R&D SURVEY

Investment ▪ Insight ▪ Impact

SOUTH AFRICAN NATIONAL SURVEY OF RESEARCH AND EXPERIMENTAL DEVELOPMENT

STATISTICAL REPORT 2021/22

Science and Innovation
Statistics South Africa

HSRC
Human Sciences
Research Council

Produced by the Centre for Science, Technology and Innovation Indicators (CeSTII)
on behalf of the Department of Science and Innovation (DSI).

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User feedback

A user satisfaction survey questionnaire is included as **Annexure G** of this report. It would be appreciated if users could complete the questionnaire and return it by e-mail to CeSTIIData@hsrc.ac.za. The feedback is analysed following each survey cycle to ensure the continued improvement of the R&D Survey.

Revisions

The Department of Science and Innovation (DSI), Statistics South Africa (Stats SA) and the Human Sciences Research Council's Centre for Science, Technology and Innovation Indicators (HSRC-CeSTII) jointly reserve the right to revise the data and indicators in this report. Such revisions may result from revisions by Stats SA of socio-economic indicators such as the gross domestic product (GDP) or 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 DSI and HSRC websites. The current R&D intensity series was revised to take into account the revision of the GDP series (Stats SA, 2022). The R&D expenditure in real terms was also rebased to 2015 constant prices.

FOREWORD

The Statistics Act (No. 6 of 1999) mandates the Statistician-General (SG) to coordinate statistical production in the Republic. To this effect, in order to coordinate the production of statistics in the National Statistics System (NSS), the Statistician-General has developed tools to drive this process. The South African Statistical Quality Assessment Framework (SASQAF) is among the tools that the SG has developed to effect statistical coordination.

The SASQAF is used by Statistics South Africa and other data producers within the national statistical system to assess statistical products with the aim to drive quality improvement. The assessment of statistical products identifies areas where the data is deficient. More importantly, the Statistician General uses SASQAF to designate statistical products as official statistics. The assessment process has the potential to increase the body of official statistics used for evidence-based decision making. As such, the Department of Science and Innovation (OSI) in their quest to improve quality of their statistical products subjected its national Research and Development (R&D) Survey to SASQAF. Currently, the R&D survey is undergoing an independent quality assessment which may determine if the survey can be designated as official statistics. The assessment process will also result in a quality improvement plan (QIP) for the areas where the statistical product was found to be deficient.

It is important to note, however, that this R&D survey by DSI, like many other statistical releases, has been through a clearance process. Ongoing efforts to enhance survey quality are applied across the statistical value chain (SVC) to refine the survey methodology, and these have been reflected in consistent improvements in key statistical quality indicators. The Clearance Committee for the R&D survey noted that the 2021/22 R&D Survey was conducted following good practices and achieved more than 70% of quality indicators set in the quality standards of the R&D Survey Assessment Tool.

Based on my evaluation and the evident dedication displayed by the OSI in implementing continuous quality improvements, I endorse the outcomes of the 2021/22 R&D Survey. I encourage stakeholders to utilise these results for informed decision-making and strategic planning.

Risenga Maluleke
Statistician-General
Republic of South Africa

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The HSRC-CeSTII project team for the 2021/22 South African National Survey of Research and Experimental Development comprised: Yolanda Baptista, Lindiwe Binda, Mbali Bongoza, Jacqueline Borel-Saladin, Isaac Cameron, Mario Clayford, Marco Davids, Atoko Kasongo, Jerry Mathekga, Tlangelani Makamu, Sintu Mavi, Thuliswa Mazikwana, Nazeem Mustapha, Litha Phika, Gerard Ralphs, Theodore Sass, Natasha Saunders, Kgabo Ramoroka, Viwe Sigenu, Moses Sithole, Natalie Vlotman, Darryn Whisgary, and Luthando Zondi.

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ABBREVIATIONS

AIDS	Acquired immune deficiency syndrome
BERD	Business expenditure on R&D
CeSTII	Centre for Science, Technology and Innovation Indicators
COVID-19	Coronavirus disease 2019
DSI	Department of Science and Innovation
FTE	Full-time equivalent
GDP	Gross domestic product
GERD	Gross domestic expenditure on R&D
GOVERD	Government intramural expenditure on R&D
HEMIS	Higher Education Management Information System
HERD	Expenditure on R&D in the higher education sector
HIV	Human Immunodeficiency Virus
HSRC	Human Sciences Research Council
ICT	Information and communication technologies
IMF	International Monetary Fund
Mintek	Council for Mineral Technology
NESTI	National Experts on Science and Technology Indicators
NPO	Not-for-profit organisation
NSI	National system of innovation
NSO	National Statistical Organisation
OECD	Organisation for Economic Co-operation and Development
R&D	Research and experimental development
RDI	Research, development and innovation
RDSMS	Research and Development Survey Management System
SA	South Africa
SASQAF	South African Statistical Quality Assessment Framework
SEO	Socio-economic objective
SOE	State-owned enterprise
SIC	Standard Industrial Classification
SNA	System of National Accounts
SPII	Support Programme for Industrial Innovation
Stats SA	Statistics South Africa
SVC	Statistical value chain
TB	Tuberculosis
THRIP	Technology and Human Resources for Industry Programme
UN	United Nations
VAT	Value added tax

DEFINITIONS AND DESCRIPTIONS

Applied research is original investigation undertaken to acquire new knowledge. It is, however, 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.

Biotechnology is an application of science and technology to living organisms as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services.

Capital expenditures are the annual gross expenditures on fixed assets used in the R&D programmes of statistical units. These are reported in full for the period when they took place and are not registered as an element of depreciation. Capital expenditures on R&D consist of buildings, vehicles, plant machinery and equipment.

Civil gross expenditure on research and development (Civil GERD) is the sum of all expenditure by socio-economic objective (SEO), minus expenditure on defence R&D.

Constant 2015 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 P0441, 2nd Quarter 2023 (Stats SA, 2023).

Current expenditure is expenditure on items that generally reoccur after a short period. Current expenditure on R&D activities consists of labour costs and other current expenditures.

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 and services, or to improving substantially those already produced or installed.

Full-time equivalent (FTE) is an estimate of the time spent on R&D activities. It is the proportion of time spent on R&D activities out of all time spent at work.

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. This statistic is obtained from the Statistics South Africa GDP survey P0441, 2nd Quarter 2023 (Stats SA, 2023).

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

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

In-house or intramural R&D refers to R&D performed by the unit or entity itself (i.e. by the personnel of the unit or entity). This is R&D performed within the borders of South Africa, even if funded by foreign sources.

Labour costs comprise annual wages and salaries and all associated costs or fringe benefits, such as bonus payments, holiday pay, contributions to pension funds and other social security payments, payroll taxes, etc. The labour costs of persons providing indirect services which are not included in the personnel data (such as security and maintenance personnel or the staff of central libraries, computer departments or head offices) are excluded and included in other current costs.

Master's students refer to students doing a full research master's as well as those doing coursework plus thesis with a research component.

New materials pertain to the technology and R&D activities of high-tech companies particularly in the aerospace, construction, electronic, biomedical, renewable energy, environmental remediation, food and packaging, manufacturing and motorcar industries. New materials include multi-functional materials, advanced materials, nano-materials, nano-composites and nanotechnology.

Nanotechnology is the understanding and control of matter at dimensions of roughly 1 to 100 nanometres, where unique phenomena enable novel applications.

Open-source software is computer software that is available in source code form under an open-source licence. The source code and certain other rights normally reserved for copyright holders are provided under a software licence that permits anyone to study, change, improve and at times also to distribute the software.

Other current expenditure comprise non-capital purchases of materials, supplies and equipment to support R&D performed by the statistical unit in a given year. These include, but are not limited to running costs, overhead expenses, repairs and maintenance, payments to outside organisations for use of specialised testing facilities, payments to outside organisations for specialised services and on-site consultant expenses in support of R&D projects carried out by the R&D performer.

Outsourced R&D refers to R&D done by another entity on behalf of the reporting unit and paid for by the reporting unit.

R&D intensity estimated by GERD as a proportion of GDP is the total intramural expenditures on R&D performed in the country in a given year relative to GDP.

R&D personnel refers to all persons (irrespective of nationality) employed directly on R&D, as well as those providing direct services such as R&D managers, administrators, and clerical staff. These include emeritus professors, honorary fellows and research fellows.[1]

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

Research and experimental development (R&D) comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications.

Socio-economic objective (SEO) classification provides an indication of the R&D activities by main purpose. The SEO classification used in this survey is consistent with the Nomenclature for the Analysis and Comparison of Scientific Programs and Budgets (NABS) published by Eurostat in 2007.

Statistical unit is an entity for which statistical data are collected or derived.

Standard Industrial Classification (SIC) codes are used by Statistics South Africa to describe the economic activities of industries.

State-owned enterprises (SOEs) are public corporations owned by government units mainly engaged in market production and sale of the kind of goods and services often produced by private enterprises.

Total employment is the total employed labour force in the South African economy. This statistic is obtained from Stats SA Labour Force Survey series P0211, 1st Quarter 2022 (Stats SA, 2022) where employed persons were defined as 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).

[1] Prior to 2016/17, R&D personnel measured comprised only South African researchers, technicians and other R&D personnel. Also, emeritus professors, honorary fellows and research fellows were not explicitly included in the estimates of R&D personnel

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A. INTRODUCTION

This Statistical Report presents data tables from the 2021/22 South African National Survey of Research and Experimental Development (R&D Survey). The report provides key findings of the survey with commentary, standard summary tables of the overall findings from 2020/21 and time series from previous instances of the survey. The R&D Survey covers a 12-month period corresponding with the sectoral financial year. For the business, government, science councils and NPO sectors this is from 1 April to 31 March, or the nearest complete financial year. In the higher education sector the calendar year is surveyed, ending 31 December.

The survey covers these sectors that perform R&D in South Africa:

- **Business enterprise sector**, comprising large, medium and small enterprises, including state-owned enterprises.
- **Government sector**, comprising national, provincial and local government with an R&D component; government research institutions and museums.
- **Higher education sector**, comprising all public and private higher education institutions with an R&D component.
- **Not-for-profit sector**, comprising non-governmental and other organisations formally registered as not-for-profit institutions.
- **Science council sector**, comprising the seven science councils established through Acts of Parliament.

This approach is followed to maintain consistency with the institutional sector categorisation recommended by the Organisation for Economic Co-operation and Development (OECD) in *The Measurement of Scientific and Technological Activities: Proposed Standard Practice for Surveys on Research and Experimental Development*, known as the Frascati Manual (OECD, 2015). The split of government into two sectors – a government sector and a science council sector – is an adjustment for the South African situation.

This report presents R&D statistics in tables according to the following categories:

- Gross domestic expenditure on research and development (GERD), and R&D expenditure by R&D-performing sectors
- Local and international sources of funding for R&D sectors
- R&D expenditure by field of research and socio-economic objective, and by industrial sector in the business sector
- R&D expenditure in selected areas of policy interest, namely: biotechnology, nanotechnology, space science, environment-related, open-source software, new materials, and tuberculosis (TB), HIV/AIDS and malaria research
- R&D personnel

GDP values were obtained from the Stats SA GDP statistical release P0441 (Stats SA, 2023) and the total employment level was taken from the Stats SA Quarterly Labour Force Survey statistical release P0211 (Stats SA, 2022).

All financial quantities presented in this report are in current values, unless otherwise indicated. Constant 2015 Rand values were calculated using the GDP deflator.

The headline indicator of GERD/GDP has been recalculated to adjust for ongoing revisions in the Stats SA GDP series.[2]

The classification of main institutional sectors recommended in the System of National Accounts (EC, IMF, OECD, UN and World Bank, 2009) is indicated in terms of those used in the Frascati Manual (OECD, 2002; 2015). This is only used indicatively in this report to assist users of data for R&D capitalisation purposes. Full implementation of the main institutional sectors will be done once the changes published in the 7th edition of the Frascati Manual have been finalised.

Since the 2014/15 R&D Survey, tables have been included to assess the R&D activities of SOEs.

From the 2016/17 R&D Survey onwards, the master's students category was split into two types: students doing a research master's degree and students doing a master's degree with coursework and a dissertation component. Furthermore, non-SA R&D staff were included in headcount estimates from 2016/17.

Section B provides the main findings of the survey, including commentary on key developments. Section C contains a detailed set of tables describing the survey results for 2021/22 and the preceding nine years. The description of the survey methodology is contained in section D, and the government/science council/not-for-profit sector questionnaire for the 2021/22 R&D Survey is reproduced in section F.

[2] The R&D Survey has historically used the GDP series calculated according to the production method by Stats SA.

B. KEY FINDINGS FOR 2021/22

Gross domestic expenditure on R&D (GERD) increased in real terms for the first time in three years

In 2015 prices, GERD grew by 6.9% year-on-year in 2021/22, from R25.965 billion in 2020/21 to R27.756 billion in 2021/22.

GERD as a percentage of gross domestic product (GDP) was 0.62% in 2021/22, which is two basis points higher than the 0.60% recorded in 2020/21.

Table B.1 summarises the key R&D indicators for the 2019/20, 2020/21 and 2021/22 survey reference periods.

Table B.1: Summary of key statistics and indicators (2019/20 to 2021/22)

KEY INDICATOR	2019/20	2020/21	2021/22
Expenditure on R&D			
Gross domestic expenditure on R&D (GERD) (Rm)	34 485	33 541	38 186
Business enterprise expenditure on R&D (BERD) (Rm)	*10 704*	*10 047*	*13 527*
Not-for-profit (NPO) expenditure on R&D (Rm)	*1 510*	*1 568*	*1 600*
Government expenditure on R&D (GOVERD) (Rm)	*1 894*	*2 238*	*2 472*
Science council (SCI) expenditure on R&D (Rm)	*6 198*	*5 902*	*6 354*
Higher education (HE) expenditure on R&D (HERD) (Rm)	*14 179*	*13 786*	*14 232*
Gross domestic expenditure on R&D in constant 2015 prices (Rm)	28 100	25 965	27 756
Funding sources			
Government-funded* R&D (Rm)	19 417	18 872	20 049
Business-funded R&D (Rm)	9 359	9 034	11 081
Foreign funding of R&D (Rm)	4 662	4 462	5 539
Foreign funding of BERD (Rm)	*1 169*	*978*	*2 003*
Foreign funding of NPO R&D (Rm)	*941*	*1 018*	*845*
Foreign funding of GOVERD (Rm)	*134*	*56*	*55*
Foreign funding of SCI R&D (Rm)	*440*	*433*	*629*
Foreign funding of HERD (Rm)	*1 979*	*1 977*	*2 006*
R&D personnel			
Total R&D personnel (FTE**)	41 856.5	42 925.9	44 355.4
Total researchers# (FTE**)	28 358.6	27 697.6	27 763.3
Total researchers# (headcount)	62 002	61 406	63 122
Female researchers# (headcount)	28 623	28 597	29 658
Indicators computed from R&D Survey			
GERD as a percentage of GDP (%)	0.61	0.60	0.62
Civil GERD as a percentage of GDP (%)	0.58	0.57	0.59
BERD as a percentage of GERD (%)	31.0	30.0	35.4
Basic research (Rm)	11 043	9 856	11 148
Total R&D personnel (FTE**) per 1 000 in total employment	2.8	2.9	3.0
Total researchers# (FTE**) per 1 000 in total employment	1.9	1.8	1.9
Female researcher# headcount as a percentage of total researcher headcount (%)	46.2	46.6	47.0
Indicators obtained from external data sources			
Gross domestic product (GDP) level at current prices (Rm)	5 625 207	5 567 974	6 208 786
GDP (%)	0.3	-6.0	4.7
SA employment ('000)	16 383	14 995	14 914

*Government-funded R&D includes science council and university own funds.
**FTE: Full-time equivalent.
#Includes doctoral students and post-doctoral fellows. Also includes emeritus professors, research fellows and honorary research fellows (2016/17 onwards). These categories do not incur salary, but there are time and costs (included in "Other current costs") associated with them.
Note: Headcounts have included non-SA R&D personnel since 2016/17. Non-South African personnel are classified as personnel that are not citizens of South Africa but are undertaking research in South Africa for a period exceeding six months.

Selected highlights reflected in key indicators

South Africa's economy experienced some growth

Unlike the 6.0% contraction in GDP witnessed during the COVID-19 epidemic in 2020, South Africa experienced a notable recovery with a 4.7% increase in GDP in 2021(Stats SA, 2023).

Business sector R&D expenditure drove the increase in GERD

Nominal R&D expenditure increased in all five institutional sectors, particularly in the business sector, which increased by R3.480 billion. The higher education sector increased R&D expenditure by R446 million, the government sector increased by R235 million, while the not-for-profit sector increased R&D expenditure by R31 million (Table C.1).

R&D personnel grew in all sectors

R&D personnel headcount went up by 2 857 (an increase of 3.5% year-on-year) to 85 061 in 2021/22, of which researchers accounted for 1 716 (an increase of 2.8% year-on-year (Table C.28)). Enterprises in the business sector employed 917 new R&D personnel, however, they shed 140 researchers (Table C.52). R&D personnel increased by 1 657 in the higher education sector, 155 in the government sector and 79 in the science councils sector. The non-profit sector recorded an increase in the R&D personnel headcount of 49 (Table C.30).

In 2021/22, 1.9 full-time equivalent researchers were employed for every 1 000 R&D workers, an increase from the 1.8 reported in 2020/21 (Table B.1). The ratio of female researcher headcounts as a percentage of total researchers (including doctoral and post doctoral fellows) rose by 0.4 percentage points to 47.0% (Table B.1).

R&D expenditure in state-owned enterprises went up in 2021/22

State-owned enterprises spent R421 million (25.4%) more on R&D in 2021/22, bringing their total R&D expenditure to R2.080 billion (Table C.56). Of this, a noticeable R810 million was allocated for capital expenses on R&D (Table C.59). SOEs spent R427 million on space science R&D, more so than all other selected areas of interest (Table C.63).

Government remains the largest funder of R&D

Government-funded R&D amounted to 52.5% (R20.049 billion), while business-funded R&D was 29.0% (R11.081 billion) and foreign-funded R&D totalled 14.5% (R5.539 billion) (Table C.20). Foreign funding is the largest it has been in ten years (R5.539 billion), contributing R1.078 billion more in 2021/22 (Table C.19). Foreign investment appears to be generally trending upwards over the last ten years, the majority of it directed to the higher education and business sectors.

Manufacturing and financial intermediation show increases in R&D activity

Within the business sector, the financial services (financial intermediation, real estate and business services) and manufacturing sectors continue to drive most R&D expenditure, accounting for 45.7% (R6.187 billion) and 29.9% (R4.049 billion) of total expenditure, respectively (Table C.51). The financial services sector increased by R1.937 billion and the manufacturing sector by R1.154 billion in 2021/22 (Table C.50). The manufacturing subsector composed of manufacture of refined petroleum, coke and nuclear fuel; manufacture of chemicals and chemical products (incl. pharmaceuticals); manufacture of rubber and plastic products increased by R608 million, while transportation, storage, and communication increased by R531 million.

Applied research remains most prevalent

Applied research, which continues to be the most common type of research, accounted for 48.1% (R18.380 billion) of R&D activity in 2021/22 (Table C.6). Basic research constituted 29.2% (R11.148 billion) of research activity. The least common type of research was experimental development research (22.7%) (R8.657 billion). Applied research dominates in all the sectors except in higher education institutions, where basic research is the predominant type of R&D.

Further decline in the proportion of R&D performed in Gauteng

Gauteng contains most of the research and development enterprises across all institutional sectors in South Africa, together contributing 41.1% (R15.690 billion) of GERD. However, the province's contribution dropped proportionately by 2.8 percentage points in 2021/22, even though there was a nominal increase in expenditure (Table C.18 and C.19). Western Cape and KwaZulu-Natal made up the second and third highest contributions, with R10.171 billion (26.6%) and R3.716 billion (9.7%) respectively. The provinces of Mpumalanga and the Free State saw increases in R&D expenditure of R557 million (1.2 percentage points) and R491 million (0.8 percentage points), respectively.

Social sciences and medical and health sciences remain the strongest research areas

The majority of R&D was in the medical and health sciences (22.8%) (R8.718 billion), and the social sciences (18.4%) (R7.041 billion). The field of research with the third-highest R&D expenditure in South Africa is information, computer, and communication technology (13.1%) (R5.008 billion), which surpasses the engineering sciences field (11.7%) (R4.463 billion). The increase in 2021/22 came mainly from R&D in the natural sciences. Growth in social sciences is stagnant.

R&D in most priority policy areas increased

Biotechnology increased by R326 million in 2021/22 (Table C. 9). Furthermore, R&D expenditure rose by R613 million for research connected to space science, R550 million for the field of new materials, and R475 million for research related to the environment. Research expenditure for open-source software increased by R228 million, whereas funding for communicable diseases (TB, HIV/AIDS, and malaria) went up by R329 million (Table C.11). R&D related to the environment maintained its growing trend, with other areas of interest displaying more erratic growth trends.

C. TABLES

Notes:

- Totals in the tables may not add up to the sum of their constituent items due to rounding effects.
- Data from 2001/02 onwards may be downloaded from https://hsrc.ac.za/accessing-cestii-data/

C.1. General survey results

C.1.1. Expenditure on research and experimental development

Table C.1: R&D expenditure by sector (2012/13 to 2021/22)

YEAR	GERD	GOVERNMENT	SCIENCE COUNCILS	HIGHER EDUCATION	BUSINESS	NOT-FOR-PROFIT
	R'000	R'000	R'000	R'000	R'000	R'000
2012/13	**23 871 219**	1 437 509	4 025 998	7 333 153	10 570 726	503 833
2013/14	**25 660 573**	1 697 151	4 304 556	7 292 853	11 782 848	583 165
2014/15	**29 344 977**	1 893 010	5 004 669	8 377 575	13 290 951	778 772
2015/16	**32 336 679**	2 013 021	5 740 897	9 876 623	13 814 995	891 142
2016/17	**35 692 973**	2 098 646	6 136 183	11 659 258	14 781 270	1 017 616
2017/18	**38 724 590**	2 325 875	6 313 344	13 009 876	15 859 185	1 216 310
2018/19	**36 783 968**	2 223 426	5 443 885	13 183 119	14 447 833	1 485 704
2019/20	**34 484 862**	1 893 543	6 198 363	14 178 960	10 704 481	1 509 515
2020/21	**33 541 332**	2 237 531	5 902 414	13 785 736	10 047 344	1 568 307
2021/22	**38 185 599**	2 472 434	6 354 298	14 232 128	13 527 182	1 599 557

Table C.2: R&D expenditure by sector, constant 2015 Rand values (2012/13 to 2021/22)

YEAR	GERD	GOVERNMENT	SCIENCE COUNCILS	HIGHER EDUCATION	BUSINESS	NOT-FOR-PROFIT
	R'000	R'000	R'000	R'000	R'000	R'000
2012/13	**28 098 548**	1 692 076	4 738 958	8 631 773	12 442 685	593 056
2013/14	**28 537 040**	1 887 396	4 787 083	8 110 358	13 103 667	648 536
2014/15	**30 972 311**	1 997 987	5 282 204	8 842 156	14 028 004	821 959
2015/16	**32 336 679**	2 013 021	5 740 897	9 876 623	13 814 995	891 142
2016/17	**33 372 836**	1 962 229	5 737 315	10 901 375	13 820 449	951 469
2017/18	**34 328 482**	2 061 836	5 596 638	11 532 964	14 058 812	1 078 231
2018/19	**31 356 025**	1 895 331	4 640 571	11 237 782	12 315 872	1 266 470
2019/20	**28 099 791**	1 542 943	5 050 700	11 553 644	8 722 484	1 230 020
2020/21	**25 965 298**	1 732 136	4 569 226	10 671 930	7 777 935	1 214 071
2021/22	**27 756 358**	1 797 164	4 618 814	10 345 053	9 832 641	1 162 686

Table C.3: R&D percentage expenditure composition by sector (2012/13 to 2021/22)

YEAR	GOVERNMENT	SCIENCE COUNCILS	HIGHER EDUCATION	BUSINESS	NOT-FOR-PROFIT
	%	%	%	%	%
2012/13	6.0	16.9	30.7	44.3	2.1
2013/14	6.6	16.8	28.4	45.9	2.3
2014/15	6.5	17.1	28.5	45.3	2.7
2015/16	6.2	17.8	30.5	42.7	2.8
2016/17	5.9	17.2	32.7	41.4	2.9
2017/18	6.0	16.3	33.6	41.0	3.1
2018/19	6.0	14.8	35.8	39.3	4.0
2019/20	5.5	18.0	41.1	31.0	4.4
2020/21	6.7	17.6	41.1	30.0	4.7
2021/22	6.5	16.6	37.3	35.4	4.2

Table C.4: R&D expenditure as a percentage of GDP by sector (2012/13 to 2021/22)

YEAR	GERD/GDP	GOVERNMENT	SCIENCE COUNCILS	HIGHER EDUCATION	BUSINESS	NOT-FOR-PROFIT
	%	%	%	%	%	%
2012/13	**0.67**	0.04	0.11	0.21	0.30	0.01
2013/14	**0.66**	0.04	0.11	0.19	0.30	0.02
2014/15	**0.71**	0.05	0.12	0.20	0.32	0.02
2015/16	**0.73**	0.05	0.13	0.22	0.31	0.02
2016/17	**0.75**	0.04	0.13	0.24	0.31	0.02
2017/18	**0.76**	0.05	0.12	0.26	0.31	0.02
2018/19	**0.69**	0.04	0.10	0.25	0.27	0.03
2019/20	**0.62**	0.03	0.11	0.25	0.19	0.03
2020/21	**0.61**	0.04	0.11	0.25	0.18	0.03
2021/22	**0.62**	0.04	0.10	0.23	0.22	0.03

Table C.5: R&D expenditure by type of research (2012/13 to 2021/22)

YEAR	GERD	BASIC RESEARCH	APPLIED RESEARCH	EXPERIMENTAL DEVELOPMENT
	R'000	R'000	R'000	R'000
2012/13	**23 871 219**	6 030 827	11 064 247	6 776 146
2013/14	**25 660 573**	6 102 085	12 132 211	7 426 277
2014/15	**29 344 977**	7 133 213	14 331 016	7 880 748
2015/16	**32 336 679**	8 209 662	15 349 070	8 777 948
2016/17	**35 692 973**	9 542 644	17 061 167	9 089 162
2017/18	**38 724 590**	10 223 956	20 623 856	7 876 778
2018/19	**36 783 968**	10 364 091	19 316 433	7 103 444
2019/20	**34 484 862**	11 043 171	16 074 948	7 366 744
2020/21	**33 541 332**	9 856 349	15 848 231	7 836 752
2021/22	**38 185 599**	11 148 327	18 380 000	8 657 271

Table C.6: Proportional R&D expenditure by type of research (2012/13 to 2021/22)

YEAR	BASIC RESEARCH	APPLIED RESEARCH	EXPERIMENTAL DEVELOPMENT
	%	%	%
2012/13	25.3	46.3	28.4
2013/14	23.8	47.3	28.9
2014/15	24.3	48.8	26.9
2015/16	25.4	47.5	27.1
2016/17	26.7	47.8	25.5
2017/18	26.4	53.3	20.3
2018/19	28.2	52.5	19.3
2019/20	32.0	46.6	21.4
2020/21	29.4	47.2	23.4
2021/22	29.2	48.1	22.7

Table C.7: R&D expenditure by accounting category (2012/13 to 2021/22)

YEAR		CAPITAL EXPENDITURE ON R&D					CURRENT EXPENDITURE ON R&D			
	GERD	LAND: BUILDINGS AND OTHER STRUCTURES	VEHICLES, PLANT, MACHINERY, EQUIPMENT	#CAPITALISED COMPUTER SOFTWARE	TOTAL: VEHICLES, PLANT, MACHINERY, EQUIPMENT AND SOFTWARE	SUBTOTAL: CAPITAL EXPENDITURE	LABOUR COSTS	TOTAL COST OF R&D POST-GRADUATE STUDENTS	OTHER CURRENT EXPENDITURE*	SUBTOTAL: CURRENT EXPENDITURE
	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000
2012/13	**23 871 219**	495 842	1 747 183	0	1 747 183	2 243 025	11 922 169	1 186 653	8 519 372	21 628 194
2013/14	**25 660 573**	529 575	1 857 913	0	1 857 913	2 387 488	13 304 413	1 224 611	8 744 061	23 273 085
2014/15	**29 344 977**	805 961	2 311 181	0	2 311 181	3 117 142	14 443 903	1 579 088	10 204 844	26 227 835
2015/16	**32 336 679**	711 631	3 008 992	0	3 008 992	3 720 622	14 781 549	1 926 301	11 908 207	28 616 057
2016/17	**35 692 973**	1 274 737	2 822 229	0	2 822 229	4 096 967	16 505 080	1 928 108	13 162 819	31 596 007
2017/18	**38 724 590**	1 715 060	2 385 032	0	2 385 032	4 100 092	18 757 628	1 889 065	13 977 805	34 624 498
2018/19	**36 783 968**	879 489	2 393 110	0	2 393 110	3 272 599	18 112 670	1 938 984	13 459 715	33 511 369
2019/20	**34 484 862**	843 941	1 733 054	135 027	1 868 080	2 712 021	15 984 538	1 969 872	13 818 431	31 772 841
2020/21	**33 541 332**	500 532	1 552 588	433 636	1 986 224	2 486 756	15 743 599	1 895 876	13 415 100	31 054 575
2021/22	**38 185 599**	800 666	2 426 402	377 722	2 804 124	3 604 791	17 638 424	1 989 659	14 952 725	34 580 808

*Includes specific categories of R&D personnel costs for 2017/18 to 2021/22. #Capitalised computer software collected from 2019/20.

Table C.8: Proportional R&D expenditure by accounting category (2012/13 to 2021/22)

YEAR	CAPITAL EXPENDITURE ON R&D					CURRENT EXPENDITURE ON R&D			
	LAND: BUILDINGS AND OTHER STRUCTURES	VEHICLES, PLANT, MACHINERY, EQUIPMENT	#CAPITALISED COMPUTER SOFTWARE	TOTAL: VEHICLES, PLANT, MACHINERY, EQUIPMENT AND SOFTWARE	SUBTOTAL: CAPITAL EXPENDITURE	LABOUR COSTS	TOTAL COST OF R&D POST-GRADUATE STUDENTS	OTHER CURRENT EXPENDITURE*	SUBTOTAL: CURRENT EXPENDITURE
	%	%	%	%	%	%	%	%	%
2012/13	2.1	7.3	0.0	7.3	9.4	49.9	5.0	35.7	90.6
2013/14	2.1	7.2	0.0	7.2	9.3	51.8	4.8	34.1	90.7
2014/15	2.7	7.9	0.0	7.9	10.6	49.2	5.4	34.8	89.4
2015/16	2.2	9.3	0.0	9.3	11.5	45.7	6.0	36.8	88.5
2016/17	3.6	7.9	0.0	7.9	11.5	46.2	5.4	36.9	88.5
2017/18	4.4	6.2	0.0	6.2	10.6	48.4	4.9	36.1	89.4
2018/19	2.4	6.5	0.0	6.5	8.9	49.2	5.3	36.6	91.1
2019/20	2.4	5.0	0.4	5.4	7.9	46.4	5.7	40.1	92.1
2020/21	1.5	4.6	1.3	5.9	7.4	46.9	5.7	40.0	92.6
2021/22	2.1	7.3	1.0	7.3	9.4	46.2	5.2	39.2	90.6

*Includes specific categories of R&D personnel costs for 2017/18 to 2021/22. #Capitalised computer software collected from 2019/20.

Table C.9: Expenditure on multidisciplinary areas of R&D (2012/13 to 2021/22)

YEAR	GERD	BIOTECHNOLOGY	NANOTECHNOLOGY
	R'000	R'000	R'000
2012/13	**23 871 219**	1 179 478	662 634
2013/14	**25 660 573**	1 266 325	664 139
2014/15	**29 344 977**	1 576 727	818 919
2015/16	**32 336 679**	1 843 363	871 426
2016/17	**35 692 973**	1 788 728	853 121
2017/18	**38 724 590**	1 797 013	718 527
2018/19	**36 783 968**	1 862 865	824 420
2019/20	**34 484 862**	2 459 421	855 790
2020/21	**33 541 332**	2 659 080	1 349 918
2021/22	**38 185 599**	2 985 191	1 284 063

Table C.10: Proportional expenditure on multidisciplinary areas of R&D (2012/13 to 2021/22)

YEAR	BIOTECHNOLOGY	NANOTECHNOLOGY
	%	%
2012/13	4.9	2.8
2013/14	4.9	2.6
2014/15	5.4	2.8
2015/16	5.7	2.7
2016/17	5.0	2.4
2017/18	4.6	1.9
2018/19	5.1	2.2
2019/20	7.1	2.5
2020/21	7.9	4.0
2021/22	7.8	3.4

Table C.11: R&D expenditure on selected areas of interest (2012/13 to 2021/22)

YEAR	GERD	OPEN-SOURCE SOFTWARE	TUBERCULOSIS (TB), HIV/AIDS, MALARIA	ENVIRONMENT / ENVIRONMENT RELATED	NEW MATERIALS	SPACE SCIENCE
	R'000	R'000	R'000	R'000	R'000	R'000
2012/13	**23 871 219**	211 264	2 478 422	1 051 035	1 327 832	N/A
2013/14	**25 660 573**	339 065	2 867 954	1 088 094	794 016	N/A
2014/15	**29 344 977**	818 735	3 008 176	1 996 195	1 053 783	N/A
2015/16	**32 336 679**	1 145 590	3 462 704	2 056 659	1 146 470	N/A
2016/17	**35 692 973**	826 648	3 947 430	2 452 367	1 008 578	633 930
2017/18	**38 724 590**	1 233 636	4 621 859	2 815 269	850 606	300 763
2018/19	**36 783 968**	465 624	5 105 952	3 083 232	965 820	888 214
2019/20	**34 484 862**	629 995	4 684 747	3 317 882	1 195 028	982 824
2020/21	**33 541 332**	632 882	4 727 038	3 788 949	926 881	1 041 747
2021/22	**38 185 599**	860 999	5 056 305	4 263 513	1 477 114	1 654 313

N/A: Environment-related data were collected from the 2012/13 R&D Survey onwards. Space science data were collected for the first time in the 2016/17 R&D Survey.

Table C.12: Proportional R&D expenditure on selected areas of interest (2012/13 to 2021/22)

YEAR	OPEN-SOURCE SOFTWARE	TUBERCULOSIS (TB), HIV/AIDS, MALARIA	ENVIRONMENT / ENVIRONMENT-RELATED	NEW MATERIALS	SPACE SCIENCE
	%	%	%	%	%
2012/13	0.9	10.4	4.4	5.6	N/A
2013/14	1.3	11.2	4.2	3.1	N/A
2014/15	2.8	10.3	6.8	3.6	N/A
2015/16	3.5	10.7	6.4	3.5	N/A
2016/17	2.3	11.1	6.9	2.8	1.8
2017/18	3.2	11.9	7.3	2.2	0.8
2018/19	1.3	13.9	8.4	2.6	2.4
2019/20	1.8	13.6	9.6	3.5	2.9
2020/21	1.9	14.1	11.3	2.8	3.1
2021/22	2.3	13.2	11.2	3.9	4.3

N/A: Environment-related data were collected from the 2012/13 R&D Survey onwards. Space science data were collected for the first time in the 2016/17 R&D Survey.

Table C.13: R&D expenditure by research field (2012/13 to 2021/22)

MAIN RESEARCH FIELD	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Division 1: Natural sciences, technology and engineering	19 384 947	20 587 093	23 687 304	25 562 694	27 253 955	28 666 760	27 582 242	27 590 791	25 894 833	30 105 115
Mathematical sciences	634 658	627 017	636 084	646 870	713 360	879 045	934 136	969 234	799 796	888 597
Physical sciences	370 616	379 813	582 267	769 739	876 009	1 070 851	930 033	973 726	911 291	834 297
Chemical sciences	1 460 180	1 305 139	1 299 969	1 491 410	1 761 693	1 668 359	1 685 031	1 460 763	1 127 071	1 231 637
Earth sciences	499 210	498 427	690 040	635 291	780 402	766 556	826 869	1 020 560	1 061 388	1 143 310
Information, computer and communication technologies	2 000 453	1 994 502	2 946 625	3 877 852	4 494 987	4 006 992	3 636 363	3 560 762	3 640 261	5 007 507
Applied sciences and technologies	2 252 175	2 164 025	1 555 897	1 525 646	1 585 106	1 628 489	1 537 213	1 362 852	1 367 857	1 545 204
Engineering sciences	3 903 931	4 315 051	5 485 812	5 444 740	4 611 038	5 068 338	4 735 131	4 627 317	4 332 527	4 462 856
Biological sciences	1 555 035	1 578 516	1 398 611	1 452 763	1 416 454	1 562 103	1 579 782	1 685 936	1 530 697	1 682 135
Agricultural sciences	1 810 114	2 196 122	2 656 038	2 573 509	2 741 962	2 999 821	3 051 678	3 119 335	2 654 666	2 942 151
Medical and health sciences	4 107 641	4 668 417	5 459 721	6 389 455	6 868 131	7 540 190	7 793 148	7 407 626	7 404 019	8 717 753
Environmental sciences	587 113	611 007	533 065	375 455	992 281	1 125 709	435 578	602 065	440 186	701 600
Material sciences	155 379	192 199	368 315	299 069	287 507	206 687	190 551	545 685	328 498	735 472
Marine sciences	48 442	56 857	74 858	80 897	125 024	143 621	246 728	254 931	296 576	212 597
Division 2: Social sciences and humanities	4 486 272	5 073 480	5 657 674	6 773 985	8 439 018	10 057 830	9 201 726	6 894 071	7 646 499	8 080 484
Social sciences	3 999 853	4 489 054	5 000 339	6 043 806	7 495 167	9 168 767	8 238 808	5 836 521	6 597 460	7 040 864
Humanities	486 420	584 426	657 335	730 179	943 851	889 064	962 918	1 057 550	1 049 039	1 039 620
Total	23 871 219	25 660 573	29 344 977	32 336 679	35 692 973	38 724 590	36 783 968	34 484 862	33 541 332	38 185 599

Table C.14: Proportional R&D expenditure by research field (2012/13 to 2021/22)

MAIN RESEARCH FIELD	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Division 1: Natural sciences, technology and engineering	81.2	80.2	80.7	79.1	76.4	74.0	75.0	80.0	77.2	78.8
Mathematical sciences	2.7	2.4	2.2	2.0	2.0	2.3	2.5	2.8	2.4	2.3
Physical sciences	1.6	1.5	2.0	2.4	2.5	2.8	2.5	2.8	2.7	2.2
Chemical sciences	6.1	5.1	4.4	4.6	4.9	4.3	4.6	4.2	3.4	3.2
Earth sciences	2.1	1.9	2.4	2.0	2.2	2.0	2.2	3.0	3.2	3.0
Information, computer and communication technologies	8.4	7.8	10.0	12.0	12.6	10.3	9.9	10.3	10.9	13.1
Applied sciences and technologies	9.4	8.4	5.3	4.7	4.4	4.2	4.2	4.0	4.1	4.0
Engineering sciences	16.4	16.8	18.7	16.8	12.9	13.1	12.9	13.4	12.9	11.7
Biological sciences	6.5	6.2	4.8	4.5	4.0	4.0	4.3	4.9	4.6	4.4
Agricultural sciences	7.6	8.6	9.1	8.0	7.7	7.7	8.3	9.0	7.9	7.7
Medical and health sciences	17.2	18.2	18.6	19.8	19.2	19.5	21.2	21.5	22.1	22.8
Environmental sciences	2.5	2.4	1.8	1.2	2.8	2.9	1.2	1.7	1.3	1.8
Material sciences	0.7	0.7	1.3	0.9	0.8	0.5	0.5	1.6	1.0	1.9
Marine sciences	0.2	0.2	0.3	0.3	0.4	0.4	0.7	0.7	0.9	0.6
Division 2: Social sciences and humanities	18.8	19.8	19.3	20.9	23.6	26.0	25.0	20.0	22.8	21.2
Social sciences	16.8	17.5	17.0	18.7	21.0	23.7	22.4	16.9	19.7	18.4
Humanities	2.0	2.3	2.2	2.3	2.6	2.3	2.6	3.1	3.1	2.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.15: R&D expenditure by socio-economic objectives (2012/13 to 2021/22)

SOCIO-ECONOMIC OBJECTIVES	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Division 1: Defence	1 351 337	1 386 428	1 826 784	1 814 789	1 629 650	2 124 098	1 571 796	1 747 323	1 594 793	1 672 596
Defence	1 351 337	1 386 428	1 826 784	1 814 789	1 629 650	2 124 098	1 571 796	1 747 323	1 594 793	1 672 596
Division 2: Economic development	12 223 017	14 166 615	15 359 534	16 644 668	18 357 187	19 528 226	17 902 898	14 919 363	14 081 873	16 420 497
Economic development unclassified	0	0	0	0	0	0	0	0	0	0
Plant production and plant primary products	1 218 852	1 739 038	1 364 018	1 426 609	1 920 246	1 701 055	1 746 483	1 879 578	1 379 102	1 555 544

SOCIO-ECONOMIC OBJECTIVES	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Animal production and animal primary products	598 602	803 403	694 423	655 059	746 579	794 314	748 145	764 501	707 826	778 689
Mineral resources (excluding energy)	1 143 762	1 351 239	1 779 068	1 759 268	1 328 413	1 256 826	1 321 249	1 259 257	1 401 816	1 518 802
Energy resources	294 820	288 314	197 072	178 434	556 147	546 831	605 311	265 828	303 671	451 002
Energy supply	509 128	590 980	778 805	636 596	730 849	853 099	927 403	1 008 795	932 553	978 400
Manufacturing	2 394 239	2 608 207	2 619 974	2 665 871	2 543 694	2 628 725	2 495 718	2 440 795	1 924 862	2 391 995
Construction	426 960	450 907	270 226	229 284	300 582	318 837	363 788	282 651	305 468	393 604
Transport	992 504	1 115 027	998 136	1 115 349	1 195 426	1 247 963	1 099 974	712 749	512 148	715 539
Information and communication services	1 159 823	1 124 614	1 661 660	2 347 021	2 694 355	2 129 740	1 768 149	1 559 066	1 522 190	2 134 145
Commercial services	1 895 734	2 443 529	2 701 523	2 789 611	3 134 235	4 448 419	3 492 749	1 269 391	1 532 397	1 581 135
Economic framework	715 759	689 386	1 331 844	1 797 751	1 997 933	2 343 788	2 147 239	2 248 020	2 262 348	2 589 298
Natural resources	872 835	961 971	962 787	1 043 816	1 208 728	1 258 630	1 186 690	1 228 735	1 297 494	1 332 345
Division 3: Society	**4 473 657**	**4 585 825**	**5 885 267**	**6 815 987**	**7 558 386**	**8 517 207**	**8 323 617**	**8 721 748**	**8 732 871**	**10 358 127**
Society unclassified	0	0	0	0	0	0	0	0	0	0
Health	2 942 262	2 859 623	3 638 036	4 154 557	4 733 478	5 118 330	5 675 740	5 128 170	5 397 930	6 281 588
Education and training	672 473	882 976	1 346 974	1 603 117	1 307 791	1 398 846	1 344 005	1 594 278	1 566 843	1 629 780
Social development and community services	858 922	843 226	900 257	1 058 313	1 517 117	2 000 031	1 303 872	1 999 300	1 768 099	2 446 759
Division 4: Environment	**979 981**	**861 976**	**1 414 524**	**1 475 053**	**2 015 344**	**2 092 706**	**2 166 332**	**1 953 590**	**2 147 652**	**2 156 591**
Environment unclassified	0	0	0	0	0	0	0	0	0	0
Environmental knowledge	443 987	388 688	828 768	853 071	969 476	1 016 592	964 261	1 029 870	1 180 361	1 060 660
Environmental aspects of development	258 144	226 299	288 823	304 008	361 391	357 509	455 915	425 587	419 346	504 860
Environmental and other aspects	277 849	246 989	296 934	317 975	684 478	718 604	746 156	498 133	547 945	591 071
Division 5: Advancement of knowledge	**4 843 227**	**4 659 729**	**4 858 868**	**5 586 182**	**6 132 406**	**6 462 352**	**6 819 325**	**7 142 838**	**6 984 142**	**7 577 788**
Advancement of knowledge unclassified	0	0	0	0	0	0	0	0	0	0
Natural sciences, technologies and engineering	3 497 129	3 407 325	3 445 842	3 891 834	4 424 024	4 771 950	5 022 207	5 258 091	5 075 189	5 661 980
Social sciences and humanities	1 346 098	1 252 404	1 413 026	1 694 348	1 708 382	1 690 403	1 797 118	1 884 747	1 908 953	1 915 809
Total	**23 871 219**	**25 660 573**	**29 344 977**	**32 336 679**	**35 692 973**	**38 724 590**	**36 783 968**	**34 484 862**	**33 541 332**	**38 185 599**

Table C.16: Proportional R&D expenditure by socio-economic objectives (2012/13 to 2021/22)

SOCIO-ECONOMIC OBJECTIVES	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Division 1: Defence	5.7	5.4	6.2	5.6	4.6	5.5	4.3	5.1	4.8	4.4
Defence	5.7	5.4	6.2	5.6	4.6	5.5	4.3	5.1	4.8	4.4
Division 2: Economic development	51.2	55.2	52.3	51.5	51.4	50.4	48.7	43.3	42.0	43.0
Economic development unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Plant production and plant primary products	5.1	6.8	4.6	4.4	5.4	4.4	4.7	5.5	4.1	4.1
Animal production and animal primary products	2.5	3.1	2.4	2.0	2.1	2.1	2.0	2.2	2.1	2.0
Mineral resources (excluding energy)	4.8	5.3	6.1	5.4	3.7	3.2	3.6	3.7	4.2	4.0
Energy resources	1.2	1.1	0.7	0.6	1.6	1.4	1.6	0.8	0.9	1.2
Energy supply	2.1	2.3	2.7	2.0	2.0	2.2	2.5	2.9	2.8	2.6
Manufacturing	10.0	10.2	8.9	8.2	7.1	6.8	6.8	7.1	5.7	6.3
Construction	1.8	1.8	0.9	0.7	0.8	0.8	1.0	0.8	0.9	1.0
Transport	4.2	4.3	3.4	3.4	3.3	3.2	3.0	2.1	1.5	1.9
Information and communication services	4.9	4.4	5.7	7.3	7.5	5.5	4.8	4.5	4.5	5.6
Commercial services	7.9	9.5	9.2	8.6	8.8	11.5	9.5	3.7	4.6	4.1
Economic framework	3.0	2.7	4.5	5.6	5.6	6.1	5.8	6.5	6.7	6.8
Natural resources	3.7	3.7	3.3	3.2	3.4	3.3	3.2	3.6	3.9	3.5
Division 3: Society	18.7	17.9	20.1	21.1	21.2	22.0	22.6	25.3	26.0	27.1
Society unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Health	12.3	11.1	12.4	12.8	13.3	13.2	15.4	14.9	16.1	16.5
Education and training	2.8	3.4	4.6	5.0	3.7	3.6	3.7	4.6	4.7	4.3
Social development and community services	3.6	3.3	3.1	3.3	4.3	5.2	3.5	5.8	5.3	6.4
Division 4: Environment	4.1	3.4	4.8	4.6	5.6	5.4	5.9	5.7	6.4	5.6
Environment unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Environmental knowledge	1.9	1.5	2.8	2.6	2.7	2.6	2.6	3.0	3.5	2.8
Environmental aspects of development	1.1	0.9	1.0	0.9	1.0	0.9	1.2	1.2	1.3	1.3

SOCIO-ECONOMIC OBJECTIVES	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
	%	%	%	%	%	%	%	%	%	%
Environmental and other aspects	1.2	1.0	1.0	1.0	1.9	1.9	2.0	1.4	1.6	1.5
Division 5: Advancement of knowledge	20.3	18.2	16.6	17.3	17.2	16.7	18.5	20.7	20.8	19.8
Advancement of knowledge unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Natural sciences, technologies and engineering	14.6	13.3	11.7	12.0	12.4	12.3	13.7	15.2	15.1	14.8
Social sciences and humanities	5.6	4.9	4.8	5.2	4.8	4.4	4.9	5.5	5.7	5.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.17: R&D expenditure by province (2012/13 to 2021/22)

YEAR	GERD	EASTERN CAPE	FREE STATE	GAUTENG	KWAZULU-NATAL	LIMPOPO	MPUMA-LANGA	NORTHERN CAPE	NORTH-WEST	WESTERN CAPE
	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000
2012/13	**23 871 219**	1 463 589	1 714 473	10 602 434	3 013 372	619 437	612 031	400 974	890 364	4 554 545
2013/14	**25 660 573**	1 478 850	1 943 131	11 975 916	2 752 543	444 015	615 773	473 722	1 027 448	4 949 174
2014/15	**29 344 977**	1 734 411	1 456 461	13 686 734	3 187 481	628 607	859 201	575 584	1 402 742	5 813 758
2015/16	**32 336 679**	2 142 919	1 778 469	14 666 111	3 335 141	627 125	791 248	660 963	1 209 434	7 125 269
2016/17	**35 692 973**	2 206 473	1 834 572	16 421 582	3 639 100	728 874	699 720	532 530	1 298 778	8 331 345
2017/18	**38 724 590**	2 300 631	2 149 267	17 319 635	4 172 713	854 885	715 616	576 963	1 306 478	9 328 402
2018/19	**36 783 968**	2 211 524	1 976 953	15 767 101	4 074 154	806 624	853 859	905 844	1 682 406	8 505 504
2019/20	**34 484 862**	2 091 071	1 711 039	14 385 849	3 629 403	772 074	841 877	900 545	1 700 184	8 452 820
2020/21	**33 541 332**	1 998 900	1 241 827	14 717 743	3 278 682	983 369	706 459	867 333	1 364 854	8 382 165
2021/22	**38 185 599**	2 010 947	1 732 973	15 689 758	3 716 120	1 016 496	1 263 082	1 086 102	1 499 418	10 170 702

Table C.18: Proportional R&D expenditure by province (2012/13 to 2021/22)

YEAR	EASTERN CAPE	FREE STATE	GAUTENG	KWAZULU-NATAL	LIMPOPO	MPUMA-LANGA	NORTHERN CAPE	NORTH-WEST	WESTERN CAPE
	%	%	%	%	%	%	%	%	%
2012/13	6.1	7.2	44.4	12.6	2.6	2.6	1.7	3.7	19.1
2013/14	5.8	7.6	46.7	10.7	1.7	2.4	1.8	4.0	19.3
2014/15	5.9	5.0	46.6	10.9	2.1	2.9	2.0	4.8	19.8
2015/16	6.6	5.5	45.4	10.3	1.9	2.4	2.0	3.7	22.0
2016/17	6.2	5.1	46.0	10.2	2.0	2.0	1.5	3.6	23.3
2017/18	5.9	5.6	44.7	10.8	2.2	1.8	1.5	3.4	24.1
2018/19	6.0	5.4	42.9	11.1	2.2	2.3	2.5	4.6	23.1
2019/20	6.1	5.0	41.7	10.5	2.2	2.4	2.6	4.9	24.5
2020/21	6.0	3.7	43.9	9.8	2.9	2.1	2.6	4.1	25.0
2021/22	5.3	4.5	41.1	9.7	2.7	3.3	2.8	3.9	26.6

C.1.2. Source of R&D funds

Table C.19: Funding for R&D by source (2012/13 to 2021/22)

YEAR	TOTAL FUNDS	GOVERNMENT*	BUSINESS	OTHER SOUTH AFRICAN SOURCES**	FOREIGN SOURCES
	R'000	R'000	R'000	R'000	R'000
2012/13	**23 871 219**	10 831 893	9 152 042	770 300	3 116 984
2013/14	**25 660 573**	11 007 083	10 615 902	722 361	3 315 227
2014/15	**29 344 977**	12 873 458	11 981 974	923 530	3 566 015
2015/16	**32 336 679**	14 425 992	12 578 499	1 122 328	4 209 861
2016/17	**35 692 973**	16 427 596	14 045 892	1 047 980	4 171 507
2017/18	**38 724 590**	18 082 182	16 066 846	638 858	3 936 705
2018/19	**36 783 968**	17 475 173	14 534 123	775 938	3 998 734
2019/20	**34 484 862**	19 416 933	9 358 770	1 046 861	4 662 299
2020/21	**33 541 332**	18 871 543	9 034 026	1 174 220	4 461 542
2021/22	**38 185 599**	20 049 283	11 080 806	1 516 441	5 539 069

*Includes science council and university own funds.
**Includes funds from higher education institutions, not-for-profit organisations and individual donations disbursed to all sectors.

Table C.20: Proportional funding for R&D by source (2012/13 to 2021/22)

YEAR	GOVERNMENT*	BUSINESS	OTHER SOUTH AFRICAN SOURCES**	FOREIGN SOURCES
	%	%	%	%
2012/13	45.4	38.3	3.2	13.1
2013/14	42.9	41.4	2.8	12.9
2014/15	43.9	40.8	3.1	12.2
2015/16	44.6	38.9	3.5	13.0
2016/17	46.0	39.4	2.9	11.7
2017/18	46.7	41.5	1.6	10.2
2018/19	47.5	39.5	2.1	10.9
2019/20	56.3	27.1	3.0	13.5
2020/21	56.3	26.9	3.5	13.3
2021/22	52.5	29.0	4.0	14.5

*Includes science council and university own funds.
**Includes funds from higher education institutions, not-for-profit organisations and individual donations disbursed to all sectors.

Table C.21: Sources of R&D funding by sector, amount and as a percentage of total funds (2021/22)

SOURCE OF FUNDS	TOTAL		GOVERNMENT		SCIENCE COUNCILS		HIGHER EDUCATION		BUSINESS		NOT-FOR-PROFIT	
	R'000	%	R'000	%	R'000	%	R'000	%	R'000	%	R'000	%
Own funds	20 984 484	55.0	1 959 327	79.2	604 211	9.5	8 025 183	56.4	9 993 683	73.9	402 080	25.1
Internal sources	20 984 484	55.0	1 959 327	79.2	604 211	9.5	8 025 183	56.4	9 993 683	73.9	402 080	25.1
Government	9 460 562	24.8	388 825	15.7	4 788 482	75.4	3 328 684	23.4	773 672	5.7	180 899	11.3
Grants	3 468 665	9.1	341 690	13.8	2 633 628	41.4	N/A	N/A	444 858	3.3	48 490	3.0
Contracts	2 663 213	7.0	47 135	1.9	2 154 854	33.9	N/A	N/A	328 815	2.4	132 409	8.3
All other government source	3 328 684	8.7	N/A	N/A	N/A	N/A	3 328 684	23.4	N/A	N/A	N/A	N/A
National, provincial and local government	659 896	1.7	N/A	N/A	N/A	N/A	659 896	4.6	N/A	N/A	N/A	N/A
Government research institutes	89 036	0.2	N/A	N/A	N/A	N/A	89 036	0.6	N/A	N/A	N/A	N/A

SOURCE OF FUNDS	TOTAL		GOVERNMENT		SCIENCE COUNCILS		HIGHER EDUCATION		BUSINESS		NOT-FOR-PROFIT	
	R'000	%	R'000	%	R'000	%	R'000	%	R'000	%	R'000	%
Agency funding (e.g. NRF, MRC, ARC, etc.)	2 345 875	6.1	N/A	N/A	N/A	N/A	2 345 875	16.5	N/A	N/A	N/A	N/A
Science councils	233 877	0.6	N/A	N/A	N/A	N/A	233 877	1.6	N/A	N/A	N/A	N/A
Business	1 087 122	2.8	10 296	0.4	238 561	3.8	564 157	4.0	183 309	1.4	90 799	5.7
Local business	1 087 122	2.8	10 296	0.4	238 561	3.8	564 157	4.0	183 309	1.4	90 799	5.7
Other SA sources	1 114 361	2.9	58 637	2.4	93 552	1.5	307 832	2.2	573 910	4.2	80 430	5.0
Higher education	204 278	0.5	37 285	1.5	28 085	0.4	89 314	0.6	11 006	0.1	38 588	2.4
Not-for-profit	773 031	2.0	0	0.0	65 467	1.0	120 539	0.8	556 230	4.1	30 795	1.9
Individual donations	137 051	0.4	21 352	0.9	0	0.0	97 979	0.7	6 674	0.0	11 046	0.7
Foreign	5 539 069	14.5	55 349	2.2	629 492	9.9	2 006 272	14.1	2 002 607	14.8	845 349	52.8
*All sources	5 539 069	14.5	55 349	2.2	629 492	9.9	2 006 272	14.1	2 002 607	14.8	845 349	52.8
Total	38 185 599	100.0	2 472 434	100.0	6 354 298	100.0	14 232 128	100.0	13 527 182	100.0	1 599 557	100.0

Note: N/A indicates that data were not collected.
*Refers to all funds for R&D from outside South Africa.

Table C.22: Government-funded R&D by sector (2012/13 to 2021/22)

YEAR	TOTAL	GOVERNMENT*	SCIENCE COUNCILS*	HIGHER EDUCATION*	BUSINESS	NOT-FOR-PROFIT
	R'000	R'000	R'000	R'000	R'000	R'000
2012/13	**10 831 893**	1 269 337	3 368 555	5 395 871	683 669	114 461
2013/14	**11 007 083**	1 436 141	3 412 790	5 369 334	685 670	103 148
2014/15	**12 873 458**	1 711 809	4 319 393	6 020 572	690 396	131 288
2015/16	**14 425 992**	1 425 598	4 922 223	7 393 857	522 631	161 682
2016/17	**16 427 596**	1 530 964	5 076 805	9 222 246	453 958	143 623
2017/18	**18 082 182**	1 769 929	5 311 190	10 486 989	371 165	142 908
2018/19	**17 475 173**	1 898 230	4 644 414	10 501 066	214 541	216 922
2019/20	**19 416 933**	1 682 484	5 493 352	11 380 375	648 604	212 118
2020/21	**18 871 543**	2 125 220	5 025 925	10 933 622	592 551	194 225
2021/22	**20 049 283**	2 348 152	5 392 693	11 353 867	773 672	180 899

*Includes science council and university own funds.

Table C.23: Proportional government-funded R&D by sector (2012/13 to 2021/22)

YEAR	GOVERNMENT*	SCIENCE COUNCILS*	HIGHER EDUCATION*	BUSINESS	NOT-FOR-PROFIT
	%	%	%	%	%
2012/13	11.7	31.1	49.8	6.3	1.1
2013/14	13.0	31.0	48.8	6.2	0.9
2014/15	13.3	33.6	46.8	5.4	1.0
2015/16	9.9	34.1	51.3	3.6	1.1
2016/17	9.3	30.9	56.1	2.8	0.9
2017/18	9.8	29.4	58.0	2.1	0.8
2018/19	10.9	26.6	60.1	1.2	1.2
2019/20	8.7	28.3	58.6	3.3	1.1
2020/21	11.3	26.6	57.9	3.1	1.0
2021/22	11.7	26.9	56.6	3.9	0.9

*Includes science council and university own funds.

Table C.24: Business-funded R&D by sector (2012/13 to 2021/22)

YEAR	TOTAL	GOVERNMENT	SCIENCE COUNCILS	HIGHER EDUCATION	BUSINESS	NOT-FOR-PROFIT
	R'000	R'000	R'000	R'000	R'000	R'000
2012/13	**9 152 042**	11 552	135 729	577 527	8 402 340	24 894
2013/14	**10 615 902**	1 759	419 469	588 598	9 552 717	53 359
2014/15	**11 981 974**	290	222 892	885 280	10 810 428	63 084
2015/16	**12 578 499**	41 109	326 648	770 448	11 384 710	55 585
2016/17	**14 045 892**	1 261	483 166	906 651	12 586 109	68 705
2017/18	**16 066 846**	519	354 820	679 563	14 963 198	68 747
2018/19	**14 534 123**	4 614	206 648	463 413	13 787 512	71 937
2019/20	**9 358 770**	42 664	191 520	519 848	8 541 773	62 965
2020/21	**9 034 026**	0	310 034	546 329	8 101 658	76 005
2021/22	**11 080 806**	10 296	238 561	564 157	10 176 993	90 799

Table C.25: Proportional business-funded R&D by sector (2012/13 to 2021/22)

YEAR	GOVERNMENT	SCIENCE COUNCILS	HIGHER EDUCATION	BUSINESS	NOT-FOR-PROFIT
	%	%	%	%	%
2012/13	0.1	1.5	6.3	91.8	0.3
2013/14	0.0	4.0	5.5	90.0	0.5
2014/15	0.0	1.9	7.4	90.2	0.5
2015/16	0.3	2.6	6.1	90.5	0.4
2016/17	0.0	3.4	6.5	89.6	0.5
2017/18	0.0	2.2	4.2	93.1	0.4
2018/19	0.0	1.4	3.2	94.9	0.5
2019/20	0.5	2.0	5.6	91.3	0.7
2020/21	0.0	3.4	6.0	89.7	0.8
2021/22	0.1	2.2	5.1	91.8	0.8

Table C.26: Foreign-funded R&D by sector (2012/13 to 2021/22)

YEAR	TOTAL	GOVERNMENT	SCIENCE COUNCILS	HIGHER EDUCATION	BUSINESS	NOT-FOR-PROFIT
	R'000	R'000	R'000	R'000	R'000	R'000
2012/13	**3 116 984**	143 994	510 846	1 010 244	1 189 865	262 035
2013/14	**3 315 227**	258 531	454 527	1 042 627	1 226 966	332 576
2014/15	**3 566 015**	179 473	431 215	1 079 732	1 418 823	456 772
2015/16	**4 209 861**	499 966	469 507	1 206 192	1 532 766	501 430
2016/17	**4 171 507**	512 090	537 503	1 143 451	1 338 662	639 801
2017/18	**3 936 705**	471 786	617 838	1 506 077	474 762	866 241
2018/19	**3 998 734**	296 918	550 456	1 851 900	400 462	898 998
2019/20	**4 662 299**	133 832	439 774	1 979 372	1 168 659	940 661
2020/21	**4 461 542**	55 787	432 691	1 976 510	978 260	1 018 294
2021/22	**5 539 069**	55 349	629 492	2 006 272	2 002 607	845 349

Table C.27: Proportional foreign-funded R&D by sector (2012/13 to 2021/22)

YEAR	GOVERNMENT	SCIENCE COUNCILS	HIGHER EDUCATION	BUSINESS	NOT-FOR-PROFIT
	%	%	%	%	%
2012/13	4.6	16.4	32.4	38.2	8.4
2013/14	7.8	13.7	31.4	37.0	10.0
2014/15	5.0	12.1	30.3	39.8	12.8
2015/16	11.9	11.2	28.7	36.4	11.9
2016/17	12.3	12.9	27.4	32.1	15.3
2017/18	12.0	15.7	38.3	12.1	22.0
2018/19	7.4	13.8	46.3	10.0	22.5
2019/20	2.9	9.4	42.5	25.1	20.2
2020/21	1.3	9.7	44.3	21.9	22.8
2021/22	1.0	11.4	36.2	36.2	15.3

C.1.3. R&D personnel

Table C.28: R&D personnel in headcounts and full-time equivalents by occupation (2012/13 to 2021/22)

YEAR	R&D PERSONNEL			RESEARCHERS			TECHNICIANS		OTHER R&D PERSONNEL	
	(HEAD-COUNTS*)	(FTEs)	(FTEs) PER 1000 IN TOTAL EM-PLOYMENT	(HEAD-COUNTS*)	(FTEs)	(FTEs) PER 1000 IN TOTAL EM-PLOYMENT	(HEAD-COUNTS)	(FTEs) PER 1000 IN TOTAL EM-PLOYMENT	(HEAD-COUNTS)	(FTEs) PER 1000 IN TOTAL EM-PLOYMENT
2012/13	**64 917**	**35 050.3**	**2.4**	42 828	21 382.4	1.5	10 790	6 582.3	11 299	7 085.5
2013/14	**68 838**	**37 956.5**	**2.5**	45 935	23 346.0	1.6	10 800	6 905.5	12 103	7 705.0
2014/15	**72 400**	**38 465.0**	**2.5**	48 479	23 571.9	1.5	12 183	7 731.3	11 738	7 161.9
2015/16	**74 931**	**41 054.5**	**2.6**	51 877	26 159.4	1.7	11 518	7 688.3	11 536	7 206.9
2016/17	**80 029**	**42 533.0**	**2.6**	56 761	27 656.2	1.7	11 346	7 563.1	11 922	7 313.6
2017/18	**84 262**	**44 259.3**	**2.7**	61 840	29 515.2	1.8	11 219	7 383.3	11 203	7 360.8
2018/19	**84 036**	**43 774.3**	**2.7**	62 166	29 110.8	1.8	10 545	7 069.0	11 325	7 594.5
2019/20	**82 068**	**41 856.5**	**2.8**	62 002	28 358.3	1.9	10 080	6 879.9	9 986	6 618.0
2020/21	**82 744**	**42 925.9**	**2.9**	61 406	27 697.6	1.8	9 870	6 846.5	11 468	8 381.7
2021/22	**85 601**	**44 355.4**	**3.0**	63 122	27 763.3	1.9	10 221	7 657.1	12 258	8 935.0

*Includes doctoral students and post-doctoral fellows. Also includes specific categories of R&D personnel (from 2016/17).
Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.29: R&D personnel in headcounts (*including and **excluding doctoral and post-doctoral students) and full-time equivalents by occupation and gender (2019/20 to 2021/22)

YEAR	HEADCOUNTS			FULL-TIME EQUIVALENTS (FTEs)			
2019/20	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**TOTAL FTEs AS % OF TOTAL HEADCOUNTS**
Researchers*	**62 002**	33 379	28 623	**28 358.3**	15 469.8	12 888.5	45.7
Technicians directly supporting R&D	**10 080**	5 710	4 370	**6 879.9**	3 641.2	3 238.7	68.3
Other personnel directly supporting R&D	**9 986**	4 152	5 834	**6 618.0**	2 779.5	3 838.5	66.3
Total	82 068	43 241	38 827	41 856.2	21 890.6	19 965.7	51.0
Researchers**	**34 358**	18 547	15 811	**12 370.9**	6 712.9	5 658.0	36.0
Technicians directly supporting R&D	**10 080**	5 710	4 370	**6 879.9**	3 641.2	3 238.7	68.3
Other personnel directly supporting R&D	**9 986**	4 152	5 834	**6 618.0**	2 779.5	3 838.5	66.3
Total	54 424	28 409	26 015	25 868.8	13 133.7	12 735.1	47.5
2020/21	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**TOTAL FTEs AS % OF TOTAL HEADCOUNTS**
Researchers*	**61 406**	32 809	28 597	**27 697.6**	14 820.1	12 877.5	45.1
Technicians directly supporting R&D	**9 870**	5 617	4 253	**6 846.5**	3 624.0	3 222.6	69.4
Other personnel directly supporting R&D	**11 468**	4 496	6 972	**8 381.7**	3 286.9	5 094.9	73.1
Total	82 744	42 922	39 822	42 925.9	21 731.0	21 195.0	51.9
Researchers**	**34 072**	18 315	15 757	**11 954.1**	6 371.0	5 583.2	35.1
Technicians directly supporting R&D	**9 870**	5 617	4 253	**6 846.5**	3 624.0	3 222.6	69.4
Other personnel directly supporting R&D	**11 468**	4 496	6 972	**8 381.7**	3 286.9	5 094.9	73.1
Total	55 410	28 428	26 982	27 182.4	13 281.8	13 900.6	49.1
2021/22	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**TOTAL FTEs AS % OF TOTAL HEADCOUNTS**
Researchers*	**63 122**	33 464	29 658	**27 763.3**	14 799.6	12 963.7	44.0
Technicians directly supporting R&D	**10 221**	5 434	4 787	**7 657.1**	3 789.3	3 867.9	74.9
Other personnel directly supporting R&D	**12 258**	4 823	7 435	**8 935.0**	3 500.4	5 434.7	72.9
Total	85 601	43 721	41 880	44 355.4	22 089.2	22 266.2	51.8
Researchers**	**35 097**	18 770	16 327	**11 798.1**	6 317.6	5 480.5	33.6
Technicians directly supporting R&D	**10 221**	5 434	4 787	**7 657.1**	3 789.3	3 867.9	74.9
Other personnel directly supporting R&D	**12 258**	4 823	7 435	**8 935.0**	3 500.4	5 434.7	72.9
Total	57 576	29 027	28 549	28 390.2	13 607.3	14 783.0	49.3

*Includes doctoral students and post-doctoral fellows. Also includes specific categories of R&D personnel (from 2016/17).
**Excluding doctoral and post-doctoral students. Also includes specific categories of R&D personnel (from 2016/17).
Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.30: R&D personnel in headcounts by sector (2012/13 to 2021/22)

YEAR	TOTAL R&D PERSONNEL (HEADCOUNTS)	GOVERNMENT	SCIENCE COUNCILS	HIGHER EDUCATION	BUSINESS	NOT-FOR-PROFIT
2012/13	**64 917**	3 252	5 399	38 205	17 155	906
2013/14	**68 838**	2 874	5 884	41 464	17 599	1 017
2014/15	**72 400**	2 893	4 836	44 457	18 743	1 471
2015/16	**74 931**	2 997	5 162	48 034	17 245	1 493
2016/17	**80 029**	3 076	4 955	52 384	17 998	1 616
2017/18	**84 262**	3 027	4 866	57 074	17 554	1 741
2018/19	**84 036**	2 910	4 514	57 799	16 876	1 937
2019/20	**82 068**	3 157	4 070	60 168	12 748	1 925
2020/21	**82 744**	3 159	4 111	59 502	14 177	1 795
2021/22	**85 601**	3 314	4 190	61 159	15 094	1 844

Note: Includes doctoral students and post-doctoral fellows at higher education institutes.
Researchers includes specific categories of R&D for 2016/17 onwards
Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.31: R&D personnel full-time equivalents by sector (2012/13 to 2021/22)

YEAR	TOTAL R&D PERSONNEL* (FTEs)	GOVERNMENT	SCIENCE COUNCILS	HIGHER EDUCATION	BUSINESS	NOT-FOR-PROFIT
2012/13	**35 050.3**	2 597.0	4 748.5	15 614.4	11 322.3	768.0
2013/14	**37 956.5**	2 245.5	5 164.5	17 777.7	11 877.4	891.4
2014/15	**38 465.0**	2 181.5	4 180.4	17 944.4	12 927.5	1 231.2
2015/16	**41 054.5**	2 056.2	4 361.2	20 812.0	12 457.8	1 367.3
2016/17	**42 533.0**	2 031.6	4 421.4	22 061.4	12 549.2	1 469.5
2017/18	**44 259.3**	2 000.4	4 294.9	23 415.1	12 952.9	1 596.0
2018/19	**43 774.3**	1 999.0	3 941.8	24 456.8	11 691.0	1 685.8
2019/20	**41 856.5**	2 173.1	3 562.8	25 109.4	9 300.8	1 710.1
2020/21	**42 925.9**	2 060.4	3 606.0	24 843.1	10 860.3	1 556.1
2021/22	**44 355.4**	2 095.5	3 838.5	24 789.8	12 054.6	1 577.1

*Includes doctoral students and post-doctoral fellows. Also includes specific categories of R&D personnel (2016/17 only).
Note: Headcounts include non-SA R&D personnel (2016/17 only). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.32: Researcher headcounts by sector (2012/13 to 2021/22)

YEAR	TOTAL RESEARCHERS (HEADCOUNTS*)	GOVERNMENT	SCIENCE COUNCILS	HIGHER EDUCATION	BUSINESS	NOT-FOR-PROFIT
2012/13	**42 828**	1 409	1 879	32 955	6 191	394
2013/14	**45 935**	1 229	1 956	36 133	6 182	435
2014/15	**48 479**	1 343	1 988	38 381	6 261	506
2015/16	**51 877**	1 573	2 072	41 639	6 128	465
2016/17	**56 761**	1 677	2 189	46 028	6 463	404
2017/18	**61 840**	1 671	2 053	50 549	7 142	425
2018/19	**62 166**	1 662	1 951	51 187	6 942	424
2019/20	**62 002**	1 742	1 858	53 371	4 641	390
2020/21	**61 406**	1 706	1 774	52 985	4 510	431
2021/22	**63 122**	1 789	1 735	54 784	4 370	444

*Includes doctoral students and post-doctoral fellows. Researchers includes specific categories of R&D personnel (from 2016/17).
Note: Headcounts include non-SA R&D personnel (2016/17 only). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.33: Researcher headcounts by gender (2012/13 to 2021/22)

YEAR	TOTAL RESEARCHERS* (HEADCOUNTS)	MALE	FEMALE
2012/13	**27 314**	15 378	11 936
2013/14	**28 014**	15 520	12 494
2014/15	**28 723**	15 824	12 899
2015/16	**29 455**	16 150	13 305
2016/17	**33 035**	17 957	15 078
2017/18	**36 233**	19 800	16 433
2018/19	**35 597**	19 116	16 481
2019/20	**34 358**	18 547	15 811
2020/21	**34 072**	18 315	15 757
2021/22	**35 097**	18 770	16 327

*Excludes doctoral students and post-doctoral fellows. Researchers includes specific categories of R&D personnel (from 2016/17).
Note: Headcounts include non-SA R&D personnel (2016/17 only). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.34: Researcher headcounts by race (2012/13 to 2021/22)

YEAR	TOTAL RESEARCHERS* (HEADCOUNTS)	AFRICAN	COLOURED	INDIAN/ASIAN	WHITE	NON-SA
2012/13	**27 314**	8 101	1 591	2 514	15 108	N/A
2013/14	**28 014**	8 024	1 685	2 530	15 775	N/A
2014/15	**28 723**	8 468	1 815	2 522	15 919	N/A
2015/16	**29 454**	9 548	1 881	2 629	15 396	N/A
2016/17	**33 035**	9 968	1 957	2 921	15 151	3 038
2017/18	**36 233**	10 815	2 209	3 352	15 795	4 062
2018/19	**35 597**	10 572	2 099	3 370	14 890	4 667
2019/20	**34 358**	10 724	1 968	3 191	14 224	4 251
2020/21	**34 072**	10 950	2 077	3 145	13 450	4 450
2021/22	**35 097**	11 880	2 066	3 285	13 091	4 775

*Excludes doctoral students and post-doctoral fellows. Researchers includes specific categories of R&D personnel (from 2016/17).
Note: Headcounts include non-SA R&D personnel (2016/17 only). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.35: R&D personnel in headcounts (*including and **excluding doctoral and post-doctoral students) (2021/22)

OCCUPATION AND QUALIFICATION	TOTAL R&D PERSONNEL (HEADCOUNTS)	SUBTOTAL		AFRICAN		COLOURED		INDIAN/ASIAN		WHITE		NON-SA	
		MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
Researchers*	63 122	33 464	29 658	11 108	10 506	1 437	1 965	1 993	2 742	8 865	9 274	10 061	5 171
Doctoral degree or equivalent	44 360	24 067	20 293	7 340	6 486	954	1 232	1 090	1 685	5 394	6 152	9 289	4 738
Master's, honours, bachelor or equivalent	16 246	8 064	8 182	3 322	3 529	405	617	782	913	2 924	2 765	631	358
Diplomas	2 516	1 333	1 183	446	491	78	116	121	144	547	357	141	75
Technicians directly supporting R&D	10 221	5 434	4 787	2 284	2 409	607	487	397	336	1 982	1 446	164	109
Doctoral degree or equivalent	450	240	210	47	32	8	12	11	19	141	131	33	16
Master's, honours, bachelor or equivalent	4 376	2 222	2 154	952	954	179	207	175	206	832	731	84	56
Diplomas	5 395	2 972	2 423	1 285	1 423	420	268	211	111	1 009	584	47	37
Other personnel directly supporting R&D	12 258	4 823	7 435	2 925	4 418	592	1 080	217	314	884	1 394	205	229
Doctoral degree or equivalent	522	262	260	114	63	17	38	20	35	77	92	34	32
Master's, honours, bachelor or equivalent	3 477	1 335	2 142	650	956	128	299	78	149	386	643	93	95
Diplomas	8 259	3 226	5 033	2 161	3 399	447	743	119	130	421	659	78	102
Total	85 601	43 721	41 880	16 317	17 333	2 636	3 532	2 607	3 392	11 731	12 114	10 430	5 509

*Researchers includes specific categories of R&D personnel (from 2016/17). To enable comparison, the table below excludes doctoral students and post-doctoral fellows from the Researchers indicator, and provides a total for this modified Researchers value, including Technicians directly supporting R&D (unchanged) and Other personnel directly supporting R&D (unchanged). Note: Non-SA student data are not collected by population group. Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA. **Total may vary due to extrapolations.

OCCUPATION AND QUALIFICATION	TOTAL R&D PERSONNEL (HEADCOUNTS)	SUBTOTAL		AFRICAN		COLOURED		INDIAN/ASIAN		WHITE		NON-SA	
		MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
Researchers**	35 097	18 770	16 327	6 165	5 715	900	1 166	1 527	1 758	6 785	6 306	3 393	1 382
Doctoral degree or equivalent	16 335	9 373	6 962	2 397	1 695	417	433	624	701	3 314	3 184	2 621	949
Master's, honours, bachelor or equivalent	16 246	8 064	8 182	3 322	3 529	405	617	782	913	2 924	2 765	631	358
Diplomas	2 516	1 333	1 183	446	491	78	116	121	144	547	357	141	75
Technicians directly supporting R&D	10 221	5 434	4 787	2 284	2 409	607	487	397	336	1 982	1 446	164	109
Other personnel directly supporting R&D	12 258	4 823	7 435	2 925	4 418	592	1 080	217	314	884	1 394	205	229
Total	57 576	29 027	28 549	11 374	12 542	2 099	2 733	2 141	2 408	9 651	9 146	3 762	1 720

C.2. Sector tables

C.2.1. Business sector

Table C.36: Business sector R&D expenditure by type of research (2012/13 to 2021/22)

TYPE OF RESEARCH	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Basic research	802 753	968 504	845 527	906 730	909 278	1 021 152	948 319	758 971	788 740	1 567 352
Applied research	5 569 024	6 087 791	7 541 596	7 492 229	8 389 888	10 551 512	9 819 344	6 218 563	6 014 078	7 834 505
Experimental development research	4 198 949	4 726 553	4 903 827	5 416 037	5 482 104	4 286 521	3 680 170	3 726 947	3 244 526	4 125 325
Total	10 570 726	11 782 848	13 290 951	13 814 995	14 781 270	15 859 185	14 447 833	10 704 481	10 047 344	13 527 182

Table C.37: Proportional business sector R&D expenditure by type of research (2012/13 to 2021/22)

TYPE OF RESEARCH	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Basic research	7.6	8.2	6.4	6.6	6.2	6.4	6.6	7.1	7.9	11.6
Applied research	52.7	51.7	56.7	54.2	56.8	66.5	68.0	58.1	59.9	57.9
Experimental development research	39.7	40.1	36.9	39.2	37.1	27.0	25.5	34.8	32.3	30.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.38: Business sector R&D expenditure by accounting category (2012/13 to 2021/22)

TYPE OF EXPENDITURE	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Capital expenditure	1 072 556	1 132 520	1 397 243	1 289 228	1 727 929	1 421 699	1 545 944	984 728	969 093	1 851 120
Land: buildings & other structures	140 053	159 162	117 656	186 396	288 957	270 191	370 231	343 953	183 111	451 832
TOTAL: Vehicles, plant, machinery, equipment and software	932 503	973 358	1 279 587	1 102 833	1 438 972	1 151 508	1 175 713	640 776	785 982	1 399 288
Vehicles, plant, machinery, equipment	932 503	973 358	1 279 587	1 102 833	1 438 972	1 151 508	1 175 713	584 324	559 525	1 118 884
*Capitalised computer software	N/A	N/A	N/A	N/A	N/A	N/A	N/A	56 452	226 457	280 404
Current expenditure	9 498 170	10 650 328	11 893 708	12 525 767	13 053 341	14 437 485	12 901 890	9 719 752	9 078 252	11 676 062
Labour costs	5 821 884	6 768 527	7 659 365	7 821 865	8 486 640	9 747 037	8 612 310	5 992 573	5 387 961	6 793 891
Other current expenditure	3 676 286	3 881 801	4 234 343	4 703 901	4 566 701	4 690 449	4 289 579	3 727 179	3 690 290	4 882 170
Total	10 570 726	11 782 848	13 290 951	13 814 995	14 781 270	15 859 185	14 447 833	10 704 481	10 047 344	13 527 182

*Capitalised computer software collected from 2019/20.

Table C.39: Proportional business sector R&D expenditure by accounting category (2012/13 to 2021/22)

TYPE OF EXPENDITURE	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Capital expenditure	9.6	10.5	9.3	11.7	9.0	10.7	9.2	9.2	9.6	13.7
Land: buildings & other structures	1.4	0.9	1.3	2.0	1.7	2.6	3.2	3.2	1.8	3.3
TOTAL: Vehicles, plant, machinery, equipment and software	8.3	9.6	8.0	9.7	7.3	8.1	6.0	6.0	7.8	10.3
Vehicles, plant, machinery, equipment	8.3	9.6	8.0	9.7	7.3	8.1	5.5	5.5	5.6	8.3
*Capitalised computer software	N/A	N/A	N/A	N/A	N/A	N/A	1	1	2	2.1
Current expenditure	90.4	89.5	90.7	88.3	91.0	89.3	90.8	90.8	90.4	86.3
Labour costs	57.4	57.6	56.6	57.4	61.5	59.6	56.0	56.0	53.6	50.2
Other current expenditure	32.9	31.9	34.0	30.9	29.6	29.7	34.8	34.8	36.7	36.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

*Capitalised computer software collected from 2019/20.

Table C.40: Business sector expenditure on multidisciplinary areas of R&D (2012/13 to 2021/22)

MULTI-DISCIPLINARY AREA OF R&D	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Biotechnology	499 589	556 275	578 747	729 299	685 170	721 698	702 168	992 682	901 293	993 533
Nanotechnology	225 557	170 479	217 216	134 063	268 320	113 260	155 956	77 163	73 309	102 815
Total	725 145	726 754	795 963	863 362	953 490	834 958	858 124	1 069 845	974 603	1 096 348
Business expenditure on R&D	10 570 726	11 782 848	13 290 951	13 814 995	14 781 270	15 859 185	14 447 833	10 704 481	10 047 344	13 527 182

Table C.41: Proportional business sector expenditure on multidisciplinary areas of R&D (2012/13 to 2021/22)

MULTI-DISCIPLINARY AREA OF R&D	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Biotechnology	4.7	4.7	4.4	5.3	4.6	4.6	4.9	9.3	9.0	7.3
Nanotechnology	2.1	1.4	1.6	1.0	1.8	0.7	1.1	0.7	0.7	0.8
Total	6.9	6.2	6.0	6.2	6.5	5.3	5.9	10.0	9.7	8.1

Table C.42: Business sector R&D expenditure on selected areas of interest (2012/13 to 2021/22)

AREA OF INTEREST	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Environment-related	183 921	228 905	176 463	173 356	280 651	377 030	472 759	532 424	591 414	1 008 487
Open-source software	87 200	233 576	241 710	326 856	207 849	193 239	154 894	176 450	219 128	453 683
New materials	225 897	151 890	245 752	224 433	179 108	186 858	268 298	447 596	354 411	569 008
Tuberculosis, HIV/AIDS, malaria	929 121	992 538	1 082 646	1 176 149	1 153 668	1 332 248	1 801 869	1 347 208	1 316 084	1 687 720
Space science	N/A	N/A	N/A	N/A	33 099	42 291	47 018	19 990	4 659	498 372
Total	**1 426 139**	**1 606 909**	**1 746 571**	**1 900 794**	**1 854 375**	**2 131 666**	**2 744 839**	**2 523 667**	**2 485 695**	**4 217 269**
Business expenditure on R&D	**10 570 726**	**11 782 848**	**13 290 951**	**13 814 995**	**14 781 270**	**15 859 185**	**14 447 833**	**10 704 481**	**10 047 344**	**13 527 182**

N/A: Space science data were collected for the first time in the 2016/17 R&D Survey.

Table C.43: Proportional business sector R&D expenditure on selected areas of interest (2012/13 to 2021/22)

AREA OF INTEREST	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Environment-related	1.7	1.9	1.3	1.3	1.9	2.4	3.3	5.0	5.9	7.5
Open-source software	0.8	2.0	1.8	2.4	1.4	1.2	1.1	1.6	2.2	3.4
New materials	2.1	1.3	1.8	1.6	1.2	1.2	1.9	4.2	3.5	4.2
Tuberculosis, HIV/AIDS, malaria	8.8	8.4	8.1	8.5	7.8	8.4	12.5	12.6	13.1	12.5
Space science	N/A	N/A	N/A	N/A	0.2	0.3	0.3	0.2	0.0	3.7
Total	**13.5**	**13.6**	**13.1**	**13.8**	**12.5**	**13.4**	**19.0**	**23.6**	**24.7**	**31.2**

N/A: Environment-related data were collected from the 2011/12 R&D Survey onwards. Space science data were collected for the first time in the 2016/17 R&D Survey.

Table C.44: Business sector R&D expenditure by research field (2012/13 to 2021/22)

MAIN RESEARCH FIELD	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Division 1: Natural sciences, technology and engineering	9 127 446	9 765 859	10 977 250	11 447 693	11 918 539	11 793 445	11 719 001	10 552 496	9 533 861	12 883 090
Mathematical sciences	149 220	209 344	211 324	119 900	138 858	188 550	196 143	181 438	184 125	188 752
Physical sciences	47 672	50 708	56 997	35 616	45 816	90 281	87 440	108 895	123 589	78 346
Chemical sciences	980 021	979 760	847 321	972 398	1 153 685	1 154 404	1 102 373	800 201	628 780	714 191
Earth sciences	102 892	109 665	118 539	93 302	104 072	160 745	156 112	285 180	197 020	219 212
Information, computer and communication technologies	1 576 163	1 610 718	1 908 985	2 572 364	3 111 146	2 584 726	2 295 683	2 074 429	2 118 762	3 442 168
Applied sciences and technologies	872 014	808 899	955 119	903 958	915 101	1 143 251	942 480	608 833	539 767	773 565
Engineering sciences	2 827 677	3 093 088	3 548 019	3 429 786	2 651 327	2 971 162	2 786 664	2 332 755	2 232 226	2 339 006

MAIN RESEARCH FIELD	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Biological sciences	210 627	213 124	248 838	254 071	250 356	220 193	154 696	175 572	245 176	250 139
Agricultural sciences	444 593	593 315	665 703	671 194	686 697	778 583	1 008 216	1 070 593	666 564	742 632
Medical and health sciences	1 812 411	1 974 213	2 170 317	2 300 587	2 283 200	2 384 920	2 855 116	2 395 653	2 289 175	3 238 019
Environmental sciences	44 563	50 909	85 932	21 920	480 612	60 379	69 676	130 311	101 190	295 153
Material sciences	53 855	64 090	154 500	71 967	97 670	56 253	63 653	388 110	206 974	601 417
Marine sciences	5 738	8 026	5 655	630	0	0	750	526	512	489
Division 2: Social sciences and humanities	1 443 280	2 016 989	2 313 701	2 367 302	2 862 731	4 065 740	2 728 832	151 985	513 483	644 092
Social sciences	1 443 280	2 016 989	2 313 701	2 367 302	2 858 585	4 065 740	2 727 641	151 985	513 483	644 092
Humanities	0	0	0	0	4 146	0	1 191	0	0	0
Total	10 570 726	11 782 848	13 290 951	13 814 995	14 781 270	15 859 185	14 447 833	10 704 481	10 047 344	13 527 182

Table C.45: Proportional business sector R&D expenditure by research field (2012/13 to 2021/22)

MAIN RESEARCH FIELD	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Division 1: Natural sciences, technology and engineering	86.3	82.9	82.6	82.9	80.6	74.4	81.1	98.6	94.9	95.2
Mathematical sciences	1.4	1.8	1.6	0.9	0.9	1.2	1.4	1.7	1.8	1.4
Physical sciences	0.5	0.4	0.4	0.3	0.3	0.6	0.6	1.0	1.2	0.6
Chemical sciences	9.3	8.3	6.4	7.0	7.8	7.3	7.6	7.5	6.3	5.3
Earth sciences	1.0	0.9	0.9	0.7	0.7	1.0	1.1	2.7	2.0	1.6
Information, computer and communication technologies	14.9	13.7	14.4	18.6	21.0	16.3	15.9	19.4	21.1	25.4
Applied sciences and technologies	8.2	6.9	7.2	6.5	6.2	7.2	6.5	5.7	5.4	5.7
Engineering sciences	26.8	26.3	26.7	24.8	17.9	18.7	19.3	21.8	22.2	17.3
Biological sciences	2.0	1.8	1.9	1.8	1.7	1.4	1.1	1.6	2.4	1.8
Agricultural sciences	4.2	5.0	5.0	4.9	4.6	4.9	7.0	10.0	6.6	5.5
Medical and health sciences	17.1	16.8	16.3	16.7	15.4	15.0	19.8	22.4	22.8	23.9
Environmental sciences	0.4	0.4	0.6	0.2	3.3	0.4	0.5	1.2	1.0	2.2
Material sciences	0.5	0.5	1.2	0.5	0.7	0.4	0.4	3.6	2.1	4.4
Marine sciences	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Division 2: Social sciences and humanities	13.7	17.1	17.4	17.1	19.4	25.6	18.9	1.4	5.1	4.8
Social sciences	13.7	17.1	17.4	17.1	19.3	25.6	18.9	1.4	5.1	4.8
Humanities	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.46: Business sector R&D expenditure by socio-economic objective (2012/13 to 2021/22)

SOCIO-ECONOMIC OBJECTIVE	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Division 1: Defence	1 040 025	1 096 986	1 034 893	937 964	830 331	1 187 443	975 765	985 893	923 205	1 082 978
Defence	1 040 025	1 096 986	1 034 893	937 964	830 331	1 187 443	975 765	985 893	923 205	1 082 978
Division 2: Economic development	7 234 533	8 308 177	9 663 402	10 362 668	11 554 708	11 730 578	10 197 220	6 944 128	6 471 578	8 413 717
Economic development unclassified	0	0	0	0	0	0	0	0	0	0
Plant production and plant primary products	374 327	454 990	593 610	622 367	1 026 707	628 123	791 508	919 470	529 292	590 356
Animal production and animal primary products	38 484	69 916	74 045	74 267	66 547	41 588	55 615	45 062	50 273	62 704
Mineral resources (excluding energy)	853 544	977 365	1 405 074	1 348 618	947 258	812 439	867 249	787 924	973 275	1 048 406
Energy resources	90 975	95 375	100 061	79 210	470 860	431 681	488 026	116 459	209 543	301 461
Energy supply	321 456	349 710	503 222	362 656	461 804	555 067	574 180	674 663	659 620	689 021
Manufacturing	1 639 077	1 869 926	2 096 271	2 106 255	1 924 020	1 965 446	1 788 564	1 758 500	1 281 713	1 770 822
Construction	96 071	125 059	138 237	55 625	54 328	22 942	32 416	22 651	53 209	100 008
Transport	951 435	1 080 427	935 483	1 046 235	1 098 281	1 124 099	1 045 650	630 950	437 619	618 080
Information and communication services	908 640	842 341	1 097 649	1 685 124	2 085 856	1 403 512	1 011 167	690 243	712 864	1 223 477
Commercial services	1 755 506	2 255 642	2 555 783	2 643 503	2 929 445	4 196 652	3 154 500	897 099	1 197 714	1 272 773
Economic framework	103 240	91 464	79 065	273 497	422 742	476 032	302 938	326 180	304 383	639 142
Natural resources	101 778	95 962	84 901	65 312	66 859	72 996	85 409	74 926	62 073	97 468
Division 3: Society	1 242 066	1 303 321	1 435 870	1 433 935	1 498 255	2 027 742	2 476 255	2 106 630	2 100 049	2 991 356
Society unclassified	0	0	0	0	0	0	0	0	0	0
Health	1 045 048	1 097 446	1 212 844	1 216 127	1 289 142	1 364 830	2 419 773	1 459 043	1 460 434	2 125 198
Education and training	29 566	33 913	35 728	33 707	21 076	23 586	16 021	27 515	24 891	32 722
Social development and community services	167 452	171 962	187 298	184 102	188 036	639 326	40 461	620 072	614 724	833 436
Division 4: Environment	173 535	171 747	219 212	196 802	201 177	283 454	207 806	195 663	198 780	332 566
Environment unclassified	0	0	0	0	0	0	0	0	0	0
Environmental knowledge	46 213	43 935	55 885	62 471	45 213	116 313	50 017	57 772	42 158	35 094
Environmental aspects of development	17 957	14 344	38 437	18 915	48 553	52 852	52 754	16 820	32 251	96 362

SOCIO-ECONOMIC OBJECTIVE	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Environmental and other aspects	109 365	113 468	124 889	115 415	107 410	114 289	105 035	121 070	124 371	201 110
Division 5: Advancement of knowledge	880 567	902 617	937 575	883 626	696 800	629 967	590 788	472 168	353 733	706 564
Advancement of knowledge unclassified	0	0	0	0	0	0	0	0	0	0
Natural sciences, technologies and engineering	877 557	899 840	932 030	880 474	696 770	629 967	590 788	472 168	353 733	706 564
Social sciences and humanities	3 010	2 776	5 545	3 152	30	0	0	0	0	0
Total	10 570 726	11 782 848	13 290 951	13 814 995	14 781 270	15 859 185	14 447 833	10 704 481	10 047 344	13 527 182

Table C.47: Proportional business sector R&D expenditure by socio-economic objective (2012/13 to 2021/22)

SOCIO-ECONOMIC OBJECTIVE	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Division 1: Defence	9.8	9.3	7.8	6.8	5.6	7.5	6.8	9.2	9.2	8.0
Defence	9.8	9.3	7.8	6.8	5.6	7.5	6.8	9.2	9.2	8.0
Division 2: Economic development	68.4	70.5	72.7	75.0	78.2	74.0	70.6	64.9	64.4	62.2
Economic development unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Plant production and plant primary products	3.5	3.9	4.5	4.5	6.9	4.0	5.5	8.6	5.3	4.4
Animal production and animal primary products	0.4	0.6	0.6	0.5	0.5	0.3	0.4	0.4	0.5	0.5
Mineral resources (excluding energy)	8.1	8.3	10.6	9.8	6.4	5.1	6.0	7.4	9.7	7.8
Energy resources	0.9	0.8	0.8	0.6	3.2	2.7	3.4	1.1	2.1	2.2
Energy supply	3.0	3.0	3.8	2.6	3.1	3.5	4.0	6.3	6.6	5.1
Manufacturing	15.5	15.9	15.8	15.2	13.0	12.4	12.4	16.4	12.8	13.1
Construction	0.9	1.1	1.0	0.4	0.4	0.1	0.2	0.2	0.5	0.7
Transport	9.0	9.2	7.0	7.6	7.4	7.1	7.2	5.9	4.4	4.6
Information and communication services	8.6	7.1	8.3	12.2	14.1	8.8	7.0	6.4	7.1	9.0
Commercial services	16.6	19.1	19.2	19.1	19.8	26.5	21.8	8.4	11.9	9.4
Economic framework	1.0	0.8	0.6	2.0	2.9	3.0	2.1	3.0	3.0	4.7
Natural resources	1.0	0.8	0.6	0.5	0.5	0.5	0.6	0.7	0.6	0.7

SOCIO-ECONOMIC OBJECTIVE	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
	%	%	%	%	%	%	%	%	%	%
Division 3: Society	11.8	11.1	10.8	10.4	10.1	12.8	17.1	19.7	20.9	22.1
Society unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Health	9.9	9.3	9.1	8.8	8.7	8.6	16.7	13.6	14.5	15.7
Education and training	0.3	0.3	0.3	0.2	0.1	0.1	0.1	0.3	0.2	0.2
Social development and community services	1.6	1.5	1.4	1.3	1.3	4.0	0.3	5.8	6.1	6.2
Division 4: Environment	1.6	1.5	1.6	1.4	1.4	1.8	1.4	1.8	2.0	2.5
Environment unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Environmental knowledge	0.4	0.4	0.4	0.5	0.3	0.7	0.3	0.5	0.4	0.3
Environmental aspects of development	0.2	0.1	0.3	0.1	0.3	0.3	0.4	0.2	0.3	0.7
Environmental and other aspects	1.0	1.0	0.9	0.8	0.7	0.7	0.7	1.1	1.2	1.5
Division 5: Advancement of knowledge	8.3	7.7	7.1	6.4	4.7	4.0	4.1	4.4	3.5	5.2
Advancement of knowledge unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Natural sciences, technologies and engineering	8.3	7.6	7.0	6.4	4.7	4.0	4.1	4.4	3.5	5.2
Social sciences and humanities	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.48: Business sector R&D expenditure by province (2012/13 to 2021/22)

PROVINCE	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000
Eastern Cape	468 197	646 497	608 398	651 533	690 478	707 348	674 516	439 537	214 755	241 315
Free State	1 265 285	1 374 960	831 575	1 124 042	1 060 177	1 105 873	991 206	694 454	470 355	998 559
Gauteng	5 356 550	5 813 673	7 160 280	7 183 557	7 876 139	8 285 425	7 617 873	5 447 407	5 577 133	6 785 927
KwaZulu-Natal	1 237 563	1 434 084	1 501 659	1 436 737	1 553 130	1 679 718	1 446 281	1 193 914	821 492	1 061 049
Limpopo	127 451	140 026	161 331	145 736	171 567	223 014	184 199	78 484	199 637	136 397
Mpumalanga	222 974	301 831	435 770	339 985	284 655	304 990	392 986	370 695	258 575	438 496
North West	380 144	435 849	681 634	451 891	526 962	565 486	601 653	566 308	526 476	581 045
Northern Cape	78 471	124 150	226 303	206 786	49 508	60 007	50 561	39 576	29 084	112 703
Western Cape	1 434 090	1 511 778	1 684 001	2 274 728	2 568 653	2 927 324	2 488 558	1 874 107	1 949 835	3 171 691
Total	10 570 726	11 782 848	13 290 951	13 814 995	14 781 270	15 859 185	14 447 833	10 704 481	10 047 344	13 527 182

Table C.49: Proportional business sector R&D expenditure by province (2012/13 to 2021/22)

PROVINCE	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
	%	%	%	%	%	%	%	%	%	%
Eastern Cape	4.4	5.5	4.6	4.7	4.7	4.5	4.7	4.1	2.1	1.8
Free State	12.0	11.7	6.3	8.1	7.2	7.0	6.9	6.5	4.7	7.4
Gauteng	50.7	49.3	53.9	52.0	53.3	52.2	52.7	50.9	55.5	50.2
KwaZulu-Natal	11.7	12.2	11.3	10.4	10.5	10.6	10.0	11.2	8.2	7.8
Limpopo	1.2	1.2	1.2	1.1	1.2	1.4	1.3	0.7	2.0	1.0
Mpumalanga	2.1	2.6	3.3	2.5	1.9	1.9	2.7	3.5	2.6	3.2
North West	3.6	3.7	5.1	3.3	3.6	3.6	4.2	5.3	5.2	4.3
Northern Cape	0.7	1.1	1.7	1.5	0.3	0.4	0.3	0.4	0.3	0.8
Western Cape	13.6	12.8	12.7	16.5	17.4	18.5	17.2	17.5	19.4	23.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.50: Business sector R&D expenditure by Standard Industrial Classification code (2012/13 to 2021/22)

STANDARD INDUSTRIAL CLASSIFICATION	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000
Agriculture, hunting, forestry and fishing	286 832	364 424	460 464	484 384	472 472	395 011	560 631	707 251	451 499	454 235
Mining and quarrying	1 554 284	1 675 153	1 340 103	1 220 985	1 069 826	1 101 202	1 748 437	686 064	927 055	888 716
Manufacturing	3 476 647	3 793 066	4 501 146	4 442 466	4 107 936	4 473 167	3 166 486	3 456 739	2 895 406	4 049 490
Manufacture of food products, beverages and tobacco products	319 143	340 427	364 178	376 884	328 832	455 335	498 001	452 243	273 509	240 474
Manufacture of textiles, clothing and leather goods	2 073	32 091	34 609	9 335	8 932	21 968	11 129	11 306	16 547	26 709
Manufacture of wood and products of wood and cork, except furniture; Manufacture of articles of straw and plaiting materials; Manufacture of paper and paper products; Manufacture of publishing, printing and reproduction of recorded material	50 531	60 437	72 870	95 555	87 814	91 005	76 413	79 627	77 126	103 141
Manufacture of refined petroleum, coke and nuclear fuel; Manufacture of chemicals and chemical products (incl. pharmaceuticals); Manufacture of rubber and plastic products	1 139 617	1 256 313	1 835 837	1 800 420	1 696 770	1 692 447	802 217	1 165 107	1 096 348	1 704 714
Manufacture of non-metallic mineral products	49 974	52 263	51 097	28 095	37 531	24 657	43 350	19 376	36 079	24 095
Manufacture of basic metals, fabricated metal products, machinery & equipment; Manufacture of office, accounting and computing machinery	585 635	620 923	607 574	660 205	519 108	581 073	525 937	548 762	422 697	695 090
Manufacture of electrical machinery and apparatus	312 102	254 042	302 575	381 971	455 378	635 655	374 509	250 907	300 913	423 722

STANDARD INDUSTRIAL CLASSIFICATION	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Manufacture of radio, television and communication equipment & apparatus; Manufacture of medical, precision and optical instruments, watches & clocks	656 639	742 033	706 308	569 127	629 240	625 773	486 808	538 682	567 514	552 318
Manufacture of transport equipment	267 788	334 276	408 448	402 772	321 638	316 503	315 433	381 531	96 840	236 450
Manufacture of furniture; Recycling; Manufacturing not elsewhere classified	93 145	100 261	117 649	118 102	22 692	28 752	32 689	9 198	7 833	42 778
Electricity, gas and water supply	385 770	355 720	548 015	439 157	544 850	639 298	708 166	762 345	708 350	412 425
Construction	9 051	8 037	6 637	5 613	4 297	3 562	9 408	5 065	4 762	9 700
Wholesale and retail	179 383	100 176	85 491	42 977	54 553	84 403	102 393	89 487	64 403	21 638
Transport, storage & communication	467 411	451 336	632 243	897 359	1 543 763	978 548	1 111 760	503 415	274 353	805 449
Financial intermediation, real estate and business services	3 914 543	4 724 439	5 357 151	5 910 332	6 555 245	7 744 370	6 402 099	4 032 237	4 250 465	6 187 437
Community, social and personal services	296 805	310 498	359 701	371 723	428 328	439 625	638 452	461 877	471 053	698 091
Total	10 570 726	11 782 848	13 290 951	13 814 995	14 781 270	15 859 185	14 447 833	10 704 481	10 047 344	13 527 182

Table C.51: Proportional business sector R&D expenditure by Standard Industrial Classification Code (SIC) (2012/13 to 2021/22)

STANDARD INDUSTRIAL CLASSIFICATION	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Agriculture, hunting, forestry and fishing	3.1	3.5	3.5	3.2	2.5	3.9	6.6	6.6	4.5	3.4
Mining and quarrying	14.2	10.1	8.8	7.2	6.9	12.1	6.4	6.4	9.2	6.6
Manufacturing	32.2	33.9	32.2	27.8	28.2	21.9	32.3	32.3	28.8	29.9
Manufacture of food products, beverages and tobacco products	2.9	2.7	2.7	2.2	2.9	3.4	4.2	4.2	2.7	1.8
Manufacture of textiles, clothing and leather goods	0.3	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2
Manufacture of wood and products of wood and cork, except furniture; Manufacture of articles of straw and plaiting materials; Manufacture of paper and paper products; Manufacture of publishing, printing and reproduction of recorded material	0.5	0.5	0.7	0.6	0.6	0.5	0.7	0.7	0.8	0.8
Manufacture of refined petroleum, coke and nuclear fuel; Manufacture of chemicals and chemical products (incl. pharmaceuticals); Manufacture of rubber and plastic products	10.7	13.8	13.0	11.5	10.7	5.6	10.9	10.9	10.9	12.6
Manufacture of non-metallic mineral products	0.4	0.4	0.2	0.3	0.2	0.3	0.2	0.2	0.4	0.2
Manufacture of basic metals, fabricated metal products, machinery & equipment; Manufacture of office, accounting and computing machinery	5.3	4.6	4.8	3.5	3.7	3.6	5.1	5.1	4.2	5.1

STANDARD INDUSTRIAL CLASSIFICATION	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Manufacture of electrical machinery and apparatus	2.2	2.3	2.8	3.1	4.0	2.6	2.3	2.3	3.0	3.1
Manufacture of radio, television and communication equipment & apparatus; Manufacture of medical, precision and optical instruments, watches & clocks	6.3	5.3	4.1	4.3	3.9	3.4	5.0	5.0	5.6	4.1
Manufacture of transport equipment	2.8	3.1	2.9	2.2	2.0	2.2	3.6	3.6	1.0	1.7
Manufacture of furniture; Recycling; Manufacturing not elsewhere classified	0.9	0.9	0.9	0.2	0.2	0.2	0.1	0.1	0.1	0.3
Electricity, gas and water supply	3.0	4.1	3.2	3.7	4.0	4.9	7.1	7.1	7.1	3.0
Construction	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1
Wholesale and retail	0.9	0.6	0.3	0.4	0.5	0.7	0.8	0.8	0.6	0.2
Transport, storage & communication	3.8	4.8	6.5	10.4	6.2	7.7	4.7	4.7	2.7	6.0
Financial intermediation, real estate and business services	40.1	40.3	42.8	44.3	48.8	44.3	37.7	37.7	42.3	45.7
Community, social and personal services	2.6	2.7	2.7	2.9	2.8	4.4	4.3	4.3	4.7	5.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.52: Business sector R&D personnel in headcounts and full-time equivalents by occupation (2012/13 to 2021/22)

YEAR	HEADCOUNTS				FULL-TME EQUIVALENTS (FTEs)			
	TOTAL	RESEARCHERS	TECHNICIANS	OTHER R&D PERSONNEL	TOTAL	RESEARCHERS	TECHNICIANS	OTHER R&D PERSONNEL
2012/13	**17 155**	6 191	6 394	4 570	**11 322.3**	4 555.9	4 065.5	2 700.9
2013/14	**17 599**	6 182	6 397	5 020	**11 877.4**	4 530.1	4 253.1	3 094.2
2014/15	**18 743**	6 261	6 912	5 570	**12 927.5**	4 636.2	4 494.4	3 796.9
2015/16	**17 245**	6 128	6 090	5 027	**12 457.8**	4 626.8	4 227.4	3 603.6
2016/17	**17 998**	6 463	6 156	5 379	**12 549.2**	4 777.3	4 149.4	3 622.5
2017/18	**17 554**	7 142	5 655	4 757	**12 952.9**	5 481.7	3 807.5	3 663.8
2018/19	**16 876**	6 942	5 286	4 648	**11 691.0**	4 535.1	3 546.9	3 609.0
2019/20	**12 748**	4 641	4 989	3 118	**9 300.8**	3 227.8	3 486.8	2 586.3
2020/21	**14 177**	4 510	4 796	4 871	**10 860.3**	3 055.5	3 454.5	4 350.3
2021/22	**15 094**	4 370	5 347	5 377	**12 054.6**	2 927.7	4 435.4	4 691.6

Note: Headcounts includes non-SA R&D personnel (from 2016/17).
Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.53: Business sector R&D personnel in headcounts and full-time equivalents by occupation and gender (2019/20 to 2021/22)

OCCUPATION	HEADCOUNTS			FULL-TIME EQUIVALENTS (FTEs)			
2019/20	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**TOTAL FTEs AS % OF TOTAL HEADCOUNTS**
Researchers	**4 641**	3 076	1 565	**3 227.8**	1 973.7	1 254.0	69.5
Technicians directly supporting R&D	**4 989**	3 023	1 966	**3 486.8**	1 885.1	1 601.7	69.9
Other personnel directly supporting R&D	**3 118**	1 432	1 686	**2 586.3**	1 114.1	1 472.2	82.9
Total	12 748	7 531	5 217	9 300.8	4 973.0	4 327.9	73.0
2020/21	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**TOTAL FTEs AS % OF TOTAL HEADCOUNTS**
Researchers	**4 510**	2 954	1 556	**3 055.5**	1 799.7	1 255.8	67.7
Technicians directly supporting R&D	**4 796**	2 925	1 871	**3 454.5**	1 865.8	1 588.8	72.0
Other personnel directly supporting R&D	**4 871**	1 998	2 873	**4 350.3**	1 681.8	2 668.6	89.3
Total	14 177	7 877	6 300	10 860.3	5 347.2	5 513.1	76.6
2021/22	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**TOTAL FTEs AS % OF TOTAL HEADCOUNTS**
Researchers	**4 370**	2 859	1 511	**2 927.7**	1 795.9	1 131.8	67.0
Technicians directly supporting R&D	**5 347**	2 882	2 465	**4 435.4**	2 159.2	2 276.1	83.0
Other personnel directly supporting R&D	**5 377**	2 225	3 152	**4 691.6**	1 799.4	2 892.2	87.3
Total	15 094	7 966	7 128	12 054.6	5 754.5	6 300.1	79.9

Note: Headcounts includes non-SA R&D personnel (from 2016/17).
Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.54: Business sector R&D personnel in headcounts by occupation, qualification, population group and gender (2021/22)

OCCUPATION AND QUALIFICATION	TOTAL	SUBTOTAL		AFRICAN		COLOURED		INDIAN/ASIAN		WHITE		NON-SA	
		MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
Researchers	4 370	2 859	1 511	569	486	119	120	329	214	1 765	651	77	40
Doctoral degree or equivalent	466	290	176	64	33	20	17	15	19	173	98	18	9
Master's, honours, bachelor or equivalent	3 047	2 003	1 044	386	348	70	65	256	157	1 255	452	36	22
Diplomas	857	566	291	119	105	29	38	58	38	337	101	23	9
Technicians directly supporting R&D	5 347	2 882	2 465	970	1 119	252	190	244	162	1 345	931	71	63
Doctoral degree or equivalent	73	33	40	7	12	0	2	1	3	18	15	7	8
Master's, honours, bachelor or equivalent	1 796	982	814	256	198	70	49	79	72	541	470	36	25
Diplomas	3 478	1 867	1 611	707	909	182	139	164	87	786	446	28	30
Other personnel directly supporting R&D	5 377	2 225	3 152	1 375	2 375	196	218	121	84	492	428	41	47
Doctoral degree or equivalent	17	7	10	0	0	0	0	0	1	7	8	0	1
Master's, honours, bachelor or equivalent	907	479	428	185	179	36	34	40	32	208	175	10	8
Diplomas	4 453	1 739	2 714	1 190	2 196	160	184	81	51	277	245	31	38
Total	15 094	7 966	7 128	2 914	3 980	567	528	694	460	3 602	2 010	189	150

Note: Headcounts include non-SA R&D staff.

Table C.55: Number of foreign and local business sector partners engaged in collaborative R&D, and total R&D collaboration expenditure (2019/20 to 2021/22)

COLLABORATION PARTNERS	2019/20		2020/21		2021/22	
	WITHIN SOUTH AFRICA	OUTSIDE SOUTH AFRICA	WITHIN SOUTH AFRICA	OUTSIDE SOUTH AFRICA	WITHIN SOUTH AFRICA	OUTSIDE SOUTH AFRICA
Government research institutes	24	7	21	9	20	7
Higher education institutions	84	24	82	22	85	22
Members of own company	37	15	36	18	41	20
Not-for-profit organisations	11	2	12	5	11	6
Other companies	70	33	71	33	76	33
Science councils	61	11	53	11	60	8
Total number of R&D collaborations	287	92	275	98	293	96
No collaboration	N/A	N/A	N/A	N/A	N/A	N/A
R&D EXPENDITURE	R'000	R'000	R'000	R'000	R'000	R'000
Total in-house plus outsourced R&D collaboration expenditure (excl. VAT)	N/A	N/A	N/A	N/A	N/A	N/A

Note: Collaborative R&D entails partnerships. alliances and collaborations.
N/A: The indicator 'No collaboration' was not assessed from 2016/17 onwards.

C.2.1.1 Business sector: State-owned enterprises

Table C.56: Business sector: SOEs – Number, R&D expenditure, and R&D expenditure as a proportion of BERD (2012/13 to 2021/22)

YEAR	NUMBER OF R&D PERFORMERS	R&D EXPENDITURE	PROPORTION OF BERD
		R'000	%
2012/13	19	1 512 021	14.3
2013/14	19	1 609 771	13.7
2014/15	19	2 019 919	15.2
2015/16	18	1 973 416	14.3
2016/17	16	2 621 883	17.7
2017/18	16	2 536 374	16.0
2018/19	16	2 492 520	17.3
2019/20	16	2 053 331	19.2
2020/21	15	1 659 038	14.2
2021/22	15	2 079 682	15.4

Note: The list of SOEs was revised from 2014/15.

Table C.57: Business sector: SOEs – R&D expenditure by type of research (2012/13 to 2021/22)

TYPE OF RESEARCH	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000
Basic research	59 187	263 523	65 489	65 556	110 249	140 989	153 137	132 998	87 580	665 416
Applied research	805 106	641 358	1 216 953	860 904	1 588 222	1 886 756	1 970 733	1 406 439	1 312 496	1 108 746
Experimental development research	647 728	704 890	737 477	1 046 956	923 413	508 629	368 650	513 895	258 961	305 520
Total	1 512 021	1 609 771	2 019 919	1 973 416	2 621 883	2 536 374	2 492 520	2 053 331	1 659 038	2 079 682

Table C.58: Business sector: SOEs – Proportional R&D expenditure by type of research (2012/13 to 2021/22)

TYPE OF RESEARCH	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Basic research	3.9	16.4	3.2	3.3	4.2	5.6	6.1	6.5	5.3	32.0
Applied research	53.2	39.8	60.2	43.6	60.6	74.4	79.1	68.5	79.1	53.3
Experimental development research	42.8	43.8	36.5	53.1	35.2	20.1	14.8	25.0	15.6	14.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.59: Business sector: SOEs – R&D expenditure by accounting category (2012/13 to 2021/22)

TYPE OF EXPENDITURE	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Capital expenditure	179 959	245 077	355 725	122 272	726 071	702 156	768 912	368 628	131 658	809 848
Land: buildings & other structures	11 195	12 920	16 307	31 884	183 145	173 025	193 483	204 147	30 276	157 238
TOTAL: Vehicles, plant, machinery, equipment and software	168 764	232 157	339 418	90 388	542 926	529 131	575 429	164 481	101 382	652 610
Vehicles, plant, machinery, equipment	168 764	232 157	339 418	90 388	542 926	529 131	575 429	164 331	100 716	527 075
*Capitalised computer software	N/A	N/A	N/A	N/A	N/A	N/A	N/A	150	666	125 535
Current expenditure	1 332 062	1 364 694	1 664 194	1 851 145	1 895 812	1 834 218	1 723 607	1 684 703	1 527 380	1 269 834
Labour costs	795 414	849 371	922 321	976 713	1 040 703	968 562	892 376	842 680	721 809	773 881
Other current expenditure	536 648	515 323	741 873	874 432	855 109	865 656	831 231	842 023	805 571	495 953
Total	1 512 021	1 609 771	2 019 919	1 973 417	2 621 883	2 536 374	2 492 520	2 053 331	1 659 038	2 079 682

*Capitalised computer software collected from 2019/20.

Table C.60: Business sector: SOEs – Proportional R&D expenditure by accounting category (2012/13 to 2021/22)

TYPE OF EXPENDITURE	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Capital expenditure	11.9	15.2	17.6	6.2	27.7	27.7	30.8	18.0	7.9	38.9
Land: buildings & other structures	0.7	0.8	0.8	1.6	7.0	6.8	7.8	9.9	1.8	7.6
TOTAL: Vehicles, plant, machinery, equipment and software	11.2	14.4	16.8	4.6	20.7	20.9	23.1	8.0	6.1	31.4
Vehicles, plant, machinery, equipment	11.2	14.4	16.8	4.6	20.7	20.9	23.1	8.0	6.1	25.3
*Capitalised computer software	NA	NA	NA	NA	NA	NA	NA	0	0	6.04
Current expenditure	88.1	84.8	82.4	93.8	72.3	72.3	69.2	82.0	92.1	61.1
Labour costs	52.6	52.8	45.7	49.5	39.7	38.2	35.8	41.0	43.5	37.2
Other current expenditure	35.5	32.0	36.7	44.3	32.6	34.1	33.3	41.0	48.6	23.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

*Capitalised computer software collected from 2019/20.

Table C.61: Business sector: SOEs – R&D expenditure on multidisciplinary areas of R&D (2012/13 to 2021/22)

MULTI-DISCIPLINARY AREA OF R&D	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Biotechnology	23 479	21 845	16 591	12 278	16 457	18 514	8 116	9 352	9 705	8 636
Nanotechnology	3 768	654	700	144	0	0	0	369	384	422
Total	**27 247**	**22 499**	**17 290**	**12 422**	**16 457**	**18 514**	**8 116**	**9 721**	**10 089**	**9 058**
Business expenditure on R&D	**1 512 021**	**1 609 771**	**2 019 919**	**1 973 416**	**2 621 883**	**2 536 374**	**2 492 520**	**2 053 331**	**1 659 038**	**2 079 682**

Table C.62: Business sector: SOEs – Proportional expenditure on multidisciplinary areas of R&D (2012/13 to 2021/22)

MULTI-DISCIPLINARY AREA OF R&D	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Biotechnology	1.6	1.4	0.8	0.6	0.6	0.7	0.3	0.5	0.6	0.4
Nanotechnology	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**1.8**	**1.4**	**0.9**	**0.6**	**0.6**	**0.7**	**0.3**	**0.5**	**0.6**	**0.4**

N/A: Environment-related data was collected from the 2011/12 R&D Survey onward.

Table C.63: Business sector: SOEs – R&D expenditure on selective areas of interest (2012/13 to 2021/22)

AREA OF INTEREST	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Environment-related	15 284	22 448	51 522	30 864	136 523	150 811	171 166	187 339	152 349	383 861
Open-source software	7 599	4 124	0	50 589	0	0	0	19 769	1 894	142 591
New materials	12 082	12 233	11 111	64 021	15 353	21 144	23 841	32 115	30 962	24 070
Tuberculosis, HIV/AIDS, malaria	0	0	0	0	0	0	0	943	496	756
Space science	N/A	N/A	N/A	N/A	32 571	33 063	34 998	9 462	947	427 774
Total	**34 965**	**38 806**	**62 633**	**145 474**	**184 446**	**205 018**	**230 005**	**249 628**	**186 648**	**979 052**
Business expenditure on R&D	**1 512 021**	**1 609 771**	**2 019 919**	**1 973 416**	**2 621 883**	**2 536 374**	**2 492 520**	**2 053 331**	**1 659 038**	**2 079 682**

N/A: Environment-related data were collected from the 2011/12 R&D Survey onwards. Space science data were collected for the first time in the 2016/17 R&D Survey.

Table C.64: Business sector: SOEs - Proportional R&D expenditure on selective areas of interest (2012/13 to 2021/22)

AREA OF INTEREST	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Environment-related	1.0	1.4	2.6	1.6	5.2	5.9	6.9	9.1	9.2	18.5
Open-source software	0.5	0.3	0.0	2.6	0.0	0.0	0.0	1.0	0.1	6.9
New materials	0.8	0.8	0.6	3.2	0.6	0.8	1.0	1.6	1.9	1.2
Tuberculosis, HIV/AIDS, malaria	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Space science	N/A	N/A	N/A	N/A	1.2	1.3	1.4	0.5	0.1	20.6
Total	**2.3**	**2.4**	**3.1**	**7.4**	**7.0**	**8.1**	**9.2**	**12.2**	**11.3**	**47.1**

N/A: Environment-related data were collected from the 2011/12 R&D Survey onwards. Space science data were collected for the first time in the 2016/17 R&D Survey.

Table C.65: Business sector: SOEs – R&D expenditure by research field (2012/13 to 2021/22)

MAIN RESEARCH FIELD	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Division 1: Natural sciences, technology and engineering	1 512 021	1 609 771	1 963 779	1 963 821	2 524 169	2 437 185	2 387 524	2 043 870	1 658 091	2 044 035
Mathematical sciences	86 576	93 820	137 076	87 387	85 055	134 335	142 171	143 412	143 414	175 702
Physical sciences	40 742	44 460	46 559	32 100	42 210	81 896	86 032	83 931	106 613	73 080
Chemical sciences	133 867	132 399	86 408	64 230	68 251	55 705	50 406	56 752	58 973	70 702
Earth sciences	44 006	48 671	24 356	12 254	17 750	17 522	9 297	27 651	26 227	23 975
Information, computer and communication technologies	155 601	168 174	304 806	541 009	935 325	483 015	511 409	219 824	142 888	650 766
Applied sciences and technologies	176 600	176 391	165 214	133 687	277 702	446 635	363 768	274 949	124 361	260 083
Engineering sciences	781 073	824 057	1 034 900	981 683	971 414	1 059 843	1 040 397	924 156	877 692	537 373
Biological sciences	13 496	30 701	29 183	33 874	13 112	12 338	26 520	27 002	24 903	23 852
Agricultural sciences	5342.7	11 711	12 507	12 665	9 079	9 282	5 857	16 669	12 927	10 497
Medical and health sciences	18 012	18 316	49 357	36 548	23 990	76 571	80 711	153 719	81 265	26 028
Environmental sciences	42 440	45 772	59 270	16 310	47 674	51 225	58 605	67 425	40 162	169 783
Material sciences	8 605	9 198	9 849	12 073	32 605	8 818	12 352	48 380	18 666	22 195
Marine sciences	5 659	6 103	4 294	0	0	0	0	0	0	0
Division 2: Social sciences and humanities	0	0	56 140	9 595	9 714	99 189	104 995	9 462	947	35 648
Social sciences	0	0	56 140	9 595	9 714	99 189	104 995	9 462	947	35 648
Humanities	0	0	0	0	0	0	0	0	0	0
Total	1 512 021	1 609 771	2 019 919	1 973 416	2 621 883	2 536 374	2 492 520	2 053 331	1 659 038	2 079 682

Table C.66: Business sector: SOEs – Proportional R&D expenditure by research field (2012/13 to 2021/22)

MAIN RESEARCH FIELD	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Division 1: Natural sciences, technology and engineering	100.0	100.0	97.2	99.5	96.3	96.1	95.8	99.5	99.9	98.3
Mathematical sciences	5.7	5.8	6.8	4.4	3.2	5.3	5.7	7.0	8.6	8.4
Physical sciences	2.7	2.8	2.3	1.6	1.6	3.2	3.5	4.1	6.4	3.5
Chemical sciences	8.9	8.2	4.3	3.3	2.6	2.2	2.0	2.8	3.6	3.4
Earth sciences	2.9	3.0	1.2	0.6	0.7	0.7	0.4	1.3	1.6	1.2

MAIN RESEARCH FIELD	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
	%	%	%	%	%	%	%	%	%	%
Information, computer and communication technologies	10.3	10.4	15.1	27.4	35.7	19.0	20.5	10.7	8.6	31.3
Applied sciences and technologies	11.7	11.0	8.2	6.8	10.6	17.6	14.6	13.4	7.5	12.5
Engineering sciences	51.7	51.2	51.2	49.7	37.1	41.8	41.7	45.0	52.9	25.8
Biological sciences	0.9	1.9	1.4	1.7	0.5	0.5	1.1	1.3	1.5	1.1
Agricultural sciences	0.4	0.7	0.6	0.6	0.3	0.4	0.2	0.8	0.8	0.5
Medical and health sciences	1.2	1.1	2.4	1.9	0.9	3.0	3.2	7.5	4.9	1.3
Environmental sciences	2.8	2.8	2.9	0.8	1.8	2.0	2.4	3.3	2.4	8.2
Material sciences	0.6	0.6	0.5	0.6	1.2	0.3	0.5	2.4	1.1	1.1
Marine sciences	0.4	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Division 2: Social sciences and humanities	0.0	0.0	2.8	0.5	3.7	3.9	4.2	0.5	0.1	1.7
Social sciences	0.0	0.0	2.8	0.5	3.7	3.9	4.2	0.5	0.1	1.7
Humanities	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.67: Business sector: SOEs – R&D expenditure by socio-economic objective (2012/13 to 2021/22)

SOCIO-ECONOMIC OBJECTIVE	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000
Division 1: Defence	485 487	512 440	563 927	399 183	304 302	676 595	497 808	524 278	398 046	410 108
Defence	485 487	512 440	563 927	399 183	304 302	676 595	497 808	524 278	398 046	410 108
Division 2: Economic development	831 597	887 024	1 187 718	1 360 120	1 901 235	1 424 957	1 522 995	1 257 352	1 075 905	1 526 222
Economic development unclassified	0	0	0	0	0	0	0	0	0	0
Plant production and plant primary products	9 030	9 380	10 076	10 203	8 610	8 610	9 287	10 302	9 241	9 835
Animal production and animal primary products	0	0	0	0	0	0	0	0	0	0
Mineral resources (excluding energy)	6 433	6 541	6 996	7 743	8 500	8 818	9 236	0	0	0
Energy resources	23 158	23 549	25 185	27 874	30 602	12 479	13 070	71 813	54 254	126 681
Energy supply	249 963	253 757	419 084	316 868	410 091	516 908	546 952	614 824	584 239	543 753
Manufacturing	77 574	105 372	178 376	103 757	110 104	112 307	114 695	103 465	95 463	307 542
Construction	70 899	99 484	81 944	0	0	0	0	0	0	0
Transport	125 965	122 633	126 069	253 742	333 284	335 410	357 608	222 975	177 757	182 152

SOCIO-ECONOMIC OBJECTIVE	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Information and communication services	193 815	191 811	270 175	609 251	873 600	302 316	319 210	72 508	15 498	335 899
Commercial services	9 893	10 644	11 434	16 235	16 878	18 002	19 049	16 898	640	703
Economic framework	36 408	40 833	37 065	14 447	109 566	110 107	115 191	120 014	118 203	0
Natural resources	28 459	23 019	21 316	0	0	0	18 697	24 554	20 611	19 657
Division 3: Society	**46 872**	**59 171**	**67 371**	**54 784**	**51 876**	**70 963**	**87 496**	**188 813**	**109 720**	**76 869**
Society unclassified	0	0	0	0	0	0	0		0	0
Health	19 743	29 360	26 193	19 804	25 631	39 533	54 213	150 830	75 259	57 930
Education and training	10 862	13 281	14 266	14 447	0	0	0	0	0	0
Social development and community services	16 268	16 530	26 912	20 533	26 246	31 431	33 282	37 984	34 461	18 939
Division 4: Environment	**31 245**	**31 720**	**68 425**	**56 760**	**86 865**	**94 694**	**100 236**	**82 888**	**75 367**	**66 483**
Environment unclassified	0	0	0	0	0	0	0		0	0
Environmental knowledge	15 623	15 860	26 193	33 494	28 662	30 816	32 619	39 060	34 101	30 487
Environmental aspects of development	0	0	16 040	2 741	32 571	33 063	34 998	0	0	10 763
Environmental and other aspects	15 623	15 860	26 193	20 525	25 631	30 816	32 619	43 828	41 265	25 234
Division 5: Advancement of knowledge	**116 819**	**119 417**	**132 476**	**102 570**	**277 605**	**269 165**	**283 984**	**0**	**0**	**0**
Advancement of knowledge unclassified	0	0	0	0	0	0	0	0	0	0
Natural sciences, technologies and engineering	113 836	116 668	129 393	99 448	277 605	269 165	283 984	0	0	0
Social sciences and humanities	2 983	2 750	3 083	3 122	0	0	0	0	0	0
Total	**1 512 021**	**1 609 771**	**2 019 919**	**1 973 416**	**2 621 883**	**2 536 374**	**2 492 520**	**2 053 331**	**1 659 038**	**2 079 682**

Table C.68: Business sector: SOEs – Proportional R&D expenditure by socio-economic objective (2012/13 to 2021/22)

SOCIO-ECONOMIC OBJECTIVE	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
	%	%	%	%	%	%	%	%	%	%
Division 1: Defence	32.1	31.8	27.9	20.2	11.6	26.7	20.0	25.5	24.0	19.7
Defence	32.1	31.8	27.9	20.2	11.6	26.7	20.0	25.5	24.0	19.7
Division 2: Economic development	55.0	55.1	58.8	68.9	72.5	56.2	61.1	61.2	64.9	73.4
Economic development unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Plant production and plant primary products	0.6	0.6	0.5	0.5	0.3	0.3	0.4	0.5	0.6	0.5
Animal production and animal primary products	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mineral resources (excluding energy)	0.4	0.4	0.3	0.4	0.3	0.3	0.4	0.0	0.0	0.0
Energy resources	1.5	1.5	1.2	1.4	1.2	0.5	0.5	3.5	3.3	6.1
Energy supply	16.5	15.8	20.7	16.1	15.6	20.4	21.9	29.9	35.2	26.1
Manufacturing	5.1	6.5	8.8	5.3	4.2	4.4	4.6	5.0	5.8	14.8
Construction	4.7	6.2	4.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transport	8.3	7.6	6.2	12.9	12.7	13.2	14.3	10.9	10.7	8.8
Information and communication services	12.8	11.9	13.4	30.9	33.3	11.9	12.8	3.5	0.9	16.2
Commercial services	0.7	0.7	0.6	0.8	0.6	0.7	0.8	0.8	0.0	0.0
Economic framework	2.4	2.5	1.8	0.7	4.2	4.3	4.6	5.8	7.1	0.0
Natural resources	1.9	1.4	1.1	0.0	0.0	0.0	0.8	1.2	1.2	0.9
Division 3: Society	3.1	3.7	3.3	2.8	2.0	2.8	3.5	9.2	6.6	3.7
Society unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Health	1.3	1.8	1.3	1.0	1.0	1.6	2.2	7.3	4.5	2.8
Education and training	0.7	0.8	0.7	0.7	0.0	0.0	0.0	0.0	0.0	0.0
Social development and community services	1.1	1.0	1.3	1.0	1.0	1.2	1.3	1.8	2.1	0.9
Division 4: Environment	2.1	2.0	3.4	2.9	3.3	3.7	4.0	4.0	4.5	3.2
Environment unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Environmental knowledge	1.0	1.0	1.3	1.7	1.1	1.2	1.3	1.9	2.1	1.5
Environmental aspects of development	0.0	0.0	0.8	0.1	1.2	1.3	1.4	0.0	0.0	0.5

SOCIO-ECONOMIC OBJECTIVE	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
	%	%	%	%	%	%	%	%	%	%
Environmental and other aspects	1.0	1.0	1.3	1.0	1.0	1.2	1.3	2.1	2.5	1.2
Division 5: Advancement of knowledge	7.7	7.4	6.6	5.2	10.6	10.6	11.4	0.0	0.0	0.0
Advancement of knowledge unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Natural sciences, technologies and engineering	7.5	7.2	6.4	5.0	10.6	10.6	11.4	0.0	0.0	0.0
Social sciences and humanities	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.69: Business sector: SOEs – R&D expenditure by province (2012/13 to 2021/22)

PROVINCE	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000
Eastern Cape	33 436	38 634	37 244	10 854	45 081	52 404	50 850	27 532	18 658	18 057
Free State	28 367	26 428	25 193	10 854	42 824	45 798	48 477	34 521	17 170	89 353
Gauteng	1 014 194	1 012 556	1 448 092	1 558 538	1 937 851	1 682 598	1 715 224	1 306 669	1 037 875	1 342 306
KwaZulu-Natal	66 477	91 406	45 588	86 565	188 606	197 355	242 371	222 198	219 340	113 762
Limpopo	19 724	19 596	18 612	3 019	615	1 024	1 094	2 619	2 613	22 228
Mpumalanga	27 038	28 976	33 927	13 222	9 594	9 594	10 348	19 056	10 931	93 017
North West	151 514	160 739	289 990	170 118	180 261	214 709	189 393	245 578	175 388	157 993
Northern Cape	18 630	52 104	17 998	2 397	0	409	431	11 465	2 919	82 058
Western Cape	152 641	179 332	103 275	117 850	217 052	332 484	234 330	183 695	174 142	160 908
Total	1 512 021	1 609 771	2 019 919	1 973 416	2 621 883	2 536 374	2 492 520	2 053 331	1 659 038	2 079 682

Table C.70: Business sector: SOEs – Proportional R&D expenditure by province (2012/13 to 2021/22)

PROVINCE	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
	%	%	%	%	%	%	%	%	%	%
Eastern Cape	2.2	2.4	1.8	0.5	1.7	2.1	2.0	1.3	1.1	0.9
Free State	1.9	1.6	1.2	0.5	1.6	1.8	1.9	1.7	1.0	4.3
Gauteng	67.1	62.9	71.7	79.0	73.9	66.3	68.8	63.6	62.6	64.5
KwaZulu-Natal	4.4	5.7	2.3	4.4	7.2	7.8	9.7	10.8	13.2	5.5
Limpopo	1.3	1.2	0.9	0.2	0.0	0.0	0.0	0.1	0.2	1.1
Mpumalanga	1.8	1.8	1.7	0.7	0.4	0.4	0.4	0.9	0.7	4.5
North West	10.0	10.0	14.4	8.6	6.9	8.5	7.6	12.0	10.6	7.6
Northern Cape	1.2	3.2	0.9	0.1	0.0	0.0	0.0	0.6	0.2	3.9
Western Cape	10.1	11.1	5.1	6.0	8.3	13.1	9.4	8.9	10.5	7.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.71: Business sector: SOEs – R&D expenditure by Standard Industrial Classification code (2012/13 to 2021/22)

STANDARD INDUSTRIAL CLASSIFICATION	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Agriculture, hunting, forestry and fishing	12 592	17 187	18 413	18 646	20 052	20 390	21 702	24 242	25 263	11 875
Mining and quarrying	0	0	0	0	0	0	0	0	0	0
Manufacturing	444 185	475 294	480 601	370 407	161 096	461 776	270 718	284 344	157 561	271 556
Manufacture of food products, beverages and tobacco products	0	0	0	0	0	0	0	0	0	0
Manufacture of textiles, clothing and leather goods	0	0	0	0	0	0	0	0	0	0
Manufacture of wood and products of wood and cork, except furniture; Manufacture of articles of straw and plaiting materials; Manufacture of paper and paper products; Manufacture of publishing, printing and reproduction of recorded material	1 290	1 340	1 439	1 458	1 230	1 230	1 327	1 230	1 280	12 645
Manufacture of refined petroleum, coke and nuclear fuel; Manufacture of chemicals and chemical products (incl. pharmaceuticals); Manufacture of rubber and plastic products	69 607	72 216	77 350	8 616	14 489	24 007	14 343	14 950	15 185	13 274
Manufacture of non-metallic mineral products	7 719	7 850	8 395	0	0	0	0	0	0	0
Manufacture of basic metals, fabricated metal products, machinery & equipment; Manufacture of office, accounting and computing machinery	224 661	272 253	293 575	297 289	75 855	146 953	74 588	212 512	86 276	98 338
Manufacture of electrical machinery and apparatus	76 590	63 824	52 760	20 430	21 690	242 822	127 036	0	0	0
Manufacture of radio, television and communication equipment & apparatus; Manufacture of medical, precision and optical instruments, watches & clocks	0	0	0	0	0	0	0	0	0	25 444
Manufacture of transport equipment	64 318	57 812	47 081	42 614	47 833	46 764	53 425	55 652	54 820	121 855
Manufacture of furniture; Recycling; Manufacturing not elsewhere classified	0	0	0	0	0	0	0	0	0	0
Electricity, gas and water supply	325 822	340 670	534 569	424 561	531 606	633 700	698 810	725 835	697 653	406 475
Construction	0	0	0	0	0	0	0	0	0	0
Wholesale and retail	0	0	0	0	0	0	0	0	0	0
Transport, storage and communication	371 495	397 326	565 363	826 532	1 516 160	952 348	1 004 572	396 000	260 144	576 953
Financial intermediation, real estate and business services	137 898	158 060	150 347	196 661	174 576	176 127	184 533	288 975	201 458	426 482
Community, social and personal services	220 029	221 233	270 626	136 609	218 393	292 033	312 183	333 936	316 958	386 342
Total	1 512 021	1 609 771	2 019 919	1 973 416	2 621 883	2 536 374	2 492 520	2 053 331	1 659 038	2 079 682

Table C.72: Business sector: SOEs – Proportional R&D expenditure by Standard Industrial Classification code (2012/13 to 2021/22)

STANDARD INDUSTRIAL CLASSIFICATION	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Agriculture, hunting, forestry and fishing	0.8	1.1	0.9	0.9	0.8	0.8	0.9	1.2	1.5	0.6
Mining and quarrying	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Manufacturing	29.4	29.5	23.8	18.8	6.1	18.2	10.9	13.8	9.5	13.1
Manufacture of food products, beverages and tobacco products	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Manufacture of textiles, clothing and leather goods	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Manufacture of wood and products of wood and cork, except furniture; Manufacture of articles of straw and plaiting materials; Manufacture of paper and paper products; Manufacture of publishing, printing and reproduction of recorded material	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.7	0.1	0.6
Manufacture of refined petroleum, coke and nuclear fuel; Manufacture of chemicals and chemical products (incl. pharmaceuticals); Manufacture of rubber and plastic products	4.6	4.5	3.8	0.4	0.6	0.9	0.6	0.0	0.9	0.6
Manufacture of non-metallic mineral products	0.5	0.5	0.4	0.0	0.0	0.0	0.0	10.3	0.0	0.0
Manufacture of basic metals, fabricated metal products, machinery & equipment; Manufacture of office, accounting and computing machinery	14.9	16.9	14.5	15.1	2.9	5.8	3.0	0.0	5.2	4.7
Manufacture of electrical machinery and apparatus	5.1	4.0	2.6	1.0	0.8	9.6	5.1	0.0	0.0	0.0
Manufacture of radio, television and communication equipment & apparatus; Manufacture of medical, precision and optical instruments, watches & clocks	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.0	1.2
Manufacture of transport equipment	4.3	3.6	2.3	2.2	1.8	1.8	2.1	0.0	3.3	5.9
Manufacture of furniture; Recycling; Manufacturing not elsewhere classified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Electricity, gas and water supply	21.5	21.2	26.5	21.5	20.3	25.0	28.0	35.3	42.1	19.5
Construction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wholesale and retail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transport, storage and communication	24.6	24.7	28.0	41.9	57.8	37.5	40.3	19.3	15.7	27.7
Financial intermediation, real estate and business services	9.1	9.8	7.4	10.0	6.7	6.9	7.4	14.1	12.1	20.5
Community, social and personal services	14.6	13.7	13.4	6.9	8.3	11.5	12.5	16.3	19.1	18.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.73: Business sector: SOEs – R&D personnel in headcounts and full-time equivalents by occupation (2012/13 to 2021/22)

YEAR	HEADCOUNTS				FULL-TME EQUIVALENTS (FTEs)			
	TOTAL	RESEARCHERS	TECHNICIANS	OTHER R&D PERSONNEL	TOTAL	RESEARCHERS	TECHNICIANS	OTHER R&D PERSONNEL
2012/13	**2 699**	890	1 351	458	**1 307.1**	548.4	563.8	194.9
2013/14	**2 674**	892	1 334	448	**1 301.1**	541.8	573.0	186.3
2014/15	**2 760**	918	1 479	363	**1 335.3**	541.5	593.2	200.7
2015/16	**2 476**	959	1 163	354	**1 150.1**	477.7	587.9	84.5
2016/17	**2 983**	1 113	1 437	433	**1 213.8**	415.2	688.2	110.4
2017/18	**2 853**	1 509	1 021	323	**1 182.5**	668.6	394.4	119.6
2018/19	**2 738**	1 445	992	301	**984.3**	555.0	316.9	112.5
2019/20	**2 327**	1 146	864	317	**932.8**	472.3	322.5	138.0
2020/21	**2 279**	1 082	878	319	**771.7**	374.7	270.0	127.0
2021/22	**1 797**	857	690	250	**718.0**	318.2	274.0	125.8

Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.74: Business sector: SOEs – R&D personnel in headcounts and full-time equivalents by occupation and gender (2019/20 to 2021/22)

OCCUPATION	HEADCOUNTS			FULL-TIME EQUIVALENTS (FTEs)			
2019/20	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL FTEs AS % OF TOTAL HEADCOUNTS
Researchers	**1 146**	904	242	**472.3**	357.5	114.8	41.2
Technicians directly supporting R&D	**864**	643	221	**322.5**	225.6	96.9	37.3
Other personnel directly supporting R&D	**317**	132	185	**138.0**	52.4	85.7	43.5
Total	2 327	1 679	648	932.8	635.4	297.4	40.1
2020/21	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL FTEs AS % OF TOTAL HEADCOUNTS
Researchers	**1 082**	873	209	**374.7**	286.0	88.8	34.6
Technicians directly supporting R&D	**878**	648	230	**270.0**	181.6	88.4	30.8
Other personnel directly supporting R&D	**319**	131	188	**127.0**	43.2	83.8	39.8
Total	2 279	1 652	627	771.7	510.7	261.0	33.9
2021/22	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL FTEs AS % OF TOTAL HEADCOUNTS
Researchers	**857**	689	168	**318.2**	225.2	93.0	37.1
Technicians directly supporting R&D	**690**	535	155	**274.0**	198.5	75.5	32.0
Other personnel directly supporting R&D	**250**	90	160	**125.8**	31.5	94.3	14.7
Total	1 797	1 314	483	718.0	455.2	262.8	40.0

Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.75: Business sector: SOEs – R&D personnel in headcounts by occupation, qualification, population group and gender (2021/22)

OCCUPATION AND QUALIFICATION	TOTAL	SUBTOTAL		AFRICAN		COLOURED		INDIAN/ASIAN		WHITE		NON-SA	
		MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
Researchers	857	689	168	181	71	28	6	75	26	393	61	12	4
Doctoral degree or equivalent	90	70	20	22	11	3	0	6	4	32	3	7	2
Master's, honours, bachelor or equivalent	697	565	132	146	49	24	6	67	21	323	54	5	2
Diplomas	70	54	16	13	11	1	0	2	1	38	4	0	0
Technicians directly supporting R&D	690	535	155	198	84	23	23	25	4	287	44	2	0
Doctoral degree or equivalent	2	2	0	1	0	0	0	0	0	1	0	0	0
Master's, honours, bachelor or equivalent	174	141	33	62	17	6	4	15	2	56	10	2	0
Diplomas	514	392	122	135	67	17	19	10	2	230	34	0	0
Other personnel directly supporting R&D	250	90	160	43	89	6	10	3	5	38	56	0	0
Doctoral degree or equivalent	0	0	0	0	0	0	0	0	0	0	0	0	0
Master's, honours, bachelor or equivalent	49	16	33	10	20	0	3	2	3	4	7	0	0
Diplomas	201	74	127	33	69	6	7	1	2	34	49	0	0
Total	1 797	1 314	483	422	244	57	39	103	35	718	161	14	4

Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.76: Business sector: SOEs – Number of foreign and local business sector partners engaged in collaborative R&D*, and total R&D collaboration expenditure (2019/20 to 2021/22)

COLLABORATION PARTNERS	2019/20		2020/21		2021/22	
	WITHIN SOUTH AFRICA	OUTSIDE SOUTH AFRICA	WITHIN SOUTH AFRICA	OUTSIDE SOUTH AFRICA	WITHIN SOUTH AFRICA	OUTSIDE SOUTH AFRICA
Government research institutes	5	3	4	3	3	3
Higher education institutions	11	5	10	5	10	4
Members of own company	5	0	3	0	4	0
Not-for-profit organisations	4	1	3	1	3	1
Other companies	4	1	3	1	2	1
Science councils	11	2	10	2	10	1
Total number of R&D collaborations	40	12	33	12	32	10
No collaboration	N/A	N/A	N/A	N/A	N/A	N/A
R&D EXPENDITURE	R'000	R'000	R'000	R'000	R'000	R'000
Total in-house plus outsourced R&D collaboration expenditure (excl. VAT)	N/A	N/A	N/A	N/A	N/A	N/A

Note: Collaborative R&D entails partnerships, alliances and collaborations.
N/A: The indicator 'No collaboration' was not assessed from 2016/17 onwards. Collaboration expenditure was not calculated for 2016/17 onwards.

C.2.2. Not-for-profit sector

Table C.77: Not-for-profit sector R&D expenditure by type of research (2012/13 to 2021/22)

TYPE OF RESEARCH	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Basic research	114 755	132 478	181 492	200 040	232 304	280 032	291 509	349 219	381 683	407 280
Applied research	346 179	322 295	426 132	508 738	558 059	661 575	841 861	779 943	805 222	872 076
Experimental development research	42 898	128 391	171 149	182 365	227 254	274 703	352 334	380 353	381 402	320 201
Total	503 833	583 165	778 772	891 142	1 017 616	1 216 310	1 485 704	1 509 515	1 568 307	1 599 557

Table C.78: Proportional not-for-profit sector R&D expenditure by type of research (2012/13 to 2021/22)

TYPE OF RESEARCH	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Basic research	22.8	22.7	23.3	22.4	22.8	23.0	19.6	23.1	24.3	25.5
Applied research	68.7	55.3	54.7	57.1	54.8	54.4	56.7	51.7	51.3	54.5
Experimental development research	8.5	22.0	22.0	20.5	22.3	22.6	23.7	25.2	24.3	20.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.79: Not-for-profit sector R&D expenditure by accounting category (2012/13 to 2021/22)

TYPE OF EXPENDITURE	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Capital expenditure	37 564	39 983	49 647	53 800	91 083	75 522	103 851	57 865	65 031	80 526
Land: buildings & other structures	11 152	19 047	18 794	18 391	20 765	23 962	41 676	15 201	17 132	24 650
TOTAL: Vehicles, plant, machinery, equipment and software	26 412	20 936	30 853	35 409	70 318	51 560	62 175	42 664	47 899	55 876
Vehicles, plant, machinery, equipment	26 412	20 936	30 853	35 409	70 318	51 560	62 175	38 076	39 173	48 528
*Capitalised computer software	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4 588	8 726	7 348
Current expenditure	466 269	543 182	729 125	837 342	926 534	1 140 787	1 381 853	1 451 650	1 503 276	1 519 030
Labour costs	243 871	303 644	420 462	468 883	506 181	634 168	648 726	681 740	742 825	767 849
Other current expenditure	222 398	239 538	308 663	368 459	420 353	506 620	733 127	769 910	760 451	751 182
Total	503 833	583 165	778 772	891 142	1 017 616	1 216 310	1 485 704	1 509 515	1 568 307	1 599 557

*Capitalised computer software collected from 2019/20.

Table C.80: Proportional not-for-profit sector R&D expenditure by accounting category (2012/13 to 2021/22)

TYPE OF EXPENDITURE	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Capital expenditure	7.5	6.9	6.4	6.0	9.0	6.2	7.0	3.8	4.1	5.0
Land: buildings & other structures	2.2	3.3	2.4	2.1	2.0	2.0	2.8	1.0	1.1	1.5
TOTAL: Vehicles, plant, machinery, equipment and software	5.2	3.6	4.0	4.0	6.9	4.2	4.2	2.8	3.1	3.5
Vehicles, plant, machinery, equipment	5.2	3.6	4.0	4.0	6.9	4.2	4.2	2.5	2.5	3.0
*Capitalised computer software	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	0.6	0.5
Current expenditure	92.5	93.1	93.6	94.0	91.0	93.8	93.0	96.2	95.9	95.0
Labour costs	48.4	52.1	54.0	52.6	49.7	52.1	43.7	45.2	47.4	48.0
Other current expenditure	44.1	41.1	39.6	41.3	41.3	41.7	49.3	51.0	48.5	47.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

*Capitalised computer software collected from 2019/20.

Table C.81: Not-for-profit sector expenditure on multidisciplinary areas of R&D (2012/13 to 2021/22)

MULTI-DISCIPLINARY AREA OF R&D	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Biotechnology	29 062	62 082	128 964	159 045	123 879	160 846	261 324	339 841	305 702	401 968
Nanotechnology	10 187	4 915	70 348	81 103	841	543	569	0	0	0
Total	39 249	66 997	199 312	240 148	124 720	161 389	261 892	339 841	305 702	401 968
NPO expenditure on R&D	503 833	583 165	778 772	891 142	1 017 616	1 216 310	1 485 704	1 509 515	1 568 307	1 599 557

Table C.82: Proportional not-for-profit sector expenditure on multidisciplinary areas of R&D (2012/13 to 2021/22)

MULTI-DISCIPLINARY AREA OF R&D	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Biotechnology	5.8	10.6	16.6	17.8	12.2	13.2	17.6	22.5	19.5	25.1
Nanotechnology	2.0	0.8	9.0	9.1	0.1	0.0	0.0	0.0	0.0	0.0
Total	7.8	11.5	25.6	26.9	12.3	13.3	17.6	22.5	19.5	25.1

Table C.83: Not-for-profit sector R&D expenditure on selected areas of interest (2012/13 to 2021/22)

AREA OF INTEREST	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Environment-related	18 022	27 142	50 364	52 156	54 904	56 218	70 733	85 245	148 730	121 822
Open-source software	419	481	69 509	756	824	952	930	1 335	3 065	4 963
New materials	178	191	634	79 322	223	1 814	0	20 594	27 149	25 925
Tuberculosis, HIV/AIDS, malaria	246 760	301 086	374 460	482 298	689 315	876 132	1 118 507	1 147 804	1 142 974	1 174 877
Space science	N/A	N/A	N/A	N/A	0	0	0	0	0	0
Total	**265 379**	**328 901**	**494 966**	**614 532**	**745 265**	**935 117**	**1 190 170**	**1 254 979**	**1 321 918**	**1 327 587**
NPO expenditure on R&D	**503 833**	**583 165**	**778 772**	**891 142**	**1 017 616**	**1 216 310**	**1 485 704**	**1 509 515**	**1 568 307**	**1 599 557**

N/A: Environment-related data were collected from the 2011/12 R&D Survey onwards. Space science data were collected for the first time in the 2016/17 R&D Survey.

Table C.84: Proportional not-for-profit sector R&D expenditure on selected areas of interest (2012/13 to 2021/22)

AREA OF INTEREST	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Environment-related	3.6	4.7	6.5	5.9	5.4	4.6	4.8	5.6	9.9	7.6
Open-source software	0.1	0.1	8.9	0.1	0.1	0.1	0.1	0.1	0.2	0.3
New materials	0.0	0.0	0.1	8.9	0.0	0.1	0.0	1.4	1.8	1.6
Tuberculosis, HIV/AIDS, malaria	49.0	51.6	48.1	54.1	67.7	72.0	75.3	76.0	75.7	73.5
Space science	N/A	N/A	N/A	N/A	0.0	0.0	0.0	0.0	0.0	0.0
Total	**52.7**	**56.4**	**63.6**	**69.0**	**73.2**	**76.9**	**80.1**	**83.1**	**87.6**	**83.0**

N/A: Environment-related data were collected from the 2011/12 R&D Survey onwards. Space science data were collected for the first time in the 2016/17 R&D Survey.

Table C.85: Not-for-profit sector R&D expenditure by research field (2012/13 to 2021/22)

MAIN RESEARCH FIELD	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Division 1: Natural sciences, technology and engineering	346 961	427 237	647 068	766 355	909 337	1 096 247	1 374 844	1 402 157	1 451 797	1 469 338
Mathematical sciences	8 223	9 674	14 613	14 293	13 540	14 797	16 009	16 684	14 497	45 199
Physical sciences	765	802	989	1 191	1 300	1 504	1 551	1 616	1 284	1 429
Chemical sciences	0	1 309	0	0	0	0	0	0	0	0
Earth sciences	2 598	5 907	8 371	8 356	8 727	8 008	8 594	7 532	9 157	9 399
Information, computer and communication technologies	2 919	39	197	528	0	1 925	0	365	2 350	2 804
Applied sciences and technologies	4 317	4 666	19 123	30 565	29 946	29 379	30 941	31 097	32 863	36 228
Engineering sciences	4 075	4 915	4 638	4 005	3 393	1 572	1 645	1 746	30	554
Biological sciences	15 475	23 435	23 338	11 400	42 787	44 312	62 027	64 866	67 468	68 638

MAIN RESEARCH FIELD	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Agricultural sciences	33 105	34 165	53 777	60 727	62 269	63 037	52 807	52 884	56 448	61 799
Medical and health sciences	265 031	329 293	497 588	614 889	719 902	905 867	1 174 074	1 200 011	1 244 118	1 201 431
Environmental sciences	10 122	12 238	23 548	19 552	25 746	24 150	25 335	23 586	21 949	40 560
Material sciences	0	0	0	0	0	0	0	0	0	0
Marine sciences	331	794	886	848	1 725	1 697	1 860	1 770	1 634	1 296
Division 2: Social sciences and humanities	156 872	155 928	131 705	124 787	108 280	120 063	110 860	107 358	116 510	130 219
Social sciences	142 525	147 029	122 105	117 549	98 355	109 068	99 304	87 132	94 871	104 766
Humanities	14 348	8 898	9 599	7 238	9 925	10 995	11 556	20 226	21 639	25 452
Total	503 833	583 165	778 772	891 142	1 017 616	1 216 310	1 485 704	1 509 515	1 568 307	1 599 557

Table C.86: Proportional not-for-profit sector R&D expenditure by research field (2012/13 to 2021/22)

MAIN RESEARCH FIELD	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Division 1: Natural sciences, technology and engineering	68.9	73.3	83.1	86.0	89.4	90.1	92.5	92.9	92.6	91.9
Mathematical sciences	1.6	1.7	1.9	1.6	1.3	1.2	1.1	1.1	0.9	2.8
Physical sciences	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Chemical sciences	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Earth sciences	0.5	1.0	1.1	0.9	0.9	0.7	0.6	0.5	0.6	0.6
Information, computer and communication technologies	0.6	0.0	0.0	0.1	0.0	0.2	0.0	0.0	0.1	0.2
Applied sciences and technologies	0.9	0.8	2.5	3.4	2.9	2.4	2.1	2.1	2.1	2.3
Engineering sciences	0.8	0.8	0.6	0.4	0.3	0.1	0.1	0.1	0.0	0.0
Biological sciences	3.1	4.0	3.0	1.3	4.2	3.6	4.2	4.3	4.3	4.3
Agricultural sciences	6.6	5.9	6.9	6.8	6.1	5.2	3.6	3.5	3.6	3.9
Medical and health sciences	52.6	56.5	63.9	69.0	70.7	74.5	79.0	79.5	79.3	75.1
Environmental sciences	2.0	2.1	3.0	2.2	2.5	2.0	1.7	1.6	1.4	2.5
Material sciences	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Marine sciences	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1
Division 2: Social sciences and humanities	31.1	26.7	16.9	14.0	10.6	9.9	7.5	7.1	7.4	8.1
Social sciences	28.3	25.2	15.7	13.2	9.7	9.0	6.7	5.8	6.0	6.5
Humanities	2.8	1.5	1.2	0.8	1.0	0.9	0.8	1.3	1.4	1.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.87: Not-for-profit sector R&D expenditure by socio-economic objective (2012/13 to 2021/22)

SOCIO-ECONOMIC OBJECTIVE	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Division 1: Defence	0	0	690	0	0	0	0	0	0	0
Defence	0	0	690	0	0	0	0	0	0	0
Division 2: Economic development	110 866	113 991	152 573	157 608	129 359	118 415	103 702	92 455	108 865	119 692
Economic development unclassified	0	0	0	0	0	0	0	0	0	0
Plant production and plant primary products	36 127	35 511	28 974	32 936	35 240	35 197	26 579	23 124	22 599	22 735
Animal production and animal primary products	2 538	3 083	4 000	7 628	9 856	2 635	2 858	2 378	3 084	4 252
Mineral resources (excluding energy)	8 150	9 831	9 242	7 955	7 708	0	0	0	0	0
Energy resources	2 538	3 083	3 993	4 008	3 278	4 022	4 875	4 508	5 307	8 184
Energy supply	4 363	8 690	7 663	6 242	10 628	7 994	8 852	7 102	8 177	11 197
Manufacturing	3 896	2 955	26 291	31 646	230	0	308	321	316	352
Construction	0	0	0	0	0	0	0	0	0	0
Transport	465	424	0	0	0	0	0	0	0	0
Information and communication services	2 031	1 823	316	2 411	327	2 513	0	365	0	1 854
Commercial services	0	0	0	1 135	1 962	1 675	0	0	0	522
Economic framework	45 252	42 423	54 435	53 406	47 465	57 125	53 099	47 407	52 747	57 058
Natural resources	5 507	6 167	17 659	10 242	12 665	7 253	7 131	7 251	16 635	13 538
Division 3: Society	360 333	415 093	555 151	632 030	767 620	941 505	1 058 928	1 079 921	1 218 236	1 140 634
Society unclassified	0	0	0	0	0	0	0	0	0	0
Health	260 712	303 535	449 619	527 783	667 371	835 603	955 738	962 721	1 074 859	993 512
Education and training	58 894	63 833	61 150	59 917	59 123	61 652	60 123	80 287	102 542	95 100
Social development and community services	40 726	47 725	44 382	44 330	41 126	44 250	43 066	36 913	40 835	52 022
Division 4: Environment	12 841	15 044	16 135	17 503	19 734	38 078	39 974	37 194	45 433	46 995
Environment unclassified	0	0	0	0	0	0	0	0	0	0
Environmental knowledge	4 716	7 845	8 697	9 949	9 712	23 780	23 201	22 225	30 236	35 262
Environmental aspects of development	5 771	4 545	4 569	4 494	6 269	6 559	7 544	6 393	7 294	7 428

SOCIO-ECONOMIC OBJECTIVE	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Environmental and other aspects	2 355	2 654	2 869	3 060	3 753	7 739	9 229	8 576	7 903	4 305
Division 5: Advancement of knowledge	19 793	39 036	54 223	84 002	100 903	118 312	283 100	299 945	195 773	292 236
Advancement of knowledge unclassified	0	0	0	0	0	0	0	0	0	0
Natural sciences, technologies and engineering	7 754	31 450	42 017	69 845	90 114	107 310	272 540	286 464	186 060	280 279
Social sciences and humanities	12 039	7 586	12 206	14 157	10 789	11 001	10 561	13 481	9 713	11 957
Total	503 833	583 165	778 772	891 142	1 017 616	1 216 310	1 485 704	1 509 515	1 568 307	1 599 557

Table C.88: Proportional not-for-profit sector R&D expenditure by socio-economic objective (2012/13 to 2021/22)

SOCIO-ECONOMIC OBJECTIVE	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Division 1: Defence	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Defence	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Division 2: Economic development	22.0	19.5	19.6	17.7	12.7	9.7	7.0	6.1	6.9	7.5
Economic development unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Plant production and plant primary products	7.2	6.1	3.7	3.7	3.5	2.9	1.8	1.5	1.4	1.4
Animal production and animal primary products	0.5	0.5	0.5	0.9	1.0	0.2	0.2	0.2	0.2	0.3
Mineral resources (excluding energy)	1.6	1.7	1.2	0.9	0.8	0.0	0.0	0.0	0.0	0.0
Energy resources	0.5	0.5	0.5	0.4	0.3	0.3	0.3	0.3	0.3	0.5
Energy supply	0.9	1.5	1.0	0.7	1.0	0.7	0.6	0.5	0.5	0.7
Manufacturing	0.8	0.5	3.4	3.6	0.0	0.0	0.0	0.0	0.0	0.0
Construction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transport	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Information and communication services	0.4	0.3	0.0	0.3	0.0	0.2	0.0	0.0	0.0	0.1
Commercial services	0.0	0.0	0.0	0.1	0.2	0.1	0.0	0.0	0.0	0.0
Economic framework	9.0	7.3	7.0	6.0	4.7	4.7	3.6	3.1	3.4	3.6
Natural resources	1.1	1.1	2.3	1.1	1.2	0.6	0.5	0.5	1.1	0.8

SOCIO-ECONOMIC OBJECTIVE	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
	%	%	%	%	%	%	%	%	%	%
Division 3: Society	71.5	71.2	71.3	70.9	75.4	77.4	71.3	71.5	77.7	71.3
Society unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Health	51.7	52.0	57.7	59.2	65.6	68.7	64.3	63.8	68.5	62.1
Education and training	11.7	10.9	7.9	6.7	5.8	5.1	4.0	5.3	6.5	5.9
Social development and community services	8.1	8.2	5.7	5.0	4.0	3.6	2.9	2.4	2.6	3.3
Division 4: Environment	2.5	2.6	2.1	2.0	1.9	3.1	2.7	2.5	2.9	2.9
Environment unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Environmental knowledge	0.9	1.3	1.1	1.1	1.0	2.0	1.6	1.5	1.9	2.2
Environmental aspects of development	1.1	0.8	0.6	0.5	0.6	0.5	0.5	0.4	0.5	0.5
Environmental and other aspects	0.5	0.5	0.4	0.3	0.4	0.6	0.6	0.6	0.5	0.3
Division 5: Advancement of knowledge	3.9	6.7	7.0	9.4	9.9	9.7	19.1	19.9	12.5	18.3
Advancement of knowledge unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Natural sciences, technologies and engineering	1.5	5.4	5.4	7.8	8.9	8.8	18.3	19.0	11.9	17.5
Social sciences and humanities	2.4	1.3	1.6	1.6	1.1	0.9	0.7	0.9	0.6	0.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.89: Not-for-profit sector R&D expenditure by province (2012/13 to 2021/22)

PROVINCE	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000
Eastern Cape	25 610	25 478	27 219	21 026	17 053	15 150	19 452	19 676	20 462	14 846
Free State	15 297	15 953	14 214	8 890	6 643	8 086	11 332	29 633	9 743	2 432
Gauteng	162 866	175 651	287 783	345 937	333 359	440 863	528 725	543 971	572 423	469 019
KwaZulu-Natal	163 221	166 603	181 052	232 636	277 770	317 706	316 771	267 615	357 192	334 603
Limpopo	11 779	13 719	49 971	56 143	64 105	78 996	67 940	79 897	92 664	118 601
Mpumalanga	23 195	26 979	30 594	25 944	29 964	32 775	29 863	25 003	18 360	17 170
North West	42 960	72 446	105 904	97 918	136 641	133 473	136 626	162 503	171 737	140 181
Northern Cape	3 867	3 583	1 546	2 200	4 782	4 868	3 238	3 837	2 389	70 706
Western Cape	55 038	82 753	80 489	100 448	147 299	184 392	371 758	377 380	323 336	431 998
Total	503 833	583 165	778 772	891 142	1 017 616	1 216 310	1 485 704	1 509 515	1 568 307	1 599 557

Table C.90: Proportional not-for-profit sector R&D expenditure by province (2012/13 to 2021/22)

PROVINCE	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
	%	%	%	%	%	%	%	%	%	%
Eastern Cape	5.1	4.4	3.5	2.4	1.7	1.2	1.3	1.3	1.3	0.9
Free State	3.0	2.7	1.8	1.0	0.7	0.7	0.8	2.0	0.6	0.2
Gauteng	32.3	30.1	37.0	38.8	32.8	36.2	35.6	36.0	36.5	29.3
KwaZulu-Natal	32.4	28.6	23.2	26.1	27.3	26.1	21.3	17.7	22.8	20.9
Limpopo	2.3	2.4	6.4	6.3	6.3	6.5	4.6	5.3	5.9	7.4
Mpumalanga	4.6	4.6	3.9	2.9	2.9	2.7	2.0	1.7	1.2	1.1
North West	8.5	12.4	13.6	11.0	13.4	11.0	9.2	10.8	11.0	8.8
Northern Cape	0.8	0.6	0.2	0.2	0.5	0.4	0.2	0.3	0.2	4.4
Western Cape	10.9	14.2	10.3	11.3	14.5	15.2	25.0	25.0	20.6	27.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.91: Not-for-profit sector R&D personnel in headcounts and full-time equivalents by occupation (2012/13 to 2021/22)

YEAR	HEADCOUNTS				FULL-TME EQUIVALENTS (FTEs)			
	TOTAL	RESEARCHERS	TECHNICIANS	OTHER R&D PERSONNEL	TOTAL	RESEARCHERS	TECHNICIANS	OTHER R&D PERSONNEL
2012/13	**906**	394	132	380	**768.0**	294.5	114.2	359.4
2013/14	**1 017**	435	205	377	**891.4**	338.4	195.1	357.9
2014/15	**1 471**	506	368	597	**1 231.2**	396.0	355.5	479.8
2015/16	**1 493**	465	436	592	**1 367.3**	384.8	411.2	571.2
2016/17	**1 616**	404	607	605	**1 469.5**	340.5	575.6	553.4
2017/18	**1 741**	425	678	638	**1 596.0**	346.1	644.7	605.2
2018/19	**1 937**	424	843	670	**1 685.8**	367.3	693.2	625.4
2019/20	**1 925**	390	878	657	**1 710.1**	330.9	766.0	613.3
2020/21	**1 795**	431	718	646	**1 556.1**	352.0	595.7	608.4
2021/22	**1 844**	444	680	720	**1 577.1**	349.4	549.4	678.3

Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.92: Not-for-profit sector R&D personnel in headcounts and full-time equivalents by occupation and gender (2019/20 to 2021/22)

OCCUPATION	HEADCOUNTS			FULL-TIME EQUIVALENTS (FTEs)			
2019/20	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL FTEs AS % OF TOTAL HEADCOUNTS
Researchers	**390**	162	228	**330.9**	132.7	198.2	84.8
Technicians directly supporting R&D	**878**	214	664	**766.0**	195.3	570.7	87.2
Other personnel directly supporting R&D	**657**	189	468	**613.3**	175.0	438.3	93.3
Total	1 925	565	1 360	1 710.1	502.9	1 207.1	88.8
2020/21	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL FTEs AS % OF TOTAL HEADCOUNTS
Researchers	**431**	179	252	**352.0**	148.2	203.8	81.7
Technicians directly supporting R&D	**718**	193	525	**595.7**	152.6	443.1	83.0
Other personnel directly supporting R&D	**646**	188	458	**608.4**	177.3	431.1	94.2
Total	1 795	560	1 235	1 556.1	478.2	1 077.9	86.7
2021/22	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL FTEs AS % OF TOTAL HEADCOUNTS
Researchers	**444**	171	273	**349.4**	135.7	213.7	78.7
Technicians directly supporting R&D	**680**	182	498	**549.4**	133.5	415.9	80.8
Other personnel directly supporting R&D	**720**	213	507	**678.3**	203.0	475.3	94.2
Total	1 844	566	1 278	1 577.1	472.2	1 104.9	85.5

Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.93: Not-for-profit sector R&D personnel in headcounts by occupation, qualification, population group and gender (2021/22)

OCCUPATION AND QUALIFICATION	TOTAL	SUBTOTAL		AFRICAN		COLOURED		INDIAN/ASIAN		WHITE		NON-SA	
		MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
Researchers	444	171	273	63	95	4	26	14	36	80	99	10	17
Doctoral degree or equivalent	114	52	62	11	14	1	6	4	12	33	26	3	4
Master's, honours, bachelor or equivalent	277	97	180	38	69	3	18	5	16	44	65	7	12
Diplomas	53	22	31	14	12	0	2	5	8	3	8	0	1
Technicians directly supporting R&D	680	182	498	123	290	16	83	10	50	27	63	6	12
Doctoral degree or equivalent	11	3	8	1	0	0	1	0	3	2	4	0	0
Master's, honours, bachelor or equivalent	281	63	218	27	99	7	37	6	38	19	35	4	9
Diplomas	388	116	272	95	191	9	45	4	9	6	24	2	3
Other personnel directly supporting R&D	720	213	507	182	383	2	31	7	44	16	42	6	7
Doctoral degree or equivalent	14	7	7	2	1	0	4	1	0	3	2	1	0
Master's, honours, bachelor or equivalent	136	32	104	24	53	2	8	0	27	5	15	1	1
Diplomas	570	174	396	156	329	0	19	6	17	8	25	4	6
Total	1 844	566	1 278	368	768	22	140	31	130	123	204	22	36

Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

C.2.3. Government sector

Table C.94: Government sector R&D expenditure by type of research (2012/13 to 2021/22)

TYPE OF RESEARCH	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Basic research	331 587	245 167	338 250	358 666	348 775	329 263	416 131	400 775	411 837	442 048
Applied research	873 469	1 194 866	1 292 421	1 390 221	1 444 821	1 685 367	1 495 783	1 241 999	1 572 122	1 762 689
Experimental development research	232 453	257 118	262 339	264 134	305 051	311 246	311 513	250 769	253 572	267 697
Total	1 437 509	1 697 151	1 893 010	2 013 021	2 098 646	2 325 875	2 223 426	1 893 543	2 237 531	2 472 434

Table C.95: Proportional government sector R&D expenditure by type of research (2012/13 to 2021/22)

TYPE OF RESEARCH	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Basic research	23.1	14.4	17.9	17.8	16.6	14.2	18.7	21.2	18.4	17.9
Applied research	60.8	70.4	68.3	69.1	68.8	72.5	67.3	65.6	70.3	71.3
Experimental development research	16.2	15.1	13.9	13.1	14.5	13.4	14.0	13.2	11.3	10.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.96: Government sector R&D expenditure by spheres and institutes of government and accounting category (2012/13 to 2021/22)

TYPE OF EXPENDITURE	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000
Municipalities	**65 541**	**59 418**	**62 485**	**61 703**	**76 493**	**59 114**	**84 160**	**99 754**	**106 207**	**122 886**
Capital expenditure	**18 605**	**23 033**	**12 921**	**13 059**	**20 271**	**13 265**	**30 048**	**20 120**	**24 170**	**17 150**
Land: buildings and other structures	5 400	10 000	6 537	6 598	9 575	7 065	13 305	8 500	8 750	2 750
TOTAL: Vehicles, plant, machinery, equipment and software	13 205	13 033	6 384	6 461	10 696	6 200	16 743	11 620	15 420	14 400
Vehicles, plant, machinery, equipment	13 205	13 033	6 384	6 461	10 696	6 200	16 743	7 900	9 600	8 500
*Capitalised computer software	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3 720	5 820	5 900
Current expenditure	**46 936**	**36 385**	**49 564**	**48 644**	**56 222**	**45 849**	**54 112**	**79 634**	**82 037**	**105 736**
Labour costs	30 131	27 513	39 314	38 687	41 407	38 279	42 316	70 310	74 527	77 686
Other current expenditure	16 805	8 872	10 250	9 957	14 815	7 570	11 796	9 324	7 510	28 050
Provincial departments	**372 231**	**390 301**	**421 126**	**401 512**	**405 760**	**411 195**	**410 454**	**412 428**	**427 623**	**446 832**
Capital expenditure	**45 895**	**45 930**	**39 325**	**43 918**	**48 084**	**35 517**	**27 502**	**44 238**	**42 072**	**29 115**
Land: buildings and other structures	7 255	6 348	5 500	7 900	12 264	14 864	12 130	14 035	13 506	10 548
TOTAL: Vehicles, plant, machinery, equipment and software	38 640	39 582	33 825	36 018	35 820	20 653	15 372	30 203	28 566	18 567
Vehicles, plant, machinery, equipment	38 640	39 582	33 825	36 018	35 820	20 653	15 372	25 056	25 763	14 980
*Capitalised computer software	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5 147	2 803	3 587
Current expenditure	**326 336**	**344 371**	**381 801**	**357 594**	**357 676**	**375 678**	**382 951**	**368 190**	**385 551**	**417 716**
Labour costs	236 367	233 321	248 823	225 621	252 286	264 285	252 129	265 436	278 148	277 591
Other current expenditure	89 969	111 050	132 978	131 973	105 390	111 393	130 823	102 754	107 403	140 125
National departments	**321 632**	**249 705**	**248 041**	**356 575**	**408 803**	**512 743**	**546 432**	**453 849**	**668 116**	**729 031**
Capital expenditure	**32 669**	**17 540**	**4 406**	**57 905**	**56 999**	**71 632**	**77 174**	**66 915**	**78 421**	**86 032**
Land: buildings and other structures	12 783	2 122	811	18 037	6 424	6 920	16 143	18 321	17 861	18 480
TOTAL: Vehicles, plant, machinery, equipment and software	19 886	15 418	3 595	39 868	50 575	64 712	61 031	48 594	60 560	67 552
Vehicles, plant, machinery, equipment	19 886	15 418	3 595	39 868	50 575	64 712	61 031	46 705	58 950	65 957
*Capitalised computer software	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1 889	1 610	1 595
Current expenditure	**288 963**	**232 165**	**243 635**	**298 670**	**351 804**	**441 111**	**469 258**	**386 934**	**589 695**	**642 999**
Labour costs	158 808	198 440	150 921	171 849	216 103	228 761	194 471	204 110	181 989	198 143
Other current expenditure	130 155	33 725	92 714	126 821	135 701	212 350	274 787	182 824	407 706	444 856
Government research institutes	**644 360**	**973 807**	**1 134 875**	**1 165 161**	**1 179 994**	**1 326 427**	**1 161 197**	**885 825**	**996 858**	**1 128 652**
Capital expenditure	**157 221**	**98 010**	**233 386**	**202 878**	**199 952**	**271 029**	**342 078**	**254 023**	**236 377**	**276 091**
Land: buildings and other structures	58 280	4 542	93 477	112 710	107 971	131 824	105 507	116 115	132 749	133 505
TOTAL: Vehicles, plant, machinery, equipment and software	98 941	93 468	139 909	90 168	91 981	139 205	236 571	137 908	103 628	142 586
Vehicles, plant, machinery, equipment	98 941	93 468	139 909	90 168	91 981	139 205	236 571	132 565	93 433	119 181
*Capitalised computer software	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5 343	10 195	23 405
Current expenditure	**487 139**	**875 797**	**901 489**	**962 283**	**980 042**	**1 055 398**	**819 119**	**631 802**	**760 482**	**852 561**
Labour costs	355 503	316 256	375 939	311 876	323 121	328 656	394 182	425 678	459 866	574 592
Other current expenditure	131 636	559 541	525 550	650 407	656 921	726 741	424 937	206 124	300 616	277 969
Museums	**33 745**	**23 920**	**26 484**	**28 070**	**27 596**	**16 396**	**21 184**	**41 688**	**38 727**	**45 033**
Capital expenditure	**649**	**946**	**1 996**	**2 005**	**2 704**	**796**	**2 106**	**5 574**	**6 679**	**4 100**
Land: buildings and other structures	30	638	687	663	774	0	0	1 346	50	1 066
TOTAL: Vehicles, plant, machinery, equipment and software	619	308	1 309	1 342	1 930	796	2 106	4 228	6 629	3 034
Vehicles, plant, machinery, equipment	619	308	1 309	1 342	1 930	796	2 106	2 626	6 349	2 825
*Capitalised computer software	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1 602	280	209
Current expenditure	**33 096**	**22 974**	**24 488**	**26 065**	**24 892**	**15 600**	**19 078**	**36 114**	**32 048**	**40 933**
Labour costs	25 471	20 769	22 429	23 751	24 004	14 775	17 610	29 837	30 059	36 680
Other current expenditure	7 625	2 205	2 059	2 314	888	825	1 468	6 277	1 989	4 253
Government sector	**1 437 509**	**1 697 151**	**1 893 010**	**2 013 021**	**2 098 646**	**2 325 875**	**2 223 426**	**1 893 543**	**2 237 531**	**2 472 434**
Capital expenditure	**255 039**	**185 459**	**292 034**	**319 765**	**328 010**	**392 239**	**478 908**	**390 870**	**387 719**	**412 488**
Land: buildings and other structures	83 748	23 650	107 012	145 908	137 008	160 673	147 085	158 317	172 916	166 349
TOTAL: Vehicles, plant, machinery, equipment and software	171 291	161 809	185 022	173 857	191 002	231 566	331 823	232 553	214 803	246 139
Vehicles, plant, machinery, equipment	171 291	161 809	185 022	173 857	191 002	231 566	331 823	214 852	194 095	211 443
*Capitalised computer software	N/A	N/A	N/A	N/A	N/A	N/A	N/A	17 701	20 708	34 696
Current expenditure	**1 182 470**	**1 511 692**	**1 600 976**	**1 693 256**	**1 770 636**	**1 933 636**	**1 744 518**	**1 502 673**	**1 849 812**	**2 059 946**
Labour costs	806 280	796 299	837 425	771 784	856 921	874 757	900 707	995 370	1 024 588	1 164 692
Other current expenditure	376 190	715 393	763 551	921 472	913 715	1 058 879	843 811	507 303	825 224	895 253

N/A: Municipal data were collected from the 2012/13 R&D Survey onwards. *Capitalised computer software collected from 2019/20.

Table C.97: Proportional government sector R&D expenditure by spheres and institutes of government and accounting category (2012/13 to 2021/22)

TYPE OF EXPENDITURE	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
	%	%	%	%	%	%	%	%	%	%
Municipalities	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Capital expenditure	28.4	38.8	20.7	21.2	26.5	22.4	35.7	20.2	22.8	14.0
Land: buildings and other structures	8.2	16.8	10.5	10.7	12.5	12.0	15.8	8.5	8.2	2.2
TOTAL: Vehicles, plant, machinery, equipment and software	20.1	21.9	10.2	10.5	14.0	10.5	19.9	11.6	14.5	11.7
Vehicles, plant, machinery, equipment	20.1	21.9	10.2	10.5	14.0	10.5	19.9	7.9	9.0	6.9
*Capitalised computer software	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.7	5.5	4.8
Current expenditure	71.6	61.2	79.3	78.8	73.5	77.6	64.3	79.8	77.2	86.0
Labour costs	46.0	46.3	62.9	62.7	54.1	64.8	50.3	70.5	70.2	63.2
Other current expenditure	25.6	14.9	16.4	16.1	19.4	12.8	14.0	9.3	7.1	22.8
Provincial departments	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Capital expenditure	12.3	11.8	9.3	10.9	11.9	8.6	6.7	10.7	9.8	6.5
Land: buildings and other structures	1.9	1.6	1.3	2.0	3.0	3.6	3.0	3.4	3.2	2.4
TOTAL: Vehicles, plant, machinery, equipment and software	10.4	10.1	8.0	9.0	8.8	5.0	3.7	7.3	6.7	4.2
Vehicles, plant, machinery, equipment	10.4	10.1	8.0	9.0	8.8	5.0	3.7	6.1	6.0	3.4
*Capitalised computer software	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.2	0.7	0.8
Current expenditure	87.7	88.2	90.7	89.1	88.1	91.4	93.3	89.3	90.2	93.5
Labour costs	63.5	59.8	59.1	56.2	62.2	64.3	61.4	64.4	65.0	62.1
Other current expenditure	24.2	28.5	31.6	32.9	26.0	27.1	31.9	24.9	25.1	31.4
National departments	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Capital expenditure	10.2	7.0	1.8	16.2	13.9	14.0	14.1	14.7	11.7	11.8
Land: buildings and other structures	4.0	0.8	0.3	5.1	1.6	1.3	3.0	4.0	2.7	2.5
TOTAL: Vehicles, plant, machinery, equipment and software	6.2	6.2	1.4	11.2	12.4	12.6	11.2	10.7	9.1	9.3
Vehicles, plant, machinery, equipment	6.2	6.2	1.4	11.2	12.4	12.6	11.2	10.3	8.8	9.0
*Capitalised computer software	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.4	0.2	0.2
Current expenditure	89.8	93.0	98.2	83.8	86.1	86.0	85.9	85.3	88.3	88.2
Labour costs	49.4	79.5	60.8	48.2	52.9	44.6	35.6	45.0	27.2	27.2
Other current expenditure	40.5	13.5	37.4	35.6	33.2	41.4	50.3	40.3	61.0	61.0
Government research institutes	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Capital expenditure	24.4	10.1	20.6	17.4	16.9	20.4	29.5	28.7	23.7	24.5
Land: buildings and other structures	9.0	0.5	8.2	9.7	9.2	9.9	9.1	13.1	13.3	11.8
TOTAL: Vehicles, plant, machinery, equipment and software	15.4	9.6	12.3	7.7	7.8	10.5	20.4	15.6	10.4	12.6
Vehicles, plant, machinery, equipment	15.4	9.6	12.3	7.7	7.8	10.5	20.4	15.0	9.4	10.6
*Capitalised computer software	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.6	1.0	2.1
Current expenditure	75.6	89.9	79.4	82.6	83.1	79.6	70.5	71.3	76.3	75.5
Labour costs	55.2	32.5	33.1	26.8	27.4	24.8	33.9	48.1	46.1	50.9
Other current expenditure	20.4	57.5	46.3	55.8	55.7	54.8	36.6	23.3	30.2	24.6
Museums	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Capital expenditure	1.9	4.0	7.5	7.1	9.8	4.9	9.9	13.4	17.2	9.1
Land: buildings and other structures	0.1	2.7	2.6	2.4	2.8	0.0	0.0	3.2	0.1	2.4
TOTAL: Vehicles, plant, machinery, equipment and software	1.8	1.3	4.9	4.8	7.0	4.9	9.9	10.1	17.1	6.7
Vehicles, plant, machinery, equipment	1.8	1.3	4.9	4.8	7.0	4.9	9.9	6.3	16.4	6.3
*Capitalised computer software	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.8	0.7	0.5
Current expenditure	98.1	96.0	92.5	92.9	90.2	95.1	90.1	86.6	82.8	90.9
Labour costs	75.5	86.8	84.7	84.6	87.0	90.1	83.1	71.6	77.6	81.5
Other current expenditure	22.6	9.2	7.8	8.2	3.2	5.0	6.9	15.1	5.1	9.4
Government sector	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Capital expenditure	17.7	10.9	15.4	15.9	15.6	16.9	21.5	20.6	17.3	16.7
Land: buildings and other structures	5.8	1.4	5.7	7.2	6.5	6.9	6.6	8.4	7.7	6.7
TOTAL: Vehicles, plant, machinery, equipment and software	11.9	9.5	9.8	8.6	9.1	10.0	14.9	12.3	9.6	10.0
Vehicles, plant, machinery, equipment	11.9	9.5	9.8	8.6	9.1	10.0	14.9	11.3	8.7	8.6
*Capitalised computer software	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.9	0.9	1.4
Current expenditure	82.3	89.1	84.6	84.1	84.4	83.1	78.5	79.4	82.7	83.3
Labour costs	56.1	46.9	44.2	38.3	40.8	37.6	40.5	52.6	45.8	47.1
Other current expenditure	26.2	42.2	40.3	45.8	43.5	45.5	38.0	26.8	36.9	36.2

N/A: Municipal data were collected from the 2011/12 R&D Survey onwards. *Capitalised computer software collected from 2019/20.

Table C.98: Government sector expenditure on multidisciplinary areas of R&D (2012/13 to 2021/22)

MULTI-DISCIPLINARY AREA OF R&D	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Biotechnology	124 429	97 816	85 385	81 409	87 557	84 738	89 293	100 237	104 270	64 506
Nanotechnology	15 035	16 929	13 112	11 774	12 620	12 741	24 732	10 784	13 115	13 490
Total	**139 464**	**114 745**	**98 497**	**93 183**	**100 176**	**97 479**	**114 025**	**111 021**	**117 385**	**77 996**
Government expenditure on R&D	**1 437 509**	**1 697 151**	**1 893 010**	**2 013 021**	**2 098 646**	**2 325 875**	**2 223 426**	**1 893 543**	**2 237 531**	**2 472 434**

Table C.99: Proportional government sector expenditure on multidisciplinary areas of R&D (2012/13 to 2021/22)

MULTI-DISCIPLINARY AREA OF R&D	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Biotechnology	8.7	5.8	4.5	4.0	4.2	3.6	4.0	5.3	4.7	2.6
Nanotechnology	1.0	1.0	0.7	0.6	0.6	0.5	1.1	0.6	0.6	0.5
Total	**9.7**	**6.8**	**5.2**	**4.6**	**4.8**	**4.2**	**5.1**	**5.9**	**5.2**	**3.2**

Table C.100: Government sector R&D expenditure on selected areas of interest (2012/13 to 2021/22)

AREA OF INTEREST	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Environment-related	170 304	194 564	232 090	192 774	202 351	316 188	339 012	314 713	552 121	551 439
Open-source software	1 501	0	0	0	0	597	711	5 553	43 034	45 500
New materials	28 708	30 945	12 062	5 291	6 143	7 599	13 172	8 594	15 866	21 353
Tuberculosis, HIV/AIDS, malaria	132 264	380 640	359 074	389 279	395 996	435 045	237 974	114 727	190 057	212 240
Space science	N/A	N/A	N/A	N/A	39 882	0	0	51 887	52 566	28 322
Total	**332 777**	**606 149**	**603 226**	**587 343**	**644 372**	**759 430**	**590 869**	**495 475**	**853 644**	**858 854**
Government expenditure on R&D	**1 437 509**	**1 697 151**	**1 893 010**	**2 013 021**	**2 098 646**	**2 325 875**	**2 223 426**	**1 893 543**	**2 237 531**	**2 472 434**

N/A: Environment-related data were collected from the 2011/12 R&D Survey onwards. Space science data were collected for the first time in the 2016/17 R&D Survey.

Table C.101: Proportional government sector R&D expenditure on selected areas of interest (2012/13 to 2021/22)

AREA OF INTEREST	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Environment-related	11.8	11.5	12.3	9.6	9.6	13.6	15.2	16.6	24.7	22.3
Open-source software	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.9	1.8
New materials	2.0	1.8	0.6	0.3	0.3	0.3	0.6	0.5	0.7	0.9
Tuberculosis, HIV/AIDS, malaria	9.2	22.4	19.0	19.3	18.9	18.7	10.7	6.1	8.5	8.6
Space science	N/A	N/A	N/A	N/A	1.9	0.0	0.0	2.7	2.3	1.1
Total	**23.1**	**24.3**	**19.6**	**29.2**	**30.7**	**32.7**	**26.6**	**26.2**	**38.2**	**34.7**

N/A: Environment-related data were collected from the 2011/12 R&D Survey onwards. Space science data were collected for the first time in the 2016/17 R&D Survey.

Table C.102: Government sector R&D expenditure by research field (2012/13 to 2021/22)

MAIN RESEARCH FIELD	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Division 1: Natural sciences, technology and engineering	1 045 006	1 359 179	1 558 094	1 520 894	1 560 315	1 722 617	1 592 766	1 401 551	1 739 342	1 860 053
Mathematical sciences	1 076	1 525	28 302	397	539	85	1 855	11 408	8 075	7 075
Physical sciences	5 064	0	30 154	26 455	28 529	49 051	54 017	8 725	5 105	5 971
Chemical sciences	21 823	19 394	61 881	61 688	68 937	73 898	81 603	45 405	32 280	35 965
Earth sciences	90 571	65 501	139 388	79 942	85 550	50 110	103 767	163 319	359 200	327 087
Information, computer and communication technologies	7 760	8 431	12 141	4 662	5 540	398	0	0	35 986	36 418
Applied sciences and technologies	32 467	23 216	29 723	22 531	25 444	23 016	38 562	49 438	45 394	40 847
Engineering sciences	10 430	11 853	13 176	12 129	13 572	17 076	14 574	14 071	27 752	6 568
Biological sciences	111 871	138 000	152 735	196 053	195 922	215 624	254 654	246 541	187 733	261 068
Agricultural sciences	460 921	397 687	506 445	471 798	485 417	523 343	557 157	591 668	566 999	618 335
Medical and health sciences	211 840	594 684	553 534	608 530	615 067	673 437	370 294	167 039	307 108	343 477
Environmental sciences	54 394	55 245	14 353	14 478	13 921	13 085	17 270	29 249	30 808	29 510
Material sciences	9 771	10 537	0	0	0	0	0	0	3 244	3 050
Marine sciences	27 019	33 106	16 262	22 232	21 877	83 495	99 013	74 686	129 657	144 682
Division 2: Social sciences and humanities	392 503	337 972	334 916	492 127	538 331	603 258	630 660	491 992	498 188	612 381
Social sciences	383 172	326 603	328 522	479 316	529 080	591 813	620 433	476 565	485 014	600 385
Humanities	9 331	11 369	6 394	12 811	9 251	11 445	10 227	15 427	13 174	11 997
Total	1 437 509	1 697 151	1 893 010	2 013 021	2 098 646	2 325 875	2 223 426	1 893 543	2 237 531	2 472 434

Table C.103: Proportional government sector R&D expenditure by research field (2012/13 to 2021/22)

MAIN RESEARCH FIELD	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Division 1: Natural sciences, technology and engineering	72.7	80.1	82.3	75.6	74.3	74.1	71.6	74.0	77.7	75.2
Mathematical sciences	0.1	0.1	1.5	0.0	0.0	0.0	0.1	0.6	0.4	0.3
Physical sciences	0.4	0.0	1.6	1.3	1.4	2.1	2.4	0.5	0.2	0.2
Chemical sciences	1.5	1.1	3.3	3.1	3.3	3.2	3.7	2.4	1.4	1.5
Earth sciences	6.3	3.9	7.4	4.0	4.1	2.2	4.7	8.6	16.1	13.2

MAIN RESEARCH FIELD	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
	%	%	%	%	%	%	%	%	%	%
Information, computer and communication technologies	0.5	0.5	0.6	0.2	0.3	0.0	0.0	0.0	1.6	1.5
Applied sciences and technologies	2.3	1.4	1.6	1.1	1.2	1.0	1.7	2.6	2.0	1.7
Engineering sciences	0.7	0.7	0.7	0.6	0.6	0.7	0.7	0.7	1.2	0.3
Biological sciences	7.8	8.1	8.1	9.7	9.3	9.3	11.5	13.0	8.4	10.6
Agricultural sciences	32.1	23.4	26.8	23.4	23.1	22.5	25.1	31.2	25.3	25.0
Medical and health sciences	14.7	35.0	29.2	30.2	29.3	29.0	16.7	8.8	13.7	13.9
Environmental sciences	3.8	3.3	0.8	0.7	0.7	0.6	0.8	1.5	1.4	1.2
Material sciences	0.7	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Marine sciences	1.9	2.0	0.9	1.1	1.0	3.6	4.5	3.9	5.8	5.9
Division 2: Social sciences and humanities	27.3	19.9	17.7	24.4	25.7	25.9	28.4	26.0	22.3	24.8
Social sciences	26.7	19.2	17.4	23.8	25.2	25.4	27.9	25.2	21.7	24.3
Humanities	0.6	0.7	0.3	0.6	0.4	0.5	0.5	0.8	0.6	0.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.104: Government sector R&D expenditure by socio-economic objective (2012/13 to 2021/22)

SOCIO-ECONOMIC OBJECTIVE	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000
Division 1: Defence	19 314	21 118	21 472	42 233	34 213	7 582	46 886	31 484	26 989	22 188
Defence	19 314	21 118	21 472	42 233	34 213	7 582	46 886	31 484	26 989	22 188
Division 2: Economic development	480 373	510 688	763 932	745 129	826 860	1 009 575	1 117 257	1 045 765	1 068 644	1 257 768
Economic development unclassified	0	0	0	0	0	0	0	0	0	0
Plant production and plant primary products	100 956	89 446	107 672	92 506	103 212	117 664	115 406	127 551	117 715	114 499
Animal production and animal primary products	93 504	137 279	156 437	125 737	134 227	129 024	135 755	141 189	131 528	141 857
Mineral resources (excluding energy)	0	311	5 403	6 548	2 854	12 395	5 508	5 729	4 829	5 159
Energy resources	0	1 023	12 062	5 291	5 716	5 706	6 413	2 446	1 312	1 312
Energy supply	7 193	8 482	34 845	29 705	32 772	40 959	53 254	15 204	11 714	30 105
Manufacturing	1 557	1 544	79 583	1 318	5 201	5 433	10 794	15 855	28 956	14 533
Construction	543	741	4 312	1 394	1 501	1 584	8 501	6 112	5 935	28 103
Transport	8 774	1 672	24 105	21 537	24 896	21 926	7 268	9 686	7 231	7 186

SOCIO-ECONOMIC OBJECTIVE	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Information and communication services	5 678	5 515	14 397	7 977	6 071	19 938	18 583	13 385	5 220	14 292
Commercial services	3 587	12 162	15 532	13 531	12 616	47 515	72 388	55 141	53 609	9 749
Economic framework	161 541	116 604	167 690	262 289	343 537	394 216	404 073	381 306	388 478	503 328
Natural resources	97 042	135 909	141 895	177 298	154 258	213 214	279 313	272 162	312 117	387 645
Division 3: Society	**592 285**	**872 096**	**912 216**	**952 108**	**951 859**	**1 029 316**	**746 234**	**529 902**	**669 831**	**711 446**
Society unclassified	0	0	0	0	0	0	0	0	0	0
Health	171 741	487 130	475 983	482 472	511 031	554 746	303 831	137 831	253 420	285 713
Education and training	116 788	165 906	174 540	209 544	169 499	173 547	139 984	96 114	116 193	138 154
Social development and community services	303 756	219 061	261 693	260 092	271 328	301 023	302 419	295 956	300 218	287 579
Division 4: Environment	**199 677**	**172 006**	**127 394**	**191 334**	**204 573**	**208 704**	**237 373**	**191 622**	**374 408**	**364 490**
Environment unclassified	0	0	0	0	0	0	0	0	0	0
Environmental knowledge	137 679	124 445	91 677	107 265	116 996	100 339	117 228	123 194	340 112	328 874
Environmental aspects of development	51 795	38 877	27 206	53 541	55 508	50 936	64 148	48 503	23 399	20 336
Environmental and other aspects	10 204	8 684	8 511	30 528	32 069	57 429	55 997	19 924	10 898	15 280
Division 5: Advancement of knowledge	**145 860**	**121 243**	**67 996**	**82 217**	**81 141**	**70 698**	**75 676**	**94 771**	**97 658**	**116 542**
Advancement of knowledge unclassified	0	0	0	0	0	0	0	0	0	0
Natural sciences, technologies and engineering	120 173	96 381	43 170	58 401	57 655	57 473	61 475	78 751	77 069	88 698
Social sciences and humanities	25 687	24 862	24 825	23 816	23 486	13 225	14 201	16 019	20 590	27 844
Total	**1 437 509**	**1 697 151**	**1 893 010**	**2 013 021**	**2 098 646**	**2 325 875**	**2 223 426**	**1 893 543**	**2 237 531**	**2 472 434**

Table C.105: Proportional government sector R&D expenditure by socio-economic objective (2012/13 to 2021/22)

SOCIO-ECONOMIC OBJECTIVE	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
	%	%	%	%	%	%	%	%	%	%
Division 1: Defence	1.3	1.2	1.1	2.1	1.6	0.3	2.1	1.7	1.2	0.9
Defence	1.3	1.2	1.1	2.1	1.6	0.3	2.1	1.7	1.2	0.9
Division 2: Economic development	33.4	30.1	40.4	37.0	39.4	43.4	50.2	55.2	47.8	50.9
Economic development unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Plant production and plant primary products	7.0	5.3	5.7	4.6	4.9	5.1	5.2	6.7	5.3	4.6
Animal production and animal primary products	6.5	8.1	8.3	6.2	6.4	5.5	6.1	7.5	5.9	5.7
Mineral resources (excluding energy)	0.0	0.0	0.3	0.3	0.1	0.5	0.2	0.3	0.2	0.2
Energy resources	0.0	0.1	0.6	0.3	0.3	0.2	0.3	0.1	0.1	0.1
Energy supply	0.5	0.5	1.8	1.5	1.6	1.8	2.4	0.8	0.5	1.2
Manufacturing	0.1	0.1	4.2	0.1	0.2	0.2	0.5	0.8	1.3	0.6
Construction	0.0	0.0	0.2	0.1	0.1	0.1	0.4	0.3	0.3	1.1
Transport	0.6	0.1	1.3	1.1	1.2	0.9	0.3	0.5	0.3	0.3
Information and communication services	0.4	0.3	0.8	0.4	0.3	0.9	0.8	0.7	0.2	0.6
Commercial services	0.2	0.7	0.8	0.7	0.6	2.0	3.3	2.9	2.4	0.4
Economic framework	11.2	6.9	8.9	13.0	16.4	16.9	18.2	20.1	17.4	20.4
Natural resources	6.8	8.0	7.5	8.8	7.4	9.2	12.6	14.4	13.9	15.7
Division 3: Society	41.2	51.4	48.2	47.3	45.4	44.3	33.6	28.0	29.9	28.8
Society unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Health	11.9	28.7	25.1	24.0	24.4	23.9	13.7	7.3	11.3	11.6
Education and training	8.1	9.8	9.2	10.4	8.1	7.5	6.3	5.1	5.2	5.6
Social development and community services	21.1	12.9	13.8	12.9	12.9	12.9	13.6	15.6	13.4	11.6
Division 4: Environment	13.9	10.1	6.7	9.5	9.7	9.0	10.7	10.1	16.7	14.7
Environment unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Environmental knowledge	9.6	7.3	4.8	5.3	5.6	4.3	5.3	6.5	15.2	13.3
Environmental aspects of development	3.6	2.3	1.4	2.7	2.6	2.2	2.9	2.6	1.0	0.8

SOCIO-ECONOMIC OBJECTIVE	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
	%	%	%	%	%	%	%	%	%	%
Environmental and other aspects	0.7	0.5	0.4	1.5	1.5	2.5	2.5	1.1	0.5	0.6
Division 5: Advancement of knowledge	10.1	7.1	3.6	4.1	3.9	3.0	3.4	5.0	4.4	4.7
Advancement of knowledge unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Natural sciences, technologies and engineering	8.4	5.7	2.3	2.9	2.7	2.5	2.8	4.2	3.4	3.6
Social sciences and humanities	1.8	1.5	1.3	1.2	1.1	0.6	0.6	0.8	0.9	1.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.106: Government sector R&D expenditure by province (2012/13 to 2021/22)

PROVINCE	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000
Eastern Cape	194 258	133 657	227 427	225 603	222 456	281 201	305 629	301 816	383 648	390 162
Free State	38 659	55 095	60 860	61 802	81 957	81 890	59 694	45 660	51 714	52 374
Gauteng	427 173	689 915	760 199	832 397	885 142	974 192	836 827	581 945	626 239	821 650
KwaZulu-Natal	168 029	161 962	177 517	187 088	172 655	206 551	236 602	205 503	284 898	290 063
Limpopo	74 621	95 668	83 683	84 232	76 541	86 876	89 889	81 308	90 390	112 845
Mpumalanga	80 201	77 479	93 566	112 173	107 237	104 154	88 922	83 648	74 233	78 600
North West	45 573	73 576	56 719	61 815	57 994	60 594	66 727	57 423	60 752	25 891
Northern Cape	75 440	61 932	52 579	69 174	66 200	94 659	88 575	52 399	131 729	136 529
Western Cape	333 555	347 869	380 461	378 737	428 465	435 757	450 560	483 841	533 926	564 321
Total	1 437 509	1 697 151	1 893 010	2 013 021	2 098 646	2 325 875	2 223 426	1 893 543	2 237 531	2 472 434

Table C.107: Proportional government sector R&D expenditure by province (2012/13 to 2021/22)

PROVINCE	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
	%	%	%	%	%	%	%	%	%	%
Eastern Cape	13.5	7.9	12.0	11.2	10.6	12.1	13.7	15.9	17.1	15.8
Free State	2.7	3.2	3.2	3.1	3.9	3.5	2.7	2.4	2.3	2.1
Gauteng	29.7	40.7	40.2	41.4	42.2	41.9	37.6	30.7	28.0	33.2
KwaZulu-Natal	11.7	9.5	9.4	9.3	8.2	8.9	10.6	10.9	12.7	11.7
Limpopo	5.2	5.6	4.4	4.2	3.6	3.7	4.0	4.3	4.0	4.6
Mpumalanga	5.6	4.6	4.9	5.6	5.1	4.5	4.0	4.4	3.3	3.2
North West	3.2	4.3	3.0	3.1	2.8	2.6	3.0	3.0	2.7	1.0
Northern Cape	5.2	3.6	2.8	3.4	3.2	4.1	4.0	2.8	5.9	5.5
Western Cape	23.2	20.5	20.1	18.8	20.4	18.7	20.3	25.6	23.9	22.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.108: Government sector R&D personnel in headcounts and full-time equivalents by occupation (2012/13 to 2021/22)

YEAR	HEADCOUNTS				FULL-TME EQUIVALENTS (FTEs)			
	TOTAL	RESEARCHERS	TECHNICIANS	OTHER R&D PERSONNEL	TOTAL	RESEARCHERS	TECHNICIANS	OTHER R&D PERSONNEL
2012/13	**3 252**	1 409	517	1 326	**2 597.0**	1 091.4	385.8	1 119.9
2013/14	**2 874**	1 229	518	1 127	**2 245.5**	923.7	366.3	955.4
2014/15	**2 893**	1 343	550	1 000	**2 181.5**	970.0	337.9	873.5
2015/16	**2 997**	1 573	537	887	**2 056.2**	953.9	365.7	736.7
2016/17	**3 076**	1 677	538	861	**2 031.6**	969.1	357.9	704.6
2017/18	**3 027**	1 671	517	839	**2 000.4**	899.1	347.7	753.7
2018/19	**2 910**	1 662	416	832	**1 999.0**	920.8	324.9	753.3
2019/20	**3 157**	1 742	548	867	**2 173.1**	1 027.3	374.3	771.6
2020/21	**3 159**	1 706	534	919	**2 060.4**	963.3	334.6	762.5
2021/22	**3 314**	1 789	623	902	**2 095.5**	1 030.2	338.5	726.8

Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.109: Government sector R&D personnel in headcounts and full-time equivalents by occupation and gender (2019/20 to 2021/22)

OCCUPATION	HEADCOUNTS			FULL-TIME EQUIVALENTS (FTEs)			
2019/20	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL FTEs AS % OF TOTAL HEADCOUNTS
Researchers	**1 742**	819	923	**1 027.3**	480.6	546.7	59.0
Technicians directly supporting R&D	**548**	304	244	**374.3**	214.7	159.6	68.3
Other personnel directly supporting R&D	**867**	603	264	**771.6**	549.8	221.8	89.0
Total	3 157	1 726	1 431	2 173.1	1 245.0	928.1	68.8
2020/21	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL FTEs AS % OF TOTAL HEADCOUNTS
Researchers	**1 706**	764	942	**963.3**	431.9	531.4	56.5
Technicians directly supporting R&D	**534**	291	243	**334.6**	190.2	144.4	62.7
Other personnel directly supporting R&D	**919**	592	327	**762.5**	539.9	222.6	83.0
Total	3 159	1 647	1 512	2 060.4	1 162.0	898.4	65.2
2021/22	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL FTEs AS % OF TOTAL HEADCOUNTS
Researchers	**1 789**	774	1015	**1 030.2**	440.5	589.7	57.6
Technicians directly supporting R&D	**623**	340	283	**338.5**	186.0	152.5	54.3
Other personnel directly supporting R&D	**902**	542	360	**726.8**	487.9	238.9	80.6
Total	3 314	1 656	1 658	2 095.5	1 114.4	981.1	63.2

Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.110: Government sector R&D personnel in headcounts by occupation, qualification, population group and gender (2021/22)

OCCUPATION AND QUALIFICATION	TOTAL	SUBTOTAL		AFRICAN		COLOURED		INDIAN/ASIAN		WHITE		NON-SA	
		MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
Researchers	1 789	774	1 015	474	617	44	83	55	92	188	220	13	3
Doctoral degree or equivalent	389	188	201	76	64	9	18	19	22	75	95	9	2
Master's, honours, bachelor or equivalent	1 273	537	736	368	497	33	60	31	63	101	115	4	1
Diplomas	127	49	78	30	56	2	5	5	7	12	10	0	0
Technicians directly supporting R&D	623	340	283	197	174	55	41	26	18	56	50	6	0
Doctoral degree or equivalent	17	13	4	5	2	1	0	0	0	5	2	2	0
Master's, honours, bachelor or equivalent	404	208	196	120	119	33	28	19	13	35	36	1	0
Diplomas	202	119	83	72	53	21	13	7	5	16	12	3	0
Other personnel directly supporting R&D	902	542	360	346	244	148	64	7	14	27	37	14	1
Doctoral degree or equivalent	11	9	2	0	1	0	0	0	0	5	0	4	1
Master's, honours, bachelor or equivalent	115	47	68	19	41	5	8	4	8	9	11	10	0
Diplomas	776	486	290	327	202	143	56	3	6	13	26	0	0
Total	3 314	1 656	1 658	1 017	1 035	247	188	88	124	271	307	33	4

Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

C.2.4. Science councils sector

Table C.111: Science councils sector R&D expenditure by type of research (2012/13 to 2021/22)

TYPE OF RESEARCH	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Basic research	937 826	970 785	1 166 491	1 348 533	1 372 702	1 349 946	1 244 253	1 388 847	1 294 844	1 423 138
Applied research	1 885 484	2 114 943	2 421 309	2 781 198	3 202 019	3 460 650	2 855 564	3 337 342	3 033 375	3 276 969
Experimental development research	1 202 689	1 218 827	1 416 869	1 611 166	1 561 462	1 502 748	1 344 068	1 472 175	1 574 195	1 654 191
Total	4 025 998	4 304 556	5 004 669	5 740 897	6 136 183	6 313 344	5 443 885	6 198 363	5 902 414	6 354 298

Table C.112: Proportional science councils sector R&D expenditure by type of research (2012/13 to 2021/22)

TYPE OF RESEARCH	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Basic research	23.3	22.6	23.3	23.5	22.4	21.4	22.9	22.4	21.9	22.4
Applied research	46.8	49.1	48.4	48.4	52.2	54.8	52.5	53.8	51.4	51.6
Experimental development research	29.9	28.3	28.3	28.1	25.4	23.8	24.7	23.8	26.7	26.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.113: Science councils sector R&D expenditure by accounting category (2012/13 to 2021/22)

TYPE OF EXPENDITURE	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Capital expenditure	275 750	323 190	598 429	916 480	857 241	823 937	460 304	571 628	499 152	459 899
Land: buildings & other structures	68 565	71 602	362 246	162 904	211 246	386 063	62 598	105 660	37 189	42 472
TOTAL: Vehicles, plant, machinery, equipment and software	207 185	251 588	236 183	753 576	645 995	437 874	397 706	465 968	461 963	417 427
Vehicles, plant, machinery, equipment	207 185	251 588	236 183	753 576	645 995	437 874	397 706	430 090	424 749	371 431
*Capitalised computer software	NA	NA	NA	NA	NA	NA	NA	35 878	37 214	45 996
Current expenditure	3 750 248	3 981 366	4 406 240	4 824 418	5 278 942	5 489 407	4 983 581	5 626 735	5 403 262	5 894 399
Labour costs	2 053 204	2 187 401	1 986 918	2 142 875	2 339 348	2 421 297	2 371 273	2 260 207	2 264 933	2 601 051
Other current expenditure	1 697 044	1 793 965	2 419 322	2 681 543	2 939 594	3 068 110	2 612 308	3 366 528	3 138 329	3 293 348
Total	4 025 998	4 304 556	5 004 669	5 740 897	6 136 183	6 313 344	5 443 885	6 198 363	5 902 414	6 354 298

*Capitalised computer software collected from 2019/20.

Table C.114: Proportional science councils sector R&D expenditure by accounting category (2012/13 to 2021/22)

TYPE OF EXPENDITURE	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Capital expenditure	8.7	6.8	7.5	12.0	16.0	14.0	13.1	9.2	8.5	7.2
Land: buildings & other structures	1.8	1.7	1.7	7.2	2.8	3.4	6.1	1.7	0.6	0.7
TOTAL: Vehicles, plant, machinery, equipment and software	6.9	5.1	5.8	4.7	13.1	10.5	6.9	7.5	7.8	6.6
Vehicles, plant, machinery, equipment	6.9	5.1	5.8	4.7	13.1	10.5	6.9	6.9	7.2	5.8
*Capitalised computer software	NA	NA	NA	NA	NA	NA	NA	0.6	0.6	0.7
Current expenditure	91.3	93.2	92.5	88.0	84.0	86.0	86.9	90.8	91.5	92.8
Labour costs	41.1	51.0	50.8	39.7	37.3	38.1	38.4	36.5	38.4	40.9
Other current expenditure	50.3	42.2	41.7	48.3	46.7	47.9	48.6	54.3	53.2	51.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

*Capitalised computer software collected from 2019/20.

Table C.115: Science councils sector expenditure on multidisciplinary areas of R&D (2012/13 to 2021/22)

MULTI-DISCIPLINARY AREA OF R&D	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Biotechnology	145 671	143 868	312 793	320 048	360 163	299 783	257 498	325 251	296 543	348 861
Nanotechnology	118 555	114 990	125 107	139 107	139 783	272 372	222 662	289 934	95 110	104 250
Total	264 226	258 857	437 900	459 154	499 946	572 155	480 160	615 186	391 652	453 110
Science councils expenditure on R&D	4 025 998	4 304 556	5 004 669	5 740 897	6 136 183	6 313 344	5 443 885	6 198 363	5 902 414	6 354 298

Table C.116: Proportional science councils sector expenditure on multidisciplinary areas of R&D (2012/13 to 2021/22)

MULTI-DISCIPLINARY AREA OF R&D	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Biotechnology	3.6	3.3	6.3	5.6	5.9	4.7	4.7	5.2	5.0	5.5
Nanotechnology	2.9	2.7	2.5	2.4	2.3	4.3	4.1	4.7	1.6	1.6
Total	6.6	6.0	8.7	8.0	8.1	9.1	8.8	9.9	6.6	7.1

Table C.117: Science councils sector R&D expenditure on selected areas of interest (2012/13 to 2021/22)

AREA OF INTEREST	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Environment-related	378782	297097	1 037 320	1 054 651	1 031 393	953 077	831 377	881 520	802 772	946 401
Open-source software	36 636	0	389 871	692 096	453878,55	842 548	107 063	226 090	56 908	61 508
New materials	751 305	229 854	358 361	374 463	373 768	401 995	329 199	297 042	225 040	234 872
Tuberculosis, HIV/AIDS, malaria	455 311	398 880	346 751	470 488	625 806	670 209	572 650	492 341	519 670	620 403
Space science	N/A	N/A	N/A	N/A	296 236	0	593 920	614 780	635 906	743 319
Total	1 622 034	925 831	2 132 304	2 591 697	2 781 082	2 867 828	2 434 208	2 511 774	2 240 296	2 606 502
Science councils expenditure on R&D	4 025 998	4 304 556	5 004 669	5 740 897	6 136 183	6 313 344	5 443 885	6 198 363	5 902 414	6 354 298

N/A: Environment-related data were collected from the 2011/12 R&D Survey onwards. Space science data were collected for the first time in the 2016/17 R&D Survey.

Table C.118: Proportional science councils sector R&D expenditure on selected areas of interest (2012/13 to 2021/22)

AREA OF INTEREST	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Environment-related	9.4	6.9	20.7	18.4	16.8	15.1	15.3	14.2	13.6	14.9
Open-source software	0.9	0.0	7.8	12.1	7.4	13.3	2.0	3.6	1.0	1.0
New materials	18.7	5.3	7.2	6.5	6.1	6.4	6.0	4.8	3.8	3.7
Tuberculosis, HIV/AIDS, malaria	11.3	9.3	6.9	8.2	10.2	10.6	10.5	7.9	8.8	9.8
Space science	N/A	N/A	N/A	N/A	4.8	0.0	10.9	9.9	10.8	11.7
Total	40.3	21.5	42.6	45.1	45.3	45.4	44.7	40.5	38.0	41.0

N/A: Environment-related data were collected from the 2011/12 R&D Survey onwards. Space science data were collected for the first time in the 2016/17 R&D Survey.

Table C.119: Science councils sector R&D expenditure by research field (2012/13 to 2021/22)

MAIN RESEARCH FIELD	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Division 1: Natural sciences, technology and engineering	3 819 642	4 109 105	4 800 742	5 486 847	5 889 463	6 112 974	5 314 694	6 062 356	5 801 859	6 197 153
Mathematical sciences	134 046	128 291	48 258	54 212	47 890	61 223	180 075	154 147	44 050	46 717
Physical sciences	123 267	129 568	263 302	418 648	444 274	502 615	410 797	457 042	423 591	446 937
Chemical sciences	14 078	18 166	63 775	71 024	66 188	77 952	48 685	94 308	59 447	61 528
Earth sciences	112 406	110 092	162 880	181 876	254 414	198 140	202 037	231 490	214 568	286 203
Information, computer and communication technologies	181 521	182 402	780 044	977 891	999 538	1 124 366	852 856	996 778	977 489	1 008 671
Applied sciences and technologies	1 092 098	1 046 934	277 649	296 162	475 568	356 409	369 603	474 058	538 072	499 354
Engineering sciences	292 940	349 666	1 001 486	1 107 289	1 016 283	1 171 287	849 940	1 171 031	1 176 104	1 233 584
Biological sciences	485 673	482 728	148 268	144 341	138 673	169 717	87 630	138 416	113 597	124 691
Agricultural sciences	594 638	859 600	1 075 165	1 043 494	1 067 146	989 974	898 199	886 212	790 931	822 351
Medical and health sciences	426 520	430 472	596 600	775 858	836 967	1 021 905	984 580	885 544	1 048 315	1 347 929
Environmental sciences	330 667	326 122	228 909	240 075	343 218	267 495	212 887	283 782	181 584	186 033
Material sciences	22 905	35 093	113 457	133 231	122 130	143 684	114 491	151 654	111 190	117 631
Marine sciences	8 885	9 970	40 949	42 747	77 173	28 207	102 913	137 894	122 922	15 524
Division 2: Social sciences and humanities	206 356	195 452	203 927	254 050	246 721	200 370	129 191	136 007	100 554	157 145
Social sciences	186 132	173 407	179 456	223 966	239 011	192 200	123 414	136 007	100 554	157 145
Humanities	20 224	22 044	24 471	30 084	7 710	8 170	5 777	0	0	0
Total	4 025 998	4 304 556	5 004 669	5 740 897	6 136 183	6 313 344	5 443 885	6 198 363	5 902 414	6 354 298

Table C.120: Proportional science councils sector R&D expenditure by research field (2012/13 to 2021/22)

MAIN RESEARCH FIELD	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Division 1: Natural sciences, technology and engineering	94.9	95.5	95.9	95.6	96.0	96.8	97.6	97.8	98.3	97.5
Mathematical sciences	3.3	3.0	1.0	0.9	0.8	1.0	3.3	2.5	0.7	0.7
Physical sciences	3.1	3.0	5.3	7.3	7.2	8.0	7.5	7.4	7.2	7.0
Chemical sciences	0.3	0.4	1.3	1.2	1.1	1.2	0.9	1.5	1.0	1.0
Earth sciences	2.8	2.6	3.3	3.2	4.1	3.1	3.7	3.7	3.6	4.5

MAIN RESEARCH FIELD	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Information, computer and communication technologies	4.5	4.2	15.6	17.0	16.3	17.8	15.7	16.1	16.6	15.9
Applied sciences and technologies	27.1	24.3	5.5	5.2	7.8	5.6	6.8	7.6	9.1	7.9
Engineering sciences	7.3	8.1	20.0	19.3	16.6	18.6	15.6	18.9	19.9	19.4
Biological sciences	12.1	11.2	3.0	2.5	2.3	2.7	1.6	2.2	1.9	2.0
Agricultural sciences	14.8	20.0	21.5	18.2	17.4	15.7	16.5	14.3	13.4	12.9
Medical and health sciences	10.6	10.0	11.9	13.5	13.6	16.2	18.1	14.3	17.8	21.2
Environmental sciences	8.2	7.6	4.6	4.2	5.6	4.2	3.9	4.6	3.1	2.9
Material sciences	0.6	0.8	2.3	2.3	2.0	2.3	2.1	2.4	1.9	1.9
Marine sciences	0.2	0.2	0.8	0.7	1.3	0.4	1.9	2.2	2.1	0.2
Division 2: Social sciences and humanities	5.1	4.5	4.1	4.4	4.0	3.2	2.4	2.2	1.7	2.5
Social sciences	4.6	4.0	3.6	3.9	3.9	3.0	2.3	2.2	1.7	2.5
Humanities	0.5	0.5	0.5	0.5	0.1	0.1	0.1	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.121: Science councils sector R&D expenditure by socio-economic objective (2012/13 to 2021/22)

SOCIO-ECONOMIC OBJECTIVE	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Division 1: Defence	279 989	262 203	762 464	826 261	754 207	915 281	536 553	715 553	630 997	552 826
Defence	279 989	262 203	762 464	826 261	754 207	915 281	536 553	715 553	630 997	552 826
Division 2: Economic development	2 400 747	2 686 504	2 306 795	2 529 244	2 471 163	2 625 282	2 140 026	2 419 541	2 178 829	2 317 530
Economic development unclassified	0	0	0	0	0	0	0	0	0	0
Plant production and plant primary products	473 133	624 675	413 737	396 612	396 536	368 829	339 896	290 267	258 061	319 184
Animal production and animal primary products	287 431	419 259	269 519	247 883	247 835	230 518	212 435	207 333	184 329	191 131
Mineral resources (excluding energy)	213 007	234 273	232 114	265 006	255 226	274 778	287 423	303 480	294 486	330 010
Energy resources	108 360	106 823	5 590	5 063	8 108	6 682	5 568	21 334	20 002	55 770
Energy supply	13 237	2 937	0	0	0	1 468	1 499	4 072	4 065	0
Manufacturing	400 864	393 152	88 746	146 395	170 040	179 215	138 141	147 634	147 455	149 384
Construction	256 024	245 333	31 034	60 828	67 003	70 943	65 389	69 621	71 721	91 572
Transport	0	0	0	0	0	0	0	0	0	7 611

SOCIO-ECONOMIC OBJECTIVE	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Information and communication services	141 495	135 629	396 310	419 252	410 724	462 785	386 839	499 564	455 370	503 252
Commercial services	25 053	19 724	5 236	5 671	7 756	2 937	2 998	0	0	0
Economic framework	70 509	75 411	537 499	664 440	571 815	713 045	419 073	559 622	467 458	400 333
Natural resources	411 634	429 288	327 009	318 094	336 119	314 082	280 766	316 614	275 882	269 284
Division 3: Society	**413 060**	**425 943**	**801 370**	**977 159**	**1 074 539**	**978 471**	**1 053 871**	**1 254 643**	**1 041 731**	**1 573 279**
Society unclassified	0	0	0	0	0	0	0	0		0
Health	314 412	316 987	424 639	552 314	613 932	632 851	722 673	653 443	727 194	843 323
Education and training	64 941	72 216	335 946	374 704	145 215	98 348	70 575	93 081	50 329	53 431
Social development and community services	33 707	36 741	40 785	50 141	315 392	247 273	260 622	508 119	264 208	676 525
Division 4: Environment	**39 169**	**46 559**	**422 650**	**455 404**	**852 597**	**782 034**	**610 761**	**423 727**	**389 939**	**317 858**
Environment unclassified	0	0	0	0	0	0	0	0	0	0
Environmental knowledge	22 939	28 295	402 820	426 582	466 312	434 251	304 725	373 973	344 017	218 392
Environmental aspects of development	13 665	14 071	15 824	14 179	17 451	13 215	13 493	0	0	32 980
Environmental and other aspects	2 565	4 194	4 006	14 644	368 834	334 567	292 543	49 754	45 922	66 486
Division 5: Advancement of knowledge	**893 033**	**883 346**	**711 390**	**952 830**	**983 677**	**1 012 276**	**1 102 675**	**1 384 899**	**1 660 917**	**1 592 806**
Advancement of knowledge unclassified	0	0	0	0	0	0	0	0	0	0
Natural sciences, technologies and engineering	760 107	746 397	422 429	620 283	692 258	708 020	723 871	1 074 410	1 260 670	1 263 423
Social sciences and humanities	132 926	136 949	288 961	332 547	291 419	304 256	378 804	310 489	400 247	329 382
Total	**4 025 998**	**4 304 556**	**5 004 669**	**5 740 897**	**6 136 183**	**6 313 344**	**5 443 885**	**6 198 363**	**5 902 414**	**6 354 298**

Table C.122: Proportional science councils sector R&D expenditure by socio-economic objective (2012/13 to 2021/22)

SOCIO-ECONOMIC OBJECTIVE	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
	%	%	%	%	%	%	%	%	%	%
Division 1: Defence	7.0	6.1	15.2	14.4	12.3	14.5	9.9	11.5	10.7	8.7
Defence	7.0	6.1	15.2	14.4	12.3	14.5	9.9	11.5	10.7	8.7
Division 2: Economic development	59.6	62.4	46.1	44.1	40.3	41.6	39.3	39.0	36.9	36.5
Economic development unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Plant production and plant primary products	11.8	14.5	8.3	6.9	6.5	5.8	6.2	4.7	4.4	5.0
Animal production and animal primary products	7.1	9.7	5.4	4.3	4.0	3.7	3.9	3.3	3.1	3.0
Mineral resources (excluding energy)	5.3	5.4	4.6	4.6	4.2	4.4	5.3	4.9	5.0	5.2
Energy resources	2.7	2.5	0.1	0.1	0.1	0.1	0.1	0.3	0.3	0.9
Energy supply	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0
Manufacturing	10.0	9.1	1.8	2.6	2.8	2.8	2.5	2.4	2.5	2.4
Construction	6.4	5.7	0.6	1.1	1.1	1.1	1.2	1.1	1.2	1.4
Transport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Information and communication services	3.5	3.2	7.9	7.3	6.7	7.3	7.1	8.1	7.7	7.9
Commercial services	0.6	0.5	0.1	0.1	0.1	0.0	0.1	0.0	0.0	0.0
Economic framework	1.8	1.8	10.7	11.6	9.3	11.3	7.7	9.0	7.9	6.3
Natural resources	10.2	10.0	6.5	5.5	5.5	5.0	5.2	5.1	4.7	4.2
Division 3: Society	10.3	9.9	16.0	17.0	17.5	15.5	19.4	20.2	17.6	24.8
Society unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Health	7.8	7.4	8.5	9.6	10.0	10.0	13.3	10.5	12.3	13.3
Education and training	1.6	1.7	6.7	6.5	2.4	1.6	1.3	1.5	0.9	0.8
Social development and community services	0.8	0.9	0.8	0.9	5.1	3.9	4.8	8.2	4.5	10.6
Division 4: Environment	1.0	1.1	8.4	7.9	13.9	12.4	11.2	6.8	6.6	5.0
Environment unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Environmental knowledge	0.6	0.7	8.0	7.4	7.6	6.9	5.6	6.0	5.8	3.4
Environmental aspects of development	0.3	0.3	0.3	0.2	0.3	0.2	0.2	0.0	0.0	0.5

SOCIO-ECONOMIC OBJECTIVE	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
	%	%	%	%	%	%	%	%	%	%
Environmental and other aspects	0.1	0.1	0.1	0.3	6.0	5.3	5.4	0.8	0.8	1.0
Division 5: Advancement of knowledge	22.2	20.5	14.2	16.6	16.0	16.0	20.3	22.3	28.1	25.1
Advancement of knowledge unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Natural sciences, technologies and engineering	18.9	17.3	8.4	10.8	11.3	11.2	13.3	17.3	21.4	19.9
Social sciences and humanities	3.3	3.2	5.8	5.8	4.7	4.8	7.0	5.0	6.8	5.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.123: Science councils sector R&D expenditure by province (2012/13 to 2021/22)

PROVINCE	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000
Eastern Cape	182 664	115 925	259 128	269 658	273 509	279 550	183 931	206 142	189 604	202 745
Free State	39 054	47 271	58 608	59 953	60 149	59 300	110 995	94 188	85 089	59 246
Gauteng	2 537 028	3 062 983	2 745 142	2 998 643	3 221 705	3 350 135	3 053 440	3 624 098	3 467 734	3 500 581
KwaZulu-Natal	307 302	239 387	484 142	575 016	477 823	540 084	427 585	448 070	437 452	558 627
Limpopo	105 150	7 286	117 270	111 649	114 852	107 457	80 249	65 682	59 687	72 253
Mpumalanga	103 468	62 349	124 613	122 432	128 883	118 267	171 535	148 618	134 637	143 892
North West	110 361	39 615	153 911	153 676	108 010	97 730	43 764	57 117	50 771	109 872
Northern Cape	78 714	122 454	148 387	218 317	223 524	236 797	601 757	634 734	651 793	691 351
Western Cape	562 256	607 285	913 468	1 231 555	1 527 729	1 524 025	770 631	919 714	825 647	1 015 731
Total	4 025 998	4 304 556	5 004 669	5 740 897	6 136 183	6 313 344	5 443 885	6 198 363	5 902 414	6 354 298

Table C.124: Proportional science councils sector R&D expenditure by province (2012/13 to 2021/22)

PROVINCE	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
	%	%	%	%	%	%	%	%	%	%
Eastern Cape	4.5	2.7	5.2	4.7	4.5	4.4	3.4	3.3	3.2	3.2
Free State	1.0	1.1	1.2	1.0	1.0	0.9	2.0	1.5	1.4	0.9
Gauteng	63.0	71.2	54.9	52.2	52.5	53.1	56.1	58.5	58.8	55.1
KwaZulu-Natal	7.6	5.6	9.7	10.0	7.8	8.6	7.9	7.2	7.4	8.8
Limpopo	2.6	0.2	2.3	1.9	1.9	1.7	1.5	1.1	1.0	1.1
Mpumalanga	2.6	1.4	2.5	2.1	2.1	1.9	3.2	2.4	2.3	2.3
North West	2.7	0.9	3.1	2.7	1.8	1.5	0.8	0.9	0.9	1.7
Northern Cape	2.0	2.8	3.0	3.8	3.6	3.8	11.1	10.2	11.0	10.9
Western Cape	14.0	14.1	18.3	21.5	24.9	24.1	14.2	14.8	14.0	16.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.125: Science councils sector R&D personnel in headcounts and full-time equivalents by occupation (2012/13 to 2021/22)

YEAR	HEADCOUNTS				FULL-TME EQUIVALENTS (FTEs)			
	TOTAL	RESEARCHERS	TECHNICIANS	OTHER R&D PERSONNEL	TOTAL	RESEARCHERS	TECHNICIANS	OTHER R&D PERSONNEL
2012/13	**5 399**	1 879	1 403	2 117	**4 748.5**	1 697.1	1 279.6	1 771.8
2013/14	**5 884**	1 956	1 396	2 532	**5 164.5**	1 781.3	1 247.3	2 136.0
2014/15	**4 836**	1 988	1 857	991	**4 180.4**	1 765.4	1 686.2	728.9
2015/16	**5 162**	2 072	1 839	1 251	**4 361.2**	1 827.2	1 683.7	850.4
2016/17	**4 955**	2 189	1 818	948	**4 421.4**	1 940.5	1 676.0	804.9
2017/18	**4 866**	2 053	1 885	928	**4 294.9**	1 792.1	1 745.4	757.4
2018/19	**4 514**	1 951	1 728	835	**3 941.8**	1 697.0	1 579.6	665.2
2019/20	**4 070**	1 858	1 505	707	**3 562.8**	1 619.4	1 403.7	539.7
2020/21	**4 111**	1 774	1 555	782	**3 606.0**	1 549.2	1 440.3	616.5
2021/22	**4 190**	1 735	1 528	927	**3 838.5**	1 594.4	1 451.0	793.1

Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.126: Science councils sector R&D personnel in headcounts and full-time equivalents by occupation and gender (2019/20 to 2021/22)

OCCUPATION	HEADCOUNTS			FULL-TIME EQUIVALENTS (FTEs)			
2019/20	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL FTEs AS % OF TOTAL HEADCOUNTS
Researchers	**1 858**	1 009	849	**1 619.4**	870.6	748.8	87.2
Technicians directly supporting R&D	**1 505**	886	619	**1 403.7**	815.9	587.8	93.3
Other personnel directly supporting R&D	**707**	380	327	**539.7**	263.3	276.4	76.3
Total	4 070	2 275	1 795	3 562.8	1 949.8	1 613.0	87.5
2020/21	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL FTEs AS % OF TOTAL HEADCOUNTS
Researchers	**1 774**	966	808	**1 549.2**	831.4	717.8	87.3
Technicians directly supporting R&D	**1 555**	894	661	**1 440.3**	816.5	623.8	92.6
Other personnel directly supporting R&D	**782**	416	366	**616.5**	302.0	314.5	78.8
Total	4 111	2 276	1 835	3 606.0	1 949.9	1 656.1	87.7
2021/22	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL FTEs AS % OF TOTAL HEADCOUNTS
Researchers	**1 735**	914	821	**1 594.4**	859.5	734.9	91.9
Technicians directly supporting R&D	**1 528**	848	680	**1 451.0**	799.0	652.0	95.0
Other personnel directly supporting R&D	**927**	479	448	**793.1**	386.2	406.9	85.6
Total	4 190	2 241	1 949	3 838.5	2 044.7	1 793.8	91.6

Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.127: Science councils sector R&D personnel in headcounts by occupation, qualification, population group and gender (2021/22)

OCCUPATION AND QUALIFICATION	TOTAL	SUBTOTAL		AFRICAN		COLOURED		INDIAN/ASIAN		WHITE		NON-SA	
		MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
Researchers	1 735	914	821	380	384	49	58	53	74	291	249	141	56
Doctoral degree or equivalent	871	470	401	145	133	24	34	27	39	155	149	119	46
Master's, honours, bachelor or equivalent	717	366	351	185	197	19	22	24	30	116	92	22	10
Diplomas	147	78	69	50	54	6	2	2	5	20	8	0	0
Technicians directly supporting R&D	1 528	848	680	467	454	77	37	50	57	225	124	29	8
Doctoral degree or equivalent	72	50	22	12	4	1	1	1	3	27	12	9	2
Master's, honours, bachelor or equivalent	979	502	477	276	323	36	23	43	49	131	77	16	5
Diplomas	477	296	181	179	127	40	13	6	5	67	35	4	1
Other personnel directly supporting R&D	927	479	448	330	293	51	63	26	30	61	56	11	6
Doctoral degree or equivalent	34	23	11	10	3	3	3	2	3	5	1	3	1
Master's, honours, bachelor or equivalent	458	198	260	130	190	19	11	13	20	29	35	7	4
Diplomas	435	258	177	190	100	29	49	11	7	27	20	1	1
Total	4 190	2 241	1 949	1 177	1 131	177	158	129	161	577	429	181	70

Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.128: Science councils sector overview (2020/21 to 2021/22)

SCIENCE COUNCILS	2020/21				2021/22			
	R&D EXPENDITURE	RESEARCHERS	BASIC RESEARCH	CAPITAL EXPENDITURE	R&D EXPENDITURE	RESEARCHERS	BASIC RESEARCH	CAPITAL EXPENDITURE
	R'000	FTEs	R'000	R'000	R'000	FTEs	R'000	R'000
Agricultural Research Council	737 316	415.0	147 463	36 367	764 522	415.0	152 904	36 668
Council for Scientific and Industrial Research	2 496 675	471.0	113 599	36 193	2 573 255	451.0	117 083	50 972
Council for Geoscience	203 263	97.8	30 489	88 755	253 692	163.0	50 738	44 555
Human Sciences Research Council	230 801	109.0	34 620	5 693	356 120	99.0	53 418	15 128
Medical Research Council	942 641	201.0	565 585	40 325	1 049 232	212.0	629 539	8 235
Mintek	383 601	150.4	76 720	46 104	394 924	150.4	78 985	52 017
National Research Foundation	908 116	105.0	326 368	245 715	962 554	104.0	340 470	250 324
Total	5 902 414	1 549.2	1 294 844	499 152	6 354 298	1 594.4	1 423 138	459 899

C.2.5. Higher education sector

Table C.129: Higher education sector R&D expenditure by type of research (2012/13 to 2021/22)

TYPE OF RESEARCH	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Basic research	3 843 906	3 785 149	4 601 453	5 395 693	6 679 585	7 243 562	7 463 879	8 145 359	6 979 245	7 308 509
Applied research	2 390 090	2 412 316	2 649 558	3 176 685	3 466 381	4 264 753	4 303 881	4 497 102	4 423 435	4 633 761
Experimental development research	1 099 157	1 095 388	1 126 565	1 304 245	1 513 291	1 501 561	1 415 358	1 536 500	2 383 056	2 289 858
Total	7 333 153	7 292 853	8 377 575	9 876 623	11 659 258	13 009 876	13 183 119	14 178 960	13 785 736	14 232 128

Table C.130: Proportional higher education sector R&D expenditure by type of research (2012/13 to 2021/22)

TYPE OF RESEARCH	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Basic research	52.4	51.9	54.9	54.6	57.3	55.7	56.6	57.4	50.6	51.4
Applied research	32.6	33.1	31.6	32.2	29.7	32.8	32.6	31.7	32.1	32.6
Experimental development research	15.0	15.0	13.4	13.2	13.0	11.5	10.7	10.8	17.3	16.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.131: Higher education sector R&D expenditure by accounting category (2012/13 to 2021/22)

TYPE OF EXPENDITURE	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Capital expenditure	602 116	706 336	779 789	1 141 349	1 092 704	1 386 695	683 592	706 929	565 762	800 757
Land: buildings & other structures	192 324	256 114	200 253	198 032	616 761	874 171	257 899	220 810	90 184	115 363
TOTAL: Vehicles, plant, machinery, equipment and software	409 792	450 222	579 536	943 317	475 943	512 524	425 693	486 119	475 578	685 394
Vehicles, plant, machinery, equipment	409 792	450 222	579 536	943 317	475 943	512 524	425 693	465 711	335 047	676 116
#Capitalised computer software	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20 408	140 531	9 278
Current expenditure	6 731 037	6 586 517	7 597 786	8 735 274	10 566 554	11 623 181	12 499 527	13 472 031	13 219 974	13 431 371
Labour costs	2 996 929	3 248 542	3 539 733	3 576 140	4 315 989	5 080 369	5 579 653	6 054 648	6 323 292	6 310 941
Total cost of R&D postgraduate students	1 186 653	1 224 611	1 579 088	1 926 301	1 928 108	1 889 065	1 938 984	1 969 872	1 895 876	1 989 659
Other current expenditure*	2 547 455	2 113 364	2 478 965	3 232 833	4 322 457	4 653 747	4 980 889	5 447 511	5 000 806	5 130 771
Total	7 333 153	7 292 853	8 377 575	9 876 623	11 659 258	13 009 876	13 183 119	14 178 960	13 785 736	14 232 128

*Includes specific categories of R&D personnel costs from 2016/17.
#Capitalised computer software collected from 2019/20.

Table C.132: Proportional higher education sector R&D expenditure by accounting category (2012/13 to 2021/22)

TYPE OF EXPENDITURE	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Capital expenditure	8.2	9.7	9.3	11.6	9.4	10.7	5.2	5.0	4.1	5.6
Land: buildings & other structures	2.6	3.5	2.4	2.0	5.3	6.7	2.0	1.6	0.7	0.8
TOTAL: Vehicles, plant, machinery, equipment and software	5.6	6.2	6.9	9.6	4.1	3.9	3.2	3.4	3.4	4.8
Vehicles, plant, machinery, equipment	5.6	6.2	6.9	9.6	4.1	3.9	3.2	3.3	2.4	4.8
#Capitalised computer software	NA	NA	NA	NA	NA	NA	NA	0.1	1.0	0.1
Current expenditure	91.8	90.3	90.7	88.4	90.6	89.3	94.8	95.0	95.9	94.4
Labour costs	40.9	44.5	42.3	36.2	37.0	39.1	42.3	42.7	45.9	44.3
Total cost of R&D postgraduate students	16.2	16.8	18.8	19.5	16.5	14.5	14.7	13.9	13.8	14.0
Other current expenditure*	34.7	29.0	29.6	32.7	37.1	35.8	37.8	38.4	36.3	36.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

*Includes specific categories of R&D personnel costs from 2016/17.
#Capitalised computer software collected from 2019/20.

Table C.133: Higher education sector expenditure on multidisciplinary areas of R&D (2012/13 to 2021/22)

MULTI-DISCIPLINARY AREA OF R&D	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Biotechnology	380 727	406 285	470 837	553 562	531 958	529 948	552 583	701 411	1 051 272	1 176 323
Nanotechnology	293 300	356 826	393 137	505 380	431 558	319 610	420 500	477 909	1 168 384	1 063 508
Total	674 028	763 111	863 974	1 058 942	963 516	849 558	973 083	1 179 319	2 219 656	2 239 831
Higher education expenditure on R&D	7 333 153	7 292 853	8 377 575	9 876 623	11 659 258	13 009 876	13 183 119	14 178 960	13 785 736	14 232 128

Table C.134: Proportional higher education sector expenditure on multidisciplinary areas of R&D (2012/13 to 2021/22)

MULTI-DISCIPLINARY AREA OF R&D	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Biotechnology	5.2	5.6	5.6	5.6	4.6	4.1	4.2	4.9	7.6	8.3
Nanotechnology	4.0	4.9	4.7	5.1	3.7	2.5	3.2	3.4	8.5	7.5
Total	9.2	10.5	10.3	10.7	8.3	6.5	7.4	8.3	16.1	15.7

Table C.135: Higher education sector R&D expenditure on selected areas of interest (2012/13 to 2021/22)

AREA OF INTEREST	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Environment-related	300 006	340 386	499 958	583 723	883 069	1 112 755	1 369 351	1 503 980	1 693 912	1 635 364
Open-source software	85 508	105 008	117 646	125 883	164 097	196 300	202 026	220 567	310 748	295 344
New materials	321 744	381 136	436 975	462 962	449 336	252 340	355 152	421 202	304 415	625 956
Tuberculosis, HIV/AIDS, malaria	714 966	794 810	845 245	944 490	1 082 645	1 308 224	1 374 952	1 582 666	1 558 253	1 361 066
Space science	N/A	N/A	N/A	N/A	264 712	258 472	247 276	296 166	348 616	384 300
Total	1 422 224	1 621 339	1 899 823	2 117 058	2 843 859	3 128 090	3 548 757	4 024 580	4 215 944	4 302 031
Higher education expenditure on R&D	**7 333 153**	**7 292 853**	**8 377 575**	**9 876 623**	**11 659 258**	**13 009 876**	**13 183 119**	**14 178 960**	**13 785 736**	**14 232 128**

N/A: Environment-related data were collected from the 2011/12 R&D Survey onwards. Space science data were collected for the first time in the 2016/17 R&D Survey.

Table C.136: Proportional higher education sector R&D expenditure on selected areas of interest (2012/13 to 2021/22)

AREA OF INTEREST	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Environment-related	4.1	4.7	6.0	5.9	7.6	8.6	10.4	10.6	12.3	11.5
Open-source software	1.2	1.4	1.4	1.3	1.4	1.5	1.5	1.6	2.3	2.1
New materials	4.4	5.2	5.2	4.7	3.9	1.9	2.7	3.0	2.2	4.4
Tuberculosis, HIV/AIDS, malaria	9.7	10.9	10.1	9.6	9.3	10.1	10.4	11.2	11.3	9.6
Space science	N/A	N/A	N/A	N/A	2.3	2.0	1.9	2.1	2.5	2.7
Total	19.4	22.2	22.7	21.4	24.4	24.0	26.9	28.4	30.6	30.2

N/A: Environment-related data were collected from the 2011/12 R&D Survey onwards. Space science data were collected for the first time in the 2016/17 R&D Survey.

Table C.137: Higher education sector R&D expenditure by research field (2012/13 to 2021/22)

MAIN RESEARCH FIELD	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Division 1: Natural sciences, technology and engineering	5 045 892	4 925 713	5 704 150	6 340 905	6 976 302	7 941 477	7 580 936	8 172 232	7 366 884	7 695 481
Mathematical sciences	342 093	278 183	333 587	458 068	512 534	614 391	540 054	605 557	549 049	600 854
Physical sciences	193 849	198 735	230 826	287 830	356 090	427 400	376 229	397 447	357 722	301 613
Chemical sciences	444 258	286 511	326 992	386 300	472 883	362 105	452 369	520 849	406 563	419 953
Earth sciences	190 744	207 261	260 862	271 814	327 638	349 553	356 360	333 039	281 443	301 410
Information, computer and communication technologies	232 090	192 911	245 257	322 406	378 763	295 577	487 825	489 190	505 675	517 445
Applied sciences and technologies	251 278	280 310	274 283	272 429	139 046	76 434	155 627	199 427	211 761	195 209
Engineering sciences	768 810	855 529	918 494	891 532	926 463	907 241	1 082 308	1 107 713	896 415	883 144
Biological sciences	731 389	721 229	825 432	846 897	788 716	912 256	1 020 774	1 060 541	916 723	977 599

MAIN RESEARCH FIELD	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Agricultural sciences	276 857	311 355	354 949	326 296	440 433	644 885	535 299	517 978	573 725	697 034
Medical and health sciences	1 391 838	1 339 755	1 641 683	2 089 591	2 412 996	2 554 061	2 409 084	2 759 378	2 515 304	2 586 897
Environmental sciences	147 367	166 493	180 324	79 430	128 784	760 600	110 409	135 137	104 655	150 344
Material sciences	68 849	82 479	100 358	93 871	67 707	6 751	12 407	5 921	6 000	13 374
Marine sciences	6 469	4 961	11 105	14 441	24 249	30 223	42 192	40 056	41 851	50 605
Division 2: Social sciences and humanities	2 287 261	2 367 140	2 673 425	3 535 718	4 682 956	5 068 399	5 602 183	6 006 728	6 418 852	6 536 647
Social sciences	1 844 744	1 825 026	2 056 555	2 855 673	3 770 136	4 209 945	4 668 015	4 984 831	5 404 627	5 534 476
Humanities	442 517	542 114	616 870	680 046	912 820	858 454	934 167	1 021 897	1 014 225	1 002 171
Total	7 333 153	7 292 853	8 377 575	9 876 623	11 659 258	13 009 876	13 183 119	14 178 960	13 785 736	14 232 128

Table C.138: Proportional higher education sector R&D expenditure by research field (2012/13 to 2021/22)

MAIN RESEARCH FIELD	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Division 1: Natural sciences, technology and engineering	68.8	67.5	68.1	64.2	59.8	61.0	57.5	57.6	53.4	54.1
Mathematical sciences	4.7	3.8	4.0	4.6	4.4	4.7	4.1	4.3	4.0	4.2
Physical sciences	2.6	2.7	2.8	2.9	3.1	3.3	2.9	2.8	2.6	2.1
Chemical sciences	6.1	3.9	3.9	3.9	4.1	2.8	3.4	3.7	2.9	3.0
Earth sciences	2.6	2.8	3.1	2.8	2.8	2.7	2.7	2.3	2.0	2.1
Information, computer and communication technologies	3.2	2.6	2.9	3.3	3.2	2.3	3.7	3.5	3.7	3.6
Applied sciences and technologies	3.4	3.8	3.3	2.8	1.2	0.6	1.2	1.4	1.5	1.4
Engineering sciences	10.5	11.7	11.0	9.0	7.9	7.0	8.2	7.8	6.5	6.2
Biological sciences	10.0	9.9	9.9	8.6	6.8	7.0	7.7	7.5	6.6	6.9
Agricultural sciences	3.8	4.3	4.2	3.3	3.8	5.0	4.1	3.7	4.2	4.9
Medical and health sciences	19.0	18.4	19.6	21.2	20.7	19.6	18.3	19.5	18.2	18.2
Environmental sciences	2.0	2.3	2.2	0.8	1.1	5.8	0.8	1.0	0.8	1.1
Material sciences	0.9	1.1	1.2	1.0	0.6	0.1	0.1	0.0	0.0	0.09
Marine sciences	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.3	0.4
Division 2: Social sciences and humanities	31.2	32.5	31.9	35.8	40.2	39.0	42.5	42.4	46.6	45.9
Social sciences	25.2	25.0	24.5	28.9	32.3	32.4	35.4	35.2	39.2	38.9
Humanities	6.0	7.4	7.4	6.9	7.8	6.6	7.1	7.2	7.4	7.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.139: Higher education sector R&D expenditure by socio-economic objective (2012/13 to 2021/22)

SOCIO-ECONOMIC OBJECTIVE	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Division 1: Defence	12 009	6 121	7 266	8 330	10 899	13 792	12 592	14 392	13 602	14 603
Defence	12 009	6 121	7 266	8 330	10 899	13 792	12 592	14 392	13 602	14 603
Division 2: Economic development	1 996 497	2 547 254	2 472 831	2 850 018	3 375 098	4 044 376	4 344 693	4 417 475	4 253 957	4 311 790
Economic development unclassified	0	0	0	0	0	0	0	0	0	0
Plant production and plant primary products	234 309	534 417	220 024	282 188	358 551	551 241	473 094	519 167	451 434	508 770
Animal production and animal primary products	176 645	173 865	190 421	199 545	288 114	390 549	341 481	368 539	338 612	378 745
Mineral resources (excluding energy)	69 062	129 459	127 236	131 141	115 367	157 215	161 069	162 124	129 226	135 226
Energy resources	92 947	82 011	75 367	84 862	68 184	98 739	100 429	121 081	67 507	84 276
Energy supply	162 879	221 160	233 075	237 993	225 645	247 610	289 618	307 754	248 977	248 077
Manufacturing	348 845	340 630	329 083	380 258	444 203	478 631	557 911	518 485	466 422	456 904
Construction	74 322	79 775	96 642	111 437	177 750	223 367	257 483	184 267	174 602	173 922
Transport	31 830	32 503	38 549	47 577	72 250	101 938	47 056	72 113	67 299	82 662
Information and communication services	101 980	139 305	152 987	232 257	191 378	240 992	351 560	355 508	348 737	391 270
Commercial services	111 587	156 001	124 971	125 771	182 456	199 639	262 863	317 151	281 074	298 091
Economic framework	335 217	363 483	493 154	544 118	612 373	703 369	968 057	933 506	1 049 281	989 437
Natural resources	256 874	294 645	391 322	472 871	638 827	651 085	534 072	557 782	630 786	564 410
Division 3: Society	1 865 914	1 569 371	2 180 662	2 820 755	3 266 113	3 540 172	2 988 330	3 750 653	3 703 025	3 941 413
Society unclassified	0	0	0	0	0	0	0	0	0	0
Health	1 150 349	654 525	1 074 951	1 375 861	1 652 001	1 730 300	1 273 726	1 915 131	1 882 024	2 033 842
Education and training	402 285	547 108	739 611	925 245	912 877	1 041 714	1 057 301	1 297 282	1 272 888	1 310 373
Social development and community services	313 280	367 738	366 099	519 649	701 234	768 158	657 303	538 240	548 113	597 198
Division 4: Environment	554 758	456 619	629 133	614 011	737 262	780 436	1 070 418	1 105 385	1 139 091	1 094 682
Environment unclassified	0	0	0	0	0	0	0	0	0	0
Environmental knowledge	232 440	184 169	269 688	246 804	331 243	341 909	469 090	452 706	423 839	443 038
Environmental aspects of development	168 956	154 462	202 787	212 879	233 609	233 947	317 976	353 870	356 402	347 753

SOCIO-ECONOMIC OBJECTIVE	2012/13 R'000	2013/14 R'000	2014/15 R'000	2015/16 R'000	2016/17 R'000	2017/18 R'000	2018/19 R'000	2019/20 R'000	2020/21 R'000	2021/22 R'000
Environmental and other aspects	153 362	117 989	156 658	154 328	172 411	204 580	283 352	298 809	358 850	303 890
Division 5: Advancement of knowledge	2 903 975	2 713 487	3 087 684	3 583 508	4 269 886	4 631 099	4 767 086	4 891 055	4 676 061	4 869 640
Advancement of knowledge unclassified	0	0	0	0	0	0	0	0	0	0
Natural sciences, technologies and engineering	1 731 540	1 633 257	2 006 195	2 262 831	2 887 227	3 269 179	3 373 533	3 346 297	3 197 657	3 323 014
Social sciences and humanities	1 172 435	1 080 231	1 081 488	1 320 677	1 382 659	1 361 920	1 393 552	1 544 758	1 478 404	1 546 626
Total	7 333 153	7 292 853	8 377 575	9 876 623	11 659 258	13 009 876	13 183 119	14 178 960	13 785 736	14 232 128

Table C.140: Proportional higher education sector R&D expenditure by socio-economic objective (2012/13 to 2021/22)

SOCIO-ECONOMIC OBJECTIVE	2012/13 %	2013/14 %	2014/15 %	2015/16 %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %	2021/22 %
Division 1: Defence	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Defence	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Division 2: Economic development	27.2	34.9	29.5	28.9	28.9	31.1	33.0	31.2	30.9	30.3
Economic development unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Plant production and plant primary products	3.2	7.3	2.6	2.9	3.1	4.2	3.6	3.7	3.3	3.6
Animal production and animal primary products	2.4	2.4	2.3	2.0	2.5	3.0	2.6	2.6	2.5	2.7
Mineral resources (excluding energy)	0.9	1.8	1.5	1.3	1.0	1.2	1.2	1.1	0.9	1.0
Energy resources	1.3	1.1	0.9	0.9	0.6	0.8	0.8	0.9	0.5	0.6
Energy supply	2.2	3.0	2.8	2.4	1.9	1.9	2.2	2.2	1.8	1.7
Manufacturing	4.8	4.7	3.9	3.9	3.8	3.7	4.2	3.7	3.4	3.2
Construction	1.0	1.1	1.2	1.1	1.5	1.7	2.0	1.3	1.3	1.2
Transport	0.4	0.4	0.5	0.5	0.6	0.8	0.4	0.5	0.5	0.6
Information and communication services	1.4	1.9	1.8	2.4	1.6	1.9	2.7	2.5	2.5	2.7
Commercial services	1.5	2.1	1.5	1.3	1.6	1.5	2.0	2.2	2.0	2.1
Economic framework	4.6	5.0	5.9	5.5	5.3	5.4	7.3	6.6	7.6	7.0
Natural resources	3.5	4.0	4.7	4.8	5.5	5.0	4.1	3.9	4.6	4.0

SOCIO-ECONOMIC OBJECTIVE	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
	%	%	%	%	%	%	%	%	%	%
Division 3: Society	25.4	21.5	26.0	28.6	28.0	27.2	22.7	26.5	26.9	27.7
Society unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Health	15.7	9.0	12.8	13.9	14.2	13.3	9.7	13.5	13.7	14.3
Education and training	5.5	7.5	8.8	9.4	7.8	8.0	8.0	9.1	9.2	9.2
Social development and community services	4.3	5.0	4.4	5.3	6.0	5.9	5.0	3.8	4.0	4.2
Division 4: Environment	7.6	6.3	7.5	6.2	6.3	6.0	8.1	7.8	8.3	7.7
Environment unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Environmental knowledge	3.2	2.5	3.2	2.5	2.8	2.6	3.6	3.2	3.1	3.1
Environmental aspects of development	2.3	2.1	2.4	2.2	2.0	1.8	2.4	2.5	2.6	2.4
Environmental and other aspects	2.1	1.6	1.9	1.6	1.5	1.6	2.1	2.1	2.6	2.1
Division 5: Advancement of knowledge	39.6	37.2	36.9	36.3	36.6	35.6	36.2	34.5	33.9	34.2
Advancement of knowledge unclassified	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Natural sciences, technologies and engineering	23.6	22.4	23.9	22.9	24.8	25.1	25.6	23.6	23.2	23.3
Social sciences and humanities	16.0	14.8	12.9	13.4	11.9	10.5	10.6	10.9	10.7	10.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.141: Higher education sector R&D expenditure by province (2012/13 to 2021/22)

PROVINCE	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000	R'000
Eastern Cape	592 861	557 292	612 239	975 099	1 002 978	1 017 383	1 027 996	1 123 901	1 190 432	1 161 879
Free State	356 177	449 852	491 203	523 782	625 646	894 118	803 727	847 104	624 925	620 362
Gauteng	2 118 817	2 233 696	2 733 330	3 305 576	4 105 237	4 269 020	3 730 236	4 188 428	4 474 214	4 112 581
KwaZulu-Natal	1 137 258	750 507	843 111	903 664	1 157 722	1 428 653	1 646 915	1 514 301	1 377 646	1 471 778
Limpopo	300 435	187 317	216 352	229 364	301 809	358 543	384 346	466 703	540 991	576 400
Mpumalanga	182 192	147 134	174 657	190 716	148 981	155 430	170 553	213 914	220 654	584 924
North West	311 325	405 963	404 575	444 135	469 171	449 196	833 635	856 833	555 118	642 430
Northern Cape	164 483	161 603	146 769	164 487	188 515	180 632	161 714	169 999	52 337	74 812
Western Cape	2 169 606	2 399 489	2 755 339	3 139 800	3 659 198	4 256 902	4 423 997	4 797 779	4 749 419	4 986 962
Total	7 333 153	7 292 853	8 377 575	9 876 623	11 659 258	13 009 876	13 183 119	14 178 960	13 785 736	14 232 128

Table C.142: Proportional higher education sector R&D expenditure by province (2012/13 to 2021/22)

PROVINCE	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
	%	%	%	%	%	%	%	%	%	%
Eastern Cape	8.1	7.6	7.3	9.9	8.6	7.8	7.8	7.9	8.6	8.2
Free State	4.9	6.2	5.9	5.3	5.4	6.9	6.1	6.0	4.5	4.4
Gauteng	28.9	30.6	32.6	33.5	35.2	32.8	28.3	29.5	32.5	28.9
KwaZulu-Natal	15.5	10.3	10.1	9.1	9.9	11.0	12.5	10.7	10.0	10.3
Limpopo	4.1	2.6	2.6	2.3	2.6	2.8	2.9	3.3	3.9	4.0
Mpumalanga	2.5	2.0	2.1	1.9	1.3	1.2	1.3	1.5	1.6	4.1
North West	4.2	5.6	4.8	4.5	4.0	3.5	6.3	6.0	4.0	4.5
Northern Cape	2.2	2.2	1.8	1.7	1.6	1.4	1.2	1.2	0.4	0.5
Western Cape	29.6	32.9	32.9	31.8	31.4	32.7	33.6	33.8	34.5	35.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C.143: Higher education sector R&D personnel in headcounts and full-time equivalents by occupation (2012/13 to 2021/22)

YEAR	HEADCOUNTS				FULL-TME EQUIVALENTS (FTEs)			
	TOTAL	RESEARCHERS*	TECHNICIANS	OTHER R&D PERSONNEL	TOTAL	RESEARCHERS*	TECHNICIANS	OTHER R&D PERSONNEL
2012/13	**22 691**	17 441	2 344	2 906	**6 571.5**	4 700.6	737.3	1 133.5
2013/14	**23 543**	18 212	2 284	3 047	**7 005.7**	5 000.5	843.7	1 161.5
2014/15	**24 701**	18 625	2 496	3 580	**7 237.8**	5 097.7	857.3	1 282.8
2015/16	**25 612**	19 217	2 616	3 779	**7 147.1**	4 701.9	1 000.3	1 445.0
2016/17	**28 658**	22 302	2 227	4 129	**7 652.9**	5 220.4	804.2	1 628.3
2017/18	**31 467**	24 942	2 484	4 041	**8 459.4**	6 040.6	838.0	1 580.8
2018/19	**31 230**	24 618	2 272	4 340	**8 873.3**	6 007.2	924.5	1 941.6
2019/20	**32 524**	25 727	2 160	4 637	**9 122.3**	6 165.9	849.2	2 107.2
2020/21	**32 168**	25 651	2 267	4 250	**9 099.6**	6 034.1	1021.5	2 044.0
2021/22	**33 134**	26 759	2 043	4 332	**8 824.6**	5 896.4	882.9	2 045.3

Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

* Excluding doctoral and post-doctoral students.

Table C.144: Higher education sector R&D personnel in headcounts (*including and **excluding doctoral and post-doctoral students) and full-time equivalents by occupation and gender (2019/20 to 2021/22)

YEAR	HEADCOUNTS			FULL-TIME EQUIVALENTS (FTEs)			
2019/20	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**TOTAL FTEs AS % OF TOTAL HEADCOUNTS**
Researchers*	**53 371**	28 313	25 058	**22 153.0**	12 012.2	10 140.8	41.5
Technicians directly supporting R&D	**2 160**	1 283	877	**849.2**	530.3	318.9	39.3
Other personnel directly supporting R&D	**4 637**	1 548	3 089	**2 107.2**	677.4	1 429.9	45.4
Total	60 168	31 144	29 024	25 109.4	13 219.9	11 889.5	41.7
Researchers**	**25 727**	13 481	12 246	**6 165.6**	3 255.4	2 910.2	24.0
Technicians directly supporting R&D	**2 160**	1 283	877	**849.2**	530.3	318.9	39.3
Other personnel directly supporting R&D	**4 637**	1 548	3 089	**2 107.2**	677.4	1 429.9	45.4
Total	32 524	16 312	16 212	9 122.0	4 463.0	4 659.0	28.0
2020/21	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**TOTAL FTEs AS % OF TOTAL HEADCOUNTS**
Researchers*	**52 985**	27 946	25 039	**21 777.6**	11 608.9	10 168.8	41.1
Technicians directly supporting R&D	**2 267**	1 314	953	**1 021.5**	598.9	422.5	45.1
Other personnel directly supporting R&D	**4 250**	1 302	2 948	**2 044.0**	585.9	1 458.1	48.1
Total	59 502	30 562	28 940	24 843.1	12 793.7	12 049.4	41.8
Researchers**	**25 651**	13 452	12 199	**6 034.1**	3 159.8	2 874.4	23.5
Technicians directly supporting R&D	**2 267**	1 314	953	**1 021.5**	598.9	422.5	45.1
Other personnel directly supporting R&D	**4 250**	1 302	2 948	**2 044.0**	585.9	1 458.1	48.1
Total	32 168	16 068	16 100	9 099.6	4 344.6	4 755.0	28.3
2021/22	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**MALE**	**FEMALE**	**TOTAL FTEs AS % OF TOTAL HEADCOUNTS**
Researchers*	**54 784**	28 746	26 038	**21 861.6**	11 568.0	10 293.6	39.9
Technicians directly supporting R&D	**2 043**	1 182	861	**882.9**	511.6	371.3	43.2
Other personnel directly supporting R&D	**4 332**	1 364	2 968	**2 045.3**	623.9	1 421.4	47.2
Total	61 159	31 292	29 867	24 789.8	12 703.5	12 086.3	40.5
Researchers**	**26 759**	14 052	12 707	**5 896.4**	3 086.0	2 810.4	22.0
Technicians directly supporting R&D	**2 043**	1 182	861	**882.9**	511.6	371.3	43.2
Other personnel directly supporting R&D	**4 332**	1 364	2 968	**2 045.3**	623.9	1 421.4	47.2
Total	33 134	16 598	16 536	8 824.6	4 221.5	4 603.1	26.6

*Includes doctoral students and post-doctoral fellows. Also includes specific categories of R&D personnel (from 2016/17).
**Excluding doctoral and post-doctoral students. Also includes specific categories of R&D personnel (from 2016/17).
Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.145: Higher education sector R&D personnel in headcounts and full-time equivalents by occupation and gender (2019/20 to 2021/22)

OCCUPATION	HEADCOUNTS			FULL-TIME EQUIVALENTS (FTEs)	
2019/20	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**TOTAL FTEs AS % OF TOTAL HEADCOUNTS**
Researchers*	**25 727**	13 481	12 246	**6 165.6**	24.0
Technicians directly supporting R&D	**2 160**	1 283	877	**849.2**	39.3
Other personnel directly supporting R&D	**4 637**	1 548	3 089	**2 107.2**	45.4
Total	**32 524**	**16 312**	**16 212**	**9 122.0**	**28.0**
2020/21	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**TOTAL FTEs AS % OF TOTAL HEADCOUNTS**
Researchers*	**25 651**	13 452	12 199	**6 034.1**	23.5
Technicians directly supporting R&D	**2 267**	1 314	953	**1 021.5**	45.1
Other personnel directly supporting R&D	**4 250**	1 302	2 948	**2 044.0**	48.1
Total	**32 168**	**16 068**	**16 100**	**9 099.6**	**28.3**
2021/22	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**TOTAL FTEs AS % OF TOTAL HEADCOUNTS**
Researchers*	**26 759**	14 052	12 707	**5 896.4**	22.0
Technicians directly supporting R&D	**2 043**	1 182	861	**882.9**	43.2
Other personnel directly supporting R&D	**4 332**	1 364	2 968	**2 045.3**	47.2
Total	**33 134**	**16 598**	**16 536**	**8 824.6**	**26.6**

*Excludes doctoral students and post-doctoral fellows. Includes specific categories of R&D personnel.
Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.146: Higher education sector R&D postgraduates in headcounts by qualification and gender, and full-time equivalents by qualification (2019/20 to 2021/22)

OCCUPATION	HEADCOUNTS			FULL-TIME EQUIVALENTS (FTEs)	
2019/20	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**TOTAL FTEs AS % OF TOTAL HEADCOUNTS**
Post-doctoral fellows	**2 867**	1 693	1 174	**2 717.6**	94.8
Doctoral students	**24 777**	13 139	11 638	**13 269.7**	53.6
Master's students (full research master's)	**29 578**	13 507	16 071	**14 593.6**	49.3
Master's students (coursework plus thesis with research component)	**29 924**	14 019	15 905	**9 758.2**	32.6
Total	**87 146**	**42 358**	**44 788**	**40 339.2**	**46.3**
2020/21	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**TOTAL FTEs AS % OF TOTAL HEADCOUNTS**
Post-doctoral fellows	**2 978**	1 745	1 233	**2 817.3**	94.6
Doctoral students	**24 356**	12 749	11 607	**12 926.2**	53.1
Master's students (full research master's)	**28 558**	12 674	15 884	**13 429.1**	47.0
Master's students (coursework plus thesis with research component)	**31 411**	14 170	17 241	**8 671.3**	27.6
Total	**87 303**	**41 338**	**45 965**	**37 844.9**	**46.3**
2021/22	**TOTAL**	**MALE**	**FEMALE**	**TOTAL**	**TOTAL FTEs AS % OF TOTAL HEADCOUNTS**
Post-doctoral fellows	**3 028**	1 761	1 267	**2 689.1**	88.8
Doctoral students	**24 997**	12 933	12 064	**13 276.1**	53.1
Master's students (full research master's)	**29 665**	12 993	16 672	**13 327.4**	44.9
Master's students (coursework plus thesis with research component)	**27 755**	12 233	15 522	**8 668.8**	31.2
Total	**85 445**	**39 920**	**45 525**	**37 961.4**	**44.4**

Note: Master's students are separated into two categories (from 2016/17).

Table C.147: Higher education sector R&D personnel in headcounts by occupation, qualification, population group and gender (2021/22)

OCCUPATION AND QUALIFICATION	TOTAL	SUBTOTAL		AFRICAN		COLOURED		INDIAN/ASIAN		WHITE		NON-SA	
		MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
Researchers*	26 759	14 052	12 707	4 679	4 133	684	879	1 076	1 342	4 461	5 087	3 152	1 266
Doctoral degree or equivalent	14 495	8 373	6 122	2 101	1 451	363	358	559	609	2 878	2 816	2 472	888
Master's, honours, bachelor or equivalent	10 932	5 061	5 871	2 345	2 418	280	452	466	647	1 408	2 041	562	313
Diplomas	1 332	618	714	233	264	41	69	51	86	175	230	118	65
Technicians directly supporting R&D	2 043	1 182	861	527	372	207	136	67	49	329	278	52	26
Doctoral degree or equivalent	277	141	136	22	14	6	8	9	10	89	98	15	6
Master's, honours, bachelor or equivalent	916	467	449	273	215	33	70	28	34	106	113	27	17
Diplomas	850	574	276	232	143	168	58	30	5	134	67	10	3
Other personnel directly supporting R&D	4 332	1 364	2 968	692	1 123	195	704	56	142	288	831	133	168
Doctoral degree or equivalent	446	216	230	102	58	14	31	17	31	57	81	26	29
Master's, honours, bachelor or equivalent	1 861	579	1 282	292	493	66	238	21	62	135	407	65	82
Diplomas	2 025	569	1 456	298	572	115	435	18	49	96	343	42	57
Total	33 134	16 598	16 536	5 898	5 628	1 086	1 719	1 199	1 533	5 078	6 196	3 337	1 460

*Excludes doctoral students and post-doctoral fellows. Includes specific categories of R&D personnel.
Note: Headcounts include non-SA R&D personnel (from 2016/17). Non-SA personnel are classified as those that are not from South Africa but are undertaking research in South Africa for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.148: Higher education sector overview (2020/21 to 2021/22)

HIGHER EDUCATION OVERVIEW	2020/21					2021/22				
	R&D EXPENDITURE	RESEARCHER HEADCOUNT*	RESEARCHER FTE*	POSTGRAD HEADCOUNT	POSTGRAD FTE	R&D EXPENDITURE	RESEARCHER HEADCOUNT*	RESEARCHER FTE*	POSTGRAD HEADCOUNT	POSTGRAD FTE
	R' 000					R' 000				
Private universities	86 064	165	73.4	371	118.9	141 429	139	41.7	471.0	121.1
Public universities	12 177 813	21 044	4 986.2	24 707	14 335.5	12 773 127	22 126	5 083.2	25 230.0	14 364.3
Nelson Mandela Metropolitan University	401 472	868	145.4	662	321.4	407 031	888	132.6	718.0	352.5
North-West University	498 343	875	262.5	1 711	1 127.8	580 071	699	349.5	1 749.0	1 106.6
Rhodes University	306 532	443	175.4	685	679.5	305 470	431	167.7	654.0	654.0
Sefako Makgatho Health Sciences University	199 141	645	127.4	90	64.5	208 553	704	140.0	139.0	98.8
University of Cape Town	1 871 443	1 041	410.5	2 561	1 610.4	2 026 477	1 036	380.0	2 600.0	1 640.7
University of Fort Hare	181 585	347	104.1	582	341.6	190 795	326	104.1	546.0	341.6
University of Johannesburg	687 668	1 672	309.3	1 805	1 228.5	792 760	1 941	249.2	1 956.0	1 255.3
University of KwaZulu-Natal	822 415	2 314	532.1	3 243	1 460.3	889 371	2 687	562.2	3 351.0	1 483.4
University of Limpopo	327 328	693	227.3	310	173.5	407 543	878	314.5	267.0	138.4
University of Mpumalanga						343 419	66	65.4	7.0	5.3
University of Pretoria	1 374 844	2 464	492.8	2673	1 589.8	1 124 017	2 449	289.3	2 814.0	1 502.1
University of South Africa	1 350 722	1982	381.2	2 649	1 864.7	993 566	1 933	381.2	2 729.0	1 864.7
University of Stellenbosch	1 838 086	1 789	529.8	2 009	1 149.3	1 973 377	1 811	532.5	2 019.0	1 135.3
University of the Free State	350 027	677	187.7	1 435	578.4	407 801	666	188.2	1 229.0	606.1
University of the Western Cape	782 888	1 040	312.0	1 261	564.8	793 623	1 040	312.0	1 388.0	612.8
University of the Witwatersrand	1 012 628	3 875	704.1	2 712	1 419.5	1 132 171	4 226	742.3	2 717.0	1 366.6
University of Zululand	172 690	319	159.5	319	161.5	197 082	345	172.5	347.0	200.3

HIGHER EDUCATION OVERVIEW	2020/21					2021/22				
	R&D EXP-ENDITURE	RESEARCHER HEADCOUNT*	RESEARCHER FTE*	POSTGRAD HEADCOUNT	POSTGRAD FTE	R&D EXP-ENDITURE	RESEARCHER HEADCOUNT*	RESEARCHER FTE*	POSTGRAD HEADCOUNT	POSTGRAD FTE
	R' 000					R' 000				
Universities of (science) and technology	1 521 859	4 442	899.8	2 256	1 289.1	1 317 572	4 494	771.5	2 324.0	1 479.8
Cape Peninsula University of Technology	237 193	787	124.6	393	200.0	219 364	698	109.6	339.0	245.7
Walter Sisulu University of Technology and Science	279 321	714	142.8	88	64.9	219 052	908	136.2	82.0	60.7
Central University of Technology	212 552	323	193.8	215	99.7	135 751	252	100.8	206.0	89.7
Durban University of Technology	175 143	704	120.1	567	323.9	229 129	777	130.1	673.0	361.0
Mangosuthu University of Technology	33 515	209	32.6	17	17.0	29 835	181	28.2	19.0	19.0
Tshwane University of Technology	381 466	922	193.6	574	314.0	283 306	879	175.8	632.0	459.2
University of Venda for Science and Technology	105 208	433	43.3	253	177.1	111 190	425	42.5	234.0	163.8
Vaal University of Technology	97 462	350	49.1	149	92.6	89 944	374	48.3	139.0	80.7
TOTAL	13 785 736	25 651	6 034.1	27 334	15 743.5	14 232 128	26 759	5 896.4	28 025.0	15 965.2

**Missing personnel data were supplemented from the HEMIS database. Collected personnel data may differ from HEMIS data in some cases due to definitional differences in personnel categories. Where no data was provided, a statistically generated estimate was created.
*Excludes post-doctoral and doctoral students. Includes specific categories of R&D personnel.
Note: Headcounts include non-SA R&D staff from 2016/17. Non-South African personnel are classified as those that are not from South Africa but undertaking research for a period exceeding six months. They can be temporary or permanent residents as described by the SNA.

Table C.149: Gross domestic product and employment (2012/13 to 2021/22)

REFERENCE YEAR	SURVEY YEAR	GDP LEVEL (CURRENT VALUES)	GDP LEVEL (CONSTANT 2015 VALUES)	EMPLOYMENT
		R mill.	R mill.	(000.)
2012	2012/13	3 566 385	4 197 952	14 558
2013	2013/14	3 868 630	4 302 291	15 055
2014	2014/15	4 133 873	4 363 118	15 459
2015	2015/16	4 420 793	4 420 793	15 675
2016	2016/17	4 759 555	4 450 171	16 212
2017	2017/18	5 078 190	4 501 702	16 378
2018	2018/19	5 363 190	4 571 783	16 291
2019	2019/20	5 625 207	4 583 667	16 383
2020	2020/21	5 567 974	4 310 327	14 995
2021	2021/22	6 208 786	4 513 044	14 914

Data source: Stats SA (2022a)

D. DESCRIPTION OF SURVEY METHODOLOGY

D.1. Survey design and planning

The South African National Survey of Research and Experimental Development (R&D Survey) is one of the tools used to monitor and evaluate the performance of the national system of innovation (NSI).

The R&D Survey can be thought of as three survey instruments covering the four main sectors described in the Frascati Manual: business enterprise, government, private not-for-profit and the higher education sectors. In South Africa, the science councils are extracted from the government sector and reported separately, thus comprising a fifth South African sector.

The scope of the survey includes all units performing R&D, either continuously or occasionally. Output tables are agreed in advance of the survey between CeSTII and the DSI as a standard.

The survey collects data in accordance with the guidelines recommended by the OECD in the Frascati Manual (OECD, 2002; 2015). This helps to maintain coherence and international comparability. The System of National Accounts (EC, IMF, OECD, UN and the World Bank, 2009) and the national system of innovation differ on the identification of target units and definitions.

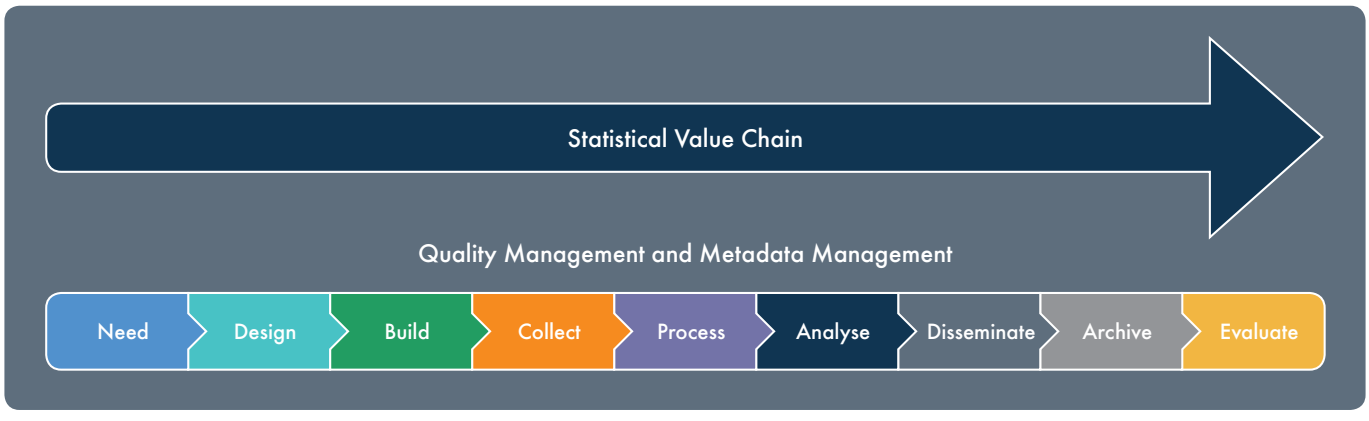
In the interests of coherence of its data with other South African economic survey data, the South African R&D Survey takes care to use standards and methods applied or recommended by Statistics South Africa. Concepts and definitions are aligned as far as possible with those in use by the National Statistical Organisation (NSO) (Stats SA, 2010a). Indicators that use external data are sourced from Stats SA surveys. These are:

- Gross domestic product values for the 2022 annual reference period taken from the quarterly Stats SA GDP statistical release P0441 (Stats SA, 2023); and
- Employment level value for the first quarter of 2022 obtained from the Stats SA Quarterly Labour Force Survey statistical release P0211 (Stats SA, 2022).

The survey also uses the Standard Industrial Classification (Stats SA, 2004) codes for business sector industrial classifications employed by Stats SA.

Overall, HSRC-CeSTII performs quality management in line with practices recommended by Stats SA in the South African Statistical Quality Assessment Framework (SASQAF) (Stats SA, 2010b). The survey was conducted according to a project plan aligned with the phases of the Statistical Value Chain (SVC) illustrated in Figure D1, which is modelled on practice at Statistics SA.

Figure D. 1: Statistical Value Chain in quality and metadata management



D.2. Frame, sample selection and fieldwork

Three questionnaires were used in the survey for the business sector, the higher education sector, and government departments, research institutes, museums, science councils and not-for-profit organisations.

R&D performers in sectors were taken to be any units that had R&D expenditure or were likely to have had R&D expenditure in 2021/22. Table D.1 describes each of the fieldwork periods employed by sector and provides their respective reference periods. All sectors were surveyed as a census.

Table D.1: Description of sectors, respective reference periods, sampling methods and fieldwork periods

SECTOR	DESCRIPTION	REFERENCE PERIOD	METHOD OF SURVEYING	FIELDWORK AND FOLLOW-UP PERIOD
Business	Large, medium and small (micro) business enterprises, including state-owned enterprises.	1 April 2021 to 31 March 2022 or nearest complete financial year	A purposive design was used for the register of the business sector, and the frame was constructed from the business register thus developed and maintained by HSRC-CeSTII since 2002. All known and likely R&D performers were targeted including those that were on the current frame.	18 November 2022 to 31 August 2023
Not-for-profit	Non-governmental and not-for-profit entities. Those registered as section 21 companies.	1 April 2021 to 31 March 2022 or nearest complete financial year	All known and likely R&D performers were surveyed following an investigation of a list of registered non-governmental and not-for-profit organisations including those that were on the current frame.	18 November 2022 to 31 August 2023
Government	National and provincial departments, local government, museums, research institutes and other research units with an R&D components.	1 April 2021 to 31 March 2022 or nearest complete financial year	Government departments were surveyed using a census approach. All government departments, associated research institutions and museums performing R&D at national, provincial and local levels were included in the government sector.	18 November 2022 to 31 August 2023
Science councils	The nine science councils established through Acts of Parliament.	1 April 2021 to 31 March 2022 or nearest complete financial year	Seven statutory science councils were surveyed.	18 November 2022 to 31 August 2023
Higher education	All public higher education institutions as well as private higher education institutions that performed R&D. Teaching hospitals were also included in this sector.	Calendar year (ending 31 December 2021)	Higher education institutions, namely universities, universities of science and technology, institutes of education and private higher education institutions were included in the higher education sector frame. All public higher education institutions were surveyed.	18 November 2022 to 31 August 2023

D.3. Fieldwork

The R&D data were collected through questionnaires that were sent to the units in each sector by electronic mail or by use of an online submission system piloted in 2021. All five sectors were surveyed between 18 November 2022 and 31 August 2023.

A unit was considered as a response if:

- The unit completed and returned a questionnaire with non-zero in-house R&D expenditure;
- If the unit's in-house R&D expenditure, headcounts, and sources of fund data as a minimum were reported by the respondent without a fully completed questionnaire, or,
- If data were confirmed by the respondent after being imputed based on secondary data sources.

The data sources used for imputation included previous R&D survey responses as well as other private and public data sources such as the Higher Education Management Information System (HEMIS) and Support Programme for Industrial Innovation (SPII).

For each sector, a list of R&D-performing units was identified from existing lists and intelligence-gathering operations. These units were verified as R&D performers to determine the units to be surveyed before collection began.

Changes made to the 2016/17 R&D Survey collection instruments on the R&D personnel tables for all sectors were maintained in the 2021/22 R&D Survey and include explanatory footnotes. This was done to report on foreign employees that could not be categorised by population group during previous surveys. The R&D personnel changes included an additional classification of the population group of R&D personnel as non-South African personnel.

Business sector

CeSTII has developed a register of known or likely R&D performers in the business sector from several information sources, including the JSE Top 100 Companies, Technology Top 100, Support Programme for Industrial Innovation (SPII) and Technology and Human Resources for Industry Programme (THRIP). A list of 920 companies was investigated. A total of 467 business sector units were selected for the 2021/22 survey period. Of this cohort, 280 units were reported as in-scope units and 32 as out-of-scope. A total of 33 units were imputed to account for non-response of in-scope units.

Non-response during the 2021/22 survey may be attributed to several issues including resistance from respondents to participate in the survey and newly appointed individuals assigned to R&D survey responsibilities within their companies. Post-COVID-19, the country reverted to more traditional business practices, however, respondents still referred to the economic challenges experienced during and post the pandemic and the lack of funding resulting in many entities phasing out their R&D activities. Negative outcomes of R&D tax incentives were also indicated as a contributor to resistance to participation in the survey.

Steps were implemented to improve the quality of the survey through new business coverage expansion activities including the Business Sector Coverage Improvement Project, continuing with traditional business intelligence efforts, and cleaning existing registers, all to expand coverage through the addition of new units to the frame to boost response rates.

The business intelligence strategies implemented for the 2021/22 R&D survey included:

1. Cleaning the existing frame – removing units that had become out-of-scope
2. Frame building activities through business intelligence – addition of new units
3. Identifying events to improve the visibility of the R&D Survey and networking with the intent of identifying entities likely to perform R&D
4. Sectoral engagements with R&D performers

The business register for the 2021/22 survey underwent a very strategic and thorough cleaning process. The previous survey cycle included many out-of-scope units. These units were identified and removed from the frame (including units that have advised no-R&D for three years or more, units that were imputed for three years or more). Prior to removal, these units were investigated again and only two units were found to be eligible for inclusion. Approximately 429 new units were investigated, of which only 11.4% were deemed eligible for inclusion in the frame. Business intelligence and register cleaning activities produced a much cleaner frame and resulted in the survey obtaining much improved response rates.

In addition to business intelligence activities, the 2021/22 survey also included several virtual engagements with respondents as well as face-to-face meetings. This strategy worked well to overcome resistance to participation in the survey and to receive more complete questionnaires from respondents.

Science councils sector

Seven R&D-active science councils responded to the survey questionnaire. One of these science councils was surveyed at the level of its constituent units resulting in a total of 11 reporting units for the 2021/22 financial period.

Not-for-profit sector

The fieldwork staff investigated a list of 103 units within the not-for-profit sector, which consisted of well-known and likely R&D performers. Fifty-four units were deemed in-scope and selected to compile statistics for the 2021/22 R&D Survey. The not-for-profit sector register also underwent a cleaning process as the previous survey cycle had included many out-of-scope units. The fieldwork staff identified and removed these units from the frame (including units that had advised no R&D for three years or more, or units that were imputed for three years or more).

Government sector

The government sector team investigated a list of 82 units consisting of national and provincial departments, municipalities, research centres and museums. Sixty-eight possible R&D performing units were selected to be surveyed for the 2021/22 survey cycle. The government sector register also underwent a cleaning process. The previous survey cycle had included many out-of-scope units. These units were identified and removed from the frame (including units that had advised no R&D for three years or more, or units that were imputed for three years or more).

Higher education sector

In the 2021/22 R&D Survey, the survey frame for the higher education sector was 32, which consisted of six private universities and 26 public universities.

The funding of research chairs is included in these estimates. Further amendments to the collection instrument included specific categories of R&D personnel relevant to higher education only – these are emeritus professors, research fellows, honorary research associates or equivalent. Such persons do not incur a salary at the university but there are time and costs associated with them. The Frascati guidelines classify specific categories of R&D personnel as researchers and recommend they be included in reporting R&D activity. Costs incurred by the specific categories of R&D personnel are included as "specific categories of R&D personnel costs" and are included in the other current expenditure. As of the 2016/17 R&D Survey, the master's student category was split into two types: master's students (full research master's) and master's students (coursework plus thesis with research component).

D.4. Methodological note on frame maintenance and coverage improvement measures for the 2021/22 R&D Survey

The frame used in previous R&D survey cycles included many out-of-scope units. Cleaning the frame for all sectors is an essential step, and it is unavoidable that a lower number of enterprises will remain on the frame at the end. To counter this effect, frame-building activities were implemented in parallel, appealing to various new sources with the intent of identifying and investigating entities most likely involved in R&D. The addition of these new units makes up for units lost and expands the register. Units that have temporarily ceased R&D activities are kept on the register and re-investigated in future surveys. The cleaner frame may be part of the reason for improved response and collection rates in the 2021/22 reference year.

In addition to frame maintenance measures, the resistance to participate in the R&D survey (mostly from the business and not-for-profit sectors) resulted in the R&D survey project team implementing strategic and focussed measures to counteract this. These are listed below.

1. **Extending fieldwork:** Fieldwork for the R&D Survey 2021/22 commenced in November 2022 to make up for time lost due to the COVID-19 pandemic. Fieldwork was scheduled to end on 31 May 2023 but was extended by two months due to a lack of responses, and the addition of new units to the existing register.

2. **Targeting the top 200 firms:** The Frascati Manual recommends that all size classes be covered in an R&D survey. However, considering that large firms contribute significantly to R&D, every effort must be made to ensure coverage of large firms (OECD, 2015: Chapter 7). In addition to the units already in the field, the top 200 South African firms were identified to guide more focused fieldwork efforts in the business sector.

3. **Sectorising firms in the business sector:** The business sector consists of 10 industrial sectors based on Standard Industrial Classification codes. Researcher expertise based on industrial sectors was identified to focus solely on these sectors based on the business frame of responding units. This ensured a higher quality of R&D frame maintenance with the inclusion of R&D performing entities and quality checking of data received, based on sectorised expertise.

4. **Prepopulated questionnaires:** In the case of new respondents or respondents who were not able to complete the survey, historical data submissions, involving or considering the use of a statistically generated GDP inflation factor, and annual reports were used by researchers to compile questionnaires. Respondents were sent the questionnaire and allowed to amend or edit where necessary and then approve and sign off the questionnaire. This strategy was implemented for all sectors with outstanding units. If no response or adjustment was received, the commute would be recorded as a regular commute/estimated value/unit imputation.

5. **Digital meetings:** Where possible, virtual meetings were scheduled with respondents to further improve response rates. Virtual meetings required no travel and were convenient for respondents' busy schedules. These meetings were conducted frequently with respondents and senior CeSTII staff members could interact with respondents, which improved response rates and the quality of data received.

6. **Face-to-face visits with respondents:** Face-to-face visits were conducted with business sector respondents to garner improved rates, especially from respondents who had difficulty returning the survey data. Three rounds of visits were conducted in Gauteng (February – March 2023) and Western Cape (November 2022). A total of 53 visits were conducted in these two provinces and proved very successful.

7. **Workshops with respondents:** A virtual workshop was held with the higher education respondents to help onboard them using the new online web-based platform for data collection. A formal structured NPO workshop was held with respondents on 9 March 2023 and 22 delegates attended the online workshop. The purpose of the workshop was to:
    - Provide a platform to share information and support engagement with respondents.
    - Improve the understanding of the purpose and value of participating in the R&D survey.
    - Provide a live demonstration of the online RDI system; look at functionalities such as submitting data online, downloading information, how to resolve log-in errors, and so on.
    - Communicate the latest 2020/21 R&D survey results, focusing on the NPO sector R&D expenditure.
    - Provide a platform for not-for-profit organisations to share and present the work they do that supports R&D activities in South Africa.

    The workshop proved to be a success and further workshops in other sectors will be held for the 2022/23 R&D Survey.

D.5. Quality indicators of survey coverage, fieldwork and analysis

Questionnaire response rates for 2021/22 improved to 66,7% in 2021/22.

In addition, the 2021/22 survey period returned a lower rate of out-of-scopes. The relatively high number of out-of-scopes in the business sector may be attributed to the requirements of the Frascati Manual guidelines, where the units selected for surveying include *likely* R&D performers in addition to known R&D performers (OECD, 2015). The nature of R&D is such that there may be a very small number of projects active in the R&D-performing business unit of a firm in any given year. These projects typically last for around three years, according to reports from the field. Upon termination of the project, the R&D expenditure of a firm would thus be nought for a particular reference period, which with the existing CeSTII operational procedures would classify it as an out-of-scope unit, even though it might very well perform R&D again in the future. For this reason, the R&D survey uses collection rates as well as questionnaire response rates as key quality indicators of the collection phase of the SVC.

Non-response[3] was defined as failure to obtain a measurement on one or more variables for one or more units selected for the survey. These include out-of-scope units. *Out-of-scope units* are defined as units that should not be included in the survey frame because they did not belong to the target population in the reference period. Entities that returned a questionnaire stating nil in-house R&D expenditure for the survey reference period were counted as out-of-scope for the 2021/22 R&D survey. *In-scope units*[4] were defined as units performing in-house R&D or with likely in-house R&D activity.

Questionnaire responses were defined as those units not classified as non-responses within the set of all questionnaires sent out. The questionnaire response rate was calculated using the following formula:

$$\text{Questionnaire response rate} = \frac{\textit{Responses}}{\textit{(Responses+Non-response)–(Out-of-scope)}}$$

[3] Adapted from (Sarndal, Swensson, & Wretman, 1992).

[4] This is the HSRC-CeSTII operational definition.

Collection rate was defined as the proportion of completed questionnaires received for the survey compared to the total number of actively-reporting sample units on the sample registry.

$$\text{Collection rate} = \frac{\textit{Responses+Out-of-scope+Refusals}}{\textit{Active reporting units}}$$

The *weighted response rate* is a measure of the fraction of R&D expenditure collected from responses. It was calculated as:

$$\text{Weighted response rate} = \frac{\textit{R\&D expenditure obtained from responses}}{\textit{(R\&D expenditure from responses + Unit imputations)}}$$

The *survey unit imputation rate* was defined as the number of eligible non-responding units that had all data imputed as a fraction of eligible units. It was calculated using the following formula:

$$\text{Survey unit imputation rate} = \frac{\textit{Unit imputations}}{\textit{(Response+Non-response)–(Out-of-scope)}}$$

Table D.2: Quality indicators of survey coverage by sector (2021/22)

SECTOR	NUMBER OF UNITS INVESTI-GATED	NUMBER OF UNITS SELECTED TO COLLECT STATISTICS	NON-RESPONSE	OUT-OF-SCOPE	RESPONSES	QUESTION-NAIRE RESPONSE RATE	COLLECTION RATE	UNIT IMPUTATION RATE	WEIGHTED RESPONSE RATE	NUMBER OF UNITS USED TO COMPILE STATISTICS
Business	920	467	187	32	280	64.4%	74.7%	7.6%	92.0%	313
Not-for-profit	103	54	20	4	34	68.0%	72.2%	16.0%	91.4%	42
Government	82	68	26	8	42	70.0%	79.4%	6.7%	96.0%	46
Science councils	11	11	0	0	11	100.0%	100.0%	0.0%	100.0%	11
Higher education	32	32	7	0	25	78.1%	78.1%	15.6%	87.8%	32
HE: Public	26	26	6	0	20	76.9%	76.9%	19.2%	87.7%	25
HE: Private	6	6	1	0	5	83.3%	83.3%	0.0%	100.0%	5
Total	**1 148**	**632**	**240**	**44**	**392**	**66.7%**	**75.6%**	**8.5%**	**92.0%**	**442**

D.6. Imputation

The unit imputation rate decreased from 12.0% in 2020/21 to 8.5% in 2021/22.

Imputation is a procedure for entering a value for a specific data item where the response is missing or unusable. The R&D survey strives to keep the rate of imputation as low as possible while striving to include all likely sources of R&D activity in the final estimates. Since 2012/13, the rates of imputation have been reported, along with the age of the data used to impute (Table D.3). Imputations are only used upon verification from respondents or where available information confirms continued R&D activity. The survey mostly employs an estimation procedure that uses data from a previous return adjusted by a GDP inflation factor. A unit is selected for imputation only if sector leaders have convinced themselves of the existence of R&D activity in those units. Where it was not possible to obtain company confirmation, individual fieldworkers were responsible for providing evidence of ongoing R&D activity to qualify units for imputation. The survey employed varying degrees of imputation. In some cases, a total R&D expenditure figure reported by the respondent (by email or telephone) was used to impute the remaining data items using a model employing available sector R&D profiles. In other cases, publicly available data were used. Lastly, an R&D profile for a unit was generated based on its known historical R&D profile adjusted by an inflation factor. In the latter case, financial data on R&D were decreased by a GDP inflation value of 11.4% in 2021/22.

All sectors reported a higher imputation rate, except for the business and private higher education sectors who reported lower imputation rates compared to those obtained in the 2020/21 R&D Survey.

Table D.3: Number of units and age of data used in the imputation models by sector

AGE OF DATA	BUSINESS	NPO	GOVERNMENT	SCIENCE COUNCILS	HIGHER EDUCATION
Imputed (data from current reference period)	0	0	0	0	0
Imputed (data from previous year)	0	0	0	0	0
Imputed (data more than one year old)	0	0	0	0	0
Commuted (data from previous year)	10	5	1	0	1
Commuted (data more than one year old)	23	3	3	0	4
Total	33	8	4	0	5

Personnel data for non-responding higher education institutions were imputed from personnel data obtained from HEMIS. R&D expenditure for these units was imputed from a mathematical model or left unchanged from previous estimates.

Details of the imputation methods are available on request.

D.7. Data processing and analysis

Data collection happened via two modalities: the online web-based data collection tool (RDI) and PDF and excel questionnaires, with built-in validations.

Once the individual responses to the questionnaires, including summation and percentage calculations, had been checked by the relevant fieldworker, the data were manually entered into the R&D Survey Management System (RDSMS). The same quality checks were applied to data submitted via the online platform. Summary data were drawn from the system, and anomalies were identified by cross-checking results and returned to sector leaders for verification and correction.

Data tables were drawn from the data in the form of outputs agreed upon by HSRC-CeSTII and the DSI at the start of the survey project process. These included time-series data that were added from previous surveys for multi-year comparison. Final data quality checks were performed using the time-series data by looking for consistency with expectations, checking other sources of data, and also taking into account the economic environment and external data sources.

Tables on the state-owned enterprises were produced by selecting known SOEs from enterprises in the business sector.

D.8. Dissemination

The 2021/22 R&D Survey reports will be disseminated to all respondents as well as other users of the R&D statistics. This report is available on request from HSRC-CeSTII and the DSI.

The report can be downloaded from the HSRC-CeSTII and DSI websites:

- https://hsrc.ac.za/divisions/centre-for-science-technology-and-innovation-indicators
- https://www.dst.gov.za/index.php/resource-center/rad-reports/r-d-survey-reports

Care is taken to ensure the confidentiality of respondent information, and the data presented in the report are therefore anonymised.

Data from 2001 onwards is available from CeSTII on request. The guidelines for accessing data may be downloaded from:

- https://hsrc.ac.za/accessing-cestii-data/

Data extractions in response to users' special data requests are generally provided free of charge, unless substantial analytical work is required to meet the request. Such data extractions are done in accordance with the approved data access protocol.

Access to the online data collection platform and several additional resources are available at:

- https://rdisurveys.hsrc.ac.za

D.9. Storage and archiving

Data from the R&D survey series is archived according to established HSRC-CeSTII procedures. Hard copies of the data from the two most recent surveys are kept in safe storage at HSRC-CeSTII, while the data from older surveys are kept in safe storage off-site. All data are stored electronically on secure servers, and daily back-ups of databases are generated.

Data is curated by the HSRC and archived according to the HSRC policies on archiving and curation. Curated datasets and the conditions under which these are available may be found at:

- http://dx.doi.org/doi:10.14749/1685446986

E. REFERENCES

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F. R&D SURVEY QUESTIONNAIRE

(Science Councils/Government/Not-for-Profit Sectors)

Organisation contact details

Organisation name	
Address line 1	
Address line 2	
Province	
Postal code	

Strictly confidential

science & innovation
Department:
Science and Innovation
REPUBLIC OF SOUTH AFRICA

HSRC
Human Sciences
Research Council

stats sa
Department:
Statistics South Africa
REPUBLIC OF SOUTH AFRICA

Mandate

The Centre for Science, Technology and Innovation Indicators (CeSTII), within the Human Sciences Research Council (HSRC), conducts the National Survey of Research & Experimental Development (R&D) Inputs 2021/22 Financial Year on behalf of the Department of Science and Innovation (DSI). **The Survey is conducted in terms of the Statistics Act No. 6 of 1999**. Organisations are therefore legally required to respond by providing accurate data on R&D performance. All data gathered for this survey are confidential. Only the survey team have access to individual organisation data. The HSRC and DSI will not disseminate any information identifiable with an organisation without their consent.

Purpose and scope

The R&D survey collects data on the inputs into **intramural** R&D activities performed in South Africa by all organisations (including Business, Government, Science Councils, Not-for-Profit and Higher Education). The data is used for planning and monitoring purposes and to support decisions that strengthen South Africa's competitiveness. Previous survey results may be viewed at http://www.hsrc.ac.za/en/departments/cestii. This survey covers the **financial year 1 April 2021 to 31 March 2022 (or your nearest complete financial year)**.

Due date

Kindly complete and return this questionnaire via email by _____ . Should you wish to post your questionnaire to us, please address your consignment to **R&D Survey, Private Bag X9182, Cape Town, 8000**.

Record keeping

PLEASE KEEP A COPY OF THIS QUESTIONNAIRE FOR YOUR RECORDS.

Assistance and feedback

If you need assistance please contact one of the survey team:

Sector	Name	Contact Number	E-mail
Government	Dr Mario Clayford (Sector Leader)	021 466 7829	mclayford@hsrc.ac.za
Government	Ms Audrey Mahlaela	021 466 7925	amahlaela@hsrc.ac.za
Government	Mr Theodore Sass	061 470 6983	tsass@hsrc.ac.za
Not-For-Profit	Ms Natasha Saunders (Sector Leader)	021 466 7886	nsaunders@hsrc.ac.za
Science Councils	Dr Mario Clayford (Sector Leader)	021 466 7829	mclayford@hsrc.ac.za

A feedback section is located on the back page of this questionnaire. We welcome your comments and suggestions.

National R&D Survey Project Leader
Dr Nazeem Mustapha, Chief Research Specialist
nmustapha@hsrc.ac.za | Tel: 021 466 7887

Details of person completing the questionnaire (please print):

Name (with title)		Tel	( )
Designation		Cell	( )
Signature		E-mail	
		Date	

In order for HSRC-CeSTII to meet our obligations to produce national STI indicators on behalf of the DSI, we collect information about R&D from various organisation types: businesses, not-for-profit organisations, science councils, government departments and higher education institutions. We store this information in a secure database that is part of a data management system within the HSRC secure server environment. This information is retained in line with S14(1) and (2) of POPIA.

The following definitions are important in the completion of the survey questionnaire:

What is R&D?

Definition

This survey follows the approach of the Organisation for Economic Co-operation and Development (OECD), which defines research and experimental development (R&D) as:

"Creative and systematic work undertaken in order to increase the stock of knowledge – including knowledge of humankind, culture and society – and to devise new applications of available knowledge."

The basic criterion for distinguishing R&D from related activities is the presence in R&D of an appreciable element of novelty and the resolution of scientific and/or technological uncertainty, i.e. when the solution to a problem is not readily apparent to someone familiar with the commonly used knowledge and techniques in the area concerned.

The R&D activity must be:

- Novel
- Creative
- Uncertain
- Systematic
- Transferable and/or reproducible.

All five criteria are to be met, at least in principle, every time an R&D activity is undertaken whether on a continuous or occasional basis.

Examples

- Investigating electrical conduction in crystals is basic research; application of crystallography to the properties of alloys is applied research.
- New chip designs involve development.
- Investigating the limiting factors in chip element placement lies at the border between basic and applied research, and increasingly involves nanotechnology.
- Much services R&D involves software development where the completion of the project is dependent on a scientific or technological advance and the aim of the project is the systematic resolution of a scientific or technological uncertainty.

Scope of survey

- The survey requests data on **intramural** R&D performed by your organisation on the national territory of South Africa.
- Intramural (or in-house) R&D expenditures are all current expenditures (including labour and other costs) plus gross fixed capital expenditures (such as for land, buildings, machinery and equipment) for R&D performed within a reporting unit during a specific reference period, whatever the source of funds. A reporting unit is a unit that supplies the data for a given survey instance.
- Part 5 asks some questions on **extramural** R&D. Extramural (or outsourced) R&D are the amounts of money spent on R&D that is performed outside a reporting unit.

R&D includes – but is not limited to activities of personnel who are obviously engaged in R&D.

In addition it includes:

- The provision of professional, technical, administrative or clerical support and/or assistance to personnel directly engaged in R&D
- Management of personnel who are either directly engaged in R&D or are providing professional, technical or clerical support to those performing R&D
- Software development where the aim of the project is the systematic resolution of a scientific or technological uncertainty
- Research work in the biological, physical and social sciences, and the humanities
- Social science research including economic, cultural, educational, psychological and sociological research
- Research work in engineering and the medical sciences
- R&D projects performed for other parties
- Feedback R&D directed at solving problems occurring beyond the original R&D phase, for example technical problems arising during initial production runs.

R&D excludes:

The following routine activities are excluded, except where they are an essential part of in-house R&D activity:

- Scientific and technical information services
- Engineering and technical services
- General purpose or routine data collection
- Standardisation and routine testing
- Feasibility studies (except into R&D projects)
- Specialised routine medical care, for example routine pathology services
- The commercial, legal and administrative aspects of patenting, copyrighting or licensing activities
- Routine computer programming, IT systems work or software maintenance where there are no technological uncertainties to be resolved
- Market research
- Feasibility studies and pilot projects.

Key

Definition Instruction

Part 1: General Information

1. Parent organisation/department

2. Name of organisation/unit

3a. Total number of employees working for the organisation during financial year (include staff on contract for six months or longer)

3b. Total number of employees working on contract for six months or less

3c. Estimate percentage of time spent on R&D per employee (working on contract for six months or less) %

4. Intramural R&D in South Africa during the 2021/22 financial year

Definition

- Intramural R&D refers to R&D performed by the reporting unit on its own behalf or on behalf of others.
- Intramural R&D expenditures are all current expenditures (including labour and other costs) plus gross fixed capital expenditures (such as for land, buildings, machinery and equipment) for R&D performed within a reporting unit during a specific reference period, whatever the source of funds.
- It excludes R&D projects funded by this organisation but carried out by others using their own facilities.

Instruction

- Intramural R&D must be distinguished from extramural R&D which should be reported under Part 5.
- Only R&D performed within the borders of South Africa should be recorded.

4a. Did the organisation/unit perform any intramural R&D in South Africa during the 2021/22 financial year?

Yes ☐ No ☐

Do you think your organisation/unit will perform intramural R&D in the future?

Please tick	2022/23	2023/24	2024/25
Yes	☐	☐	☐
No	☐	☐	☐

4b. Did the organisation have extramural (outsourced) R&D expenditures during the 2021/22 financial year?

Yes ☐ No ☐

.....

Instruction

- If you have conducted intramural (or in-house) R&D in the 2021/22 financial year please continue to Part 2.
- If you have conducted only extramural (or outsourced) R&D in the 2021/22 financial year, please continue to Part 5.
- If you have indicated **no intramural R&D** or **extramural R&D** in Questions 4a and 4b above, please tick below and return the questionnaire via post or email.

No **intramural** or **extramural R&D** – **Nil** return ☐

Part 2: Intramural R&D Personnel

Instruction

Report for all R&D personnel, permanent and contract (six months or longer)

Internal R&D personnel
Persons employed by the reporting unit who contribute to the unit's intramural R&D activities.

Researchers
Researchers are professionals engaged in the conception or creation of new knowledge. They conduct research and improve or develop concepts, theories, models, techniques, instrumentation, software or operational methods. This category must include **Research Managers** and other **Research Executives**.

Technicians directly supporting R&D
Technicians and equivalent staff are persons whose main tasks require technical knowledge and experience in one or more fields of engineering, the physical and life sciences, or the social sciences, humanities and the arts.
They participate in R&D by performing scientific and technical tasks involving the application of concepts and operational methods and the use of research equipment, normally under the supervision of researchers.

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

Note: All foreign headcounts should be recorded in the non-South African category

Do not include personnel indirectly supporting R&D
Typical examples are transportation, storage, cleaning, repair, maintenance and security activities, as well as administration and clerical activities undertaken not exclusively for R&D (such as the activities of central finance and personnel departments). Allowance for these should be made under overheads in R&D expenditure (***Other Current Expenditure*** – **Question 7D**) but such persons should not be included as R&D Personnel.

5. Headcount of R&D Personnel

Provide the headcount of all internal R&D personnel according to categories below.

Researchers (incl. Research Executives and Research Managers)

Personnel Categories & Highest Qualification	African		Coloured		Indian/Asian		White		Non-SA		Subtotal		Total
	M	F	M	F	M	F	M	F	M	F	M	F	
Doctorates													
Master's/Hons/Bachelor's or equivalent													
Diplomas and other qualifications													
Researcher Total													

Technicians and equivalent staff directly supporting R&D

Personnel Categories & Highest Qualification	African		Coloured		Indian/Asian		White		Non-SA		Subtotal		Total
	M	F	M	F	M	F	M	F	M	F	M	F	
Doctorates													
Master's/Hons/Bachelor's or equivalent													
Diplomas and other qualifications													
Technician Total													

Other personnel directly supporting R&D

Personnel Categories & Highest Qualification	African		Coloured		Indian/Asian		White		Non-SA		Subtotal		Total
	M	F	M	F	M	F	M	F	M	F	M	F	
Doctorates													
Master's/Hons/Bachelor's or equivalent													
Diplomas and other qualifications													
Other Personnel Total													

Carry subtotals over to Question 6 ↓

6. Full-Time Equivalents (FTEs) and Labour Costs of R&D Personnel

Provide an estimate of Person Years of Effort (or Full-Time Equivalents) on R&D, according to the categories below.

Instruction

CALCULATING FULL-TIME EQUIVALENT (FTE)

NOTE: For the purpose of this survey, an employee can work a maximum of 1 FTE in a year.

The following equation can be used to calculate FTE/effort on R&D:
(Person/s employed) x (Portion of their job spent on R&D) x (Portion of the year employed) = FTE on R&D

For example:

- a full-time employee who devotes 100% of their time to R&D:
  1 x 1 x 1 = 1 FTE on R&D
- a full-time employee spending 40% of his/her time on R&D during half of the survey year:
  1 x 0.4 persons x 0.5 years = 0.2 FTE on R&D
- a part-time employee working 40% of a full time year doing only R&D:
  1 x 0.4 x 1 = 0.4 FTE on R&D
- 20 full-time researchers spending 40% of their time on R&D during the survey year:
  20 x 0.4 x 1 = 8 FTE on R&D

NOTE: Please calculate FTEs for all R&D personnel.

R&D Personnel Categories	Headcounts (from Q5)			Total Full-Time Equivalents (FTEs)			Average annual labour cost per person	Calculated labour cost of R&D
	M	F	Total	M	F	Total **(A)**	R'000 (excl. VAT) **(B)**	R'000 (excl. VAT) **(A x B)**
Researchers (incl. Research Executives & Research Managers)								
Technicians directly supporting R&D								
Other personnel directly supporting R&D								
							Total Labour Cost of R&D	

Carry over total calculated labour cost to Question 7C

Part 3: Intramural R&D Expenditure

7. Allocation of Intramural R&D Expenditure

CAPITAL EXPENDITURE ON R&D

Definition

- Capital R&D expenditures are the annual gross amount paid for the acquisition of fixed assets that are used repeatedly or continuously in the performance of R&D for more than one year.
- The full value of capital expenditure must be reported in the year of purchase (do not depreciate).
- If the asset has been/will be used for more than one activity, include an estimate of the portion used for R&D.

Including - but not limited to:

- Expenditure on fixed assets used in the R&D projects of your business.
- Capitalised software includes acquisition of software for R&D, including fees, rights and licences expected to be used for more than one year, or separately identifiable software (systems or applications) and their descriptions and supporting materials.
- Purchase of databases expected to be used for more than one year.
- Major repairs and improvements on land and buildings used for R&D.

Excluding:

- Other repairs and maintenance expenses not used for R&D.
- Depreciation provisions.
- Proceeds from the sale of R&D assets.

		R'000 (excl. VAT)
Vehicles, plant, machinery and equipment		
Capitalised computer software		
Total: Vehicles, plant, machinery and equipment and software	**A**	
Land, buildings and other structures	**B**	

LABOUR COSTS OF R&D

		R'000 (excl. VAT)
Labour Costs of R&D (to match Question 6)	**C**	

OTHER CURRENT EXPENDITURE ON R&D

Definition

- Current expenditures are composed of labour costs of R&D personnel and other current costs used in R&D.
- Services and items (including equipment) used and consumed within one year are current expenditures.
- Annual fees or rents for the use of fixed assets should be included in current expenditures.

Including - but not limited to:

- Materials, fuels, water, electricity and other inputs (i.e. all overheads/ running costs).
- Repair and maintenance expenses.
- Rents for research facilities: all fees and rents associated with R&D.
- Payments to outside organisations for use of specialised testing facilities.
- Payments to outside organisations for analytical work, engineering or other specialised services in support of R&D performed by your business.
- Commission/consultant expenses for research projects carried out by your business.
- Other R&D expenses and indirect costs not specified in 11 A, B or C.

Excluding:

- R&D activities where research is outsourced.
- Payments for purchases of technical know-how.
- Payments for patent searches.
- Depreciation provisions.

		R'000 (excl. VAT)
Other Current Expenditure	**D**	

		R'000 (excl. VAT)
Total R&D Expenditure (A + B + C + D = E)	**E**	

8. Sources of Funds for Intramural R&D

Provide a breakdown of the total R&D expenditure (as reported in Question 7) according to sources of funds.

INTERNAL SOURCE OF FUNDS

Organisation	R'000 (excl. VAT)
Own funds	

EXTERNAL SOURCE OF FUNDS

Government (includes Science Councils e.g. CSIR, Departments and Institutes)	
Government support programmes for R&D (including Grants, SPII, Innovation Fund etc)	
Contracts to perform R&D	
Other Local Businesses (including Trade Associations)	
Contracts to perform R&D	
Other South African Sources	
Higher Education	
Not-for-Profit Organisations*/NGOs/Trusts/Foundations (contracts for research)	
Individual donations/NGOs/Trusts/Foundations (donations for research without the obligation for a product or service)	
Rest of the world	
All sources (complete Question 9)	
	R'000 (excl. VAT)
Total R&D Expenditure (should match Question 7E)	

*Not-for-Profit organisations primarily serving households. Funding from non-profit organisations primarily serving Business, Higher Education or Government should be allocated to these sectors.

9. Sources of Funds from the rest of the World (in R'000s) for Intramural R&D

If your organisation received R&D funding from the rest of the world, provide percentage contribution by sector and region.

Funding of R&D from the rest of the world	**Percentage of Expenditure**								
Category	DATA CHECK	Africa (outside SA)	Middle East	Europe	USA/ Canada	Central & South America	China	Rest of Asia	Other
Business*	%	%	%	%	%	%	%	%	%
Not-for-Profit Organisations**	%	%	%	%	%	%	%	%	%
Foundations	%	%	%	%	%	%	%	%	%
Government	%	%	%	%	%	%	%	%	%
Higher Education	%	%	%	%	%	%	%	%	%
Total	%	TOTAL must sum to 100% (of total funding from rest of the world Q8)							

* **Including affiliated company, trade associations** (affiliated denotes parent or subsidiary organisation)

** NPOs serving households only. Funding from non-profit organisations primarily serving Business, Higher Education or Government should be allocated to these sectors. Donations from individuals should be recorded under this category.

10. Provincial Expenditure on R&D

Please state the location where your organisations/unit carried out R&D activities and the percentage of the total R&D expenditure.

Instruction

Specify where R&D is actually performed, rather than where it is managed/financed from.

Eastern Cape	%	Mpumalanga	%
Free State	%	Northern Cape	%
Gauteng	%	North West	%
KwaZulu-Natal	%	Western Cape	%
Limpopo	%	**Total** (must sum to 100%)	%

Part 4: Categories of Intramural R&D Expenditure

11. Intramural Total R&D Expenditure by Type of R&D

Specify the percentage of total **intramural R&D expenditure** by **type of R&D**.

Basic Research

Definition

- Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view.
- The analysis of properties, structures and relationships with a view to formulating and testing hypotheses, theories or laws.
- The results of basic research are usually published in peer-reviewed scientific journals.

Percentage: %

Applied Research

Definition

- Applied research is original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific, practical aim or objective.
- Activities that determine the possible uses for the findings of basic research.
- The results of applied research are intended primarily to be valid for a single or limited number of products, operations, methods or systems.
- Applied research develops ideas into operational form and may be published in peer-reviewed journals or subjected to other forms of intellectual property protection.

Percentage: %

Experimental Development

Definition

- Experimental development is systematic work, drawing on knowledge gained from research and practical experience and producing additional knowledge, which is directed to producing new products or processes or to improving existing products or processes.

Percentage: %

Total	(must sum to 100%)	**%**

12. Research Fields (RF)

Classify R&D according to Research Fields (see Appendix A in Codes book) and provide the associated percentage of the **total** R&D expenditure per research field.

Definition

The RF Codes are based on recognised academic disciplines and emerging areas of study.

RF Codes	Percentage		RF Codes	Percentage
RF	%	RF		%
RF	%	RF		%
RF	%	RF		%
RF	%	RF		%
RF	%	RF		%
RF	%	RF		%
RF	%	RF		%
RF	%	RF		%
RF	%	RF		%
RF	%	RF		%
Total	(must sum to 100%)			**%**

13

13a. Multi-disciplinary Areas of R&D

Please estimate the percentage of R&D expenditure allocated to biotechnology and nanotechnology.

Instruction

Multi-disciplinary R&D combines several research fields or disciplines. If your organisation performs R&D, as described below, please provide the applicable percentage of total R&D expenditure.

Note that the percentages will most likely not total 100%.

Definition

Biotechnology is application of science and technology to living organisms as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services.

Nanotechnology is the understanding and control of matter at dimensions of roughly 1 to 100 nanometers, where unique phenomena enable novel applications. Encompassing nanoscale science, engineering and technology; nanotechnology involves imaging, measuring, modelling, and manipulating matter at this length scale.

Multidisciplinary Area of R&D	% of R&D expenditure
Biotechnology	%
Nanotechnology	%

No R&D in these areas ☐ ← **Tick** if no such R&D is done

13b. Specific Areas of R&D

Please estimate the percentage of R&D expenditure allocated to the following areas:

Definition

Open source software – computer software with its source code made in which the copyright holder provides the rights to study, change, and distribute the software to anyone and for any purpose

Space science – any of several scientific disciplines, such as communications, transport, engineering or health that specifically studies phenomena occurring in the upper atmosphere, in space, or on celestial bodies other than Earth

Environment / sustainability R&D – any of several fields wherein research focuses on human, economic and societal impact on the environment investigating its contemporary and future impact on society

New materials – materials science and engineering, involves the discovery and design of new materials, with an emphasis on solids.

Specific Areas of Interest	% of R&D expenditure
Open source software	%
Space science	%
Tuberculosis (TB), HIV/AIDS, Malaria	%
Environment and sustainability R&D	%
New materials	%

No R&D in these areas ☐ ← **Tick** if no such R&D is done

14

14. Socio-Economic Objectives (SEO)

Classify R&D according to Socio-Economic Objectives with associated % expenditure.
(See Appendix B in Codes book)

Definition

The SEO classification provides an indication of the sector of the national economy which will be the main beneficiary of the R&D you are practising.

	SEO Codes	Percentage			SEO Codes	Percentage	
S			%	S			%
S			%	S			%
S			%	S			%
S			%	S			%
S			%	S			%
S			%	S			%
S			%	S			%
S			%	S			%
S			%	S			%
S			%	S			%
Total			(must sum to 100%)				**%**

15. Collaborative R&D

15a. Does your organisation collaborate on R&D with persons/organisations outside your own organisation?

Yes ☐ Continue with Question 15b No ☐ Go to Question 16

15b. With whom is R&D conducted in partnerships, alliances or collaboration?

Instruction

Note: In the table below a single collaborative R&D project with several partners may be ticked in several places. Collaborative R&D may be intramural or extramural. R&D collaboration can occur without expenditure – please note zero expenditure in such cases.

			Rest of the world consisting of... (tick as appropriate)							
Tick as appropriate	South Africa	Foreign	Africa (outside SA)	Middle East	Europe	USA/ Canada	Central & South America	China	Rest of Asia	Other
Higher Education Institutions	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Science Councils (e.g. CSIR, Mintek, MRC, ARC etc.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Government Research Institutes	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Members of own organisation / Affiliated* organisations	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Other Companies (including specialist consultants, business and trade associations)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Not-for-Profit Organisations**	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

* Affiliated denotes parent or subsidiary organisation.

** NPOs serving households only. Funding from non-profit organisations primarily serving Business, Higher Education or Government should be allocated to these sectors.

Part 5: Extramural R&D (Outsourced/Contracted Out)

Definition

Extramural R&D refers to:

- Outsourced or extramural expenditures being the amounts a reporting unit paid or committed to pay to another organisation for the performance of R&D during a specific period.
- This includes acquisition of R&D performed by and/or grants given to other organisations for performing R&D.

R'000 (excl. VAT)

16a. State value of extramural R&D inside South Africa

16b. Please indicate the name of the organisation(s) that conducted the extramural R&D with the associated expenditure inside South Africa

Outsourced to:	Approximate Value R'000 (excl. VAT)

R'000 (excl. VAT)

17a. State value of extramural R&D outside South Africa

17b. If you have indicated extramural R&D outside South Africa in Question 17a, kindly provide the approximate percentage by sector and geographic location

	Percentage Extramural R&D Outside South Africa								
Category	DATA CHECK	Africa (outside SA)	Middle East	Europe	USA/ Canada	Central & South America	China	Rest of Asia	Other
Business*	%	%	%	%	%	%	%	%	%
Not-for-Profit Organisations**	%	%	%	%	%	%	%	%	%
Foundations	%	%	%	%	%	%	%	%	%
Government	%	%	%	%	%	%	%	%	%
Higher Education	%	%	%	%	%	%	%	%	%
Total	%	TOTAL must sum to 100% of total extramural R&D outside SA R&D (Q17a)							

* Including affiliated company, trade associations (affiliated denotes parent or subsidiary organisation)

** NPOs serving households only. Funding from non-profit organisations primarily serving Business, Higher Education or Government should be allocated to these sectors.

Your feedback matters

Please use this section to provide general feedback or data notes to the Survey Team

Thank you for your time and effort

R&D SURVEY

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G. USER SATISFACTION SURVEY:

SOUTH AFRICAN NATIONAL SURVEY OF RESEARCH AND EXPERIMENTAL DEVELOPMENT: STATISTICAL REPORT 2021/22

In order to improve the quality and relevance of the R&D statistics, it would be useful to receive the views of users of this publication. It would therefore be appreciated if you could complete the following questionnaire and return by fax to +27 (0)21 461 1255 or by e-mail to RnDSurvey@hsrc.ac.za.

1. Name and address of respondent:

Name and title _____

Designation/occupation _____

Name and address of organisation or enterprise _____

_____

_____

2. Which of the following describes your area of work? Mark with 'X'.

- ☐ Government
- ☐ Private enterprise
- ☐ Public enterprise
- ☐ Academic or research institution
- ☐ International organisation
- ☐ Media
- ☐ Not-for-profit organisation
- ☐ Other, specify _____

_____

_____

3. In which country do you work?

_____

4. What is your assessment of the contents of this publication?

☐ Excellent ☐ Good ☐ Average ☐ Satisfactory ☐ Poor

5. How useful is this publication for your work?

☐ Extremely useful ☐ Very useful ☐ Useful ☐ Partly useful ☐ Not at all useful

6. How accurate is the picture of R&D in your sector or research field/s as presented in this publication?

☐ Very accurate ☐ Fairly accurate ☐ Unsure ☐ Not very accurate ☐ Not at all accurate

7. How easy was it to find specific information that you required in the publication?

☐ Extremely easy ☐ Very easy ☐ Easy ☐ Not very easy ☐ Not at all easy

8. What information (i.e. tables, text or figures) were of most interest to you? Please be as specific as possible e.g. provide table, page or figure numbers.

9. What did you like best about the publication?

10. Provide any comments or recommendations for the improvement of the publication.

Thank you for completing the survey.

NOTES

R&D SURVEY

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