South African National Survey of Research and Experimental Development

R&D SURVEY

Investment ▪ Insight ▪ Impact

MAIN TRENDS IN SOUTH AFRICAN R&D 2022/23

Recovering from COVID-19

Science, Technology and Innovation Statistics South Africa

HSRC Human Sciences Research Council

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REVISIONS

The Department of Science, Technology and Innovation (DSTI), Statistics South Africa (Stats SA) and the Human Sciences Research Council's (HSRC) Centre for Science, Technology and Innovation Indicators (CeSTII) jointly reserve the right to revise the data and indicators in this report. This may result from revisions by Stats SA of socio-economic indicators such as the gross domestic product (GDP), population or employment numbers, or amendments in response to internal and external data quality and consistency monitoring such as that carried out by the Organisation for Economic Co-operation and Development (OECD), which conducts quality checks through global comparative analyses, time series analyses and other methods. Explanations of any revisions will be made available and accessible on the DSTI and HSRC websites. The current R&D intensity series was revised to take into account the revision of the GDP series. The R&D expenditure in real terms was also rebased to 2015 constant prices.

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ABBREVIATIONS

BERD	Business expenditure on R&D
BRICS	Brazil, the Russian Federation, India, China and South Africa
CeSTII	Centre for Science, Technology and Innovation Indicators
DSTI	Department of Science, Technology and Innovation
FDI	Foreign direct investment
FTE	Full-time equivalent
GDP	Gross domestic product
GERD	Gross domestic expenditure on R&D
HSRC	Human Sciences Research Council
ICT	Information and communication technology
NPO	Not-for-profit organisation
NSI	National system of innovation
OECD	Organisation for Economic Co-operation and Development
PPP	Purchasing power parity
R&D	Research and experimental development
RF	Research field
SIC	Standard Industrial Classification
SOE	State-owned enterprise
STEAM	Science, technology, engineering, arts and mathematics
Stats SA	Statistics South Africa
STI	Science, technology and innovation
UIS	UNESCO Institute for Statistics
UNESCO	United Nations Educational, Scientific and Cultural Organisation

DEFINITION OF TERMS

Applied research is original investigation undertaken to acquire new knowledge. It is directed primarily towards a specific practical aim or objective.

Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view.

BERD refers to business expenditure on research and experimental development.

Constant 2015 (real) Rands is the value of goods and services of a given year using the prices of a determined base reference year, which is 2015 in this case. These values were obtained by deflating with the GDP deflator using data published in the Statistics South Africa GDP survey (Stats SA, 2024).

Experimental development is systematic work, drawing on existing knowledge gained from research and/or practical experience, which is directed to producing new materials, products or devices, to installing new processes, systems or services, or to improving substantially those already produced or installed.

Fintech is the application of digital technology to financial services through revolutionising technologies are such as payments, lending, investment, insurance, and other financial products and services (Feyen, Natarajan and Saal, 2023).

Full-time equivalent (FTE) refers to the number of hours (person-years of effort) spent on R&D activities.

FTE per 1 000 in total employment is the number of professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems, as well as in the management of these projects during a given year expressed as a proportion of 1 000 employed people. It is calculated by number of researchers during a given year divided by the total employed people and multiplied by 1 000.

Gross domestic product (GDP) is the total market value of all final goods and services produced in a country in a given year, equal to total consumer, investment and government spending, plus the value of exports, minus the value of imports.

Gross domestic expenditure on Research and Experimental Development (GERD) covers all expenditures for R&D performed on national territory in a given year. It thus includes domestically performed R&D that is financed from abroad but excludes R&D funds paid abroad, notably to international agencies.

Headcount refers to the actual number of people directly involved in or supporting R&D (i.e. the total number of R&D personnel).

Other support staff includes skilled and unskilled craftsmen, secretarial and clerical staff participating in R&D projects or directly associated with such projects.

Quantum computing exploit principles of quantum mechanics to more effectively represent data and perform operations on them. Utilising these principles enable quantum computers to solve very specific and complex problems faster than standard computers (Rietsche et al., 2022).

Real terms see constant 2015 Rands.

Research and experimental development (R&D) comprises creative and systematic work undertaken to increase the stock of knowledge – including knowledge of humankind, culture and society – and to devise new applications of available knowledge.

Researchers are professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems, and in the management of the projects concerned.

Research field (RF) refers to a branch of science, either natural or social and humanities sciences.

R&D intensity for a country is defined as the R&D expenditure as a percentage of GDP (Eurostat, 2022).

R&D personnel include all persons (irrespective of nationality) employed directly on R&D activities, as well as those providing direct services, such as R&D managers, administrators, technicians and clerical staff. These include emeritus professors, honorary fellows and research fellows.

R&D-performing sectors comprise the government, higher education, business and not-for-profit institutional sectors.

Standard Industrial Classification (SIC) are codes used by Statistics South Africa for all economic activities of industries.

STEAM: represents an approach to teaching science, technology, engineering and mathematics (STEM) subjects that also incorporates artistic ("A") skills.

Technicians and equivalent staff are persons whose main tasks require technical knowledge and experience in one or more fields of engineering, physical and life sciences, or social sciences, humanities and the arts.

Total employment is the total employment in the economy, where employed persons are those aged 15-64 years who, during the reference week, did any work for at least one hour, or had a job or business but were not at work (temporarily absent) (Stats SA, 2023).

Year-on-year changes are calculated as follows, using constant 2015 prices:
(current year's figure - previous year's figure) / previous year's figure × 100%.

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EXECUTIVE SUMMARY

This report highlights the main trends of the most recent cycle of the South African National Survey of Research and Experimental Development (R&D Survey), 2022/23 and provides in-depth analysis of R&D data trends in South Africa over time. The report also investigates the R&D performance of South Africa's national system of innovation (NSI) in the context of post-pandemic recovery, emphasising the importance of R&D for economic growth. It aims to inform policy decisions that align immediate economic recovery with long-term innovation objectives.

The report benchmarks South Africa's R&D performance against emerging and advanced economies and reveals stagnation in gross domestic expenditure on R&D (GERD) from 2020 to 2022. The analysis highlights disparities in R&D recovery between the public and private sectors, with a focus on disrupted research fields such as healthcare and renewable energy.

Key findings of the report

1 COVID-19 had a negative impact on R&D expenditure

The COVID-19 pandemic triggered a sharp contraction in economic activity, with GDP declining by 6.4% in 2020/21. However, it also spurred the unprecedented mobilisation of R&D resources, particularly in health innovation, digital infrastructure, and crisis-responsive technologies. Despite this, growth in overall gross domestic expenditure on R&D (GERD) remained fragile, with a modest recovery to 2.1% in 2022/23, closely mirroring GDP growth of 1.9%. This recovery, however, masks underlying vulnerabilities, as pre-pandemic structural challenges—such as stagnant private-sector R&D investment and reliance on volatile public funding—persist.

GERD to GDP targets

The South African government has a policy target of a GERD-to-GDP ratio of 1.5%, to be achieved by 2030 (DST, 2019).

The analytical brief, *Pathways to reaching South Africa's R&D intensity target* (Mustapha and Sithole, 2024), models funding scenarios that could assist South Africa to meet this target.

2 There is underinvestment in R&D relative to economic growth

South Africa's R&D intensity (GERD as a percentage of GDP) has shown a cyclical pattern over the past three decades, peaking at 0.81% in 2008/09 before stabilising at 0.61% by 2022/23. This stagnation reflects a broader trend of underinvestment in R&D relative to economic growth, raising concerns about the country's capacity to sustain innovation-driven growth. The pandemic exacerbated these challenges, with business R&D expenditure (BERD) hit hardest, declining from 39.3% of GERD in 2018/19 to 30.0% in 2020/21, before partially recovering to 35.5% by 2022/23.

3 R&D performance and recovery differed across sectors

The pandemic had an asymmetric impact on R&D performance across sectors. Public-sector research institutions pivoted swiftly to pandemic-related studies, while private-sector R&D expenditure contracted sharply, reflecting broader financial strains and shifting corporate priorities. Higher education institutions emerged as the largest R&D performers by 2022/23, surpassing the business sector, which had led R&D expenditure up to 2018/19. The shift raises concerns about the commercialisation of research and the translation of academic innovation into economic benefits.

4 The number of R&D personnel did not keep pace with economic expansion

The pandemic disrupted R&D personnel dynamics, with the core pool of researchers (full-time equivalents) declining from 29 111.0 in 2018/19 to 27 520.3 in 2022/23. Despite this, the total headcount of researchers remained stable, suggesting increased part-time or intermittent engagement. Gender equity in R&D personnel showed incremental progress, with female researchers growing from 45.7% to 47.6% of the workforce over the same period. However, R&D intensity indicators stagnated, with R&D personnel per 1 000 employees holding steady at 2.7, indicating that R&D workforce growth failed to keep pace with broader economic expansion.

5 Funding for R&D investment has shifted

Government funding has increasingly dominated South Africa's R&D investment since 2019/20, peaking at 56.3% of total R&D funding in 2020/21, while business funding declined sharply. Foreign funding, however, showed consistent growth, increasing from R3.409 billion in 2018/19 to R4.880 billion in 2022/23, reflecting greater international collaboration and donor-driven investment. This shift underscores the importance of leveraging global partnerships to bolster domestic R&D capacity.

For policy consideration

The COVID-19 pandemic underscored the need for targeted investments in high-impact areas such as vaccine development, climate adaptation technologies and digital transformation. While the pandemic-driven R&D mobilisation demonstrated the agility of South Africa's innovation ecosystem, the recent downward trend in R&D personnel, as well as the uneven recovery across sectors points to the need for systemic correction and reform.

Reform should include improved R&D funding models, enhanced support for small and medium-sized enterprises in tech-driven sectors, and policies to retain skilled researchers amid global brain-drain trends.

To achieve South Africa's National Development Plan target of a 1.5% GERD-to-GDP investment ratio by 2030 requires a dual focus: advancing foundational research while ensuring that innovation ecosystems are inclusive and equitable. By integrating grassroots ingenuity with systemic investments, South Africa can transform R&D from a fiscal line item into a catalyst for sustainable, human-centric progress. Policy decisions must align short-term recovery efforts with long-term innovation goals, to ensure that South Africa's R&D ecosystem remains competitive and responsive to future challenges.

Issues for discussion to strengthen the national system of innovation

1 Enhance international collaboration

Leveraging foreign funding and global partnerships to bolster domestic R&D capacity and foster knowledge spillovers.

2 Revitalise business sector R&D

Incentivising private-sector investment in R&D, particularly in high-growth sectors such as renewable energy, digital infrastructure and healthcare.

3 Strengthen human capital

Investing in STEAM education, upskilling programmes, and talent retention policies to build a robust pipeline of researchers and technicians.

4 COVID response

Acting soon on aligning short-term recovery measures with long-term capability building.

5 Promote inclusive innovation

Prioritising R&D investments that address societal challenges and promote equitable access to the benefits of innovation.

> **"Reforms need to include improved R&D funding models, enhanced support for small and medium-sized enterprises in tech-driven sectors, and policies to retain skilled researchers amid global brain-drain trends."**

1. THE IMPACT OF COVID-19 ON SOUTH AFRICA'S R&D LANDSCAPE: A FIVE-YEAR ASSESSMENT (2018/19–2022/23)

In the aftermath of the COVID-19 pandemic, its profound effects on South Africa's economy and innovation ecosystem have come into sharper focus. During the pandemic period, the nation's research and development sector demonstrated remarkable agility, mobilising rapid responses through national task forces, collaborative "war rooms," and cross-sector partnerships to address societal needs. However, the economic shockwaves triggered by the pandemic disproportionately impacted firms, with innovative enterprises—often reliant on long-term R&D investments—faring worse than their counterparts in more stable industries (Kasongo & Mustapha, 2021). This divergence underscores the vulnerabilities of innovation-driven economies during systemic crises.

The extensive R&D Survey dataset now available provides an opportunity to evaluate structural shifts within South Africa's R&D system. This report examines the uneven recovery of R&D activities across public and private sectors, identifies research fields most severely disrupted (e.g., healthcare and digital infrastructure), and highlights emerging priorities for policy intervention. For instance, while public sector research institutions pivoted swiftly to pandemic-related studies, private sector R&D expenditure contracted sharply, reflecting broader financial strains and shifting corporate priorities.

This five-year period assessment is contextualised within South Africa's long-term R&D trajectory, including pre-pandemic trends such as stagnant gross domestic expenditure on R&D (GERD) and persistent inequalities in research capacity. Comparative insights from emerging economies (including Argentina and Egypt) and developed nations (including South Korea and Germany) further enrich the analysis.

> **Comparing R&D in South Africa and other countries**
>
> Which countries are most appropriate to compare South Africa to in terms of R&D? This is explored in the analytical brief *Comparing R&D: What South Africa can learn from other countries* (Mustapha, Borel-Saladin and Clayford, 2024).

The pandemic experience underscored the need for targeted investments in high-impact areas such as vaccine and medical devices development, climate adaptation technologies, and digital transformation. Additionally, the effects of the pandemic on innovative firms have amplified calls for systemic reforms, including improved R&D funding models, enhanced support for small and medium-sized enterprises in tech-driven sectors, and policies to retain skilled researchers amid global brain-drain trends.

By synthesising empirical data and global benchmarks, the report contributes to a forward-looking R&D strategy that balances crisis recovery with sustainable, inclusive innovation. As South Africa navigates post-pandemic realities, the integration of these insights will help to shape a resilient knowledge economy capable of addressing immediate challenges and long-term societal goals.

This report is organised to systematically evaluate South Africa's R&D trajectory in the wake of the COVID-19 pandemic. The analysis proceeds as follows:

- **Five-year trends**: Key trends over the five years from 2018/19 to 2022/23 are identified and analysed, with a focus on assessing post-pandemic recovery dynamics across sectors.
- **Long-term context**: Short-term trends are contextualised within a longer framework to distinguish pandemic-driven shifts from pre-existing systemic patterns. This "dual" lens addresses whether recent changes reflect temporary disruption or structural transformation.
- **International benchmarking**: Comparative analysis with emerging economy peers like Brazil and Egypt, and advanced economies like Germany and South Korea, is included to benchmark the resilience and adaptability of South Africa's national system of innovation. These comparisons provide useful insight into the relative strengths and weaknesses of the NSI in the post-pandemic global landscape.

By synthesising these dimensions, the report aims to inform policy decisions that align short-term recovery efforts with long-term innovation goals, to ensure that South Africa's R&D ecosystem is competitive and responsive to future challenges.

This report highlights trends from the most recent wave of the national R&D Survey and provides high-level analysis of R&D data in South Africa over time. This is presented in areas of interest, that correspond with the principal themes of the R&D Survey, and the policy concerns expressed in the White Paper on Science, Technology and Innovation (Department of Science and Technology, 2019) and the Science, Technology and Innovation Decadal Plan, 2022-2032 (Department of Science and Innovation, 2022). International comparisons are provided for each core area, as international benchmarking is an important component in monitoring South Africa's R&D progress and development. The report is divided into the remaining 5 main sections covering the following topics:

- R&D expenditure and intensity
- R&D performance
- R&D personnel
- Investment in R&D
- Navigating headwinds in South Africa's R&D landscape

2. THE IMPORTANCE OF R&D EXPENDITURE AND R&D INTENSITY

The Schumpeterian catch-up hypothesis offers a critical lens in understanding R&D's role in economic development. The Schumpeterian hypothesis, as Abramovitz (1986) put it, suggests that latecomer economies can bridge the technological and economic divide with advanced nations by harnessing innovation, technological diffusion, and industrial policies. However, their success hinges on factors such as absorptive capacity (Cohen & Levinthal, 1990), institutional frameworks, and market conditions. Advanced economies like Germany and Japan leverage both incremental and breakthrough innovation to sustain their competitive edge. In contrast, developing nations such as South Africa and Indonesia have significant potential to benefit from targeted R&D investments, enabling them to "leapfrog" traditional development pathways. By prioritising emerging technologies and adapting innovations to local needs, these countries can accelerate industrial transformation, bypassing the stages of development that advanced economies previously underwent.

For example, Kenya's mobile payment system M-Pesa bypassed traditional banking infrastructure, leveraging ICT R&D to revolutionise financial inclusion. Such leaps generally depend on complementary investments such as high-tech machinery, digital infrastructure, and advanced human capital. Without parallel upgrades in vocational training or broadband access, R&D breakthroughs risk being confined to labs rather than scaling into markets. This interdependency underscores why R&D intensity goals—such as South Africa's National Development Plan target of 1.5% GERD-to-GDP—are designed to catalyse public-private collaboration. By aligning incentives, governments and firms can co-invest in innovation clusters (e.g., India's Bengaluru tech hub or Brazil's Embrapa agricultural research network), ensuring that R&D translates into job creation, export diversification, and inclusive growth. Beyond the overall goal of a high R&D intensity, an identification of strong R&D areas or growing R&D areas can suggest areas for government to provide ancillary support to nurture new types of industries based on R&D capabilities.

What is R&D intensity?

"R&D intensity for a country is defined as the R&D expenditure as a percentage of GDP" (Eurostat, 2022).

Gross domestic expenditure on R&D (GERD) quantifies the total intramural spending on research and experimental development within a nation over a defined period. As a cornerstone metric of innovation policy, the GERD-to-GDP ratio—calculated by dividing GERD by gross domestic product—provides a normalised measure of a country's R&D intensity. This enables cross-national and temporal comparisons (OECD, 2015).

Strengthening economic resilience with high R&D intensity

High R&D intensity is strongly linked to economic dynamism. South Korea, with a GERD-to-GDP ratio that consistently exceeds 4%, demonstrates how sustained R&D investment fuels high-value industries such as semiconductor production and fintech security. Investment that achieves high R&D intensity not only enhances productivity, it also strengthens economic resilience, enabling rapid adaptation to global disruptions like supply chain crises and climate change emergencies. For example, Finland's post-COVID-19 investment in 6G research shows how strategic R&D can position economies at the forefront of emerging industries. In contrast, countries with low R&D intensity can struggle with structural stagnation, remaining dependent on commodity exports or low-tech manufacturing, which yield diminishing economic returns.

Beyond economic metrics, R&D intensity shapes societal well-being. In healthcare, mRNA vaccine development during the COVID-19 pandemic demonstrated how concentrated R&D investments can yield rapid innovations. Similarly, R&D in renewable energy—such as perovskite solar cells or green hydrogen—positions nations to lead decarbonisation while addressing energy poverty.

Building human capital for R&D

These advancements hinge on nurturing human capital: R&D-intensive economies prioritise STEAM education, upskilling programmes, and talent retention policies. For instance, Taiwan's semiconductor dominance stems partly from its robust pipeline of engineers, supported by state-funded universities and industry partnerships. Conversely, brain drains plague nations with weak R&D ecosystems, as skilled professionals migrate to innovation hubs like Silicon Valley or Shenzhen.

Private-sector engagement often mirrors national R&D priorities. Countries with transparent IP regimes and tax incentives—such as Singapore's 250% R&D tax deduction—attract multinational R&D centres, fostering knowledge spillovers and local entrepreneurship, provided that policy ensures technology and knowledge transfers. Meanwhile, mission-driven public funding like the USA's CHIPS (Creating Helpful Incentives to Produce Semiconductors) and Science Act or the EU's Green Deal Industrial Plan can channel resources into strategic sectors, de-risking private investment in cutting-edge fields like quantum computing or circular economy technologies.

In a multi-nodal world, R&D intensity also reflects geopolitical ambition. Collaborative frameworks like CERN or the International Solar Alliance demonstrate how shared R&D goals can foster multilateralism, bridging divides between the Global North and the Global South.

Future-proofing our economy with R&D intensity

For developing economies, R&D intensity is not merely a statistical target but a gateway to structural transformation. By embedding R&D within broader industrial policies—such as local content requirements or technology transfer agreements—countries can avoid the "middle-income trap."

Vietnam's focus on electronics R&D, coupled with FDI-driven manufacturing, illustrates how aligning innovation with export strategies can elevate global value chain participation. Similarly, Costa Rica's investment in biomedical R&D has pivoted its economy from agriculture to high-tech services. Ultimately, R&D intensity encapsulates a nation's commitment to future-proofing its economy. For emerging economies, this demands a dual focus: advancing foundational research while ensuring that innovation ecosystems are inclusive and equitable. By integrating grassroots ingenuity (e.g., Africa's makerspaces or Latin America's social innovation labs) with systemic investments, countries can transform R&D from a fiscal line item into a catalyst for sustainable, human-centric progress.

> **"Investment that achieves high R&D intensity not only enhances productivity, it strengthens economic resilience, enabling rapid adaptation to global disruptions like supply chain crises and climate change."**

> **"For developing economies, R&D intensity is not merely a statistical target but a gateway to structural transformation."**

South Africa's economy grew in 2022/23 and R&D activity started to keep pace with it

South Africa's real growth in GERD reached 2.1% (constant 2015 prices) in 2022/23, closely mirroring the 1.9% growth in GDP for the same period (Stats SA, 2024) (**Table 1**). This is a notable departure from pre-pandemic trends: between 2018/19 and 2020/21, GERD growth remained substantially negative, even as GDP posted modest but consistent gains. The COVID-19 pandemic appears to have disrupted this inverse relationship, acting as both a catalyst and a constraint.

The pandemic's initial shock in 2020/21 triggered a sharp contraction in economic activity, with GDP plummeting by −6.4%, as the economy and society was locked down. However, it simultaneously spurred unprecedented R&D mobilisation, particularly in health innovation, digital infrastructure and crisis-responsive technologies. Government and private sector actors redirected resources toward pandemic mitigation—such as vaccine research, telehealth platforms, and supply chain resilience—partially offsetting broader R&D declines in sectors like manufacturing and mining, which admittedly had been in decline prior to the pandemic. By 2022/23, this rebalancing had begun to stabilise, with GERD growth converging with GDP as the economy entered a fragile recovery phase.

Yet this post-COVID alignment masks underlying vulnerabilities. While GERD growth has turned positive, it remains vulnerable and unevenly distributed. Pre-pandemic structural challenges—including stagnant private-sector R&D investment and reliance on volatile public funding—persist, suggesting that the recent uptick may reflect crisis-driven tactical spending, rather than sustained strategic investment. The longer-term trajectory of South Africa's NSI will depend on whether these emergency-driven priorities evolve into systemic reforms, particularly in light of global competition for R&D talent and post-pandemic technological shifts.

Table 1: SA GERD, GDP and employment growth rates, 2018/19 to 2022/23

	2018/19	2019/20	2020/21	2021/22	2022/23
Year-on-year growth in real GERD	-8.7%	-10.4%	-7.7%	6.9%	2.1%
GDP	1.6%	0.3%	-6.2%	5.0%	1.9%
SA employment growth rate	-0.5%	0.6%	-8.5%	-0.5%	8.6%

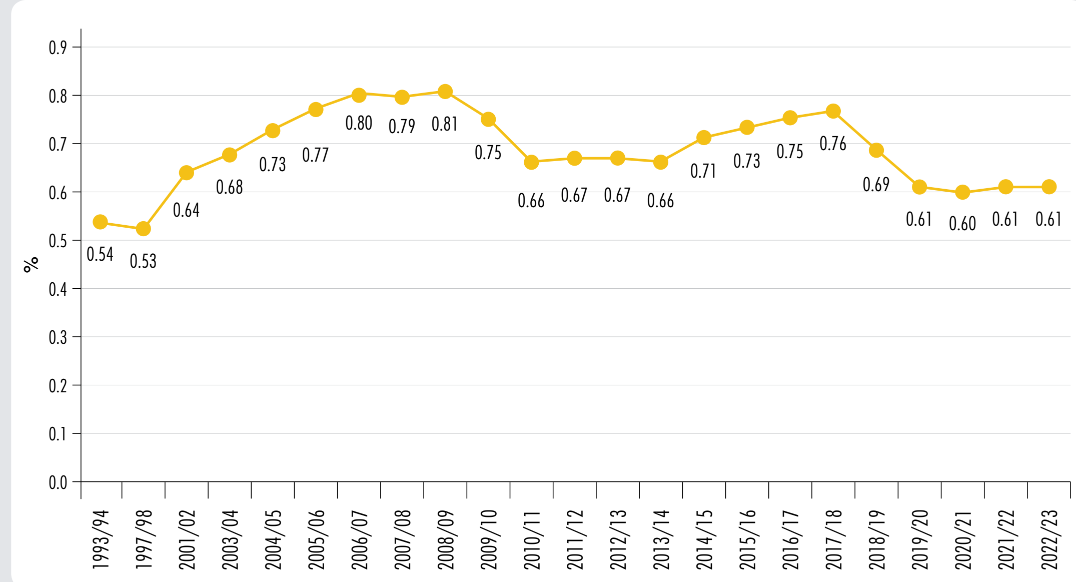
Source: GDP: Stats SA (2024); Employment: Stats SA (2023).
GERD: South African National Survey of Research and Experimental Development, 2018/19 to 2022/23.

R&D intensity rose from 0.54% in the mid-1990s peaking at 0.81% in 2008/09, followed by fluctuation and eventual stabilisation at 0.61% by 2022/23

Figure 1 illustrates percentage values of GERD to GDP over a 23-year period, from 1993/94 to 2022/23. Beginning at 0.54%, the trendline shows a general upward trajectory over the first 12 years, reaching peak values between 2006/07 and 2008/09 (0.80%, 0.79%, and 0.81%). Following this, a sharp decline occurred, dropping to 0.66% by 2010/11, after which the values stabilised as a plateau until 2014/15.

A second growth phase emerged from 2014/15 to 2017/18, with values increasing from 0.66% to 0.76%, before declining again and eventually stabilising around 0.61% in recent years (2020/21 to 2022/23). Throughout the entire period, the data exhibits cyclical behaviour, with noticeable fluctuations, yet consistently remained within a band between 0.54% and 0.81%, ending at a level higher than its starting point, but below its peak values. Since 2017/18, it has been in a pronounced downward phase.

Figure 1: GERD as a percentage of GDP, South Africa, 1993/94 to 2022/23



Source: South African National Survey of Research and Experimental Development, 1993/94 to 2022/23.

South Africa's R&D intensity declined from 0.69% to 0.61% of GDP between 2018/19 and 2022/23, with business R&D hardest hit but showing partial recovery following the pandemic

This section examines the evolution of R&D intensity in greater detail across the five-year period spanning 2018/19 to 2022/23, a timeframe that includes the COVID-19 outbreak year of 2020/21. **Table 2** outlines South Africa's GERD trends between 2018/19 and 2022/23. Adjusted for inflation (using constant 2015 prices), GERD declined from R31.356 billion in 2018/19 to R28.282 billion in 2022/23—a sustained downward trajectory interrupted only by a modest recovery in the final two years. By 2022/23, GERD had returned to levels comparable to those seen immediately prior to the COVID-19 pandemic.

This decline in R&D intensity is further evident in GERD's shrinking share of GDP, which fell from 0.69% to 0.61% over the five-year period. Civil GERD (excluding defence spending) followed a parallel trend, decreasing from 0.66% to 0.58% of GDP, signalling a broader retreat in R&D investment relative to economic output.

The business sector's role in R&D funding illustrates the pandemic's asymmetric impact: business expenditure as a share of GERD fell sharply from 39.3% in 2018/19 to 30.0% by 2020/21, reflecting COVID-19's disruptive effects on private-sector innovation budgets. While partial recovery to 35.5% occurred by 2022/23, levels remain below pre-crisis norms. The stagnation at 0.61% in 2021/22 and 2022/23 could signal persistent challenges in scaling up R&D investment relative to economic growth, potentially due to policy shifts, economic downturns, or funding constraints.

Collectively, these trends underscore a persistent contraction in R&D investment—both in absolute terms and as a proportion of GDP—raising concerns about South Africa's capacity to sustain innovation-driven growth. The post-pandemic rebound, though visible, appears insufficient to reverse longer-term declines, highlighting the need for targeted interventions to revitalise R&D ecosystems. Thus, the pandemic's impact on R&D intensity appears to have briefly arrested, but ultimately sustained, the gradual decline observed since 2017/18.

Table 2: Gross domestic expenditure on R&D in constant 2015 prices, R&D intensity and business expenditure as a percentage of the total, South Africa, 2018/19 to 2022/23

	2018/19	2019/20	2020/21	2021/22	2022/23
GERD in constant 2015 prices (R million)	31 356	28 100	25 933	27 712	28 282
GERD as a % of GDP	0.69%	0.61%	0.60%	0.61%	0.61%
Civil GERD* as a % of GDP	0.66%	0.58%	0.57%	0.59%	0.58%
BERD as a % of GERD	39.3%	31.0%	30.0%	35.4%	35.5%

Note: *GERD excluding defence expenditure.
Source: South African National Survey of Research and Experimental Development, 2018/19 to 2022/23.

"The business sector's role in R&D funding illustrates the pandemic's asymmetric impact: business expenditure as a share of GERD fell sharply."

How R&D in South Africa compares to other nations

Comparing the R&D performance of other nations—particularly through indicators such as GERD and GERD as a percentage of GDP—provides a valuable benchmark for assessing South Africa's own efforts. These metrics allow for both absolute and relative evaluations of investment intensity, enabling policymakers to identify best practices, understand structural differences, and develop informed strategies to enhance national R&D capacity and innovation performance.

South Africa's R&D expenditure is modest compared to that of global leaders in R&D and the country's middle-income peers. Slow post-pandemic recovery and limited growth threaten innovation capacity.

Comparing South Africa's R&D expenditure with significant countries in millions of current price PPP$ reveals substantial differences in scale and trend (**Table 3**). South Africa's R&D spending in 2022 (5 645 million PPP$) was modest compared to the world leaders, at just 0.6% of the USA's 923 243 million PPP$ and 0.7% of China's 811 862 million PPP$. Even among middle-income peers, South Africa's R&D commitment appears limited, with countries like Poland (29 676 million PPP$) and Turkey (43 136 million PPP$) investing substantially more, despite having comparable economic challenges.

South Africa experienced a concerning decline during the pandemic period, with expenditure dropping from 5 366 million PPP$ in 2018 to 4 627 million PPP$ in 2020 (a 13.8% decrease), before recovering to 5 645 million PPP$ by 2022. This recovery trajectory appears weaker than many comparable countries. While South Africa showed a 9.1% growth from 2021 to 2022, this lagged behind rapid expansions in countries like Egypt (27.6% growth from 2021 to 2022), Israel (20.0%), and Poland (19.3%) over the same period.

Purchasing power parities

"Purchasing power parities (PPPs) are the rates of currency conversion that try to equalise the purchasing power of different currencies, by eliminating the differences in price levels between countries. This indicator is measured in terms of national currency per US dollar." (OECD, 2022)

Among African nations in the dataset, South Africa's R&D expenditure significantly trails Egypt's investment (20 110 million PPP$ in 2022), which has seen remarkable growth of 124% since 2018. The scale of South Africa's R&D spending is more closely aligned with Latin American countries like Argentina (6 177 million PPP$ in 2021), and exceeds Chile (2 041 million PPP$ in 2021), although these economies do not share a similar structure with South Africa.

The data suggests South Africa faces challenges in prioritising and sustaining R&D activity, particularly when compared to rapidly developing economies. While South Africa maintains a position above smaller economies like Mauritius (103 million PPP$ in 2022), the relative stagnation in R&D growth could limit innovation capacity and technological competitiveness in the global knowledge economy.

> **"South Africa faces challenges in prioritising and sustaining R&D activity, particularly when compared to rapidly developing economies."**

Table 3: GERD for selected countries (millions in current price PPP$), 2018 to 2022

COUNTRY	2018	2019	2020	2021	2022	TREND
Czechia [1]	8 306	9 227	9 332	10 153	10 838	
Finland [1]	7 540	8 126	8 643	9 569	10 311	
France [1]	68 654	75 682	76 073	80 918	87 421	
Germany [1]	142 320	153 294	150 788	161 232	174 858	
Italy [1]	37 040	40 568	39 583	42 096	45 809	
Poland [1]	16 205	19 371	21 269	24 872	29 676	
Russian Federation [1,2]	41 896	47 413	50 747	54 949	55 600	
Spain [1]	23 656	25 776	26 008	29 188	33 387	
China [2]	480 643	545 462	607 601	701 115	811 862	
Japan [1]	172 036	173 929	174 927	183 467	200 770	
South Korea [1]	100 283	105 064	112 221	123 460	138 995	
Israel [1]	17 563	20 037	22 011	24 997	29 992	
Malaysia	9 515		8 851			
Türkiye [1]	29 279	31 015	32 703	37 327	43 136	
United States [1]	617 723	677 287	730 241	821 811	923 243	
Mexico	7 771	7 285	7 162	7 331	7 896	
Chile [1]	1 765	1 684	1 646	2 041		
Argentina	5 323	5 057	5 478	6 177		
Egypt	8 970	11 443	15 246	15 761	20 110	
Mauritius	97	109	109	106	103	
South Africa [2]	5 366	4 881	4 627	5 177	5 645	

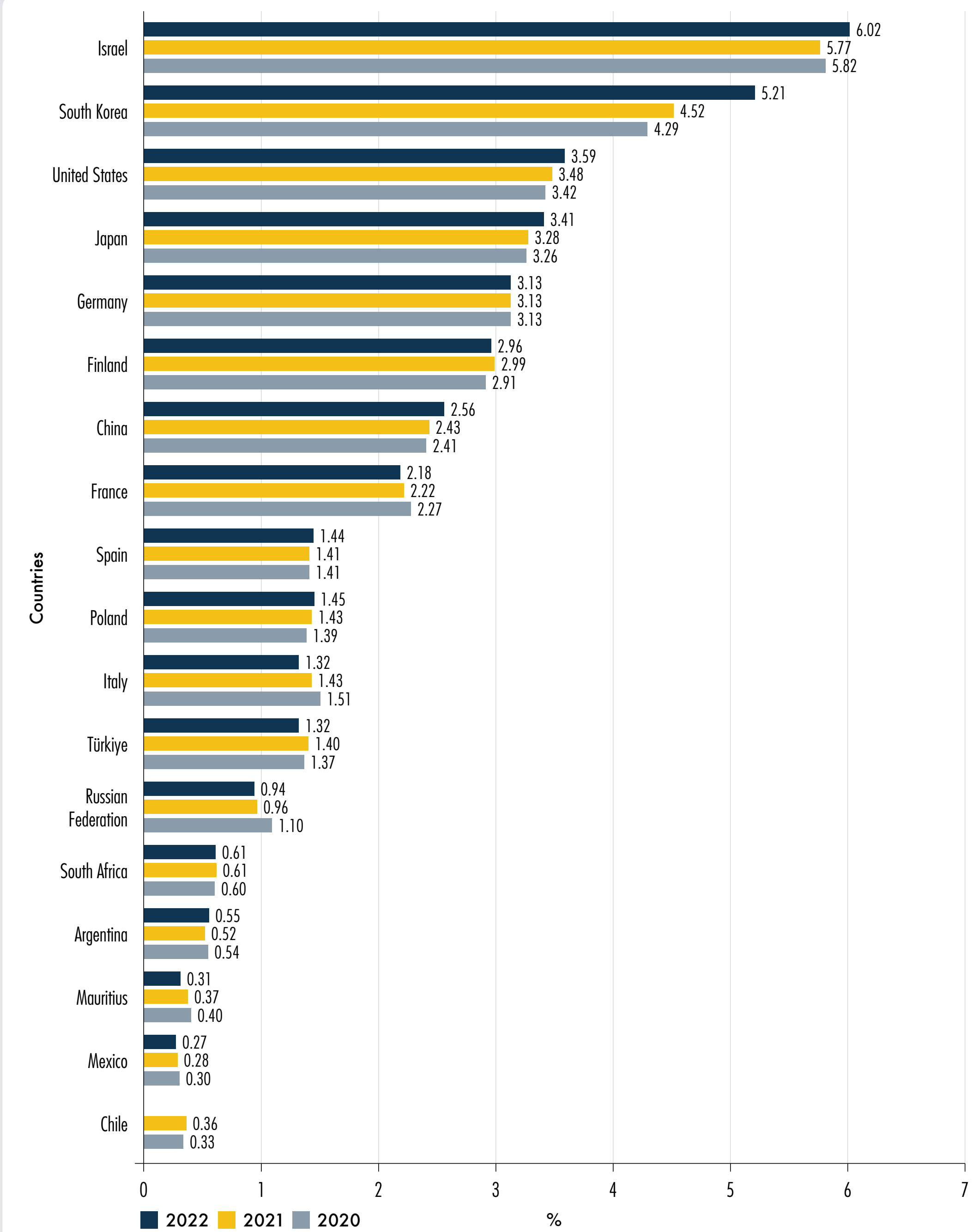
Note: OECD member states [1], BRICS member states [2].
Source: R&D intensity, GDP in local currency units, and PPP in $US from UNESCO Institute for Statistics (UIS) (2025) and author's calculations.

Legend:
- Europe
- Asia and Middle East
- North, Central and South America
- Africa

GERD/GDP growth in South Korea, China, and USA outpaces stagnation in emerging economies (2020-2022)

GERD/GDP increased in some countries in 2021 and 2022, most notably countries leading in R&D expenditure such as South Korea (to 5.21%), China and the USA (**Figure 2**). Unlike South Korea, South Africa was among the majority of emerging middle-income or developed economies that showed stagnating or even decreasing GERD/GDP between 2020 and 2022. These increases reflect sustained and strategic national commitments to research and innovation, particularly in high-technology and emerging sectors such as the fourth industrial revolution (4IR) and sustainable energy research. In contrast, South Africa remained among the group of emerging middle-income and some developed economies that experienced stagnating or even declining GERD/GDP ratios over the same period. Specifically, South Africa's GERD/GDP hovered around the 0.60% to 0.61% mark between 2020 and 2022. This indicates a growing gap between South Africa and leading innovation economies, raising concerns about the country's long-term competitiveness and its ability to leverage R&D for inclusive economic development.

Figure 2: GERD as a percentage of GDP for selected countries, 2020 to 2022



Source: UNESCO Institute for Statistics (UIS), 2025.
South African National Survey of Research and Experimental Development, 2020/21 to 2022/23.

3. PATTERNS OF R&D PERFORMANCE IN SOUTH AFRICA

Every year, South Africa uses standard, globally comparable metrics to assess its innovation capacity and progress with regard to R&D performance. This includes the amount of money allocated to R&D, which reflects the country's commitment to fostering innovation and addressing societal challenges. The distribution of this funding across various industries highlights priority areas and ensures a balanced approach to economic and technological advancement.

This section analyses trends in R&D performance in relation to each of the following domains, providing a comprehensive view of South Africa's innovation landscape and guiding future policy and investment decisions.

Tracking R&D domains to identify national priorities

Tracking R&D domains offers insights into emerging fields and national priorities, helping align innovation efforts with economic and societal needs. R&D trends in health, energy, and ICT highlight sectors needing investment or policy support.

R&D expenditure by institutional sector: roles and responsibilities

Key indicators, such as R&D expenditure by institutional sector, clarify the roles of government, academia, and industry. Government and science councils focus on public-interest science and capacity-building, while universities drive knowledge generation and collaboration. The not-for-profit sector plays a vital role in communicable diseases research, crucial for Africa. The private business sector remains a key driver of commercialisation and technological progress, with increasing expectations for SOEs to contribute. Strategic foresight is essential in linking higher education's knowledge supply with societal and business demands.

Business sector R&D: driving economic growth and innovation

Business sector R&D investment fuels economic growth by turning research into marketable products and services. Understanding the intensity of business sector R&D can reveal areas where industry-led innovation is thriving, as well as sectors where additional incentives or policy support may be required to stimulate further research activity. Identifying high-investment areas and those needing policy support strengthens industry-led innovation.

Mapping research fields: strengths, gaps, and strategic opportunities

The classification of research fields across different sectors further refines this picture, enabling the identification of national strengths and gaps. Some sectors may demonstrate a strong research base, contributing to global knowledge networks, while others may be underdeveloped, highlighting opportunities for increased collaboration or investment. Mapping these strengths and weaknesses allows for strategic decision-making in funding allocation, research capacity-building, and industry-academia partnerships.

Balancing basic, applied, and experimental R&D

Distinguishing between basic, applied, and experimental R&D clarifies the balance between knowledge creation and practical application. Basic research fosters long-term scientific progress, applied research addresses specific challenges, and experimental development refines prototypes for commercialization. Understanding these allocations helps shape policies that support both fundamental and market-driven innovation.

Regional R&D performance: addressing disparities for inclusive growth

Regional R&D performance exposes disparities and opportunities for equitable development. Concentration of research activity in certain areas may reflect existing infrastructure, skilled workforce availability, or economic hubs. While research activity often clusters in well-resourced areas, addressing imbalances fosters inclusive growth and broader innovation capacity.

The sharp decline and partial recovery in business R&D over the COVID-19 period signals a possible structural weakness in South Africa's innovation system

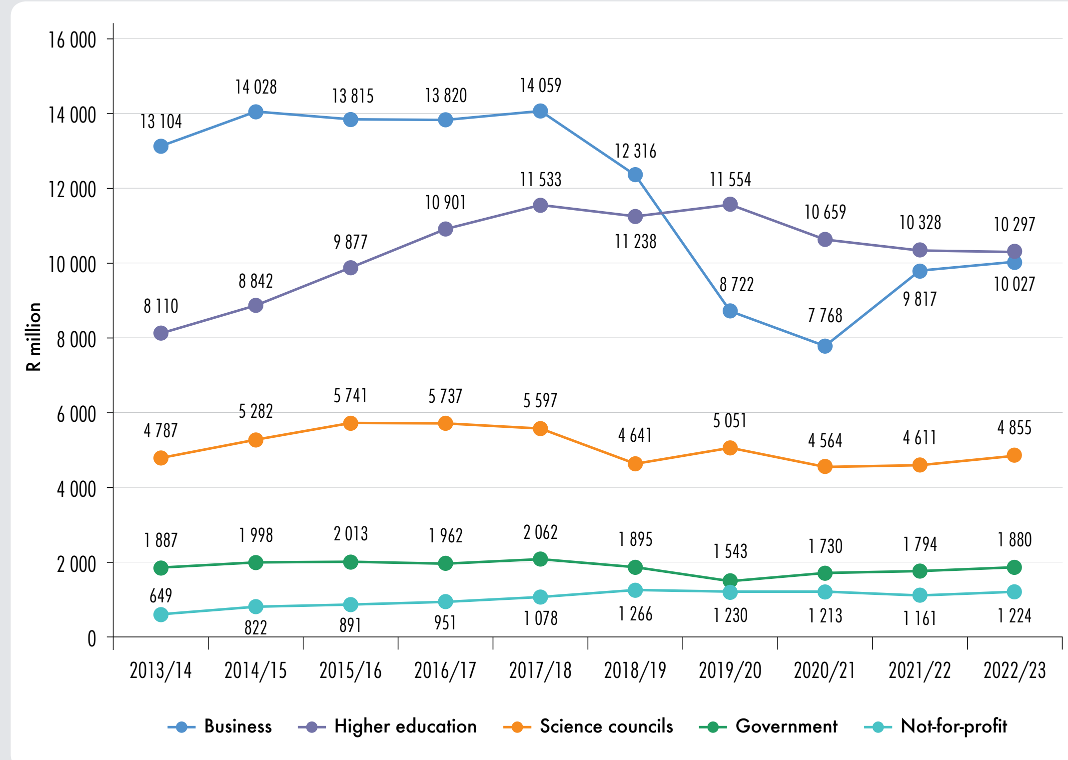
As demonstrated by the 10-year trend in (**Figure 3**), the business sector has experienced a sharp decline since at least 2017/18, continuing until the onset of COVID-19 in 2020/21. Examining the period around 2020/21 across all sectors reveals that South Africa's R&D landscape from 2018/19 to 2022/23 has followed diverse sectoral trajectories in constant 2015 prices (**Table 4**).

Business R&D expenditure (BERD) experienced the most dramatic fluctuations, declining significantly from R12.316 billion in 2018/19 to R7.768 billion in 2020/21 in real terms, before recovering to R10.027 billion by 2022/23.

Higher education R&D spending in constant 2015 prices initially increased to R11.554 billion in 2019/20 before gradually declining to R10.297 billion by 2022/23. Science council expenditure demonstrated relative stability in real terms, ranging between R4.564 billion and R5.051 billion throughout the period. Government R&D funding in constant 2015 prices showed recovery after an initial drop, growing from R1.543 billion in 2019/20 to R1.880 billion by 2022/23. Non-profit organisation contributions remained the smallest and most consistent in real terms, hovering around R1.2 billion throughout the five-year period.

Of course, the most significant trend is the dramatic decline and partial recovery of business expenditure on R&D. This has profound implications for South Africa's national system of innovation. Business R&D is typically oriented toward commercially viable innovations and practical applications that drive economic growth and competitiveness. Its substantial contraction suggests a weakening of business sector innovation capacity, which could hamper South Africa's technological advancement, productivity growth and global competitiveness.

Figure 3: R&D expenditure by institutional sector in constant 2015 prices (R million), South Africa, 2013/14 to 2022/23



Source: South African National Survey of Research and Experimental Development, 2013/14 to 2022/23.

In 2022/23, total R&D expenditure across all sectors reached R28.282 billion in constant 2015 prices, with business sector spending representing the second largest share at R10.027 billion (35.5% of total), following higher education at R10.297 billion (36.4% of total). Science councils contributed R4.855 billion (17.2%), while government and NPO sectors contributed R1.880 billion (6.6%) and R1.224 billion (4.3%) respectively (**Table 4**). Year-on-year growth rates for 2022/23 in real terms varied considerably: business R&D grew by 2.1%, while higher education experienced a marginal decline of 0.3%. Science councils showed the strongest growth at 5.3%, government expenditure increased by 4.8%, and NPO spending recovered with 5.4% growth compared to the previous year.

The timing of these changes suggests that the COVID-19 pandemic severely impacted business R&D performance, which was already declining prior to the pandemic, with companies likely redirecting resources to survival rather than innovation. While the recovery after 2020/21 is positive, BERD has not returned to pre-pandemic levels. This may indicate long-term structural damage to South Africa's innovation ecosystem. An additional concern is the shift in the R&D expenditure balance. In 2018/19, business outpaced higher education in R&D spending, but from 2019/20 until 2022/23, higher education surpassed business. While academic research is valuable, a robust national innovation system typically relies on strong business R&D downstream that can translate research into commercial applications and economic benefits.

> **Business R&D is typically oriented toward commercially viable innovations and practical applications that drive economic growth and competitiveness. Its substantial contraction suggests a weakening of business sector innovation capacity, which could hamper South Africa's technological advancement, growth and global competitiveness."**

Table 4: R&D expenditure trends by institutional sector in constant 2015 prices (R million), South Africa, 2018/19 to 2022/23

	2018/19	2019/20	2020/21	2021/22	2022/23	
Business expenditure on R&D (BERD)	12 316	8 722	7 768	9 817	10 027	
Higher education expenditure on R&D	11 238	11 554	10 659	10 328	10 297	
Science council expenditure on R&D	4 641	5 051	4 564	4 611	4 855	
Government expenditure on R&D	1 895	1 543	1 730	1 794	1 880	
NPO expenditure on R&D	1 266	1 230	1 213	1 161	1 224	

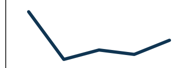
Source: South African National Survey of Research and Experimental Development, 2018/19 to 2022/23.

Business sector R&D expenditure in 2022/23 drove an increase in real GERD

GERD in constant 2015 prices increased by R571 million to R28.282 billion between 2021/22 and 2022/23. As in 2021/22, business sector R&D expenditure was the primary contributor to the increase, contributing R210 million in real terms (**Table 5**). Business sector R&D was primarily driven by higher spending in manufacturing (R192 million) and mining and quarrying (R269 million).

The financial intermediation, real estate and business services industrial sectors, along with the manufacturing industrial sector, continued to account for the majority of R&D expenditure, contributing 43.9% (R4.405 billion) and 31.2% (R3.131 billion) in constant 2015 prices of total expenditure, respectively (**Table 5**). There has been steady real growth in manufacturing over the most recent five years, excluding 2020/21, whereas, viewed in real terms, the financial intermediation, real estate and business services sector appears to be slowing down. The largest individual contributor to manufacturing R&D expenditure was the manufacture of refined petroleum, coke and nuclear fuel; chemicals and chemical products (including pharmaceuticals); and rubber and plastic products, which contributed R1.199 billion (12.0%) in 2022/23.

Table 5: R&D expenditure by the most influential industrial sectors in constant 2015 prices (R million), South Africa, 2018/19 to 2022/23

	2018/19	2019/20	2020/21	2021/22	2022/23	
Mining and quarrying	1 490	559	717	645	914	
Manufacturing	2 699	2 817	2 239	2 939	3 131	
Manufacture of refined petroleum, coke and nuclear fuel; manufacture of chemicals and chemical products (incl. pharmaceuticals); manufacture of rubber and plastic products	684	949	848	1 237	1 199	
Financial intermediation, real estate and business services	5 457	3 286	3 286	4 490	4 405	

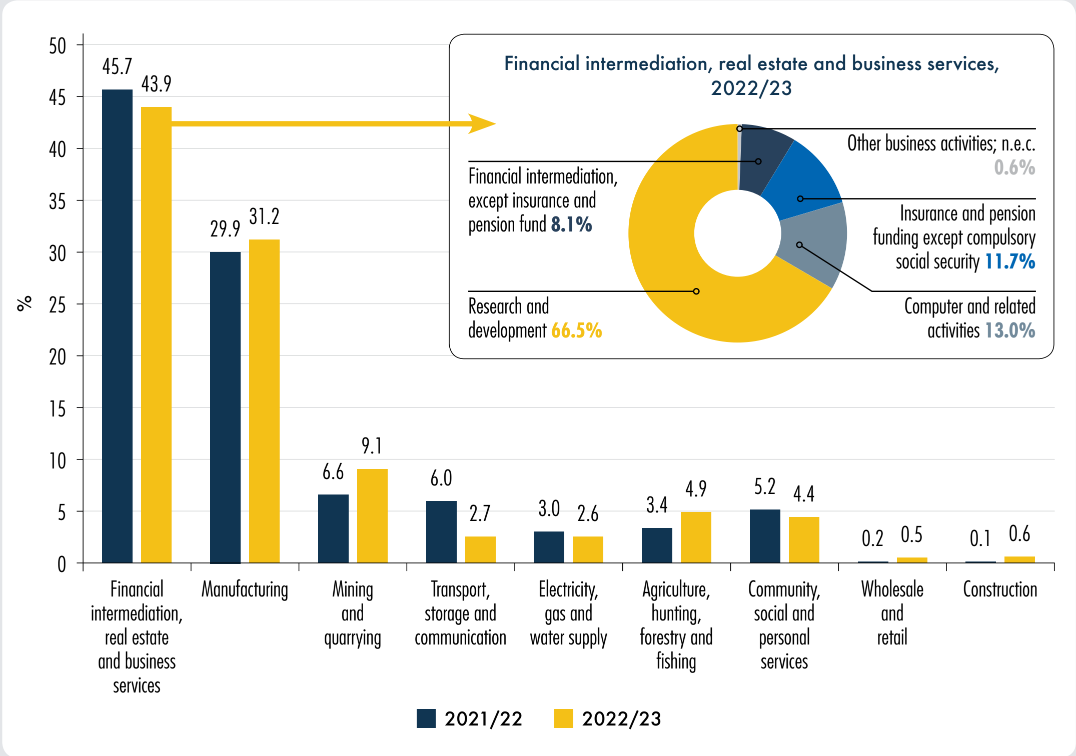
Source: South African National Survey of Research and Experimental Development, 2018/19 to 2022/23.

Mixed growth in South Africa's industrial sectors between 2021/22 and 2022/23

While financial intermediation, real estate and business services still dominated R&D spending in the business sector, it represented a smaller percentage of expenditure in 2022/23 than 2021/22 (43.9% versus 45.7%) (**Figure 4**). Declining shares of business R&D expenditure were seen in most other industrial sectors, except manufacturing; mining and quarrying; and agriculture, hunting, forestry and fishing, which all experienced small proportional gains.

Within the financial intermediation, real estate and business services sector, R&D is the dominant activity (66.5%), with computer and related activities (13.0%) and insurance and pension funding (11.7%) a distant second and third.

Figure 4: Business R&D expenditure by Standard Industrial Classification (as a percentage of GERD), South Africa, 2021/22 to 2022/23



Note: n.e.c. stands for not elsewhere classified.
Source: South African National Survey of Research and Experimental Development, 2021/22 to 2022/23.

Different types of research play distinct roles in the innovation landscape

The three types of research and experimental development are found in various sectors:

- **Basic research**: This is primarily found in universities and research institutions. It focuses on acquiring new knowledge about fundamental principles and theories without immediate practical applications in mind. Universities are well-suited for basic research due to their academic freedom, access to specialised expertise, and resources aimed at exploring theoretical concepts (OECD, 2015). In addition, government-funded research institutions also contribute significantly to basic research, particularly in fields like physics, biology and social sciences.
- **Applied research**: This is commonly conducted in both universities and the business sector, and in many countries is the most common type of research. It aims to solve specific, practical problems and often includes collaboration with industry partners to address real-world issues. Universities may engage in applied research to enhance their academic offerings and support local industries. In the business sector, applied research is integral to product development and improvement, allowing companies to innovate based on market needs (National Science Board, 2020).
- **Experimental development**: This type of R&D is most prevalent in the business sector, where companies systematically apply knowledge from research to develop new products and processes or improve existing ones. Experimental development typically involves significant investment and collaboration among various departments within a firm (OECD, 2015). While some universities engage in experimental development through partnerships with industry, it is predominantly a business-oriented activity focused on commercialisation and practical application (National Science Board, 2020).

Depending on the stage of economic development, the distribution of these types of research may reflect national research priorities, available research infrastructure or human capital capacity. This analytical framework (Godin, 2005) enables us to derive valuable insights on R&D and provide policy recommendations. Combined with the principles of endogenous growth theory (Romer, 1990), it allows us to link types of R&D to economic growth, albeit from the linear conception of innovation using R&D as the main proxy of technological innovation.

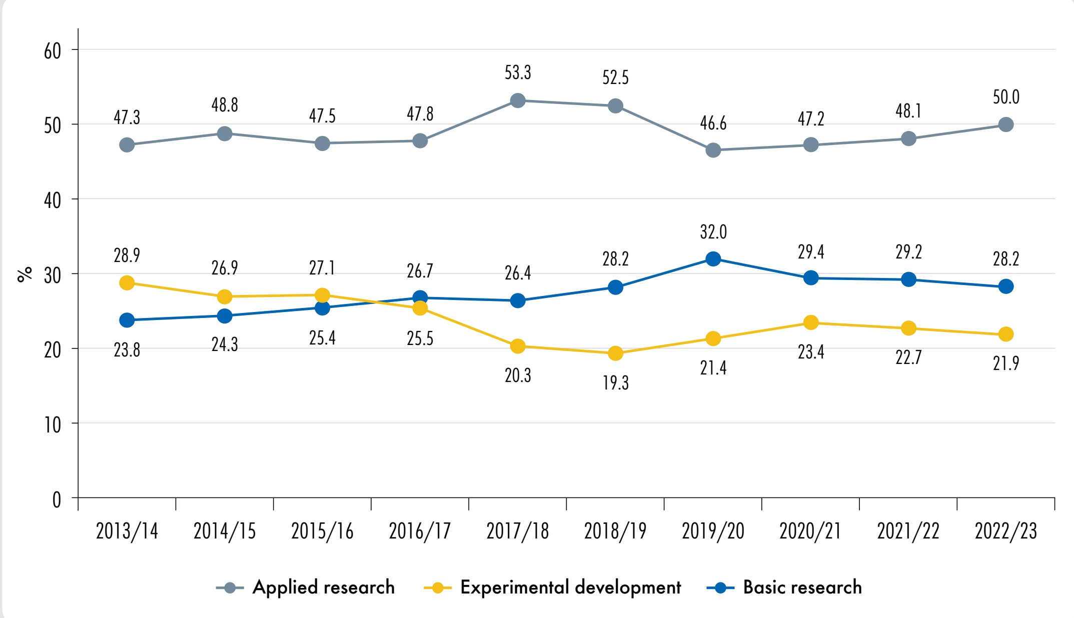
Applied research is the dominant research type since 2013/14, but basic research increased its share over the past decade

The graph in **Figure 5** depicts the percentage distribution of the three key research types from 2013/14 to 2022/23. The data reveals a nuanced picture of research dynamics that reflects potential shifts in innovation strategies and institutional priorities.

Applied research emerges as the most prominent category. It was spread across sectors and represented between 47% and 53% of all R&D activity throughout the period. Notably, it peaked at 53.3% in 2017/18 before experiencing a gradual decline, settling at around 50% by 2022/23. This suggests a sustained emphasis on problem-solving research that bridges theoretical knowledge with practical applications. Applied research accounted for half (50.0%) of all R&D, totalling R14.134 billion in 2022/23 in real terms (**Figure 5**). Basic research demonstrated remarkable stability, maintaining a consistent range between 23-32% across the decade, starting and finishing the decade at about the same level. The relatively steady trajectory implies a continuous commitment to fundamental knowledge generation, particularly within universities and research institutions. However, the lack of significant growth might indicate limitations on translating academic discoveries into broader innovation ecosystems. The most striking trend appears in experimental development, which shows a notable decline from around 28% to 29% in the early years to just 21.9% by 2022/23. This reduction is particularly concerning, as it potentially signals a diminishing capacity for transforming research insights into tangible technological innovations (artefacts and services). The downward trend could reflect reduced business sector investment in commercialising research or structural challenges in translating academic knowledge into market-ready solutions.

The steady basic research percentage suggests intellectual capacity remains robust, but the ability to transform that knowledge into tangible innovations appears constrained. The persistent plateau suggests systemic limitations rather than a strategic choice. This points most strongly to a capabilities issue—the system can generate knowledge but lacks the ecosystem and skills to effectively convert it into practical applications. The data subtly hints at potential gaps in research-industry collaboration.

Figure 5: Proportion of expenditure by research type, South Africa, 2013/14 to 2022/23



Source: South African National Survey of Research and Experimental Development, 2013/14 to 2022/23.

Applied research in South Africa remained the most prevalent in 2022/23, but experimental development showed the most stable growth in the five-year period bracketing COVID-19

The 10-year trend analysis of **Figure 5** sheds light on COVID-19's impact on the National System of Innovation (2013/14 to 2022/23). As illustrated in **Table 6**, the three research categories followed distinct trajectories. Basic research funding contracted at a CAGR of -2.5%, declining from R8,835 million to R7,968 million over the five-year period (2018/19 to 2022/23). Applied research saw a steeper decline, with a CAGR of -3.8%, falling from R16.466 billion to R14.134 billion. In contrast, experimental development registered modest growth at 0.5% CAGR, rising from R6.055 billion to R6.180 billion.

Overall research expenditure—encompassing all three categories—declined at a CAGR of -2.9%, dropping from R31.356 million to R28.282 million. A notable dip occurred across all categories in 2020/21, likely attributable to the pandemic, followed by a partial recovery in subsequent years. However, by the end of the period, funding levels had not rebounded to their 2018/19 peaks. In summary, even though experimental development picked up over the COVID-19 5-year period (within a longer-term trend of experimental decline), the structural limitations of the system may not bode well for future persistent growth in that type of R&D.

Compound Annual Growth Rate (CAGR)

Compound Annual Growth Rate (CAGR) is the rate at which an investment or revenue grows annually over a specified period, assuming the growth occurs at a constant rate. CAGR provides a smoothed growth rate, eliminating short-term fluctuations and making it useful for assessing long-term trends in financial and economic data. The formula for CAGR is:

$$CAGR = \left(\frac{Ending\ value}{Beginning\ value}\right)^{\frac{1}{n}} - 1$$

Where:

- **Ending Value** = The value of the investment or metric at the end of the period.
- **Beginning Value** = The value of the investment or metric at the start of the period.
- **n** = The number of years (or periods) over which the growth is measured.

Table 6: R&D expenditure by the type of R&D conducted in constant 2015 prices (R million), South Africa, 2018/19 to 2022/23

	2018/19	2019/20	2020/21	2021/22	2022/23
Basic Research	8 835	8 998	7 621	8 090	7 968
Applied Research	16 466	13 099	12 253	13 339	14 134
Experimental development	6 055	6 003	6 059	6 283	6 180

Source: South African National Survey of Research and Experimental Development, 2018/19 to 2022/23.

The medical and health sciences experienced consistent growth in R&D from 2013/14 to 2022/23, while social sciences and engineering R&D had declined by 2022/23

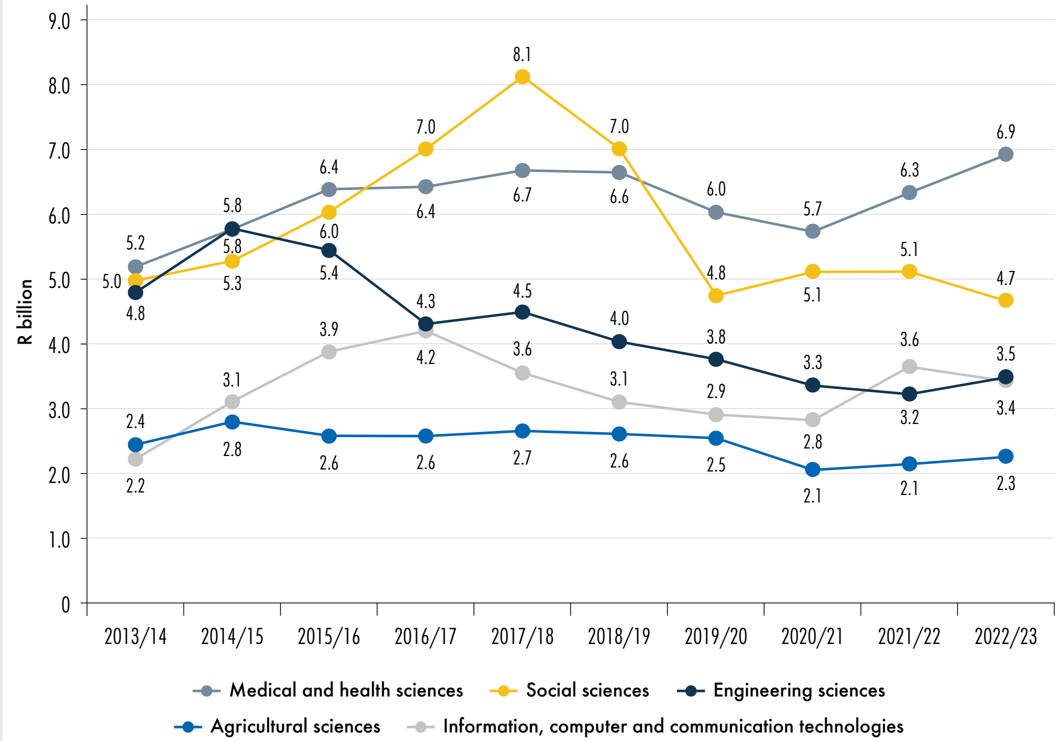
Figure 6 tracks R&D expenditure trends between the main scientific fields, over the ten-year period from 2013/14 to 2022/23. What stands out is the medical and health sciences, and ICT, that showed some noticeable growth over the ten-year period, amidst generally stagnant major fields of R&D.

Medical and health sciences showed consistent growth from R5.192 billion in 2013/14 to R6.913 billion in 2022/23, with a slight dip during the period from 2019 to 2021, before recovering strongly to become the major field of activity by 2022/23.

R&D expenditure in the social sciences exhibited dramatic fluctuations, peaking at R8.128 billion in 2017/18, before declining sharply to R4.672 billion by 2022/23. Between 2015/16 and 2018/19, social sciences was the largest field of research, surpassing the medical and health sciences. Engineering sciences demonstrated a gradual decline from around R4.799 billion to R3.469 billion over the decade, with some stabilisation in recent years. Information, computer and communication technologies present a more volatile pattern, starting at R2.442 billion, peaking at R4.203 billion in 2016/17, declining through 2020/21, then rebounding to R3.443 billion by 2022/23. Information, computer and communication technologies was the only area, other than the medical and health sciences, to show an overall increase in R&D expenditure between 2013/14 and 2022/23. Agricultural sciences maintained more stability, moving from R2.218 billion to R2.259 billion over the period, with modest fluctuations.

> **Information, computer and communication technologies was the only area, other than the medical and health sciences, to show an overall increase in R&D expenditure between 2013/14 and 2022/23."**

Figure 6: R&D expenditure by research field in constant 2015 prices (R billion), South Africa, 2013/14 to 2022/23



Source: South African National Survey of Research and Experimental Development, 2013/14 to 2022/23.

Between 2018/19 and 2022/23 COVID-19 reshaped the South African research landscape as medical sciences and ICT rebounded while social sciences faced significant declines in R&D expenditure

Medical and health sciences funding has shown a cyclical pattern over the decade, with periods of growth and decline, before experiencing pandemic-related disruption. From 2018/19 to 2022/23, this field demonstrated remarkable resilience, initially declining from R6.643 billion in 2018/19 to R5.724 billion in 2020/21, before rebounding strongly to R6.913 billion by 2022/23, surpassing pre-pandemic levels (**Table 7**). This recovery likely reflected the strategic pivot toward medical research during the global health crisis, confirming the field's position as South Africa's top research priority, with a 9.3% increase in the final year.

R&D expenditure in the social sciences had enjoyed substantial growth from 2013/14 to 2017/18, reaching a peak of R8.128 billion before beginning a general decline. During the 2018/19 to 2022/23 period, this field showed unusual patterns, experiencing a substantial drop of 32.3% in 2019/20, followed by a 7.3% increase in 2020/21 to R5.101 billion, possibly suggesting heightened interest in understanding the social dimensions of the pandemic. However, growth subsequently stagnated at just 0.2% in 2021/22, followed by a significant decline of 8.6% in 2022/23, bringing R&D spending down to R4.672 billion, although maintaining its position as the research field with the second highest R&D expenditure.

Information, computer and communication technologies (ICT) funding had shown steady growth from 2013/14 to 2016/17 before fluctuating around the R3 billion to R4 billion level. From 2018/19 to 2022/23, expenditure in this field surged during the 2021/22 period to reach R3.634 billion, possibly reflecting the accelerated digital transformation necessitated by pandemic conditions, before moderating slightly by 5.3% to R3.443 billion in 2022/23.

Engineering sciences R&D expenditure had demonstrated general stability between R5 billion and R7 billion throughout most of the decade, before entering a decline phase. During the 2018/19 to 2022/23 period, this field experienced a downward trend in R&D expenditure during the pandemic but showed signs of recovery with a 7.1% increase to R3.469 billion in 2022/23.

The Network for Genomic Surveillance in South Africa (NGS-SA) was responsible for the discovery of two SARSCoV-2 variants of concern during the COVID-19 pandemic. This collaboration was made possible by a grant from the South African government in June 2020. What started as five of the South African National Health Laboratory Services' largest laboratories, grew to include private diagnostic laboratories and other academic institutions, bringing together virologists, scientists, bio-informaticians and clinicians within South Africa and beyond. At the 2022 NSTF-South32 Awards, the NGS-SA was awarded for being one of the most successful genomic surveillance networks globally (Adepojou, 2021; NSTF, 2021).

Agricultural sciences maintained relatively stable R&D expenditure around R2.5 billion to R2.7 billion for much of the measured period. From 2018/19 to 2022/23, this field experienced a pandemic-related decline, before continuing its recovery with a 5.8% increase to R2.259 billion in 2022/23.

Applied sciences and technologies, and marine sciences, both showed concerning downward trajectories after 2019/20. Marine sciences, representing the smallest R&D investment among the research fields, presented a unique case with growth of 10.1% during 2020/21 to reach R229 million, contradicting the general trend. However, applied sciences and technologies, and marine sciences both continued their concerning decline in 2022/23, falling by 8.1% and 22.1% respectively, suggesting the potential long-term de-prioritisation of these research areas.

> **“Applied sciences and technologies and marine sciences both continued their concerning decline in 2022/23, falling by 8.1% and 22.1% respectively, suggesting the potential long-term de-prioritisation of these research areas.”**

Table 7: Noteworthy research field trends in R&D expenditure in constant 2015 prices (R million), South Africa, 2018/19 to 2022/23

	2018/19	2019/20	2020/21	2021/22	2022/23
Medical and health sciences	6 643	6 036	5 724	6 327	6 913
Social sciences	7 023	4 756	5 101	5 110	4 672
Engineering sciences	4 036	3 771	3 350	3 239	3 469
Information, computer and communication technologies	3 100	2 901	2 815	3 634	3 443
Agricultural sciences	2 601	2 542	2 052	2 135	2 259
Applied sciences and technologies	1 310	1 111	1 058	1 121	1 030
Marine sciences	210	208	229	154	120

Source: South African National Survey of Research and Experimental Development, 2018/19 to 2022/23.

South Africa's R&D expenditure declined across provinces during COVID-19, with recovery unevenly distributed. Gauteng shrank, the Western Cape grew, and smaller provinces showed emerging potential

The COVID-19 pandemic also had a significant impact on South Africa's geographic R&D landscape, with provincial expenditure reaching its lowest point in 2020/21, before showing partial recovery in subsequent years for almost all provinces (**Table 8**). Geographic inequality remains a defining feature of the country's R&D distribution, with Gauteng and Western Cape collectively accounting for 66.3% of national expenditure in 2022/23. However, a notable shift is occurring between the two dominant provinces, as Gauteng experienced a concerning 17.9% decline over the five-year period, while Western Cape demonstrated resilience with a 6.3% increase, gradually narrowing the gap. Meanwhile, encouraging developments are emerging in smaller provinces, particularly Limpopo and Northern Cape, with impressive growth rates of 26.3% and 18.7% respectively, suggesting the potential formation of new innovation hubs outside the traditional centres.

> **Geographic inequality remains a defining feature of the country's R&D distribution."**

Table 8: Provincial distribution of R&D expenditure in constant 2015 prices (R million), South Africa, 2018/19 to 2022/23

	2018/19	2019/20	2020/21	2021/22	2022/23
Eastern Cape	1 885	1 704	1 545	1 459	1 489
Free State	1 685	1 394	960	1 258	1 421
Gauteng	13 440	11 722	11 379	11 386	11 034
KwaZulu-Natal	3 473	2 957	2 535	2 697	2 827
Limpopo	688	629	760	738	869
Mpumalanga	728	686	546	917	766
Northern Cape	772	734	671	788	916
North West	1 434	1 385	1 055	1 088	1 252
Western Cape	7 250	6 888	6 481	7 381	7 708

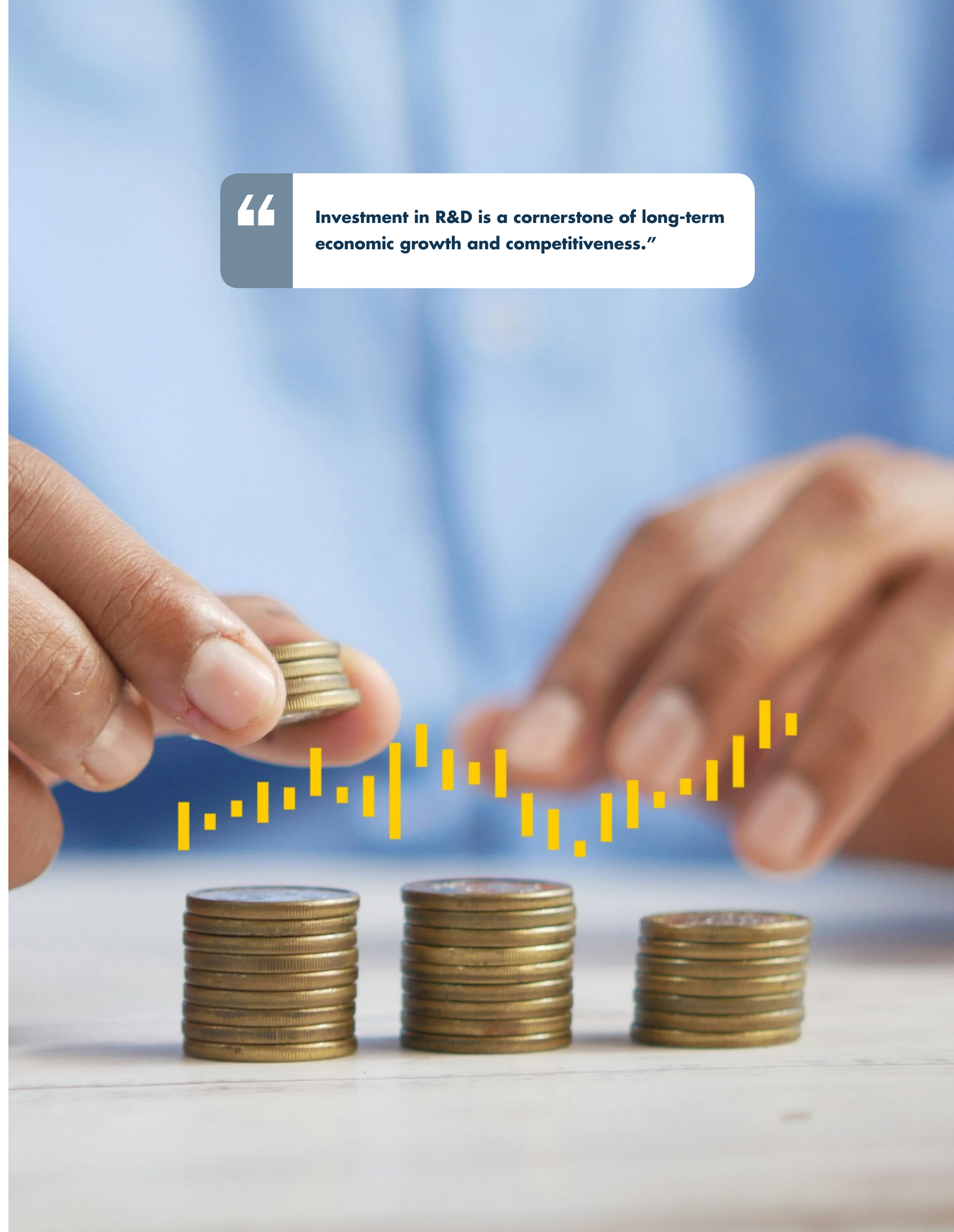
Source: South African National Survey of Research and Experimental Development, 2018/19 to 2022/23.

4. UNDERSTANDING SOUTH AFRICAN INVESTMENT IN R&D

It is essential to distinguish between R&D expenses and investment, as they represent different aspects of fostering innovation. R&D expenses refer to the money spent on facilities, machinery, equipment, labour and the other resources necessary to conduct research and development. These expenditures serve as a proxy for overall R&D activity, reflecting the operational costs of maintaining and advancing research efforts.

On the other hand, "investment" in R&D describes the funding secured from external sources or generated internally by the enterprises in various sectors to support research and development initiatives. This investment may encompass not only the direct costs of R&D (i.e. funding of R&D) but also funding for complementary activities, such as training, infrastructure development or market research, which are critical for the successful application and commercialisation of R&D outcomes.

Investment in R&D is a cornerstone of long-term economic growth and competitiveness. It enables the development of new technologies, products, and processes that can address societal challenges, improve productivity, and create high-value jobs. By allocating resources to R&D, national decision-makers can build a robust innovation ecosystem, attract skilled talent and foster collaboration between academia, industry and government. Moreover, R&D investment often yields spillover benefits, such as knowledge dissemination and the creation of new industries, which amplify its impact beyond the immediate scope of the research. In contrast, while R&D expenses are necessary to sustain day-to-day research activities, they do not always capture the strategic and forward-looking nature of R&D investment.

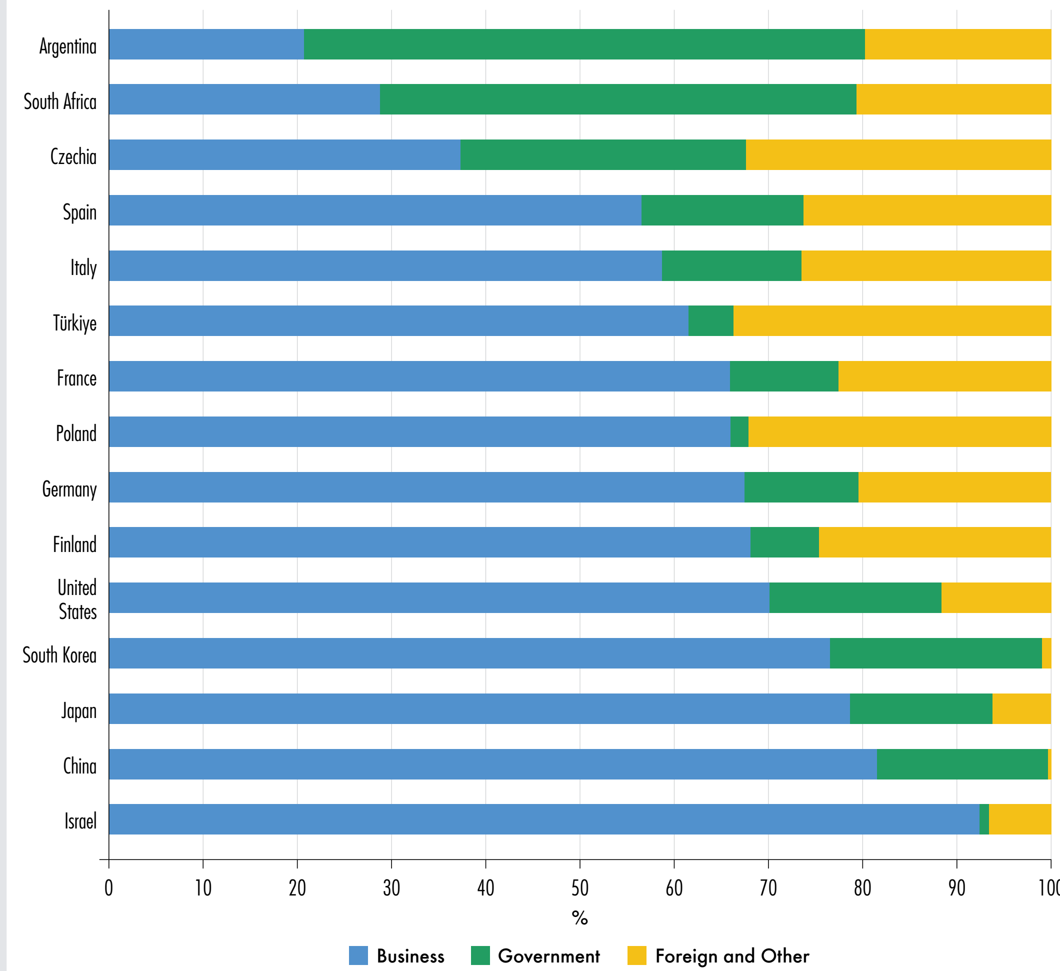


"Investment in R&D is a cornerstone of long-term economic growth and competitiveness."

The major source of R&D funding differs in developed and developing economies

In developed countries, business is typically the major source of R&D funding. Most of these countries source less than 20% of their R&D funding from government (**Figure 7**). South Korea is an anomaly in this regard, with 22.6% of its R&D funding being provided by government. In contrast, developing countries like Argentina (59.5%) and South Africa (50.5%) sourced most of the funding for research and development from government in 2022/23.

Figure 7: GERD by source of funds in selected countries, 2021/22



Source: OECD (n.d.).
South African National Survey of Research and Experimental Development, 2022/23.

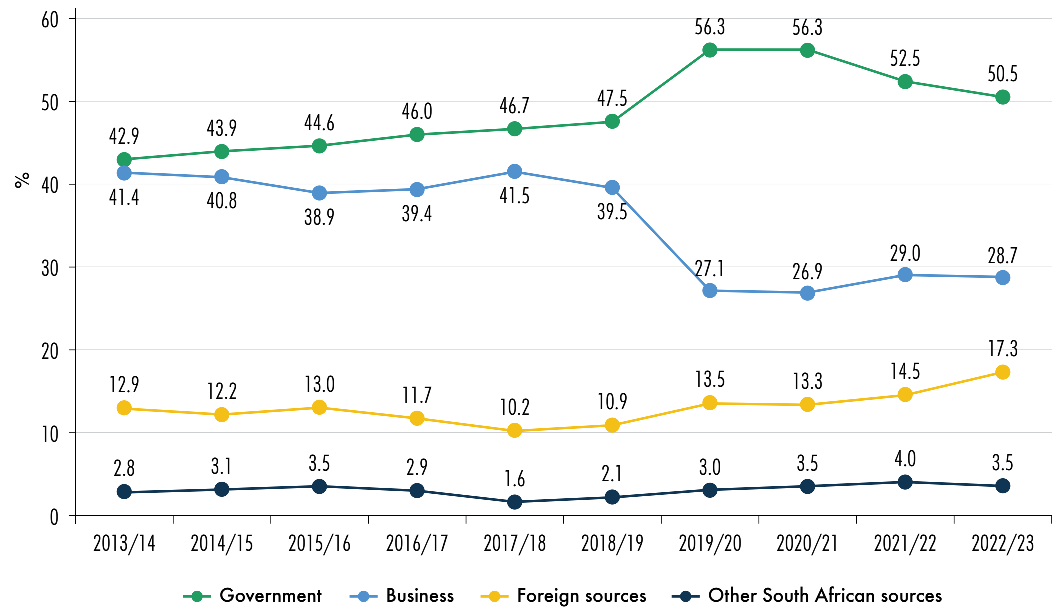
Government markedly increased its support to R&D funding in South Africa since 2019/20, while business investment declined, and foreign funding rose gradually

The government sector has long been the largest funder of R&D in South Africa (**Figure 8**). Between 2013/14 and 2018/19, government accounted for 42.9% to 47.5% of GERD by source of funds. During this time, the business sector was the next highest funder of R&D, funding 41.4% to 39.5% of expenditure. In 2019/20, however, government drastically increased its contribution to R&D funding, reaching levels as high as 56.3% in 2019/20 and 2020/21, while business displayed the reverse trend, sinking to 27.1% in 2019/20, ending in 2022/23 with a contribution of 28.7%.

Foreign funding was flat over the early part of the ten-year period and even dipped slightly in 2016/17 and 2017/18. In recent years, starting in 2018/19, there has been consistent growth in foreign funding of R&D, reaching 17.3% in 2022/23.

> **Starting in 2018/19, there has been consistent growth in foreign funding of R&D reaching 17.3% in 2022/23."**

Figure 8: GERD by source of funds, South Africa, 2013/14 to 2022/23



Note: Other South African sources include contributions from higher education, not-for-profit organisations and individual donations; government includes science councils.
Source: South African National Survey of Research and Experimental Development, 2013/14 to 2022/23.

In the wake of COVID-19, South Africa's R&D funding landscape has shifted to one of stable government support, weak business recovery and rising foreign investment

Government-funded R&D had shown a steady upward trajectory since 2013/14, before reaching a turning point during the pandemic. From 2018/19 to 2022/23, government funding peaked at R15.822 billion (constant 2015 prices) in 2019/20, before declining to R14.283 billion in 2022/23. Despite this moderate contraction, government funding demonstrated relative stability compared to other sources during the pandemic period, when its share of total R&D funding increased from 47.5% to 50.5%, and it solidified its position as South Africa's dominant R&D funder.

Business-funded R&D maintained a substantial contribution of around 40% for most of the pre-pandemic decade, before experiencing a dramatic decline (**Table 9**). From 2018/19 to 2022/23, business funding saw the sharpest contraction of any funding source, with real values plummeting from R12.389 billion to a low of R6.985 billion in 2020/21, and its share of total funding dropping from 39.5% to 26.9%. Although business R&D funding recovered slightly to R8.125 billion (28.7%) by 2022/23, it remained well below pre-pandemic levels, indicating lasting damage to private sector R&D investment capacity.

Foreign-funded R&D fluctuated between 10% and 13.5% of total funding over the decade, before beginning a notable upward trend. From 2018/19 to 2022/23, foreign funding increased substantially from R3.409 billion (10.9%) to R4.880 billion (17.3%), showing strong post-pandemic growth with a 21.4% year-on-year increase in the final year. This significant rise in international funding, contrasting with government's 1.8% decline and business's modest 1.0% growth in 2022/23, suggests a meaningful shift in South Africa's research funding landscape, toward greater international collaboration and donor-driven investment.

Other South African sources consistently contributed a small but steady proportion of R&D funding throughout the measured period. From 2018/19 to 2022/23, this contribution increased slightly from 2.1% to 3.5%, showing minimal pandemic impact, and representing the most stable funding source throughout this turbulent period.

Table 9: Funding of R&D in South Africa, in constant 2015 prices (R million), South Africa, 2018/19 to 2022/23

	2018/19	2019/20	2020/21	2021/22	2022/23	
Government-funded R&D (including science council and university own funds)	14 896	15 822	14 591	14 550	14 283	
Business-funded R&D	12 389	7 626	6 985	8 041	8 125	
Foreign-funded R&D	3 409	3 799	3 449	4 020	4 880	

Source: South African National Survey of Research and Experimental Development, 2018/19 to 2022/23.

There was strong government support for publicly funded research, substantial business self-funding and significant international investment for higher education and business R&D in 2022/23

Figure 9 presents source of finance and performer (recipient) expenditures in R&D for South Africa in 2015 prices (R million), illustrating the flow of funding between institutional sectors in 2022/23. The South African government directed R5 799 million to public entities, including its own governmental R&D activities, and R7 930 million to higher education institutions, highlighting the state's substantial investment in academic research.

The business sector primarily funded its own R&D activities with R7 551 million, while also providing smaller amounts to government (R209 million), higher education (R293 million), and non-profit organisations (R72 million).

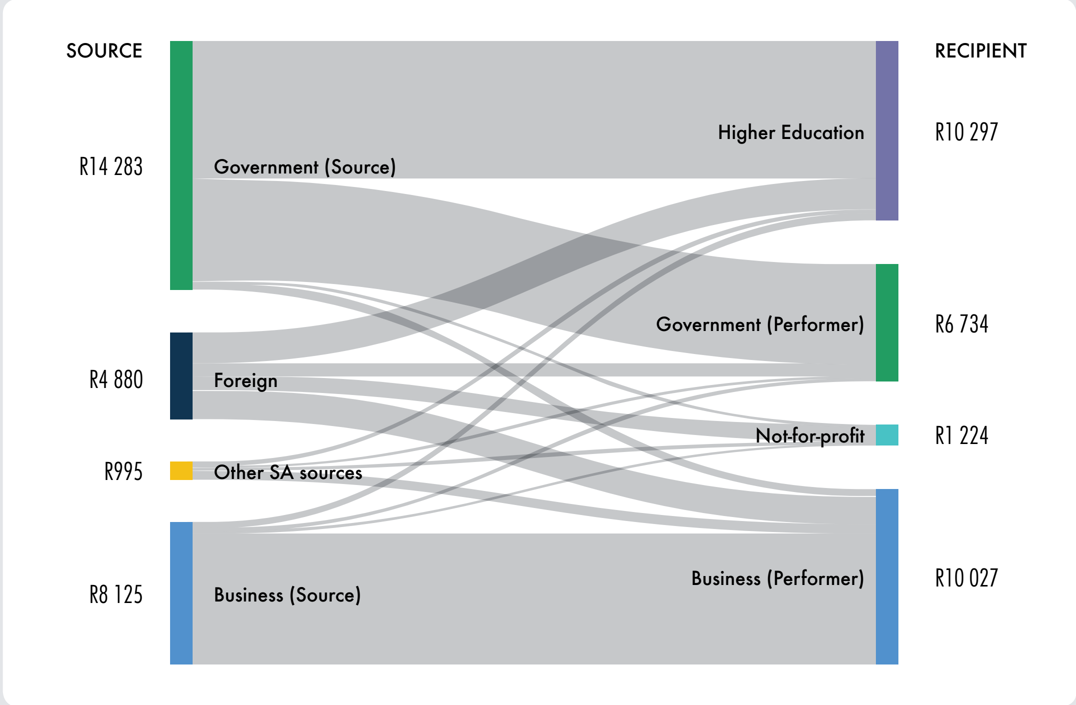
Foreign funding represents an important contribution across all sectors, with higher education receiving the largest foreign investment (R1 791 million), followed by business (R1 622 million), non-profit organisations (R806 million), and government (R661 million). Other South African sources provided modest funding across sectors, with higher education receiving R283 million and business R424 million.

This funding pattern reveals a research ecosystem with strong government support for public institutions, substantial business self-funding, and significant international investment particularly targeting higher education and business research efforts.

Sources of funding for R&D

Many argue that strong performance in business sector R&D is essential to achieve the 1.5% GERD/GDP goal. The analytical brief, *Funding of R&D in a deindustrialising South Africa* (Mustapha, 2024), seeks to illustrate the capacity of public funding to spark and accelerate business sector investment in R&D.

Figure 9: Major flows of funding for R&D in constant 2015 prices (R million), South Africa, 2022/23



Note: Other SA sources includes the contribution from higher education, not-for-profit organisations and individual donations. Government includes science councils.
Source: South African National Survey of Research and Experimental Development, 2022/23.

5. WHY SOUTH AFRICA NEEDS TO GROW ITS R&D PERSONNEL

R&D personnel are the most vital component of R&D activities, encompassing all individuals directly engaged in research and development, whether internal or external, who are fully integrated into the R&D activities of the performing unit.

A nation's ability to conduct effective R&D hinges on having enough well-qualified research staff, as their expertise and creativity drive innovation and problem-solving. Understanding the movements in R&D personnel can be particularly insightful to reflect tangible changes in R&D capacity. Unlike R&D expenditures, which can be distorted by inflation or regional variations in salaries and wages, changes in R&D personnel provide a more direct and reliable measure of real growth in R&D activity. In essence, an increase in R&D personnel signifies a genuine expansion of a nation's research capabilities, making it a more accurate indicator of progress than financial metrics alone. This underscores the importance of investing in human capital to sustain and enhance R&D performance.

> **"A nation's ability to conduct effective R&D hinges on having enough well-qualified research staff, as their expertise and creativity drive innovation and problem-solving."**

Growth in R&D personnel between 2005/06 and 2022/23 was slow but sustained, with recent stabilisation

Trendlines in **Figure 10** track R&D personnel metrics from 2005/06 to 2022/23. The headcount showed steady growth from 57 275 in 2005/06 to a peak of 85 601 in 2020/21, before declining slightly to 84 275 by 2022/23—representing an overall increase of approximately 47% across the period. After relatively stable numbers between 2006/07 and 2011/12, there was accelerated growth from 2012/13 to 2017/18, coinciding with a marked increase in technicians (see **Figure 13** and corresponding discussion), more so than researchers or other R&D personnel, followed by a plateau with minor fluctuations in recent years.

The full-time equivalent (FTE) trend follows a similar pattern but at lower values, starting at 28 798.0 in 2006/07 and reaching around 44 420.2 by 2022/23—an increase of about 54%. The gap between headcount and FTE figures (approximately 40 000 by the end period) indicates that a significant portion of R&D personnel worked part-time or dedicated only a portion of their time to R&D activities.

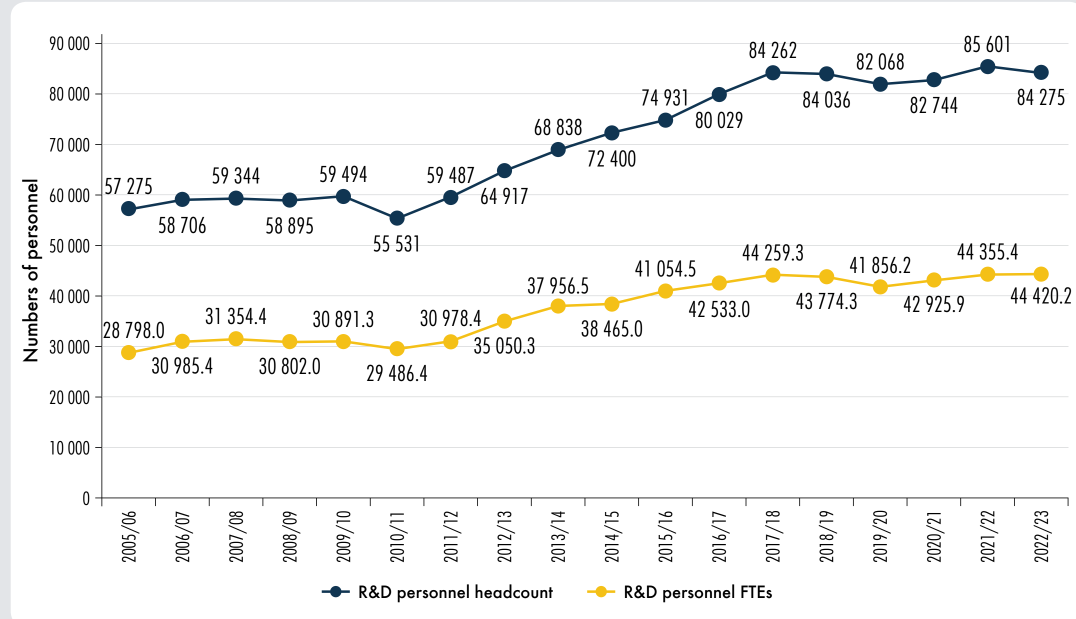
Both metrics show consistent long-term growth over the 18-year period, with the most substantial increases occurring between 2012/13 and 2017/18, followed by stabilisation in recent years.

There was a headcount decrease of 1 326 R&D personnel in 2022/23, primarily from the higher education sector. The growth in higher education sector personnel, particularly from students, buffered overall decreases in other sectors in the last five years.

The stagnant researcher intensity and increasing postgraduate student cohort data suggests that R&D investment has not kept pace with broader economic or employment growth, indicating potential public funding issues, or a brain-drain effect.

> **The stagnant researcher intensity and increasing postgraduate student cohort suggests that R&D investment has not kept pace with broader economic or employment growth."**

Figure 10: R&D personnel (headcount and FTEs), South Africa, 2005/06 to 2022/23



Source: South African National Survey of Research and Experimental Development, 2005/06 to 2022/23.

R&D personnel growth exhibited short-term volatility around the COVID-19 period

South Africa's R&D personnel data showed steady long-term growth from 2005/06 to 2022/23, with both headcount and FTE metrics following upward trajectories, despite occasional plateaus and the recent pandemic disruption (**Figure 10**). Against this backdrop of long-term expansion, the COVID-19 period (2018/19 to 2022/23) showed mixed impacts, with total R&D personnel FTEs experiencing only marginal growth from 43 774.0 to 44 420.2, while the researcher component declined significantly, from 29 111.0 to 27 520.3 (**Table 10**).

While total researcher headcount remained relatively stable during the pandemic years, declining only slightly from 62 166 to 61 547 (following the broader pattern of headcount stabilisation visible in **Figure 10** since 2017), the reduction in researcher FTEs suggests a shift toward more part-time or intermittent research engagement—likely a direct consequence of pandemic-related workplace disruptions and resource constraints.

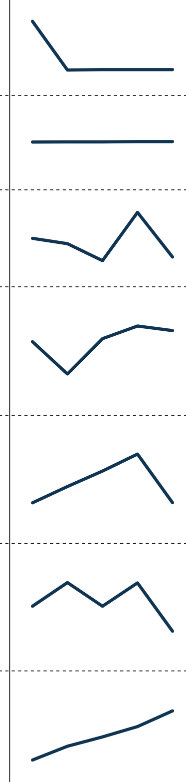
Gender representation shows steady improvement throughout the period, with female researcher participation continuing to grow, from 45.7% to 47.6% between 2018/19 and 2022/23—a positive trend maintained despite broader challenges.

However, when measured against national employment figures, R&D intensity indicators that had been strengthening throughout most of the period have recently stagnated. Total R&D personnel per 1 000 employees remained unchanged at 2.7 during the pandemic, while researcher intensity decreased slightly from 1.8 to 1.7 per 1 000 employees, indicating that R&D workforce development is no longer keeping pace with broader economic expansion.

The flattening of the FTE growth curve visible in the graph since 2017, followed by the pandemic-era decline in researcher FTE, reveals systemic vulnerabilities in South Africa's R&D ecosystem. Pre-existing underinvestment in R&D infrastructure and skills development left the sector poorly positioned to withstand the pandemic's disruptions or capitalise on recovery opportunities. Addressing these challenges requires targeted policies to strengthen resilience, retain skilled researchers, attract new talent, and realign R&D investment with South Africa's evolving economic priorities.

Table 10: R&D personnel, South Africa, 2018/19 to 2022/23

	2018/19	2019/20	2020/21	2021/22	2022/23
Total R&D personnel (FTE)	43 774.0	41 856.5	42 925.9	44 355.4	44 420.2
Total researchers # (FTE)	29 111.0	28 358.6	27 697.6	27 763.3	27 520.3
Total researchers (headcount) #*	62 166	62 002	61 406	63 122	61 547
Female researchers (headcount) #*	28 401	26 015	28 597	29 658	29 303
Total R&D personnel (FTE) per 1 000 in total employment	2.7	2.8	2.9	3.0	2.7
Total researchers (FTE) per 1 000 in total employment #	1.8	1.9	1.8	1.9	1.7
Female researcher headcount #* %	45.7	46.2	46.6	47.0	47.6



Note: # Includes doctoral students and post-doctoral fellows. In 2017/18 it also included emeritus professors, research fellows and honorary research fellows.
* Headcounts included non-SA R&D staff in 2019/20.
Source: South African National Survey of Research and Experimental Development, 2018/19 to 2022/23.

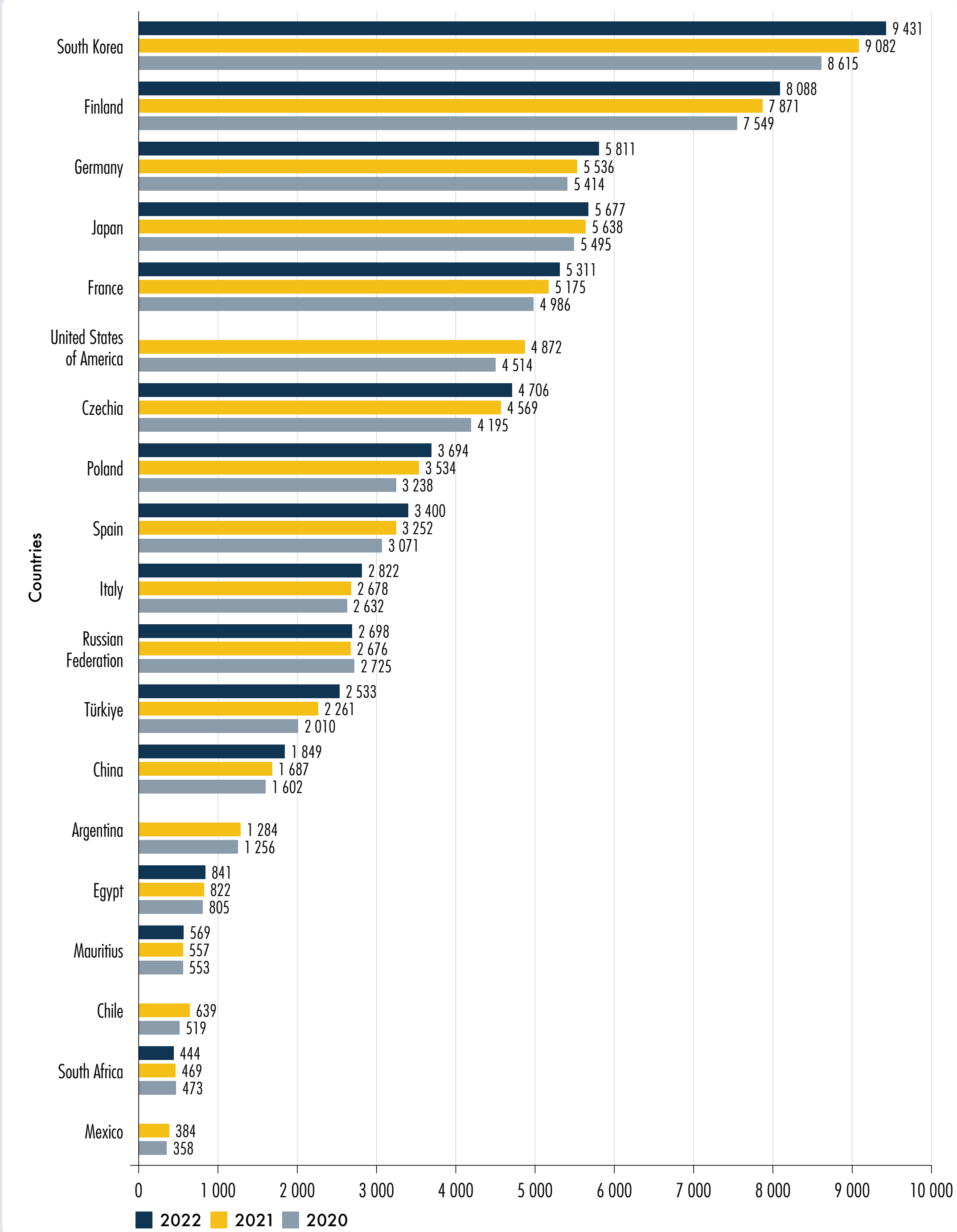
Top performing countries have over 4 000 researchers per million population to South Africa's 444

This point is reinforced by global comparison. **Figure 11** shows the stark difference in researcher numbers between high GDP-per-capita developed countries and developing countries. Several developed nations had over 4 000 researchers per million of the population in 2022. The USA (4 872), France (5 311), Japan (5 677) and Germany (5 811) had from just over 4 800 to approximately 5 800 researchers per million, while Finland (8 088) and South Korea (9 431) both exceeded 8 000 researchers per million.

By contrast, several developing countries had less than 1 000 researchers per million population between 2020 and 2022 including Mexico (384), South Africa (444), Chile (639), Mauritius (569) and Egypt (841). More importantly perhaps, while the numbers of researchers grew between 2020 and 2022 in most developed countries, the number of researchers stagnated or even declined in some developing countries. South Africa was a case in point, losing 25 researchers per million population between 2021 and 2022. South Africa needs to invest significantly in research staff to achieve the competitive level of top performing countries.

> **"South Africa lost 25 researchers per million population between 2021 and 2022."**

Figure 11: Full-time equivalent researchers per million total population for selected countries, 2020 to 2022



Source: UNESCO Institute for Statistics (UIS), 2025. South African National Survey of Research and Experimental Development, 2021 to 2022/23.

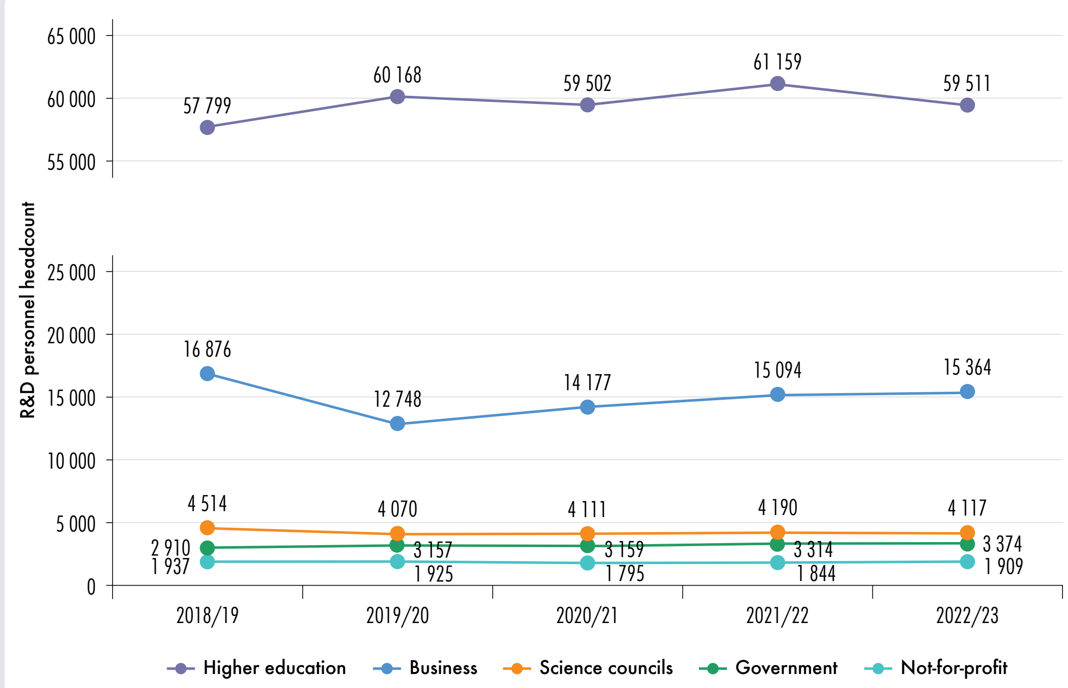
R&D personnel growth in South Africa was flat across institutional sectors

In South Africa, the higher education sector has consistently employed the majority of R&D staff since 2018/19. This is reflected in higher education's dominance of R&D expenditure since 2019/20 (**Figure 12**). R&D personnel dropped to 59 511 in 2022/23, which was comparable with levels in 2020/21. Even though there was a minor decline in 2020, possibly as a result of COVID-19's effects, the general pattern was of consistent growth over the five years, ending in 2022/23.

The number of R&D employees in the business sector has been steadily increasing since a notable decline in 2019/20, and reached 15 364 in 2022/23. Despite this growth, the business sector's R&D workforce has not yet returned to its peak 2018/19 levels (16 876). The number of R&D employees in the government, science council and non-profit sectors are much lower than the two main sectors of higher education and business, mimicking the pattern seen in R&D expenditure (**Figure 3**). Since 2018/19, the number of R&D personnel has varied between 1 937 and 4 117 in the government, science council and NPO sectors.

> **The number of R&D employees in the business sector has been steadily increasing since a notable decline in 2019/20 and reached 15 364 in 2022/23."**

Figure 12: R&D personnel headcount by sector, South Africa, 2018/19 to 2022/23



Source: South African National Survey of Research and Experimental Development, 2018/19 to 2022/23.

The slow rise in researchers contrasted with stable technician and support staff levels in South Africa's R&D workforce over the period 2011/12 to 2022/23

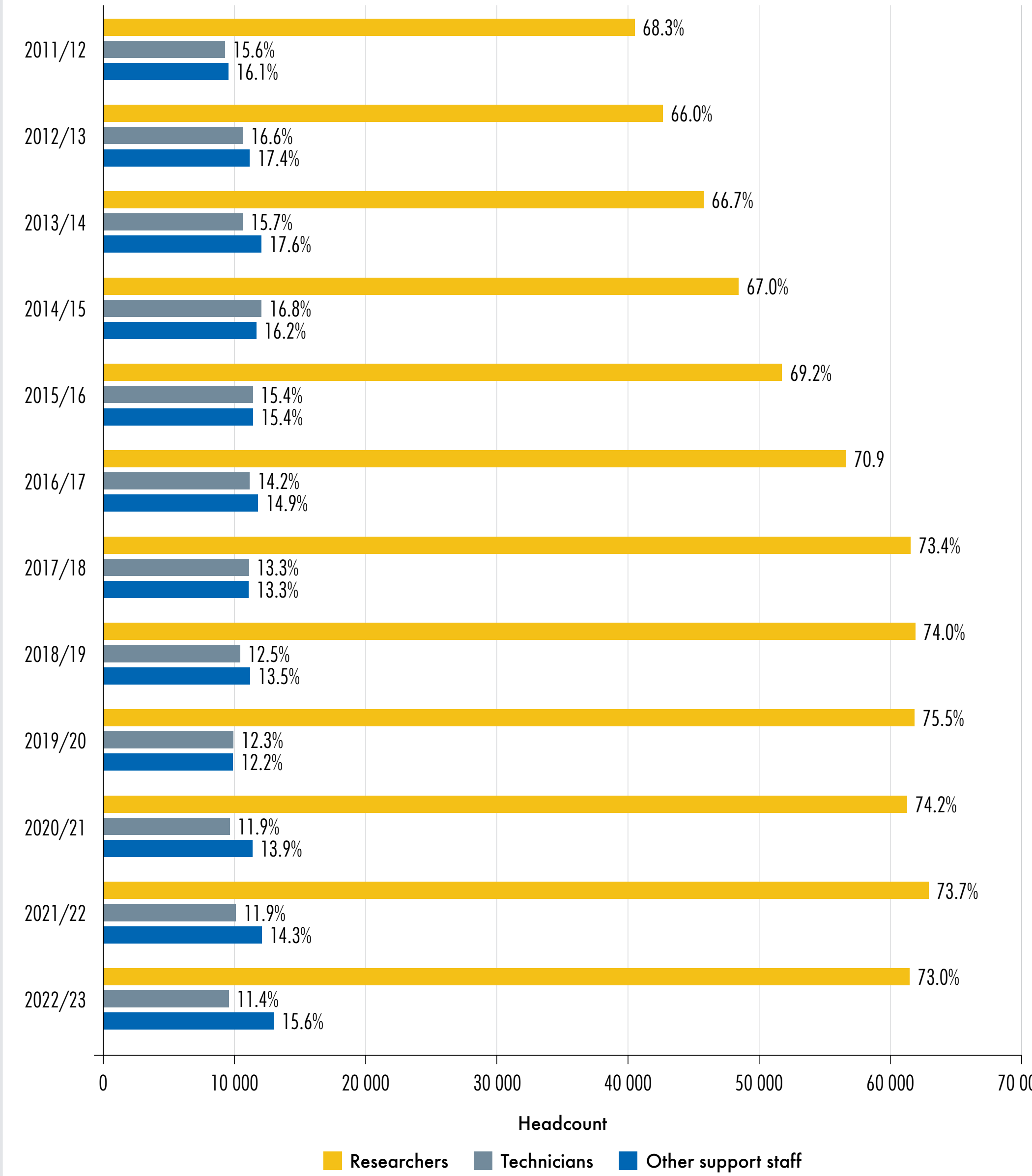
An R&D workforce of sufficient size and with a balanced mix of types of R&D personnel is necessary to promote efficiency. **Figure 13** presents a time series tracking the research personnel headcount in South Africa from 2011/12 to 2022/23. It shows three distinct categories: researchers, technicians, and other support staff. The researcher category demonstrated significant growth over the 12-year period, rising from a headcount of just over 40 500 in 2011/12 to a peak of more than 63 000 in 2021/22, before declining slightly to 61 547 in 2022/23.

The most substantial growth occurred between 2016/17 and 2017/18, when researcher numbers jumped from 56 761 to 61 840. The technician and support staff categories maintained relatively stable numbers throughout the period, hovering around 10 000 to 12 000 staff in each category annually, with minimal fluctuation.

This pattern points to slow, modest growth in South Africa's R&D system over the past decade, with only limited expansion of the researcher workforce and largely stagnant levels of technical and support staff. The long-term trend indicates a gradual maturing of South Africa's research ecosystem with slowly increasing research capacity. However, the small scale of this growth overall—combined with a slight decline in the most recent year—might warrant attention from those concerned with sustaining research momentum.

> **"The long-term trend indicates a gradual maturing of South Africa's research ecosystem with slowly increasing research capacity."**

Figure 13: R&D personnel headcount by occupation, South Africa, 2011/12 to 2022/23



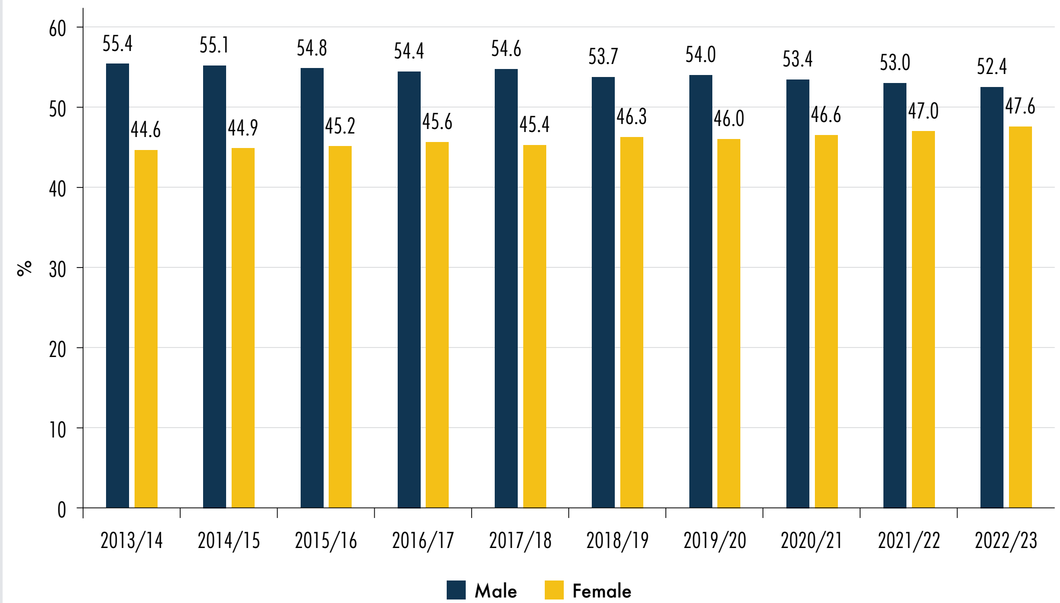
Source: South African National Survey of Research and Experimental Development, 2011/12 to 2022/23.

Growth in female researchers is a persistent, long-term trend

Men constituted a larger proportion of researchers in South Africa in 2022/23 (52.4%), as they have consistently since 2013/14 (**Figure 14**). However, the gender gap has narrowed over the last decade from 55.4% males in 2013/14 to 52.4% in 2022/23 and was unaffected by the COVID-19 pandemic. If the trend continues, male and female researchers could reach parity in South Africa around 2030.

> **The gender gap between researchers has narrowed over the last decade."**

Figure 14: Researchers by gender, South Africa, 2013/14 to 2022/23

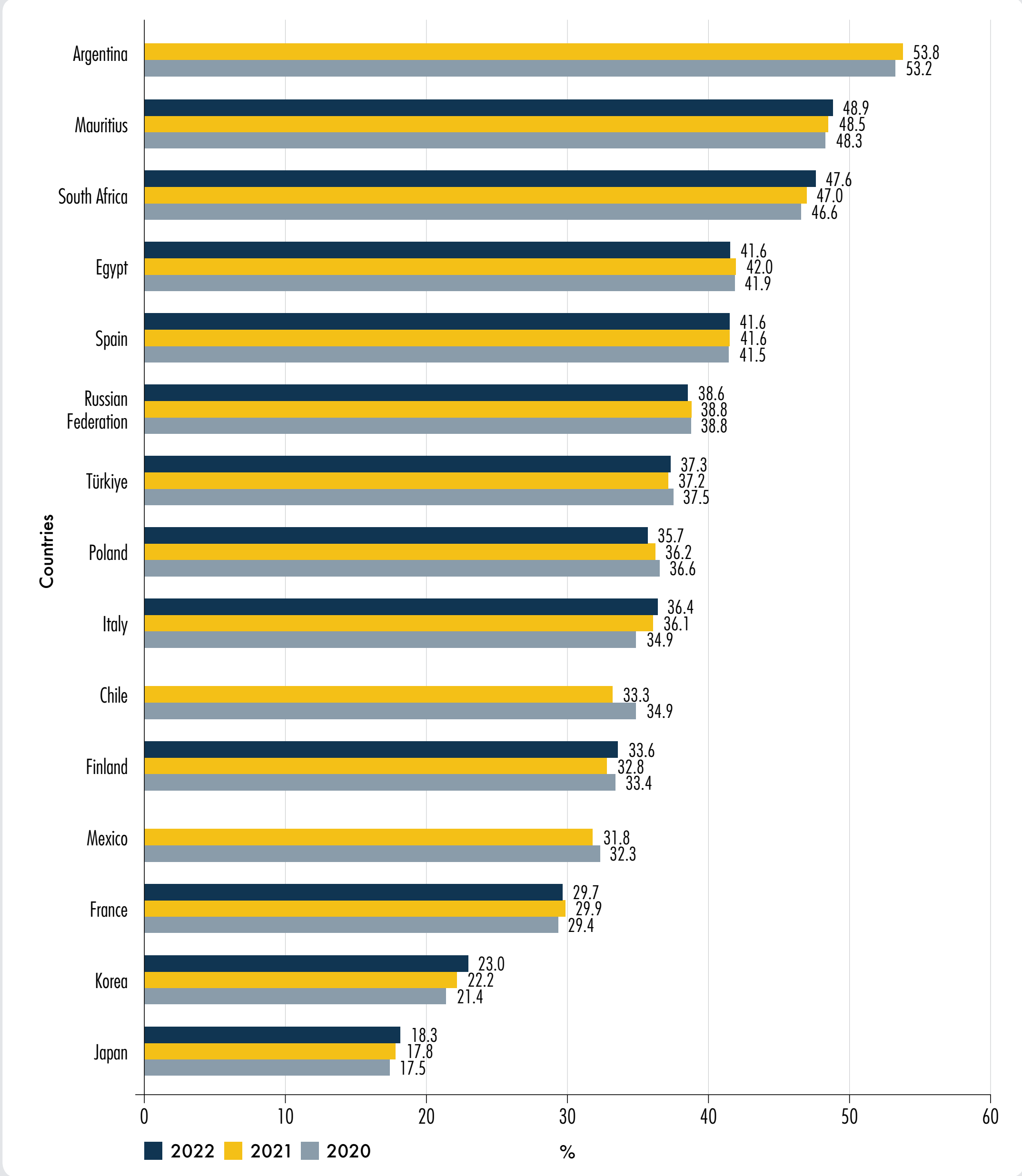


Source: South African National Survey of Research and Experimental Development, 2013/14 to 2022/23.

South Africa has a higher proportion of women researchers than many other countries

Compared with selected countries, South Africa was among the top three with the highest proportion of women researchers (47.6% in 2022) (**Figure 15**). This was just behind Mauritius (48.9% in 2022) and Argentina (53.8% in 2021). Notably, Argentina was the only country with predominantly female researchers, comprising 53.2% of researchers in 2020 and 53.8% in 2021.

Figure 15: Female researchers as a percentage of total researchers in selected countries, 2020 to 2022



Source: UNESCO Institute for Statistics (UIS), 2025.
South African National Survey of Research and Experimental Development, 2022/23.

6. NAVIGATING HEADWINDS: SOUTH AFRICA'S R&D LANDSCAPE BETWEEN CRISIS RESPONSE AND STRUCTURAL CHALLENGES

The 2022/23 South African National Survey of Research and Experimental Development reveals a complex R&D ecosystem grappling with persistent structural challenges. While the COVID-19 pandemic spurred temporary shifts in priorities—particularly in health innovation and digital infrastructure—it failed to reverse the country's longer-term R&D stagnation. With R&D expenditure remaining stagnant as a percentage of GDP, urgent policy action is needed to reignite R&D-led innovation-driven growth.

Sectoral imbalances threaten innovation potential

The survey highlights worrying disparities in R&D recovery across sectors. Public research institutions have shown resilience, but private-sector investment remains sluggish—a concerning trend given its critical role in commercialisation and economic impact. Instead of the business sector, the higher education sector now leads in R&D performance, underscoring a growing disconnect between academic research and industry application. Strengthening university-industry collaboration mechanisms must become a national priority to bridge this gap.

Pandemic gains fail to offset structural decline

While COVID-19 temporarily boosted R&D in targeted areas like vaccine development and digital technologies, these were tactical responses rather than necessarily systemic improvements. The pandemic could not counteract the decade-long decline in R&D activity, driven primarily by eroding business sector investment. Most troubling is the persistent loss of R&D personnel, suggesting that without radical intervention, South Africa risks permanent erosion of its innovation capacity.

The human capital crisis in R&D

Am emerging trend of stagnating numbers of R&D researchers relative to economic growth poses an existential threat to South Africa's innovation future. Although progress in gender equity offers some encouragement, the decline in full-time researchers demands immediate attention. Combating brain drain through competitive retention strategies and investing in STEAM education pipelines will be crucial for building a sustainable R&D workforce.

Evolving funding landscape requires strategic response

The shifting R&D funding mix presents both challenges and opportunities. While government support has increased, declining business sector contributions call for innovative incentive structures. Growing foreign investment offers potential for knowledge transfer and capability building, but requires careful management to ensure alignment with national priorities.

Pathway to 1.5% GERD-to-GDP: discussion points

Achieving South Africa's National Development Plan target demands bold, coordinated action:

- Implement smarter R&D funding models,
- Leverage foreign funding and global partnerships to bolster domestic R&D capacity and foster knowledge spillovers,
- Make incentives for private sector engagement more compelling,
- Invest in STEAM education, upskilling programmes, and talent retention policies to build a robust pipeline of researchers and technicians,
- Act soon on aligning short-term recovery measures with long-term capability building,
- Promote inclusive innovation through R&D investments that address societal challenges and promote equitable access to the benefits of innovation.

In conclusion, R&D should not be viewed merely as a budgetary expense but as a fundamental driver of economic resilience and societal progress. By fostering a robust and inclusive innovation ecosystem, South Africa can position itself competitively in the global knowledge economy while addressing pressing national challenges through targeted research and development efforts.

The South African National Survey of Research and Experimental Development data for the period 2001/02 to 2022/23 that is cited in this report was created by the Centre for Science, Technology and Innovation Indicators at the Human Sciences Research Council. Data is available for download and use by readers in different formats on the HSRC's website (https://hsrc.ac.za/). For specialised data requests from CeSTII, visit https://data-request.hsrc.ac.za/

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