MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
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# SCIENCE SYSTEM ADVISORY GROUP

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| **PAPER NUMBER** | SSAG-MBIE-006 | **DATE** | 11/04/2024 |
| **TITLE** | Models for Government owned research organisations: cross-country scan | | |
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| **PURPOSE** | To provide information about international SIT systems to support your discussion of the future for Crown Research Institutes. | | |

# Models for Government owned research organisations: cross-country scan

## PURPOSE

To provide information about international SIT systems to support your discussion of the future for Crown Research Institutes.

## SUMMARY

The attached slide deck provides an overview of OECD and SAE nations' public sector research, and international case studies into selected other countries' SI&T systems (including their funding and Public Research Organisations (PRO) configuration).

We have provided primarily factual material with limited commentary, with an expectation that members of the group may bring their own experiences of international systems to the discussion.

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# Models for Government owned research organisations

## Cross-country scan

# Public research organisations

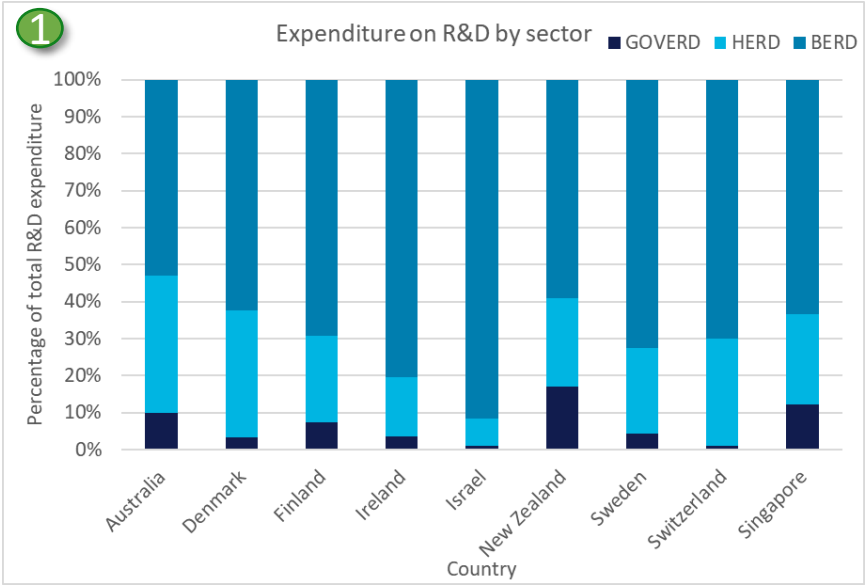
## Types and international comparisons

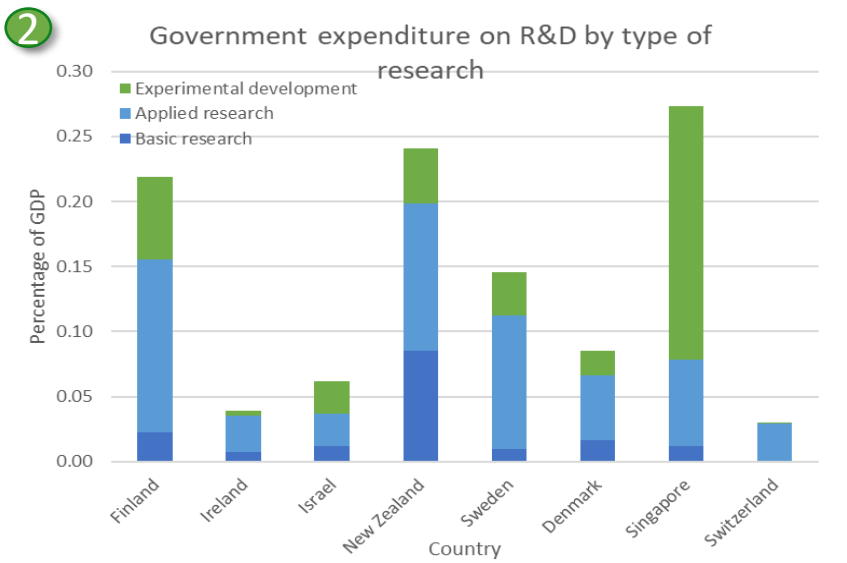
*All science systems have:*

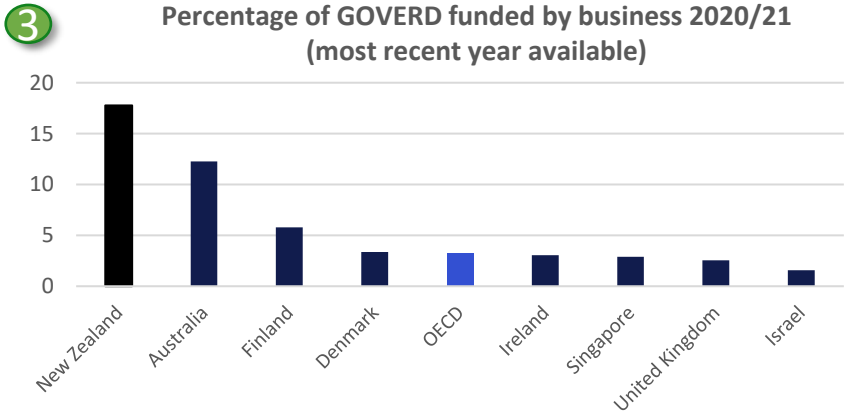
- *different combinations of funding bodies and research performing organisations (Public Research Organisations, Tertiary Education Organisations and Independent Research Organisations)*
- *different expenditure profiles in terms of government/industry, research horizon, research area/purpose*
- *different research priorities across PROs and funding mechanisms*

*The systems have evolved in different ways, as have the organisations which are often unique*

# NZ is different in terms of the contribution of “government sector R&D”



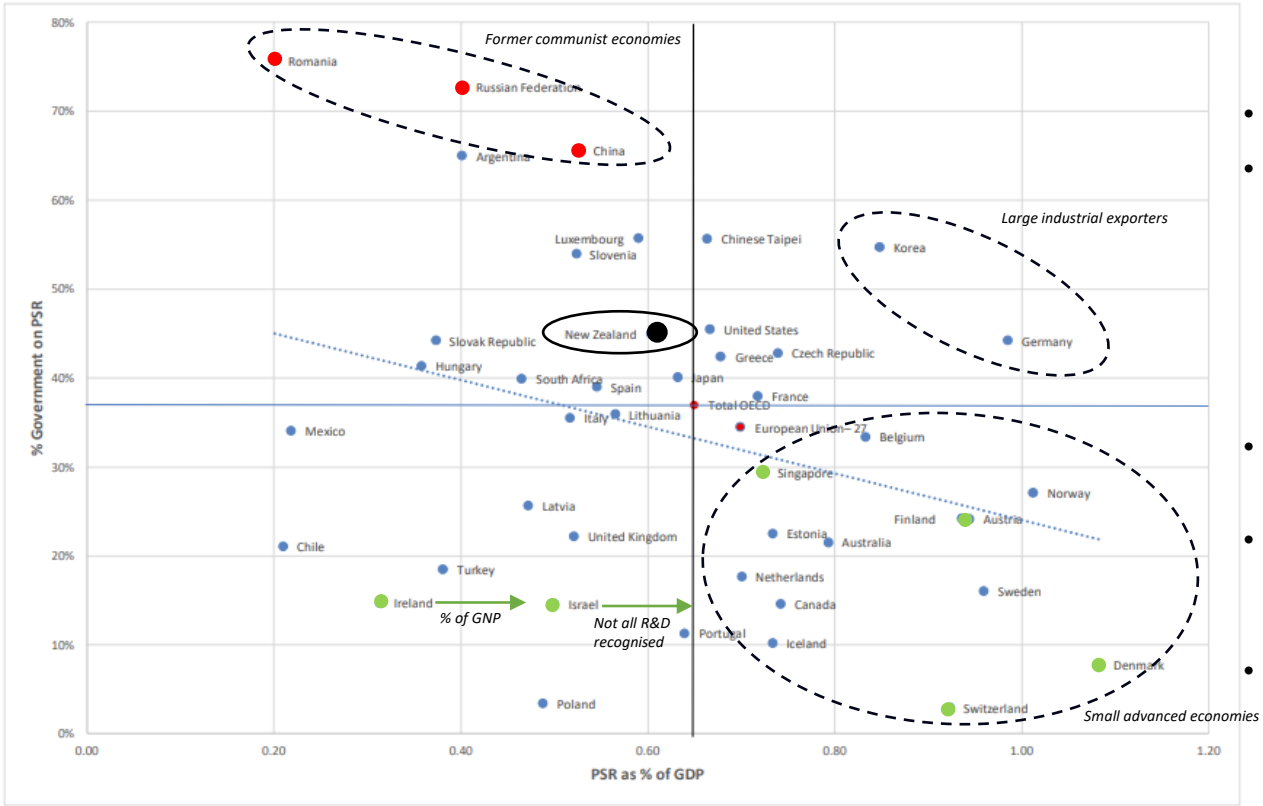

1. NZ’s R&D expenditure (GERD) is low by international standards, but government sector R&D (GOVERD) is unusually large – and dominated by CRIs (85% of total).
2. NZ GOVERD focuses more on basic research than other countries government.
3. NZ gets an unusually high proportion of its GOVERD funding from business.

GOVERD is Government expenditure on R&D; HERD is Higher Education expenditure on R&D and BERD is business expenditure on R&D.

# Countries vary across the spectrum, but there are discernible clusters

Is New Zealand in a half-way house – and unlike its peers?

**Share of government and public sector research R&D expenditure (as a % GDP)**




Source: OECD (2021) Main STI Indicators

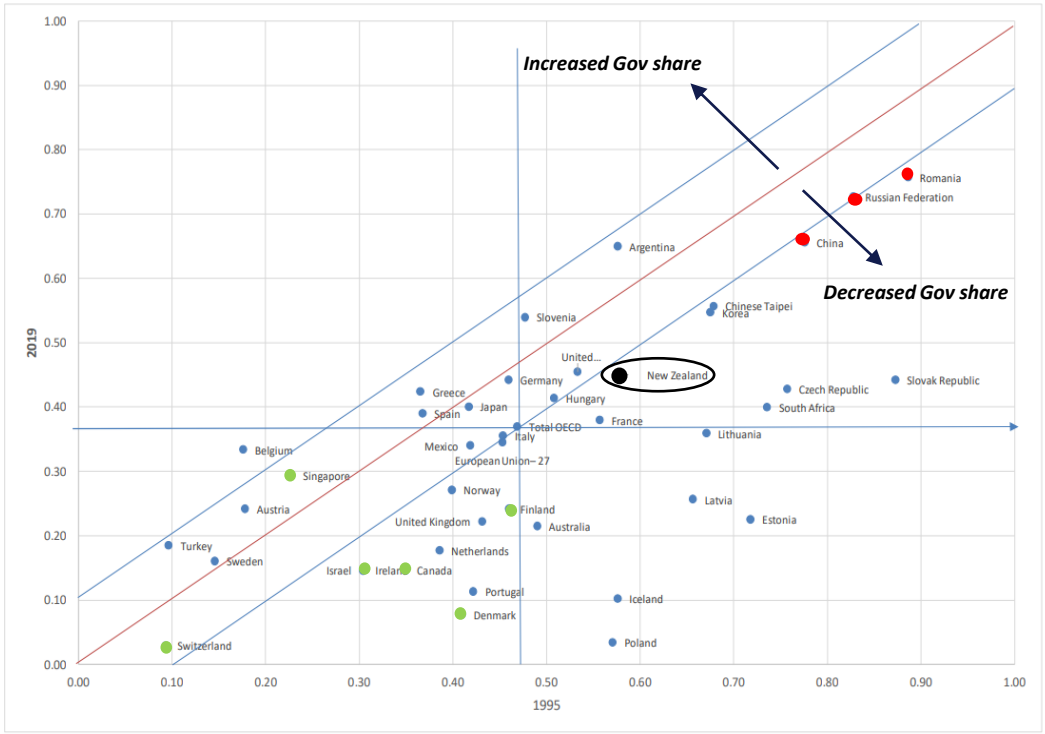
PSR = Government plus Higher Education sector.

Green = Small Advanced Economies
Red = former communist

- Country specific development and individual historical evolution has led to a large variation in how much of public research is conducted by Government owned PROs.
- But there are some discernible patterns.
- Smaller advanced economies tend to:
  - Spend a higher proportion on public research as a % of GDP, and
  - Conduct less R&D through Government owned entities (more through universities or contracted).
- Former communist countries tend to have larger government entity shares.
- Export orientated industrialist countries – tend to have larger proportion of public research.
- New Zealand finds itself in a “strange neighbourhood” slightly on low side of total public research, but with a relatively high proportion of it through Government owned entities.

# And over time most countries have reallocated R&D away from govt entities

**Government sector share of public sector research, 1995 and 2019**




Source: OECD 2021, MSTI-I

Green = SAEs
Red = former communist

PSR = Government plus Higher Education sector.

- In general, the share of Government sector performing "public sector" R&D is declining.
- In NZ, Government share of "public sector" R&D has declined, but is still relatively high
- Smaller advanced economies since 1995, with the exception of Singapore, have declined. All but Switzerland (which was low to begin with) have declined significantly – Denmark being perhaps the most prominent example (with the mergers with the Universities).

  This reflects a trend in SAE governments' investment choices and reform preferences over the last few decades, towards reducing their share of government-funded "public sector" R&D.

# There are also many different types of PROs

- There have been lots of approaches used to classify PROs:
  - Scientific field & Type of organisation
  - Ownership (legal status)
  - By what its mission is:
    - Government Laboratories, Academic Institutes, and Research and Technology Organisations (RTO)
    - Mission-oriented research, basic science, and oriented and applied research (similar to Frascati)
  - By funding source (and how responsive/ independent they are to the funders and/or the traditional owners)
  - By knowledge transfer
  - Government vs market influence (ie public science displays a high government and low market influence, and private technology shows low government and high market influence).

An empirical classification of 200 PROs in 8 countries identified the 4 main types in the tables, based on clustering of organisational variables (it is not a theoretical model). Public Research Organisations and Public Research Funding (Cruz-Castro and Sanz-Menéndez) (2023). NZ PROs don't fit neatly into these categories – they sit across PRC, TRO, MOC.

| PRO Management | | Degree of internal authority (command and control) | |
|---|---|---|---|
| | | More | Less |
| Degree of external org autonomy from Government | More | **Research & technology orgs** (RTO) | **Independent Research Institutes** (IRI) |
| | Less | **Mission-orientated centres** (MOC): | **Public Research Centres and Councils** (PRC): |

| | IRI | PRC | RTO | MOC |
|---|---|---|---|---|
| Principal Mission | Develop knowledge | Develop knowledge | Generate economic value | Contribute to solve public policy issue |
| Legal Status | Not for Profit | Public | Not for profit or Private | Public |
| Orientation of R&D | Basic/applied research | Basic/applied research | Experimental development | Applied research |
| Country Examples | Newer Hybrids – basic research in some scientific domains with strong mandate to solve social/economic probs. Centre for Genomic Regulation (Es), National Institute of Genomic Medicine (INMEGEN Mx) | National academies of science or national research councils Max Planck (De), CSIC(Es), CONICET(Ar), CNR(It) | General mission promote industrial competitiveness Frauenhofer( De), Technalia (Es) TNO(Nl), SINTEF(No) | Usually embedded in public administration structures in health, energy & environment, agriculture, defence INRAE(Fr), Canadian Energy Research Institute CERI(Ca), NASA(Us), INSA(Health research institute Pt) |

# And different types tend to have very different funding profiles

| | Max Planck Society (Germany) | Spanish National Research Council | National Research Council of Italy | Fraunhofer (Germany) | Tecnalia (mission: to transform tech into GDP) (Spain) | National Institute for Agriculture, Food and Environment (France) | Centre for Genomic Regulation, (Spain) |
|---|---|---|---|---|---|---|---|
| | MPG(DE) | CSIC(ES) | CNR(IT) | FhG(DE) | Tecnalia(ES) | INRAE(FR) | CRG(ES) |
| PRO type | PRC | PRC | PRC | RTO | RTO | MOC | IRI |
| Total Budget (2020 or nearest year (Million€)) | 2400 | 763 | 900 | 2800 | 114 | 999 | 43 |
| A. Governments direct funding (% total) | 85% | 62% | 60% | 30% | 20% | 80% | 50% |
| B. Total Third Party funding (% total) | 13% | 36% | 40% | 65% | 78% | 20% | 50% |
| B1. Public Competitive funding (regional, national) (% total) | | 20% | | 30% | 10% | | 20% |
| B1.2. Competitive funding from EU (% total) | 4% | 12% | 5% | 5% | 18% | 3% | 25% |
| B2. Commissioned "contract research" (% total) | | 3% | | 30% | 50% | | 5% |
| C. Other sources of funding (% total) | 2% | 2% | | 5% | 2% | | |

Note: Share estimates based on average bi-annual data, when available and EU Cordis.

Sources: Annual Reports, Financial statements and PROs web pages.

[Public Research Organisations and Public Research Funding (Cruz-Castro and Sanz-Menéndez)](#) (2023)

**Organisational trends**

The increased focus on the intermediation between science and industry and the separate but increased focus on the science with social relevance (Mission) has led to the evolution of new types of institution.

**Two broad and competing funding trends**

More contract research funding due to an increased focus on the intermediation between science and industry, including servicing it and facilitating innovation (*normally in RTOs Research and Technology organisations*).

More programmatic funding due to a drive to push science to the knowledge frontier and “excellence” (the Pasteur’s quadrant).

# International case studies

Australia
Singapore
UK
Denmark

*A very brief snapshot of the different models employed by different countries*

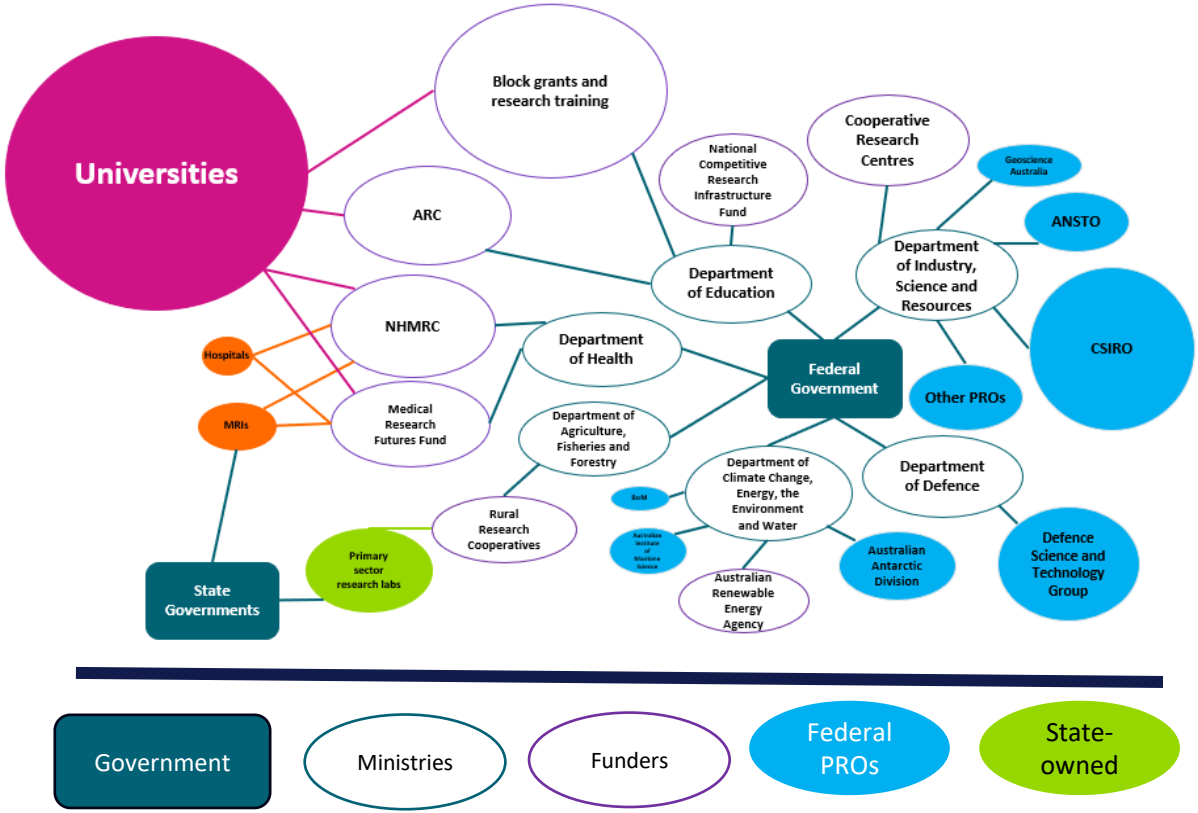
# High-level comparison of case study nations

| | Australia | Singapore | UK | Denmark | Finland |
|---|---|---|---|---|---|
| **GERD % OF GDP** | 1.8% (2019) | 2.22% (2020) | 2.93% (2020) | 2.81% (2020) | 2.99% (2021) |
| Public research | Most public research performed in the higher education sector. | Public research performed in the large PRO - A*STAR – but also in the higher education sector. | Most public research performed in the higher education sector. | Most public research performed in the higher education sector, especially since early 2000s reforms. | Most public research performed in the higher education sector. |
| Public research organisation | Large centralised PRO CSIRO, but many other public and private ROs and strong universities too. | Significant funding in each 5-year RIE Plan (around 1% of GDP) for both A*STAR and Unis. | Large centralised PRO funding body UKRI - 7 underlying research councils and many PROs (50+). | Distinct in that HE leads research, PROs much less important than elsewhere. | Several PROs but VTT largest and has significant commercial function. |
| Research priorities | Federal government currently refreshing national research priorities. | Strong govt direction from Research, Innovation and Enterprise (RIE) 2025 Plan. | UK constantly reviewing and resetting priorities for SI&T system. | RESEARCH2025 catalogue for research system outlines Denmark's national research priorities. | The national level research funding gives effect to the national level priorities. |
| **OTHER** | | Tiny landmass (city state), proximity, tiny agriculture sector (0.5% of GDP). Huge state intervention for all stages of business (spin-outs) & skills procurement | Greater focus on researcher-directed research, given the Haldane Principle. Therefore funding separated from govt depts. | Very small country by landmass; concentrated population. One university dominates. (EU Labour market) | Legislated target of overall GDP share of R&D expenditure to be 4%. (EU Labour market) |

# Australia

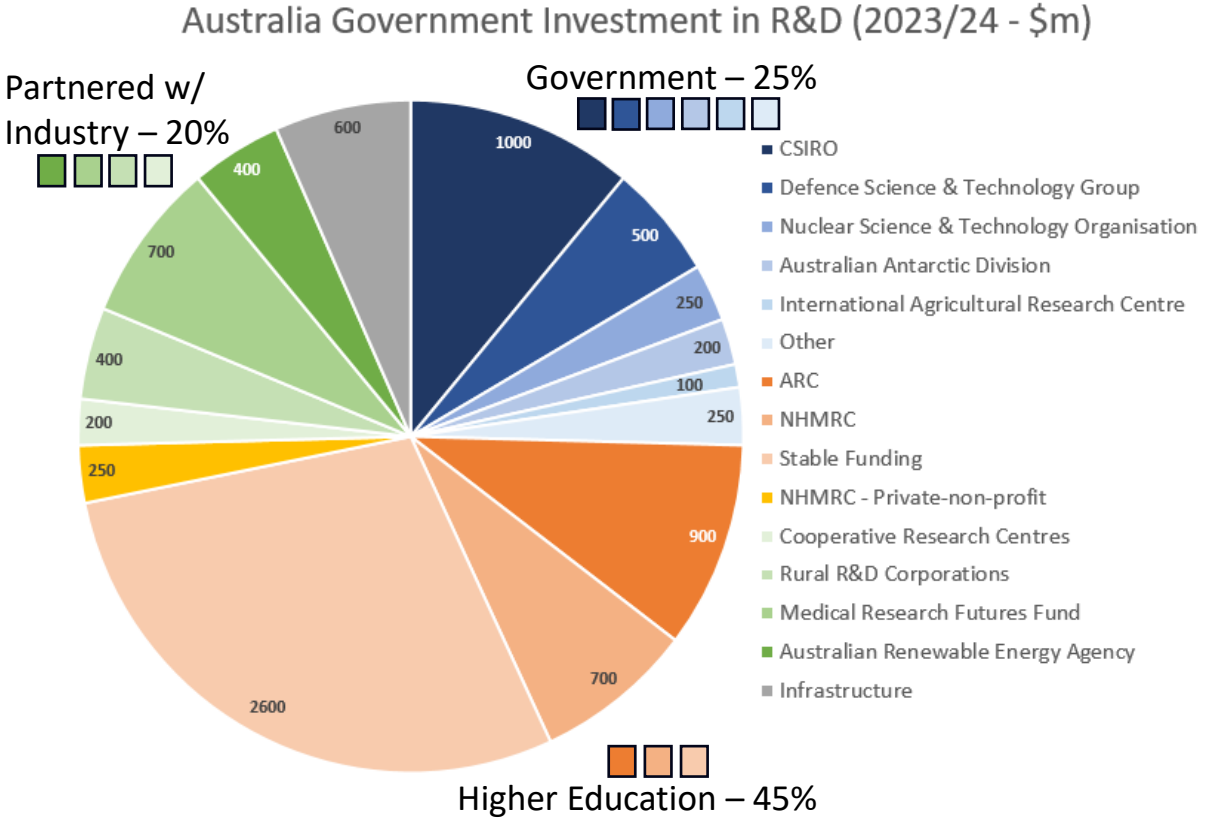
# Overview of research system

- Most research conducted in universities. Mixture of baseline, competitive and teaching funding
- Two medium-sized research councils that fund only – they don't own any research institutes themselves
- One large (CSIRO) and several smaller government PROs that cannot bid for competitive grants but can partner with other orgs
- CSIRO covers a wide range of activities (including duplication of some other PROs in eg climate or marine sciences)
- Other PROs are focused and the responsibility of sector-facing agencies rather than the science agency (DISR). In some cases these PROs are fully embedded within ministries.
- Wide range of medical research institutes, mostly embedded within universities



# Research funding

- The majority of Australian government research funding goes to the higher education sector
- PROs receive the majority of their funding through a single government ministry – either the user-agency for that research or the science ministry (DISR). Some are entities very close to the departments, CSIRO is a Corporate Commonwealth Entity (but not-for-profit).
- Industry-partnered research is funded primarily by responsible ministries (eg partnered health research by the DoH through the Medical Research Future Fund)
- CSIRO receives around 1/3rd of its funding from commercial revenue. ANSTO and other federal PROs generate 1/4th or less of their revenue from commercial activities.




- Australian State Governments (not shown) are significant funders and providers of i) science services (eg through ownership of public health labs) and ii) partnered research (eg through NSW Department of Primary Industries-owned agricultural science labs). They also fund a small amount of basic research through university-embedded research institutes aligned to the strengths of that State's universities or research infrastructure.

# Context

- Shift in 2014 – CSIRO's focus went from supporting industry to mission-oriented research to support national objectives, supported by structural change.
  - "Impact science" focused on the nation's biggest challenges
  - Managing national collections and research infrastructure
  - Providing commercial, consumer-centric products and services for industry, government and communities (including SME engagement and scientific consultancy).
- Distinguishing features:
  - PROs are not able to bid into most research funding competitions, however they can participate as a non-funded partner.
  - CSIRO manages around $1b in tech-focused VC funds called Main Sequence. Main Sequence focuses on Deep Tech startups. The capital comes partly from an Australian government investment, partly from corporate partner investors, and partly from re-investing profits from the fund in further R&D ventures.
  - Cooperative Research Centres (est. 1991, ~25) – support collaboration between public and private sector researchers and Australian industry, similar to Catapult (UK) and Fraunhofer Institutes (Germany).
- Australia is in the process of significant SI&T system reform, with reviews of the ARC and the university sector, and a research prioritisation process all underway. PROs (including CSIRO) are not a major topic of the review.

While CSIRO is the largest single PRO by a significant margin, it only makes up around half of Australia's government R&D sector.

Most other PROs are supported by line departments and industry.

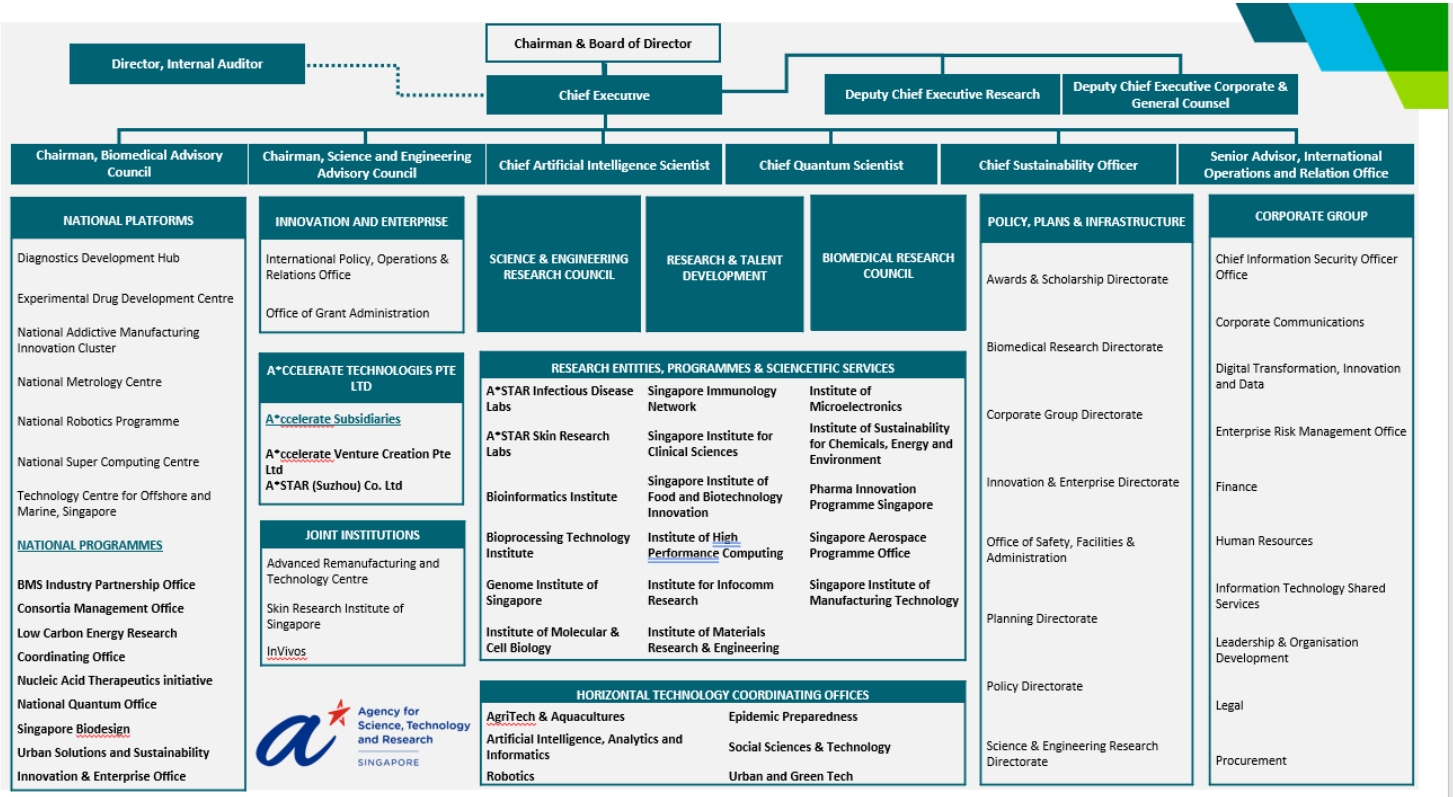
For example, there are 15 Rural Research and Development Corporations across agriculture, fisheries and forestry supported by government and levy funding. Over time many of the RDCs have transitioned to become independent, not-for-profit companies owned by the industries they serve. 5 remain statutory corporations or authorities, owned by the Commonwealth and established under legislation. All are overseen by the Department of Agriculture and Water Resources and accountable to the Federal Parliament.

There is some overlap between CSIRO areas of activity and other PROs.

# Singapore

# System review – A*STAR dominates government R&D

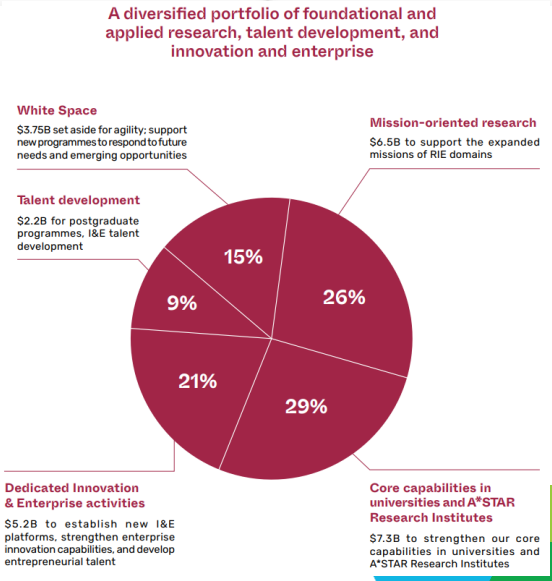
- The National Research Foundation is in PM's office, it sets system's direction and funds strategic research initiatives and infrastructure to support domestic and international research.
- One centralised PRO makes up most of system - Agency for Science, Technology and Research (A*STAR) (est. 2002), formerly the National Science and Technology Board (NSTB) (est. 1991). Under the Ministry of Trade and Industry.
- There are also critical research functions in higher education institutions, such as Research Centres of Excellence at Singapore's universities.




The A*STAR structure

# Funding

- The government will sustain investments in research, innovation and enterprise at about 1% of Singapore's GDP over 2021-2025 for RIE2025.
  - This is about SGD$25 billion (around NZD$31 billion) extra in funding.
  - Around one third of the RIE2025 funding supports basic research.
  - In Budget 2024, the Singaporean govt announced SG$3 billion (about NZD$3.6 billion) more for RIE 2025.
  - RIE Plans to 2020 and 2015, and S&T Plan to 2010 still funding SI&T.
- National Research Foundation:
  - The NRF sets the national direction for R&D and develops strategies to support the growth of technology enterprises. An operating budget of SGD$43.28 million (insert NZD conversion) allocated to the National Research Foundation Programme, 7.0% of the total operating expenditure for FY2024.
- A*STAR:
  - The estimated expenditure for A*STAR in FY 2023-24 is SGD$1,688,791,200 (around NZD$2 billion).
  - Six years ago, A*STAR deliberately separated out industry-related research from basic science.
- Science & Technology Policy & Plans Office Programme:
  - Conducts S&T masterplanning and strengthen public sector S&T capabilities. An operating budget of SGD$17.63 million (insert NZD conversion) allocated to the S&TPPO programme, 2.8% of the total operating expenditure for FY2024.

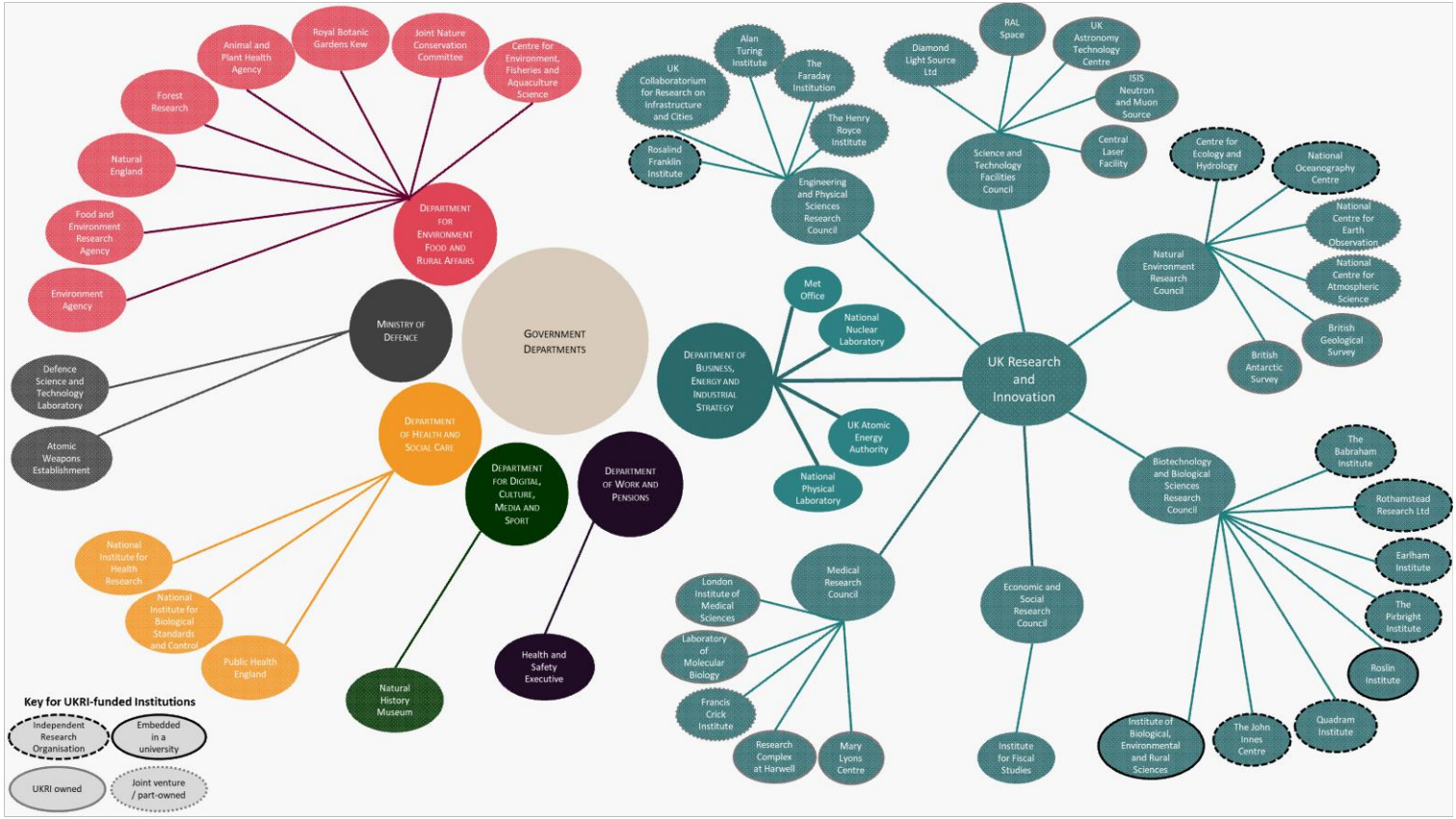
# Singapore's RIE policy is very mission-driven

- In the last 60 years, there has been a shift from Singapore's government SI&T function/s being advisory to more directive and centralised.
- SG has been led by 5-yearly research, innovation and enterprise plans since 1991, which outline sectors/domains of focus. The RIE plan to 2025 has:
  - four strategic domains (Manufacturing, Trade and Connectivity, Human Health and Potential, Urban Solutions and Sustainability, Smart Nation and Digital Economy
  - three cross-cutting horizontals (Academic Research, Manpower, Innovation and Enterprise).
- Singapore has a vast array of funds and support mechanism for skills and business in the industries the emerge from the R&D.
- Singapore strongly supports international investment, with many international companies having a  presence in Singapore.
- Some 'science services' type functions are undertaken by Government agencies. For example, the National Environment Agency undertakes public health surveillance and climate and weather services.
- A*STAR is a single nationwide umbrella for all research organisations, research funding councils, and corporate functions in Singapore.
- A*STAR is a statutory board reporting to the Ministry of Trade and Industry. It is an autonomous organisation
- The two funding agencies are the Biomedical Research Council and the Science and Engineering Research Council
- It is co-located with other public and private research functions at two R&D hubs, and has around 6,000 scientists and researchers, technical and non-technical staff, and industry development, commercialisation and corporate staff
- A*STAR identifies 10 areas of research focus, which are: biomanufacturing, chemicals, materials, greentech, electronics, engineering, food and consumer, infocomms, medical technology, pharmaceuticals and biologics, robotics and automation, security and transport.
- At a high level, Singapore's A*Star model is like the CSIRO model in Australia, as both are nationwide research organisations run through central government and each institute has its own mandate. Both have centralised services. However, A*STAR makes up a lot of the Singaporean govt SI&T system, while CSIRO is a small part of the Australian system.

# United Kingdom

# UKRI dominates the funding landscape of UK public research system

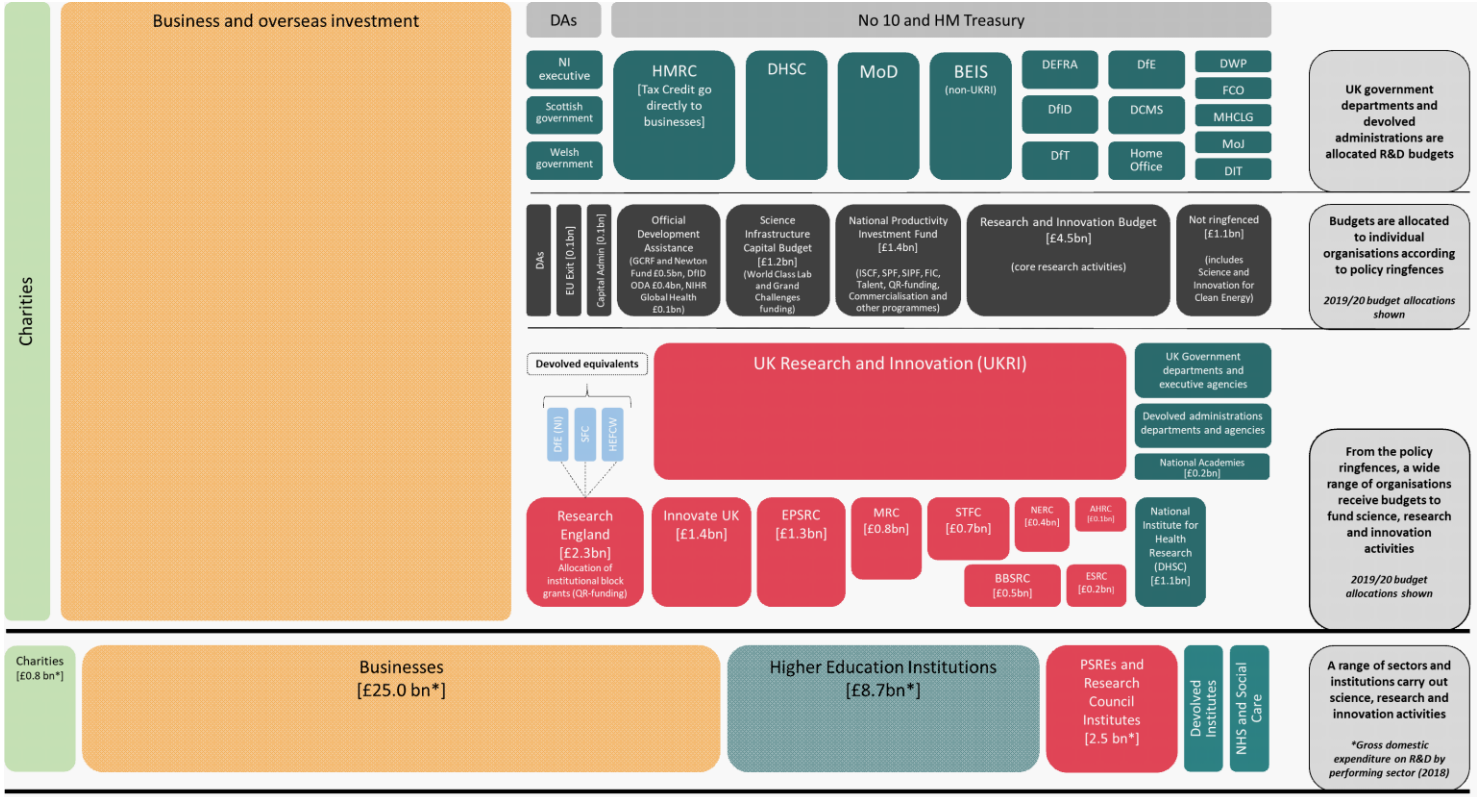
- UKRI is a non-departmental public body established under Higher Education and Research Act 2017, sponsored by Department for Science, Innovation and Technology (DSIT).
- This diagram does not include devolved administrations that fund research and innovation institutes (eg Catapult).
- It is also not a complete list of UK PROs.



# UK Funding landscape

Note: due to public sector reform, the BEIS and DCMS sections would now be DSIT.

- Most UK Government funding for R&D is provided from DSIT via UK Research and Innovation UKRI. UKRI funds R&D through Innovate UK – business-led innovation, the seven research councils – specific programmes & projects, and Research England – to HE providers, not tied to specific activities.
- A wide distribution and variety of funding arrangements across different research organisation types, comprising a mixture of 'core' research funding and project-based funding.




In 2018 GERD figures, business and overseas investment accounted for £25bn of R&D funding and charities accounted for £1.9bn.

**Acronyms**: DAs (Devolved Administrations), NI Executive (Northern Ireland Executive), HMRC (HM Revenue and Customs), DHSC (Department of Health and Social Care), MoD (Ministry of Defence), BEIS (Department of Business, Energy and Industrial Strategy), DfE (Department for Education), DfID (Department for International Development), MHCLG (Ministry of Housing, Communities and Local Government), DfT (Department for Transport), DEFRA (Department for Environment, Food and Rural Affairs), DWP (Department for Work and Pensions), DCMS (Department for Digital, Culture, Media and Sports), FCO (Foreign and Commonwealth Office), MoJ (Ministry of Justice), DIT (Department for International Trade), GCRF (Global Challenges Research Fund), ISCF (Industrial Strategy Challenge Fund), SPF (Strategic Priorities Fund), SIPF (Strengths in Places Fund), FIC (Fund for International Collaboration), QR (Quality-related), HEFCW (Higher Education Funding Council for Wales), SFC (Scottish Funding Council), DfE (NI) (Department for the Economy (Northern Ireland)), EPSRC (Engineering and Physical Sciences Research Council), MRC (Medical Research Council), STFC (Science and Technology Facilities Council), NERC (Natural Environment Research Council), AHRC (Arts and Humanities Research Council), BBSRC (Biotechnology and Biological Sciences Research Council), ESRC (Economic and Social Research Council), PSREs (Public Sector Research Establishments)

# UK is constantly iterating and reviewing system

- The rationale of UKRI consolidation reform was to allow one organisation to be more strategically placed to respond to global research and innovation challenges, break down funding silos with greater coordination, and increase the role of science in society.
- It makes sense that that the centralised PRO funding body (the UKRI) is separate from the government - unlike in many other countries - given the Haldane Principle that has governed research funding in the UK since 1918.
    - This is the idea that decisions on research expenditure should be made by researchers instead of politicians or that research should be separated from government control. This principle was reaffirmed in section 103(3) of the Higher Education and Research Act 2017.
- PRO reform and consolidation have happened relatively quickly and recently: 2017 HERA & Research Councils review, 2018 UKRI formation, 2019 research system review, 2020 R&D roadmap, 2023 Science and Technology framework.
- UKRI also includes devolved administrations that fund research and innovation institutes, such as the 9 Catapult centres run by Innovate UK under UKRI. Catapult centres are a physical network of technology organisations that provide businesses access to technical capabilities, equipment and other resources by connecting them with expertise from the UK's research and academic communities.
- Funding key characteristics:
    - No resubmissions policy for contestable funding applications.
    - Excellence primary assessment factor, then impact secondary.
    - Important research organisations are fully funded but there is limited ability to compete for grants and contestable funds.

In 2021:

- The business sector funded £38.7 billion (59%) (about NZD$75.9 billion) & performed £46.9 billion (71%) (about NZD$92.0 billion) of R&D.
- The public sector funded £12.8 billion (19%) (about NZD$25.1 billion) - about 0.59% of GDP – and performed £3.4 billion (5%) (about NZD$6.7 billion) of R&D.
- HE institutions funded £5.6 billion (8%) (about NZD$11.0 billion) & performed £14.9 billion (25%) (about NZD$29.2 billion) of R&D.

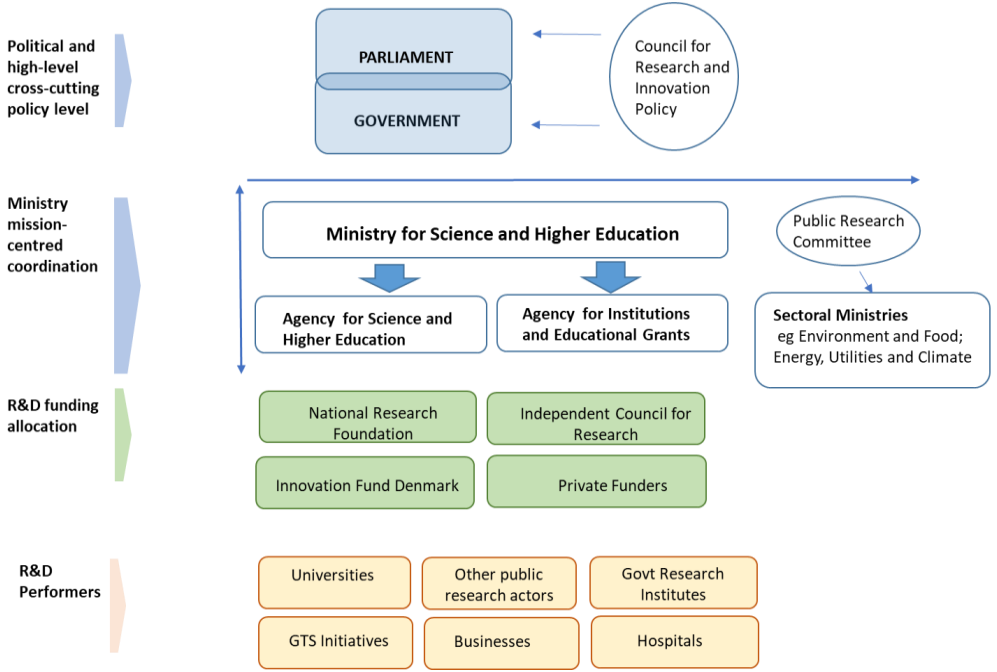
*Please note that this conversion was done based on assumption that "2021" refers to the UK's 2021 financial year, which was 1 April 2021 – 31 March 2022.

# Denmark

# Overview of research system - Denmark

- The main research institutions are the eight Danish Universities and 23 other higher education research institutions, Under the University Act of 2003 reforms, these are state-funded and autonomous.
- Public funding is allocated through the Independent Council for Research, and the Innovation fund.
- 4 Government Research Institutes were unaffected by the merger process, now positioned as independent sector research institutes.
- Research technology organisations (GTS initiatives) provide knowledge-based technology services to Danish companies, primarily intended to service SMEs. They are non-profit organisations that run as private companies.
- The country also has a significant private sector, with Danish foundations playing a substantial role in the funding of HE institutions and PROs.
- Denmark's RESEARCH2025 catalogue outlines the basis for future strategic investment in research.

## The Danish research system



# Most public research funding is channelled through universities

- Universities made up around 92% of the total public R&D expenditure in 2022 (OECD Main Science and Technology Indicators). The universities receive funding through three sources: basic funding for research, education funding and external research funding.
- The total expenditure on research and development (R&D) in 2020 was DKK 69.0 billion (about NZD$16.2 billion) , which was 3 per cent of Denmark's GDP. Business and the public sector contributed DKK 42.5 billion (about NZD$10.0 billion) and Infocom's DKK 26.5 billion (about NZD$6.2 billion) respectively.
- In 2023, the government allocated DKK 19.8 billion (about NZD$4.7 billion) in 2023 for research and development, bringing the total public research budget to approximately DKK 27 billion (about NZD$6.4 billion). DKK 2.4 billion (about NZD$0.6 billion) is earmarked for green research. It also retained the goal that public investments in research and development should account for at least 1 percent of GDP, it was 0.83% in 2019.
- There is a sinking lid on R&D funding to encourage efficiency and make space for new investment.
- Two intermediary funding bodies, both established in 2014:
    - Innovation Fund Denmark (IFD): responsible for allocating research grants to the research system (universities, government research institutes (GRIs), and industry), based on societal and commercial challenges outlined in national strategy documents. IFD has DKK 7.1 billion (about NZD$1.7 billion) in active investments over 1,996 active projects. DKK 1 billion (about NZD$0.2 billion) is in four green mission-driven R&D innovation cross-sector partnerships.
    - Danish Council for Research and Innovation: the main independent research and innovation council in Denmark which gives advice to the Minister for Higher Education and Science and the broader Danish Parliament about innovation and conditions for innovation. It is composed of actors from the universities, the GRIs and representatives from industry.
- Denmark is above OECD average for R&D intensity.

*Please note that this conversion was done based on assumption that each year refers to Denmark's financial year, which follows the calendar year.

^conversion done as at 11 April 2024 NZST.

# Denmark is the example of merging PROs into universities

- The rationale behind the University reform was to strengthen the global competitiveness of Danish universities, as part of the Danish Globalisation Strategy. Also, in 1999 EU countries committed to the Barcelona agreement that all countries would adopt a goal of 3% R&D intensity by 2010, which meant that Denmark had to double public funding for research over a ten-year period.
- PROs are relatively less important in Denmark compared to other jurisdictions because of the University Act 2003.
- Denmark has also implemented another reform within the past 10 years to simplify the funding mechanisms in place for research. In 2014, three funding agencies were merged to become the Innovation Fund Denmark (IFD). This has created more distinct divisions between institutions that develop policy and those that allocate funding and implement innovation-related programmes.
- Danish officials have indicated that:
    - In general, the mergers were successful in delivering to their policy goals.
    - Some mergers were more successful than others, with some institutions taking a very long time to coalesce into a more coherent entity. Some potentially valuable mergers haven’t taken place.
    - The mergers were executed through a voluntary process. Officials considered this the only practical way it could have worked.
    - While part of the intent of the reform had been to give govt agencies access to the full breadth of university expertise, this hasn't necessarily happened, as govt agency contracts tend to draw on the same expertise as before. Researchers seem to still be doing the same jobs. Lack of collaboration is still an issue.
    - However, the system doesn’t seem to deal well with large research infrastructure and the ongoing cost of mandatory data collection, warehousing and storage (similar to Significant Collections and Databases).

# Universities perform most public R&D and do government research services

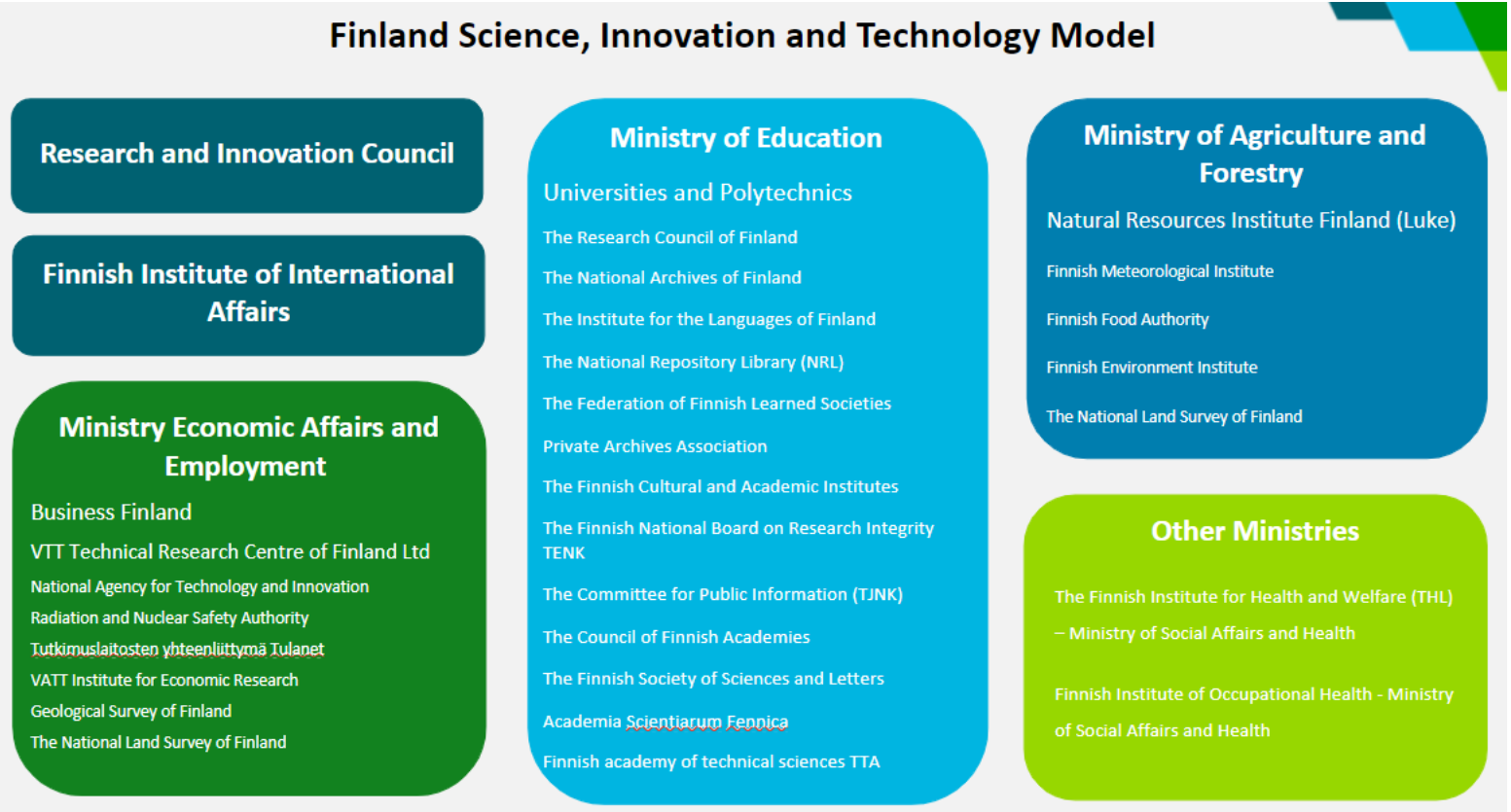
- This PRO set-up and guiding legislation is quite different from other nation case studies, given the focus on universities.
- Around 16% of the public R&D spend is on 'Science advice to government' – what we might call public good science services – is delivered through contracts between the commissioning ministry and universities and are reported to work well, mainly in areas environmental monitoring, food safety, and agriculture. The arms-length principle is followed to make sure there is no political interference in research results.
- At the national policy level, the RESEARCH2025 catalogue outlines Denmark's national research priorities. 19 areas were chosen as priorities, coming under four main themes
    - Technology, production, new materials and digitisation
    - Health
    - Food, environment, energy, transport and climate
    - Education, Public Sector and globalisation.

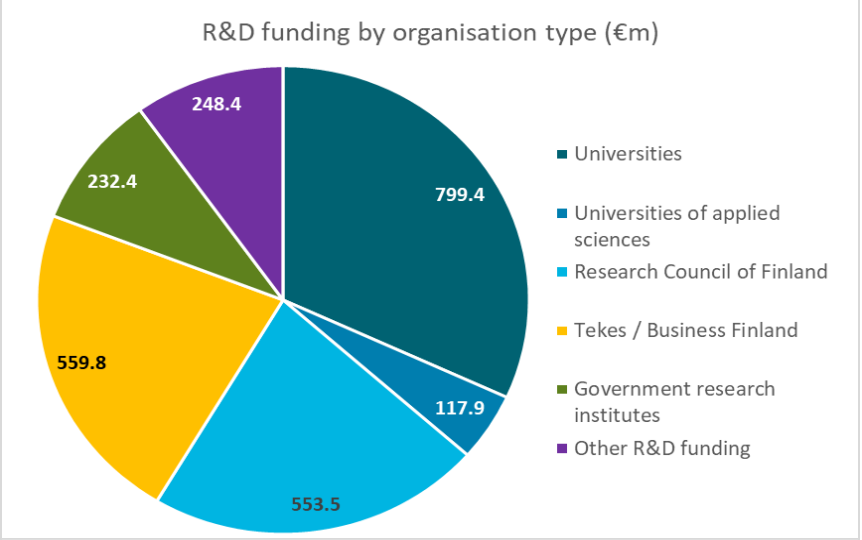
Innovation features:

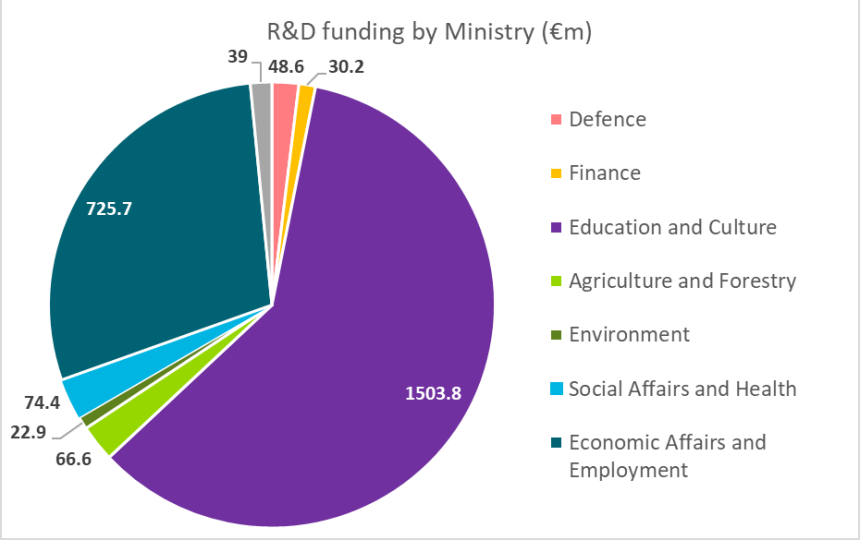
- Clustering: Ministry HE&S provides 2-yearly basic funding for 17 national innovation networks that encourage collaboration between knowledge institutions and business at the sector level in areas of perceived strength for Denmark – the energy, food and ICT sectors. Clusters are run either as independent secretariats governed by universities, RTOs or separate cluster organisations, and are being reduced over time to increase simplicity and efficiency.
- Innovation Centres: International links are supported by the Ministry HE&S and the Ministry of Foreign Affairs, by setting up eight Innovation Centres overseas to support Danish businesses and researchers in accessing international knowledge and extend research connections.
- Private foundations: These play a significant role in funding private R&D, with many such as the Novo Nordisk Foundation providing competitive funding to thematic research areas.

# Finland

# Overview

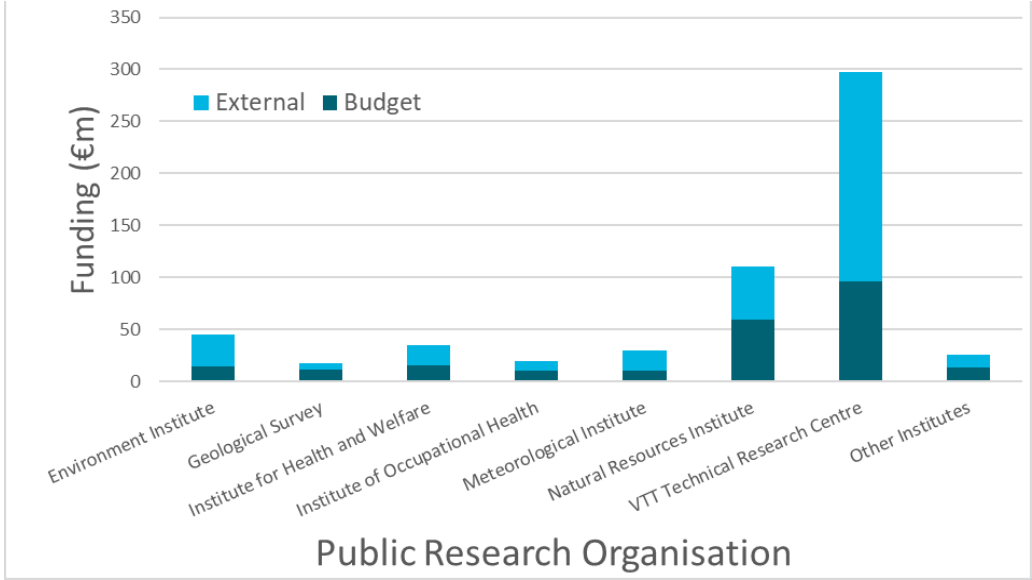

Finland Science, Innovation and Technology Model
Research and Innovation Council
Finnish Institute of International Affairs
Ministry Economic Affairs and Employment
Business Finland
VTT Technical Research Centre of Finland Ltd
National Agency for Technology and Innovation
Radiation and Nuclear Safety Authority
Tutkimuslaitosten yhteenliittymä Tulanet
VATT Institute for Economic Research
Geological Survey of Finland
The National Land Survey of Finland
Ministry of Education
Universities and Polytechnics
The Research Council of Finland
The National Archives of Finland
The Institute for the Languages of Finland
The National Repository Library (NRL)
The Federation of Finnish Learned Societies
Private Archives Association
The Finnish Cultural and Academic Institutes
The Finnish National Board on Research Integrity TENK
The Committee for Public Information (TJNK)
The Council of Finnish Academies
The Finnish Society of Sciences and Letters
Academia Scientiarum Fennica
Finnish academy of technical sciences TTA
Ministry of Agriculture and Forestry
Natural Resources Institute Finland (Luke)
Finnish Meteorological Institute
Finnish Food Authority
Finnish Environment Institute
The National Land Survey of Finland
Other Ministries
The Finnish Institute for Health and Welfare (THL) – Ministry of Social Affairs and Health
Finnish Institute of Occupational Health - Ministry of Social Affairs and Health




# Funding

- The majority of government funding for R&D goes to higher education – either directly or through competitive and strategic funding managed by the Research Council of Finland
- University funding comes from the Ministry of Education and Culture.
- The Ministry of Economic Affairs and Employment funds Finland's largest PRO, VTT Technical Research Centre, as well as direct support for business R&D.
- Other Ministries directly fund smaller PROs that support their specific research needs or sectors of responsibility, or maintain their own in-house research capability
- PROs receive between 1/2 and 1/3 of their funding from government, with the remainder coming from commercial revenue
- Business Finland is the innovation agency
- In 2023, Finland legislated their fiscal target for R&D at 4%, with cross-party consensus.



# Finland reforms sought to link R&D intensity & economic productivity

- There has been a clear shift from research-driven and big company-focused policy towards more innovation-driven, startup-focused policy. Finland sees a clear link between R&D intensity and economic productivity.
- Since the 1980s, Finland's SI&T system has made a conscious effort to invest in its industrial transformation through the ICT sector. The collapse of the USSR in the 1990s led to a national economic crisis that pushed Finland from being a more investment-driven to a more innovation-driven economy.
- There was significant investment in the early 2000, particularly in tech (eg Nokia). R&D declined for a time (to 2.5%), and there is now renewed interest. Finland has recently legislated a 4% target for R&D spend, a cross-party support achievement
- Large reforms in 2013 because PROs operated in silos corresponding to individual Ministries, a need to reform the PROs and sectoral research to better meet societal and economic needs, and a desire to shift away from a focus on basic or primary knowledge creation to more 'high value-added areas' addressing economic and societal challenges.
- The structural reforms merged several PROs (including with unis), shifted towards corporatisation of PROs, and promoted deeper cooperation between PROs and unis. Funding reforms included cutting funding using a "cheese slicer" approach and reallocating funding towards SI&T to support govt decision-making.
- The reforms have been successful in increasing the amount of collaboration between research institutes, universities and companies. This has helped to break down silos, and to foster the whole research ecosystem.
- However, some research institutes have been hit hard by the cuts to public funding. VTT, which conducts technological research, has been particularly affected by the "cheese slicer" approach to budget cuts, as it had less institutional funding to begin with than many of other institutes because of its traditional links with industry.
- Reform also significantly affected the research of the three institutes which sit under the Ministry of Social Affairs and Health. Funding cuts have required institutes to redefine their strategies, and they have been faced with declining staff numbers each year since the beginning of the reform.
- PRO strategy-setting is done much more in partnership between the Ministry and the PRO. The close relationship with Ministries ensured some content expertise was brought to bear on the strategies of the institutions.
- An evaluation of the reforms in 2018 concluded there is no need for new, major structural changes in the research environment, but there were recommendations to develop the current system, such as streamlining funding processes and practices to reduce administrative burden on govt and applicants.

# Summary

# Reflections from the international case studies

*Most international RSI systems are the result of historical reforms and government prioritisation.*

It would be hard to pick another country's PRO set-up and transplant into our system. Key differentiating factors include:

- Geography (size, concentration, distance/proximity to other economies)
- Different set of environmental/ecological/defence and cultural issues (eg Singapore or Israel) mean different levels of demand for public research
- Nature of the university system – ranking and concentration (eg in Denmark one university dominates, Singapore has 2 high-ranking universities)
- Economic/sectoral focus of the country, and the degree of intervention
- Priority put on R&D by the government and link to economic strategy
- Scale of public funding.

There are highly variable numbers of PROs and level of integration with the higher education sector in other countries. with an overall trend to smaller PRO contribution to public R&D.

*Compared with New Zealand, other countries generally have PROs in key 'public good' areas plus a technology-focussed organisation.*

Different functions are housed in different types of organisations with different funding models, ownership structures and governance mechanisms.

Some functions are within or close to government to provide advice, data, and expertise such as – *environment, weather, agriculture, natural resource exploitation, hazards, and public health.* In NZ these are housed within CRIs, who are more independent.

Institutions that are industry-facing (often advanced technology areas) are more prominent in the SIT landscapes of other counties. These are often be co-funded by industry, and specifically tasked as intermediaries between industry and academic research. Common areas of focus are digital technology, medtech, biotech, robotics, AI, and materials science.

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