovation to reduce greenhouse gas emissions. This capability will contribute to food security and biosecurity as our population and environment changes.

Biotechnology uses biological processes to develop new technologies and solve problems in medicine, agriculture, industry and the environment. Biotechnology capability is in demand for applications such as personalised medicine, rapid drug development, enhanced crops and the development of more sustainable materials and chemicals.

Geoscience capability underpins various aspects of Australia's economy, society and environment. It is essential to map our natural resources, such as critical minerals, which are necessary for decarbonisation and energy transition. Geoscience also helps us explore options for carbon capture and storage, manage groundwater systems to support water security and predict and mitigate the impacts of natural hazards.

Epidemiology helps us understand and respond to health threats in an uncertain world. It enables early detection of disease outbreaks, monitoring of the spread of diseases and understanding of who is at risk. As our population grows and changes, capability in epidemiology will support health system planning and inform public health policy.

Materials science develops the new materials that underpin new technologies. Materials science contributes to innovation, sustainability and economic opportunities through development of semiconductors, superconductors, sustainable energy technologies and circular economy solutions.

All underpinned by fundamental mathematical sciences

Artificial intelligence

The good

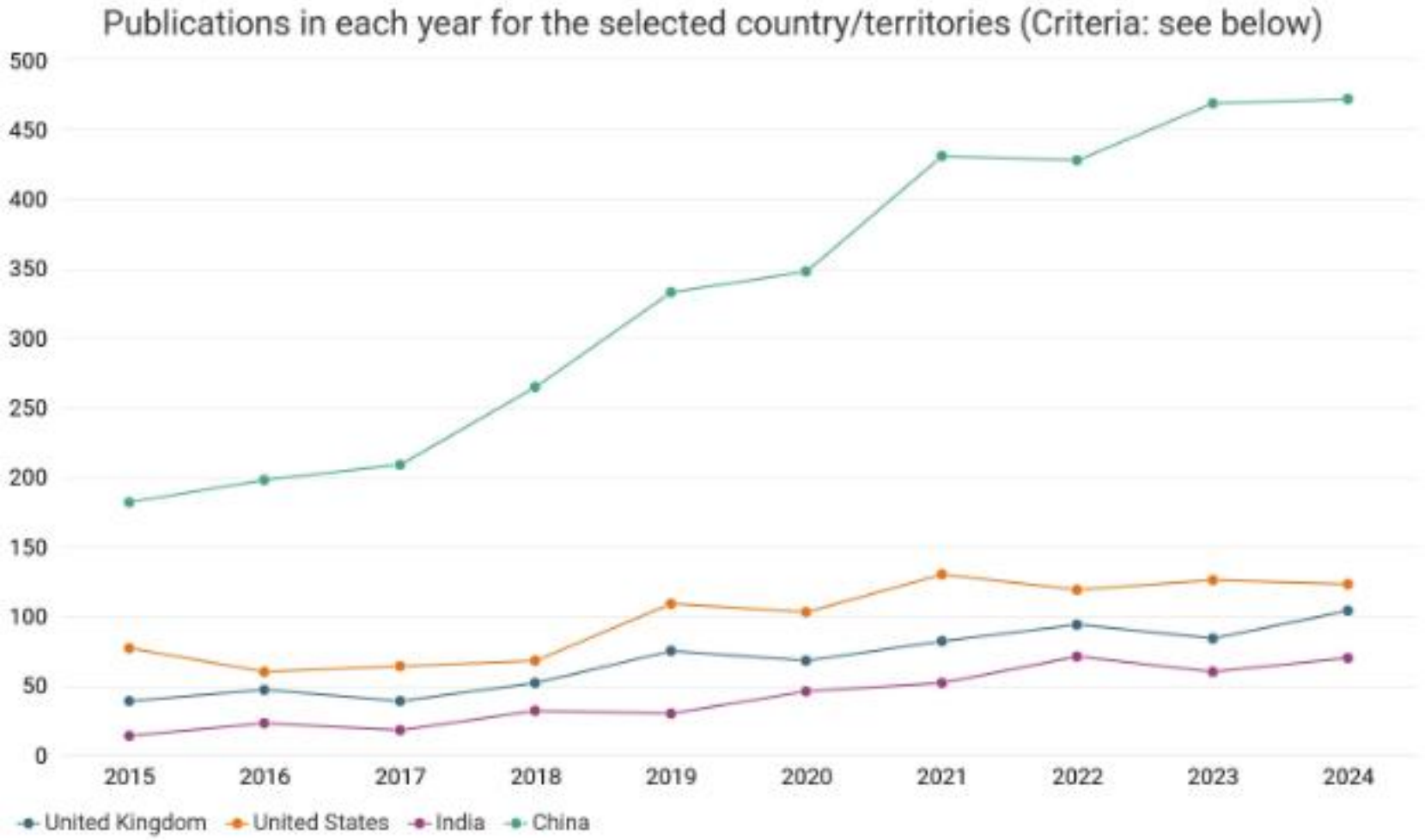
- There has been a large increase in course leavers in artificial intelligence.
- Competitive grant allocations have increased (almost doubled) from 2023 to 2024.
- There has been an increase in both domestic and international students at the undergraduate and postgraduate levels, but the increase in international students in both cases has been much greater.

The gaps

- ARC funding for AI has remained stagnant between 2010-2023, with two clear peaks in 2014 (~$35M AUD) and 2021 (~$30M AUD).
- There has been a decrease in permanent skilled migration of computer network professionals over the last decade.
- Only 20% of AI and computer science PhD students are female.

Actuaries Institute.

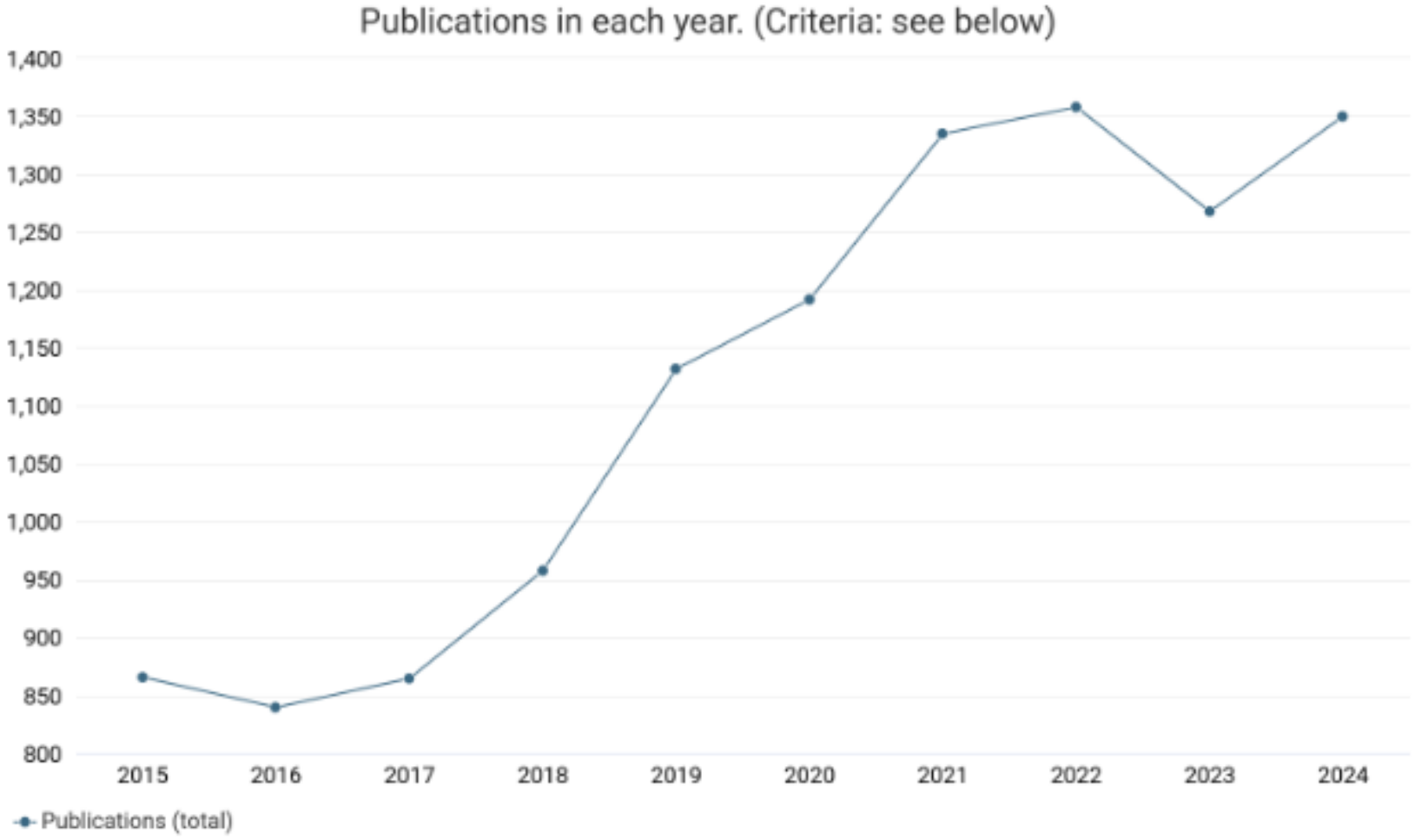
Artificial intelligence- international collaborations



Source: https://app.dimensions.ai
Exported: June 03, 2025
Criteria: Country/Territory is Australia; Fields of Research (ANZSRC 2020) is 4602 Artificial Intelligence

Actuaries Institute.

Australian AI Publications

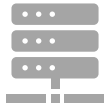


Source: https://app.dimensions.ai
Exported: June 03, 2025
Criteria: Country/Territory is Australia; Fields of Research (ANZSRC 2020) is 4602 Artificial intelligence.

Actuaries Institute.

Whole of system findings

Reliance on international collaborators (UA, China, UK)



High-Performance Computing - reaching end of life. essential for data science, statistics, modelling capabilities

Telecommunications - faster, more reliable to do science and deliver it (rural health services)

Multi-disciplinary approaches and systems thinking is essential

Science communication to demonstrate the value science to society and to build trust in science by addressing disinformation

Workforce:

Train, attract, retain. No national strategy

Accelerate science to solutions, eg medical research into clinical practice

STEM education:

Declining domestic PhDs; Vocational training for e.g. electricians to decarbonise, plumbers for supercomputers

Actuaries Institute.

Modernising Research Infrastructure

Essential to conduct cutting-edge research and co-operate with scientists abroad

National agency infrastructure, eg the OPAL reactor at the Australian Nuclear Science and Technology Organisation (ANSTO), the Australian Centre for Disease Preparedness, and the Marine National Facility.

Critical gaps exist = next-generation high-performance computing, satellite capabilities, and coordinated climate science.

Rapid evolution of technologies (AI and Quantum) and high demand for capabilities such as high-performance computing and data.

Scale of infrastructure required to support research and innovation into the future may be beyond the abilities of an individual nation to fund and host.

Australia's approach to investment in research infrastructure must evolve to strategically grow our capabilities, rather than take a 'just-in-time' approach.

Actuaries Institute.

Actuaries Institute.

Thank you

Actuaries Institute
actuaries.asn.au

Extra data if asked

24 capability indicators

Year 12 enrolments - No. of students
ACARA and STEM Equity Monitor

Year 12 enrolments – % of students
ACARA and STEM Equity Monitor

VET program enrolments
NCVER

University course leavers
Universities Australia

University enrolments – Undergraduate
Department of Education

University enrolments – Postgraduate
Department of Education

Undergraduate university applications and offers
Department of Education

Age structure analysis findings – Age structure of people in the workforce with a relevant qualification

Current shortages in relevant occupations
Jobs and Skills Australia

Employment projections for relevant occupations
Jobs and Skills Australia

Temporary skilled migration – Visas Granted
Department of Home Affairs

Permanent skilled migration
Department of Home Affairs

Number of publications
Dimensions

Proportion of global publications
Dimensions

Top international collaborators Dimensions

R&D expenditure by sector
ABS

Business R&D expenditure
ABS

Higher education R&D expenditure
ABS

Government R&D expenditure
ABS

Private non-profit R&D expenditure
ABS

Competitive grant allocations
ARC

Competitive grant allocations
NHMRC

Actuaries Institute.

Select field of research

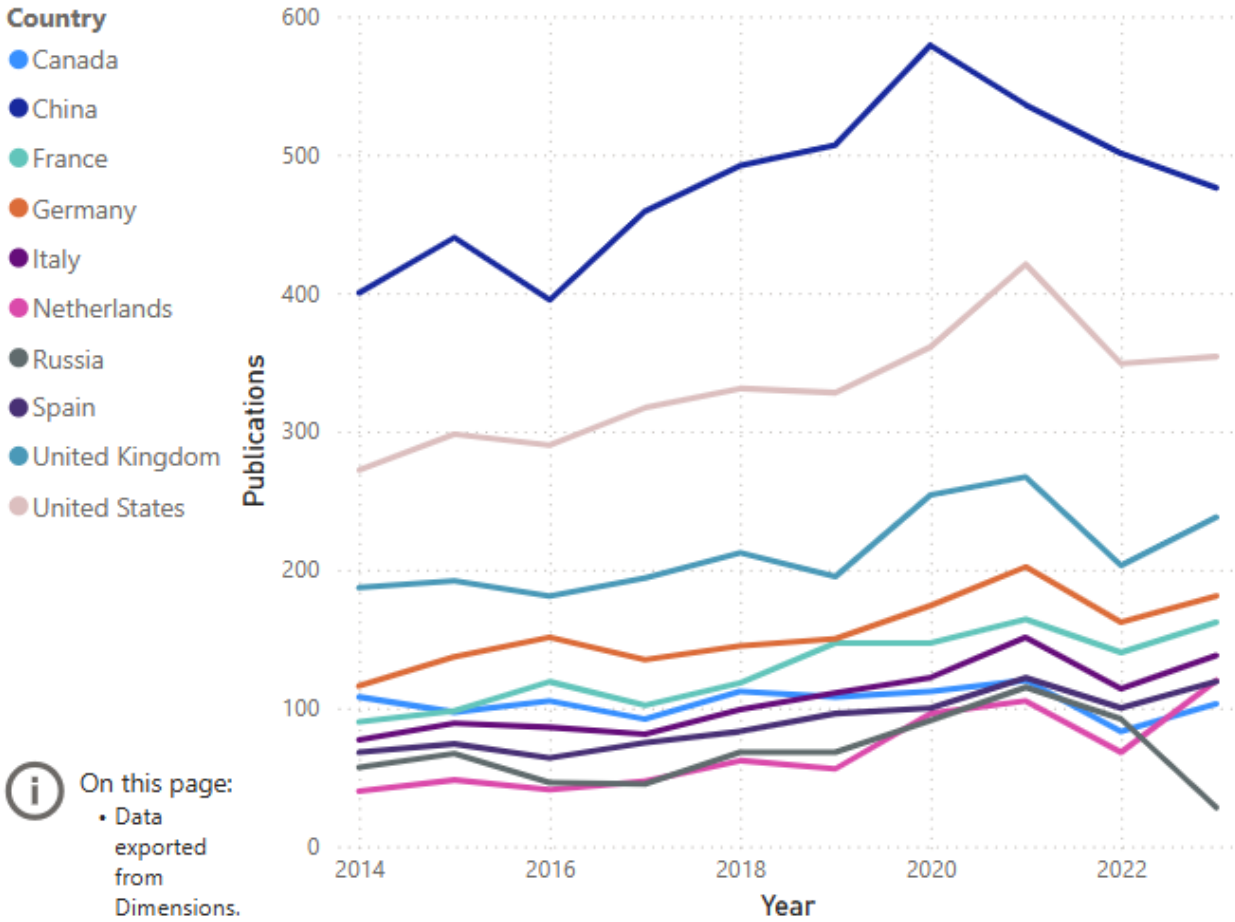
Agricultural, Veterinary and F... | Biomedical and Clinical Sciences | Earth Sciences | Environmental Sciences | Information and Computing Scien... | Physical Sciences

Biological Sciences | Chemical Sciences | Engineering | Health Sciences | **Mathematical Sciences** | Psychology

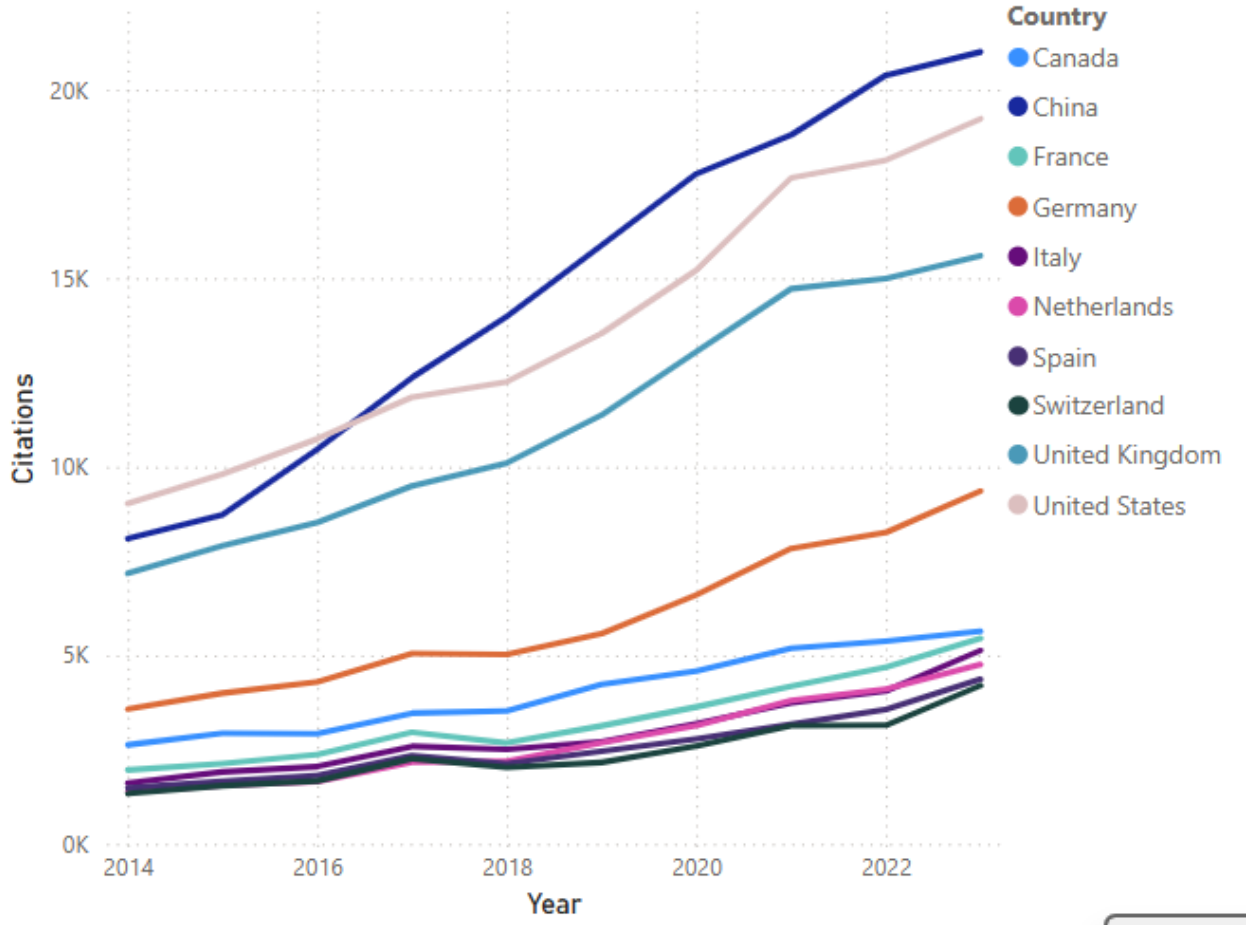
Select year

2014 – 2023

Publications with Australia's top 10 collaborators in selected field and time period

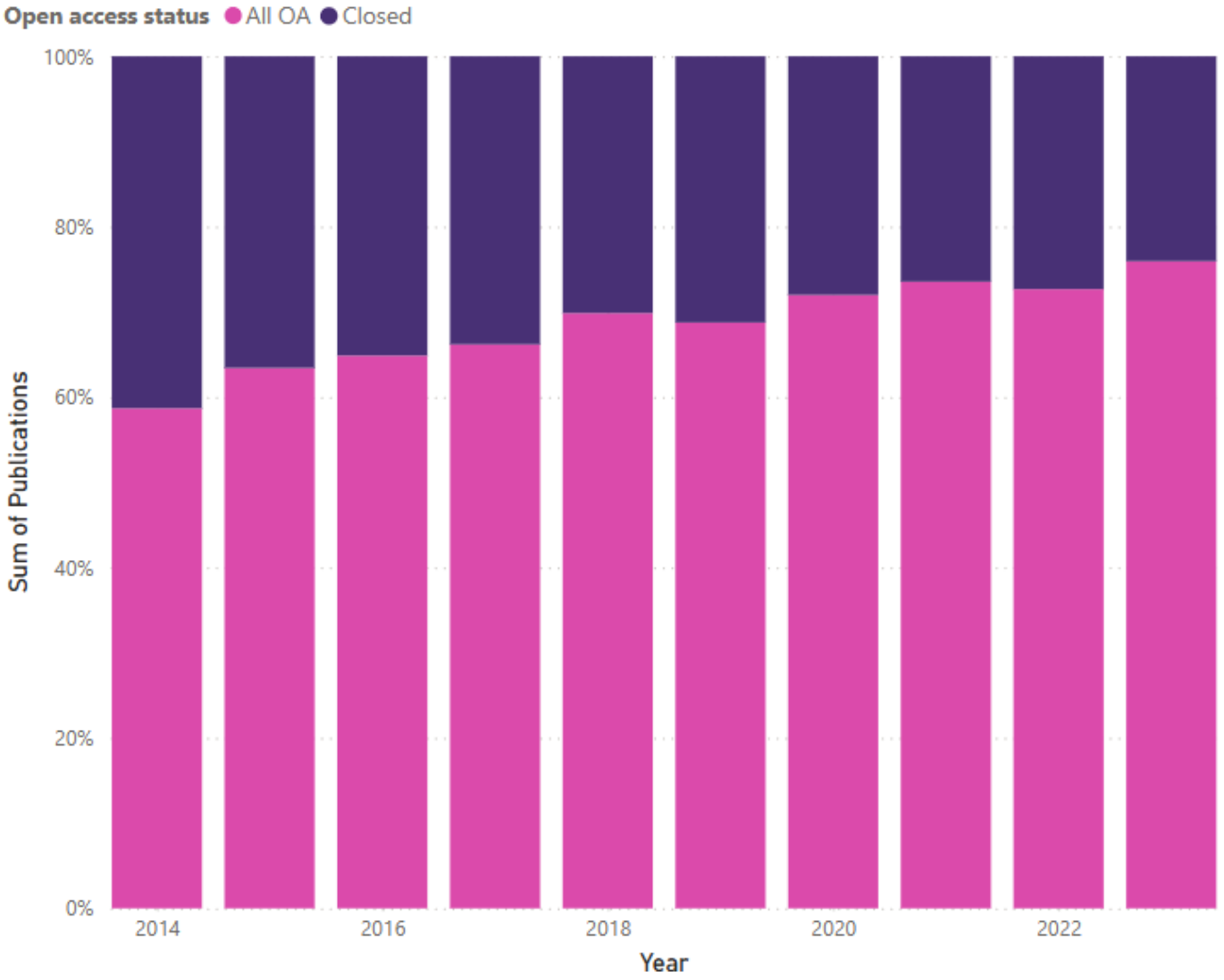


Citations with Australia's top ten collaborators in selected field and time period



On this page:
- Data exported from Dimensions.

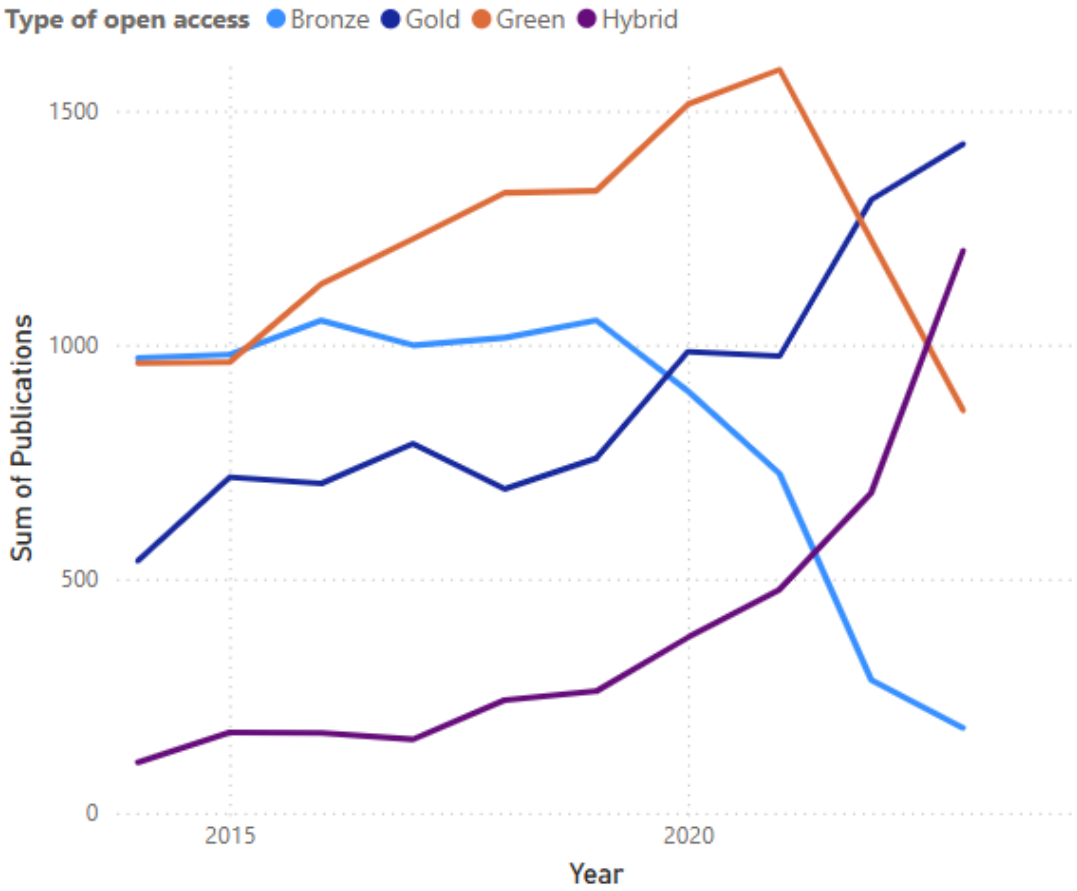
Proportion of Australian publications that are open access in selected field



Select field of research

Physical sciences

Open access Australian publications by year and type in selected field



On this page:

- Data exported from Dimensions.
- See "About this data" for definitions of open access types used by Dimensions.

Geoscience capability highlights

Over the last decade, the number of university students completing university geoscience qualifications have fallen.

Research publications are lower than a decade ago, and have fallen as a proportion of global publications.

Permanent skilled migrants in these fields have dropped significantly in the past decade.

There are current workforce shortages of geologists and geophysicists.

Projected over the next 10 years, Australia's earths science workforce is aging.

Actuaries Institute.

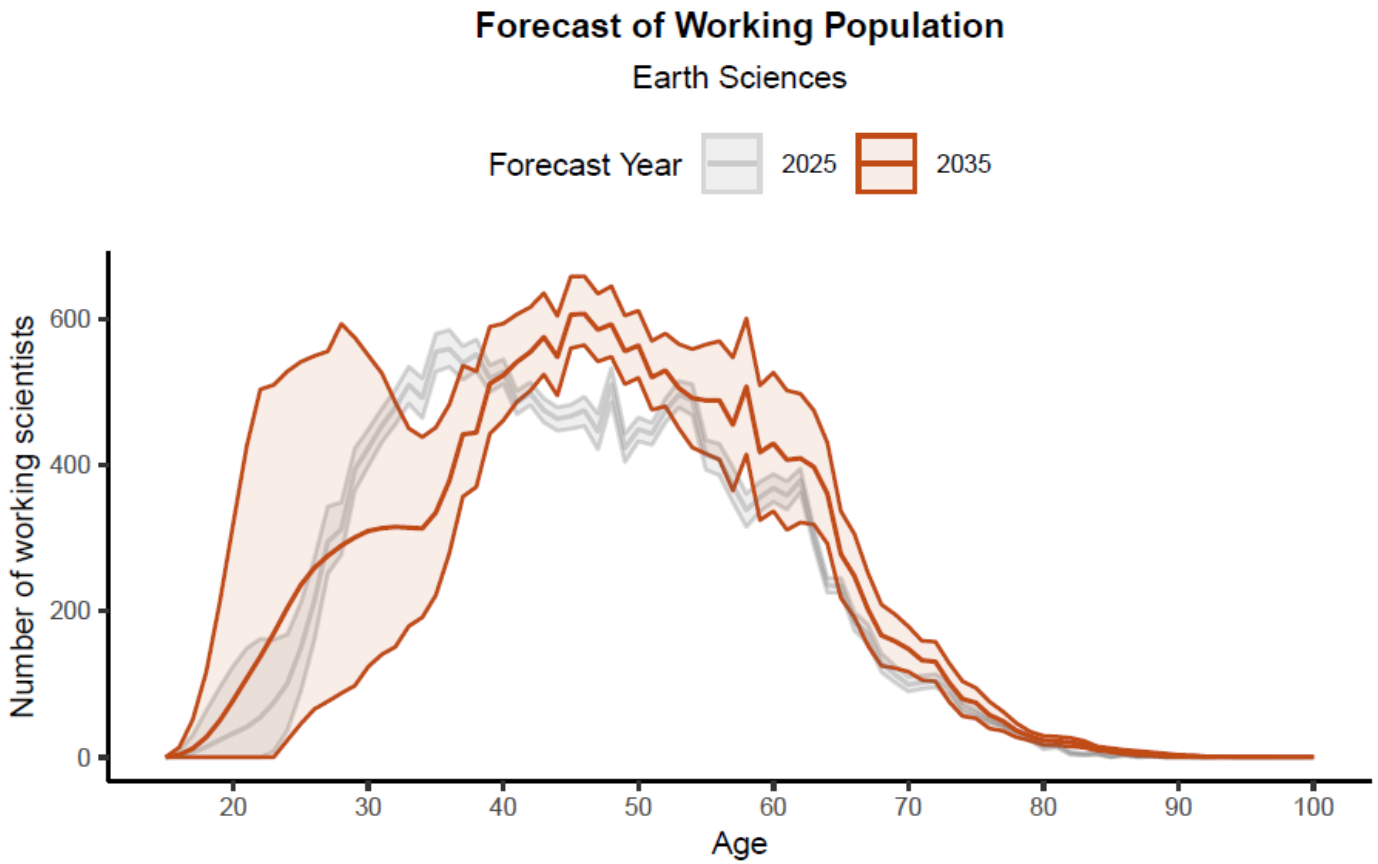


Figure 44: *Forecasted age distribution of the working population for Earth Sciences in 2025 and 2035, comparing changes over 10 years. Shaded areas represent 90% prediction intervals.*

National shortage rating

Shortage

Shortage driver

Suitability gap

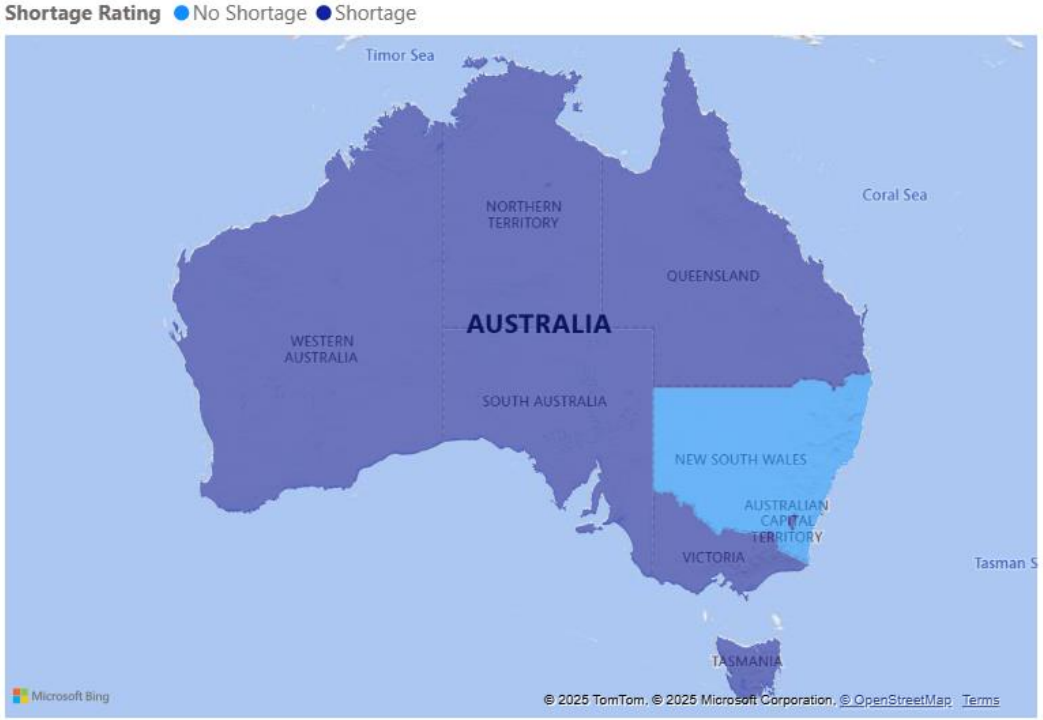
Select type of occupation

University STEM-qualified occupations

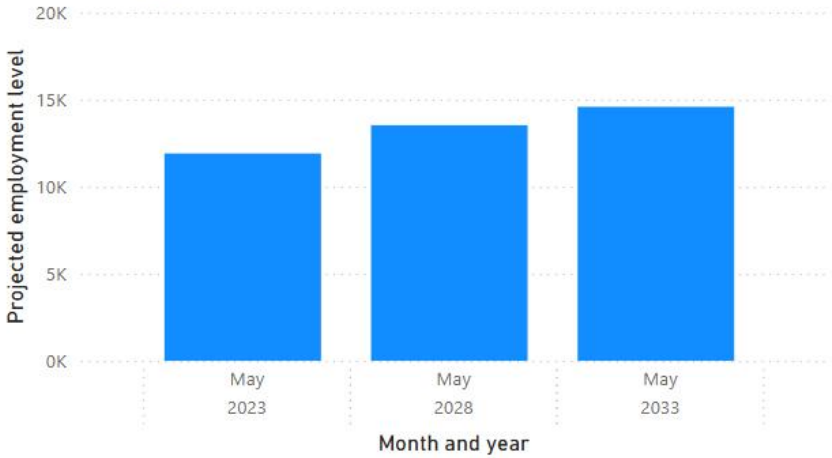
Select occupation

Geologists, Geophysicists and Hydrogeologists

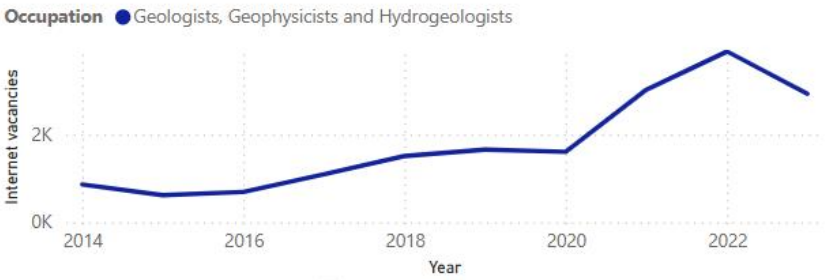
Shortage rating by state and territory



Projected employment growth (national)



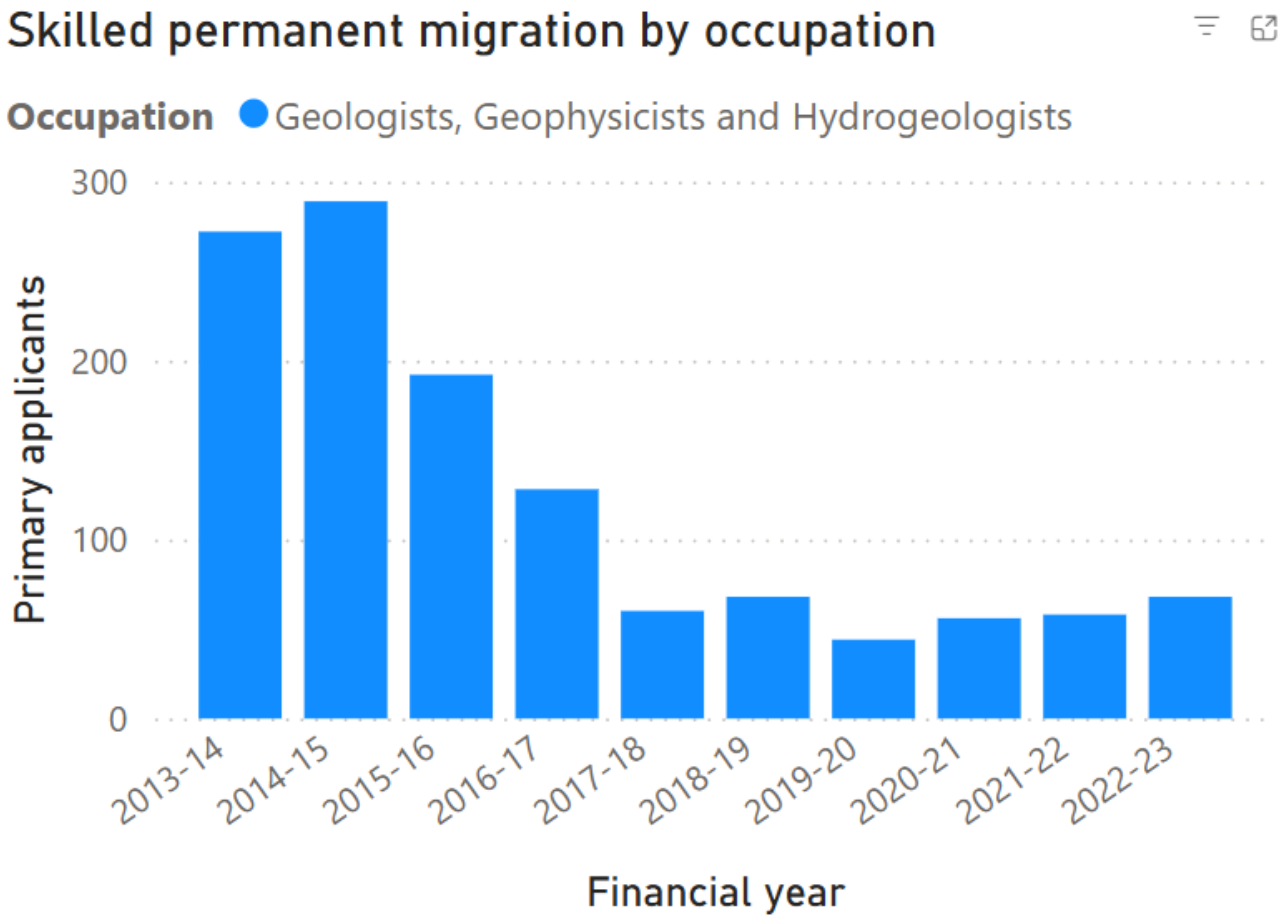
Internet vacancy index (national)



On this page:

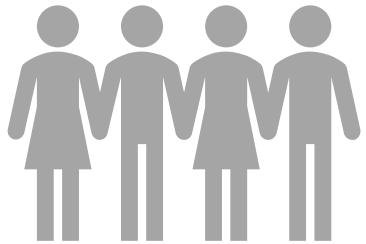
- Jobs and Skills Australia datasets: Skills Priority List, Employment Projections and Internet Vacancy Index.

Actuaries Institute.

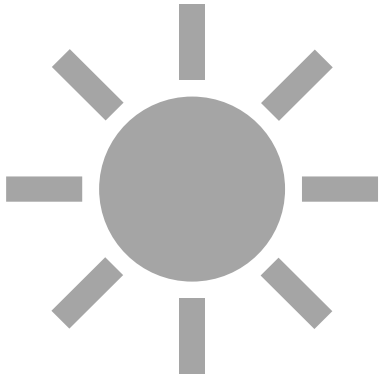


Actuaries Institute.

Why do we need Australian geoscientists?



Infrastructure to support the transport and energy needs for a changing population



Understand Australia's mineral resources and transition to clean energy

Actuaries Institute.

Underpinning challenges

1. **National capability**
   Australia lacks industrial diversity, making it susceptible to external shocks like trade disputes, extreme weather events, pandemics, and military conflicts.

2. **Education and science literacy**
   The role of education and science literacy in ensuring the Australian public is equipped to make informed choices in a rapidly changing world.

Actuaries Institute.