A 10-Year Waste Research Development and Innovation Roadmap for South Africa
2015-2025

2016/17 Annual Progress Report

REFLECTING ON THE SECOND YEAR OF IMPLEMENTATION

science & technology
Department:
Science and Technology
REPUBLIC OF SOUTH AFRICA

CSIR
our future through science

CONTENTS

FOREWORD BY
THE DEPARTMENT OF SCIENCE AND TECHNOLOGY

The last financial year was the second year of implementation of the Waste RDI Roadmap. There has been a notable increase in research capacity together with an increase in partnerships over the past year. The most significant is a strengthened partnership with the Department of Environmental Affairs (DEA), through the co-funding of a research project looking at the informal waste economy.

> The implementation of Circular Economy principles will no doubt contribute to the greening of the South African economy.

THE LAST YEAR HAS also seen the first intake for a dedicated Master's degree in Waste Management at North-West University (NWU). This degree provides a career progression path from the already offered Honours Degree at NWU. This is increasing the pool of talent available to implement the National Waste Management Strategy of the DEA.

Let us continue to consider waste as an economic resource, as waste arises from the inefficient processing of resources. Thus improvements in the efficiency of production processes and the reduction of waste through implementation of the 3Rs (Reduce, Re-use, Recycle) will result in a decrease in disposal to landfill. This is where the concept of a Circular Economy has gained the most traction in recent years. At the DST this concept extends beyond the waste sector. It encompasses sustainable livelihoods and advanced manufacturing. In South Africa Industrial Symbiosis has been shown to be economically feasible in the Western Cape and is being extended nationally through the National Cleaner Production Centre (NCPC). This concept also lends itself to the clustering of industries which has been shown in other economies to increase economic output and competitiveness.

The Circular Economy provides environmental, social and economic opportunities. As a developing economy South Africa needs to define what this means in its context. In terms of the waste sector, if built on a solid foundation where the basics of city cleansing and waste management are done properly, the implementation of Circular Economy principles will no doubt contribute to the greening of the South African economy as well as contribute to the realisation of the Sustainable Development Goals (SDGs).

I would like to thank the Waste Programme Management Unit located within the CSIR for their continued partnership and leadership in implementing the Waste RDI Roadmap for the Waste Sector.

Mr Imraan Patel
Deputy-Director General: Socio-economic Innovation Partnerships

The DST Team:

Dr Henry Roman
Director: Environmental Services and Technologies

Ms Magamase Mange
Deputy Director: Environmental Services and Technologies

MESSAGE FROM
THE WRIU MANAGER, PROF LINDA GODFREY

In only its second year of implementation, the Waste Research, Development and Innovation (RDI) Roadmap has shown very encouraging growth, and impact, in the 2016/17 financial year.

From left to right: Dr Henry Roman (DST), Ms Magamase Mange (DST), Prof Linda Godfrey (CSIR)

From left to right: Ms Auricious Mkhatshwa, Ms Zimkita Nkata, Ms Matilda Nedohe, Ms Nondumiso Mngomezulu

WITH THE POSITIVE RESULTS shown in the first year, the funding from the Department of Science and Technology (DST) was increased from R10.4m in 2015/16, to R16.4m in 2016/17. This funding was invested into research projects (open and targeted research grants), postgraduate scholarships, and the fourth Industry-meets-Science workshop on food waste.

In the previous 2015/16 financial year, the Waste RDI Roadmap Implementation Unit (WRIU) took a strong programmatic approach to investing in research projects in organic waste valorisation. These 2-3 year research projects are progressing well and are all on track to achieving their set objectives and research outputs. In 2016/17, the WRIU turned its focus to the second priority waste stream, that of Waste Electrical and Electronic Equipment (WEEE) or e-waste. In partnership with HP South Africa, a targeted call for proposals was issued in September 2016. Informed by the 2016 Industry-meets-Science workshop on e-waste, the intention of this call was to push research beyond the traditional focus on the recycling of metals from printed circuit boards, to some of the more challenging fractions of electronic waste. A total of 10 proposals were received, with five (5) research grants being awarded to public research institutions in South Africa, for projects starting in 2017.

A scholarship call was once again issued in 2016, for postgraduate studies (Master's and Doctoral) strategically aligned with the Waste RDI Roadmap. Eighteen (18) proposals were received, of which five (5) Master's and one (1) Doctoral scholarship was awarded.

The WRIU has successfully managed the portfolio of research projects and scholarships with the support of four young graduates who received one year internships in the WRIU in 2016. This workplace experience, and the exposure to the South African waste research community, proved valuable for the interns, all of whom have now moved on to careers in the environmental sector.

Building local, regional and international capacity and partnerships has been an exciting outcome of this past year. Students and researchers from across South Africa and Africa are being directly supported through the Roadmap, and South African researchers continue to partner with international scientists on research of global importance. However, much more can be done to strengthen and grow these regional and international partnerships.

Private sector and international R&D funding remain a small percentage of the total investment in the South African waste research community in 2016/17. There is a significant opportunity to grow this, but only if waste and secondary resources are identified as a priority in regional and international funding programmes, and if research is directed towards practically solving the waste challenges facing the private sector.

The CSIR Team:

Mr Bongani Memela
Manager: Strategic Initiatives

Prof Linda Godfrey
Manager: Waste Roadmap Implementation Unit

Ms Estee Opperman
Financial Manager

Ms Lulu Makapela
Contract Manager

Mr Beeza Mtamzeli
Strategic Communications

Interns:
Ms Auricious Mkhatshwa
Ms Matilda Nedohe
Ms Nondumiso Mngomezulu
Ms Zimkita Nkata

BACKGROUND AND OBJECTIVES

The Waste RDI Roadmap is an initiative of the Department of Science and Technology (DST) aimed at guiding South Africa's public and private sector investment in waste research, development and innovation (RDI) over the next 10 years (2015-2025).

Vision

Development and deployment of performance improvements in waste management has delivered a significant contribution to the strengthening of a sustainable regional secondary resources economy in South Africa.

Mission

This has been achieved by means of a National Waste RDI Programme that supports maximisation of diversion of waste from landfill towards value-adding opportunities, including prevention of waste and the optimised extraction of value from reuse, recycling and recovery, in order to create significant economic, social and environmental benefit.

Background

The DST recognised the role that RDI could play in achieving the objectives of the National Waste Management Strategy, in moving waste up the hierarchy away from landfilling, and in transforming the South African waste sector in a way that could provide environmental, social and economic benefit for the country.

In 2012, the DST, in partnership with the CSIR, embarked on a process to develop the Waste RDI Roadmap. This process, which was shaped by business, industry, government and academia, culminated in early 2015 with the publication of South Africa's first Waste RDI Roadmap.

The Waste RDI Roadmap is available to review online at **www.wasteroadmap.co.za.**

Objectives

With an investment ask of approximately R3.9 billion over the next 10 years, the successful implementation of the Roadmap is expected to assist government and industry to significantly increase the diversion of waste away from landfill towards value-adding alternatives, through more effective decision-making; faster insertion of context-appropriate technology; export of know-how and technology; and strengthened RDI capability and capacity.

The Roadmap, which is anchored in the mandate of the DST, is structured around three key pillars –

- human capital development (HCD)
- research and development (R&D)
- innovation (technological and social)

The Roadmap aims to address issues relating to five priority waste streams –

- municipal solid waste
- waste electrical and electronic equipment (WEEE)
- waste plastic
- organic waste
- waste tyres

Within six broad areas, or clusters, of activity –

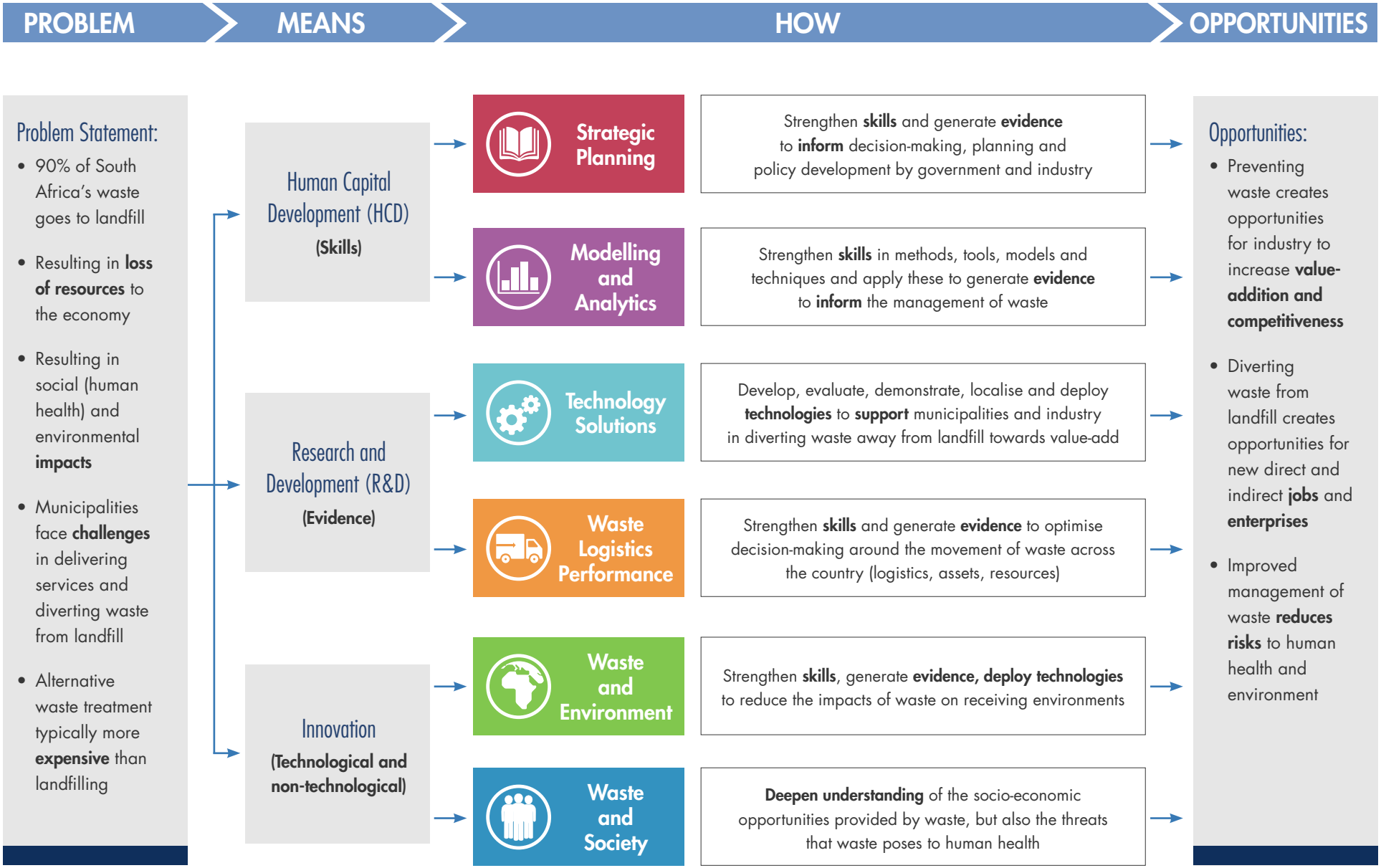
- strategic planning
- modelling and analytics
- technology solutions
- waste logistics performance
- waste and the environment
- waste and society

HUMAN CAPITAL DEVELOPMENT

RESEARCH & DEVELOPMENT

INNOVATION

PICTORIAL SUMMARY OF THE WASTE RDI ROADMAP



KEY FOCUS AREAS AND SERVICE OFFERINGS

Waste RDI Roadmap clusters and percentage of total investment per cluster expected (2015-2025)

Implementation

The CSIR was appointed by the DST to implement the Waste RDI Roadmap from 1 April 2015. The intention is for the CSIR, through the Waste RDI Roadmap Implementation Unit (WRIU), to drive human capital development (HCD), research and development (R&D) and innovation, in partnership with government, industry and academia; and to actively engage opportunities (local and international) for waste RDI collaboration and co-investment.

As shown here, the bulk of the Waste RDI Roadmap funding investment is planned for the "Technology Solutions" cluster, but with significant support to the other five clusters.

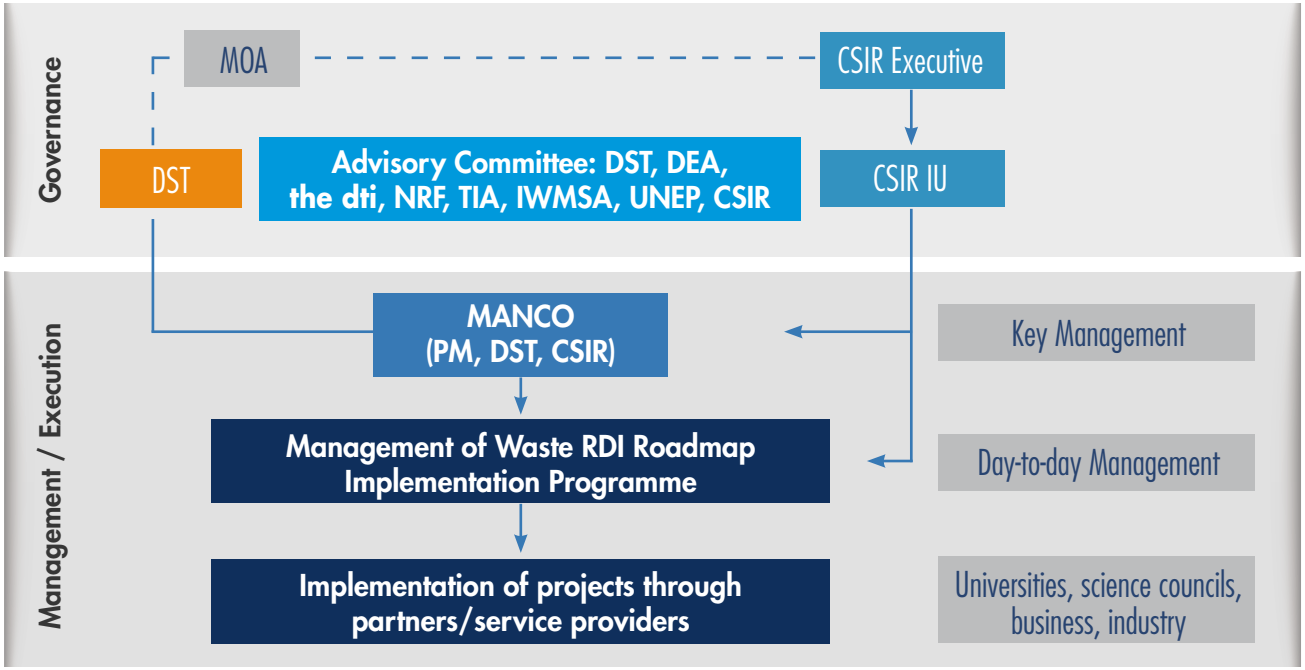
The funding available for 2016/17 provided opportunity to address RDI priorities in all six clusters. As shown in the following sections, there was a strong investment focus this year on "Technology solutions", "Modelling & Analytics" and "Waste & Society". This was achieved using funding mechanisms such as non-recoverable grants, postgraduate scholarships, and targeted procurement processes.

A series of calls and requests for proposals were issued by the CSIR in 2016/17 in support of the National System of Innovation (NSI).

GOVERNANCE

The Waste RDI Roadmap is implemented by the CSIR's Waste RDI Roadmap Implementation Unit (WRIU) in partnership with the DST, DST entities, other government departments, universities and science councils, business and industry. Effective governance and oversight of activities within the WRIU is fundamental to the Roadmap's implementation.

The Waste RDI Roadmap governance structure is as follows:



The DST would like to thank the members of the Steering Committee who served for the period 2015-2016:

Sector	Organisation
National Government	Department of Science and Technology, Department of Environmental Affairs Department of Co-operative Governance, Department of Trade and Industry
R&D and Innovation Agencies	National Research Foundation (NRF), Technology Innovation Agency (TIA), Council for Scientific and Industrial Research (CSIR) (Host)
Waste Sector	Institute of Waste Management South Africa (IWMSA)
Multilateral non-governmental organisation	United Nations Environment Programme (UNEP)

1 an **Operations Committee**, made up of the DST Director: Environmental Services and Technologies and the WRIU Manager, who meet monthly, or more frequently if required, to discuss operational matters

2 a **Management Committee** (MANCO), made up of senior representatives of the DST and CSIR Implementation Unit, who meet annually, or more frequently if required, to discuss management and oversight issues; and

3 an advisory **Steering Committee**, made up of representatives of government, government entities and the waste sector, who are tasked with reviewing the progress of the WRIU and giving input on the planned activities for the following year.

REFLECTING ON 2016/17

RESEARCH, DEVELOPMENT AND INNOVATION

1 Industry-meets-Science workshops

38 researchers supported on Grant projects

5 **new research grant projects awarded (in WEEE)**

9 **successful recipient research institutions (new and existing)**

6.5 **MILLION RAND** invested in the national system of innovation

10 new applications for RDI grants (in WEEE)

11 ongoing research grant projects funded

18.8 **MILLION RAND** **of committed funding for new and ongoing research projects**

26.5 **MILLION RAND** of new R&D proposals received

Launched: SA Biorefinery Research Network

HUMAN CAPITAL DEVELOPMENT

13 postgraduate students supported through scholarships

- **7** scholarships awarded in 2015/16 (ongoing studies)
- **6** new scholarships awarded in 2016/17

30 postgraduate students supported through Grant Projects

18 applications for postgraduate scholarships

22 students studying towards higher degrees in waste management

- **6** Ongoing Honours students (started 2016)
- **8** New Honours students (started 2017)
- **8** New Master's students (started 2017)

6 interns supported (workplace experience)

- **4** interns placed with WRIU
- **2** interns supported through Grant Projects

COMMUNICATION IMPACT

POPULAR ARTICLES

3 radio interviews

3 TV interviews

14 print articles highlighting the Waste RDI Roadmap

TOP DOWNLOADED PUBLICATIONS

- The economic benefits of moving up the waste hierarchy
- South African Waste Sector Survey
- Trends in waste management
- Waste RDI Roadmap Summary
- BSc Hon Brochure (Northwest University)

WEBSITE

19 683 UNIQUE VISITORS

17 208 NUMBER OF VISITS

30 569 PAGES VISITED

TOP 5 COUNTRIES ACCESSING THE WASTE RDI ROADMAP WEBSITE

www.wasteroadmap.co.za

HUMAN CAPITAL DEVELOPMENT

Providing a pipeline of qualified postgraduate students into the waste and secondary resources sector with the skills to drive alternative waste treatment and to unlock opportunities

Increasing the supervisory capacity to mentor postgraduate students (honours, master's, doctoral) and postdoctoral researchers

STRENGTHENING SKILLS in waste management is a key priority of the Waste RDI Roadmap. A more capable public and private sector creates a strong foundation on which to transform the South African waste economy.

Building national capacity is achieved through a number of Roadmap instruments –

- Direct scholarships for postgraduate students
- Students supported partially or fully through research Grant projects
- Internships with organisations supported under the Waste RDI Roadmap

Postgraduate scholarships

A scholarship call was issued by the WRIU in July 2016, for the 2017 academic year. The call was open to all South African citizens and South African permanent residents, and provided an opportunity for full-time studies at an accredited public South African Higher Education Institution, on a topic aligned with the Waste RDI Roadmap.

Master's applications

A total of 14 master's scholarship applications were received under the open call – a total funding request of R1.26m for postgraduate studies commencing in 2017. Applications were received from seven (7) universities. The majority of the master's applications received focused on "Technology solutions" (71%) and "Organic waste" (50%). This is fewer than the 28 master's scholarship applications received in the previous year (2015/16). One of the main reasons being the preference of universities to target the Grant funding, which provides greater funding to cover costs associated with postgraduate students, than the scholarships provide.

Doctoral applications

A total of four (4) doctoral scholarship applications were received under the open call – a total funding request of R540,000 for postgraduate studies commencing in 2017. Applications were received from three (3) universities. As with the master's applications, the majority of doctoral applications focused on "Technology solutions" (75%). However, the tendency in these proposals was towards Waste Electrical and Electronic Equipment (WEEE) (50%). This is less than the eight (8) doctoral scholarship applications received in the previous year (2015/16) *(for the same reason noted above)*.

The postgraduate scholarship call remains an important instrument for supporting human capital development in South Africa. As can be seen from the figures on the following page, the scholarship call provides a mechanism to support students in lower ranked universities, where these universities may not yet have developed the capacity to drive large waste research programmes, with multiple students. Furthermore, the scholarship programme provides an opportunity for students to propose new and innovative research topics, not yet covered under existing University research programmes.

Awarded scholarships

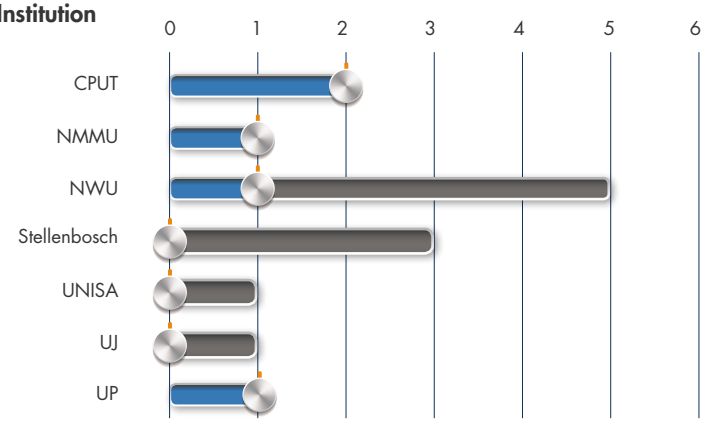
Of the 18 scholarship applications received, six (6) postgraduate scholarships were awarded (5 Master's, 1 Doctoral). The overall success rate of eligible scholarship applications under the Open Call was around 33%, up on the 25% success rate in 2015.

The majority of the scholarships awarded are in organic waste valorisation (value recovery) (40%) and municipal solid waste (40%). With the strong WRIU programmatic investment in organic waste in 2015/16, projects aligned with the other priority waste streams were favourably considered in 2016/17. In support of the transformation of the waste sector, 67% of scholarships were awarded to black students, and 50% were awarded to female students.

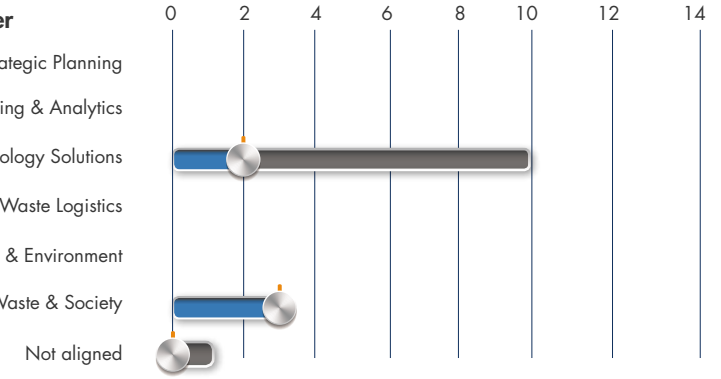
> In line with the national imperative of **equity** and **redress**, the Waste RDI Roadmap **scholarship programme** prioritised support for **appropriately qualified applicants** from designated groups viz. black and female, while ensuring that only applications that **meet the NRF merit review** and **selection criteria** are **supported**.

Thematic Spread of New Master's Applications and Awards

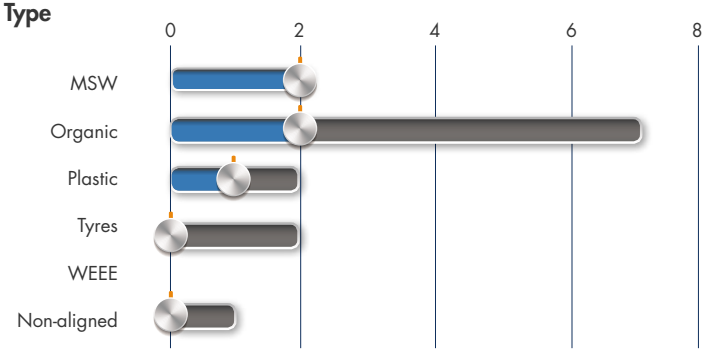
By Host Institution



By Cluster

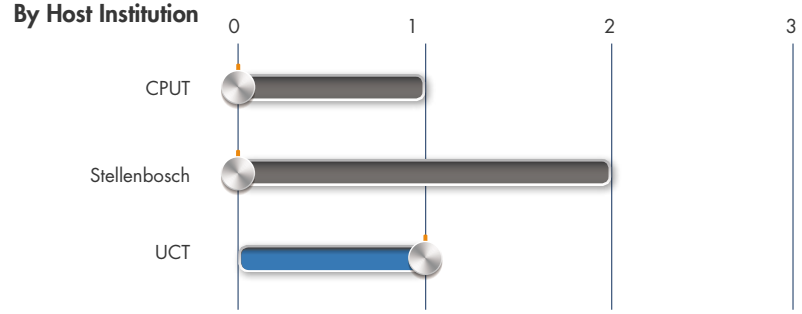


By Waste Type

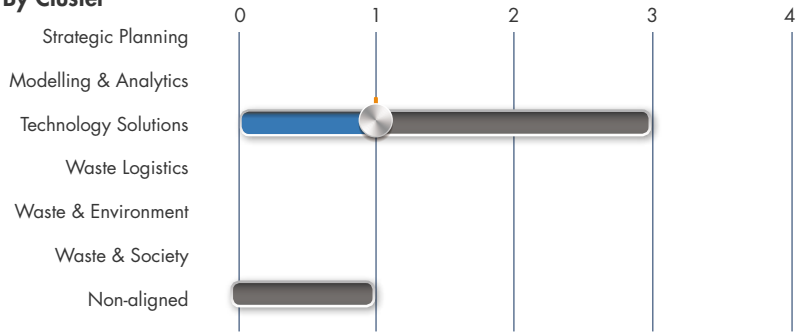


Thematic Spread of New Doctoral Applications and Awards

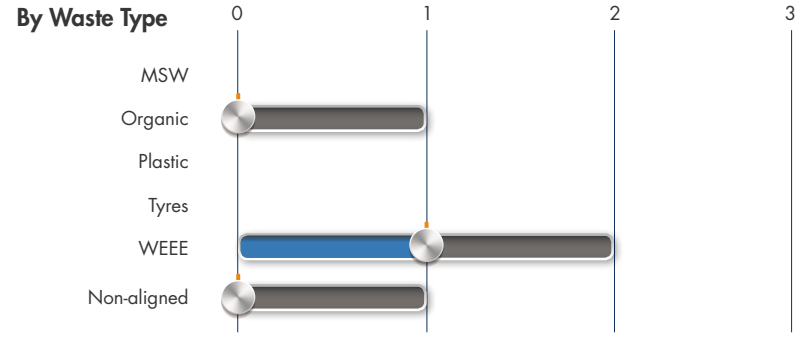
By Host Institution



By Cluster



By Waste Type



HUMAN CAPITAL DEVELOPMENT (CONTINUED)

Grant funded postgraduate students

The 11 ongoing Waste RDI Roadmap Grant projects funded in 2016/17 supported 30 honours, master's and PhD students (partially or fully). The Grant projects are an important mechanism of building capacity aligned with the Waste RDI Roadmap, in South Africa.

While the Waste RDI Roadmap Scholarship Call is only open to South African citizens and South African permanent residents, the Grant projects are able to fund any student studying at an accredited public South African Higher Education Institution. In this way, the Waste RDI Roadmap is able to support the strengthening of waste skills not only of South Africans, but of candidates from across Africa and beyond.

In addition to the 22 South African post-graduate students supported on research Grant projects, an additional eight (8) students from across Africa were supported financially through the Waste RDI Roadmap. This is further discussed in the section on "Partnerships".

Internships

Six (6) interns were provided with workplace experience under Waste RDI Roadmap initiatives in 2016/17. Four (4) interns were placed with the Waste RDI Roadmap Implementation Unit at the CSIR, while two (2) interns had the opportunity to work on Roadmap funded Grant projects.

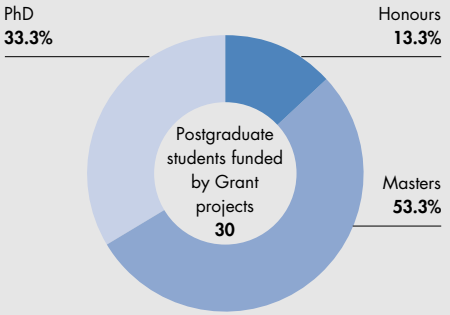
Strengthening postgraduate qualifications

As at the start of the 2017 academic year, 22 students were studying towards higher degrees specialising in waste management. Northwest University, through the recently established BSc Honours and Master's Degrees in Environmental Sciences with specialisation in Waste Management, are hosting –

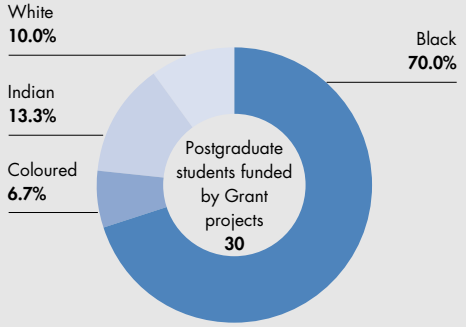
- 6 Ongoing Honours students (started 2016)
- 8 New Honours students (started 2017)
- 8 New Master's students (started 2017)

The new Master of Science in Engineering in Waste and Resources Management, to be offered by the University of KwaZulu-Natal, was scheduled for the first intake of students in 2017. However, due to a long approval process for new postgraduate degrees, this is likely to only come on line in 2018.

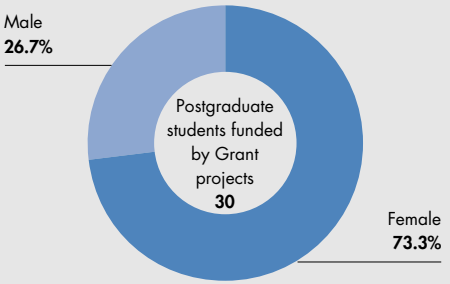
Grant funded students (by degree)



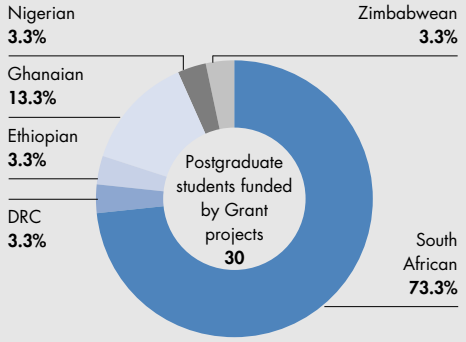
Grant funded students (by race)



Grant funded students (by gender)



Grant funded students (by nationality)



RESEARCH AND DEVELOPMENT

Supporting the generation of new scientific evidence, relevant to South Africa, that will inform policy, planning, decision-making

Supporting the development of new technology and of adapting technology to South African conditions through R&D

Research, Development and Innovation Grants

The Grant call for 2016/17 was a targeted call for research projects focussing on WEEE (electronic waste). The call was issued by the WRIU in September 2016, for projects starting in 2017. The call, which was prepared in partnership with HP South Africa, was open to all South African public research institutions.

The Grant call was informed by the Waste RDI Roadmap Industry-meets-Science workshop on WEEE held in March 2016. Through industry-academia workshop discussions, four key priority themes were identified, where research was seen as being able to support increased local beneficiation of WEEE in South Africa –

- Developing local markets (demand)
- Correcting the economics of WEEE recycling (incl. economic instruments)
- Appropriate WEEE processing technologies
- Increasing WEEE collection (supply)

Due to funding limitations, no open RDI Grant call was issued in 2016/17.

Applications received

A total of 10 grant applications were received under the 2016/17 call – a funding ask of R26.5m for R&D projects commencing in 2017. Applications were received from four (4) universities and science councils. As with the scholarship applications, the focus of R&D applications were predominantly on "Technology solutions" (90%). All proposals, as required, were focussed on WEEE.

The proposals received under the Grant Call, identified a number of local and international research partners. Universities and science councils were the most frequently included research partners (85%). Unlike the 2015/16 Grant Call, proposals received under this targeted call had few industry partners. In fact only two industry partners were listed. In neither instance was industry identified as a co-funder of the research. While the majority of the research partners were based in South Africa (77%), research partners in Europe were listed. This would suggest that research in WEEE, is an area where opportunity exists for increased research partnerships with industry and with international research institutions.

Awarded R&D grants

Of the 10 grant proposals received, 5 projects were awarded to South African public research institutions, starting in 2017. With the proposals focussing specifically on electronic waste recycling, the DST and WRIU adopted a programmatic approach to this funding call. The overall success rate of eligible proposals received under the call was 50%. This is up from the 45% success rate of proposals submitted in 2015/16 for projects commencing in 2016.

Monitoring of ongoing grant projects

The 11 R&D and Innovation Grants awarded in 2015/16 for projects starting in 2016 were monitored throughout the year by means of quarterly progress reports and Steering Committee meetings. A small number of grant projects experienced delays in starting due to the withdrawal of students planned on the projects. Students not arriving at the start of the academic year remains a problem for the implementation of Grant projects. However, this is largely out of the control of the WRIU and the Universities.

> The programmatic **investment in R&D projects** addressing organic waste valorisation, has allowed the WRIU to launch the **South African Biorefinery Research Platform**. This platform is aimed at consolidating and strengthening research on **biomass** and **organic waste** in South Africa, thereby maximising the opportunities for **value recovery** in the form of biochemicals and biopolymers **from these waste streams**.

RESEARCH AND DEVELOPMENT (CONTINUED)

Steering Committee meeting with Grant Holder Prof. J Görgens, Stellenbosch University

Targeted research projects

Growing interest in WEEE R&D and innovation was evident in both the 2015 scholarship and grant applications.

From the review of research proposals received in 2015/16, it was evident that work needed to be done to inform future strategic investment in WEEE. In particular, to map out the future research priorities for WEEE RDI in South Africa. In response to this need, the WRIU published a Request for Proposals (RFP) in March 2016 to map South Africa's WEEE dismantling, pre-processing and processing technology landscape.

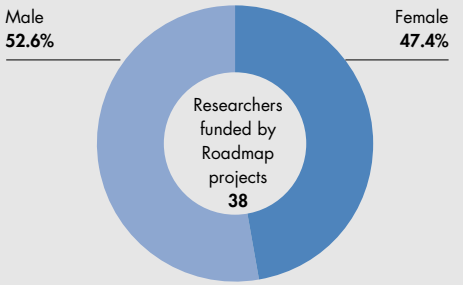
The project, which was awarded to Mintek, was completed in March 2017. A summary of the research is provided in Annexure 1, while the full report is available for download on the Waste RDI Roadmap Website.

The Waste RDI Roadmap is available to review online at **www.wasteroadmap.co.za.**

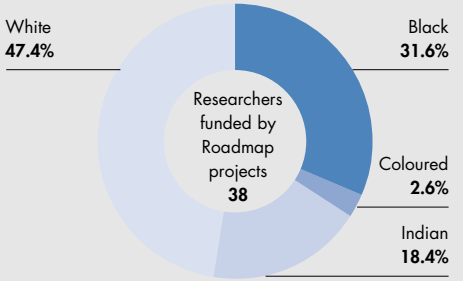
Profile of research teams on projects

The 11 Waste RDI Grants started in 2016, and the targeted research project provided funding support to 38 researchers at six research institutions across South Africa in 2016/17.

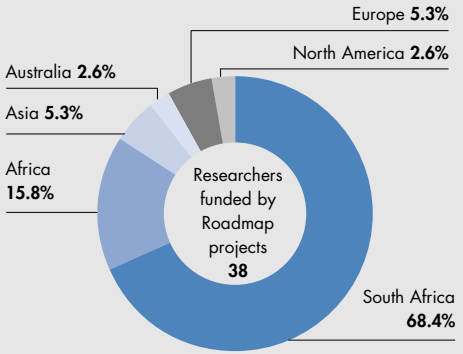
Grant funded researchers (by gender)



Grant funded researchers (by race)

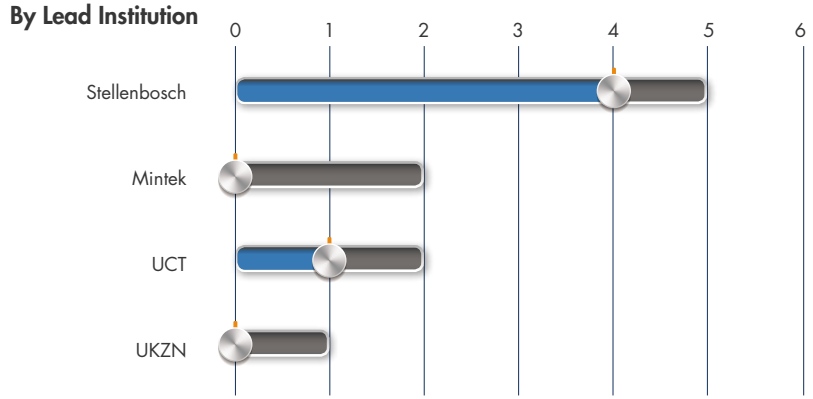


Grant funded researchers (by nationality)

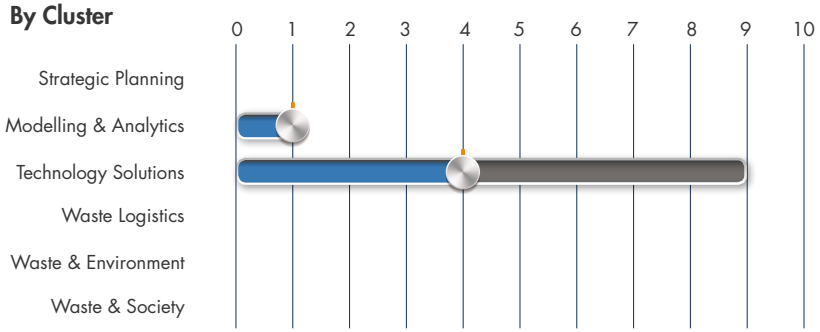


Thematic Spread of New R&D Grant Applications and Awards

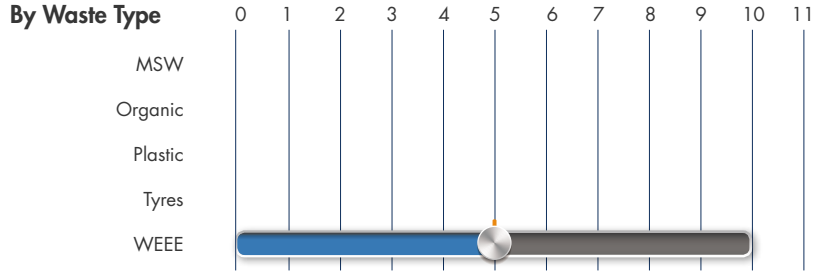
By Lead Institution



By Cluster



By Waste Type



Awards Applications

INNOVATION

Driving technological and non-technological innovation to improve the management of waste in South Africa and to unlock the social, environmental and economic opportunities in resource recovery

Developing technological solutions unique to South African conditions

Call for open innovation grants

Due to funding limitations, no Innovation Call was issued under the Waste RDI Roadmap in 2016/17. However, the WRIU continues to work with organisations such as the Technology Innovation Agency (TIA) and the Innovation Hub, to explore opportunities for driving innovation in the waste sector.

Industry-meets-Science workshop series

The Industry-meets-Science workshop series is an important instrument in implementing the Waste RDI Roadmap. It is aimed at strengthening research collaboration between industry and academia, by bringing experts from both sectors together to share on specific topics.

The workshop series has proven to be a useful tool in informing activities of the WRIU, as outlined below.

- *Organic waste workshop* (Nov 2015) – Informed the 2015/16 Call for post-graduate Scholarships and the Call for Proposals (Grant projects), from which the DST awarded 4 (of 8) scholarships and 8 (of 11) research grant projects in organic waste beneficiation
- *Bioplastics Workshop* (Jan 2016) – Established the SA Bioplastics Forum, and informed ongoing discussions with the plastics industry.
- *Electronic waste workshop* (March 2016) – Informed a targeted research project on the South African WEEE Technology Landscape (awarded to Mintek) and the 2016/17 Call for Proposals (Grant projects) from which the DST awarded five (5) new research grant projects.

One Industry-meets-Science workshop was held in 2016/17, this time on food waste.

Food waste

The DST, in partnership with the CSIR and WWF, hosted a one-day Industry-meets-Science workshop on 15 February 2017, at the WWF offices in Johannesburg. The aim of the workshop was –

- to create a knowledge sharing and leadership platform to explore current and emerging knowledge with those active in addressing the drivers of food waste in the supply chain as well as those researching, developing and piloting solutions;
- for industry/business to highlight the problems they face with respect to managing/reducing food waste across their value chain;
- for universities and science councils to showcase current research and solutions that may benefit industry/business; and
- to jointly identify priority actions and research needs to support reduced food waste

This workshop was in direct support of evidencing South Africa's adoption of Sustainable Development Goal (SDG) 12.3 to *"halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses"* by 2030.

Through industry-academia workshop discussions, three key priority themes were identified, where research can assist in decreasing food waste generation in South Africa. These included, the need for –

- Reliable, scientific data and information on food losses and waste
- Adoption of waste valorization technologies, and
- Improved awareness and behaviour change with respect to food losses and waste

As with previous Industry-meets-Science workshops, the final workshop report and all presentations made at the workshop are available for download from the Waste RDI Roadmap website.

> The **Industry-meets-Science workshop series** is an important instrument of the Waste RDI Roadmap, aimed at **strengthening research collaboration** between industry and academia, by **bringing experts** from both sectors **together.**

Delegates from the Food waste Industry-meets-Science workshop held in Johannesburg,15 February 2017.

INNOVATION (CONTINUED)

Screen capture of the recently published Biorefinery Research Platform

The South African Biorefinery Research Platform

Based on the outcomes of the 2016 Bioplastics Industry-meets-Science workshop, the DST/CSIR initiated the development of the **South African Biorefinery Research Platform**. The intention of the Platform is to better showcase – to the local and international community – South Africa's research in organic waste valorisation.

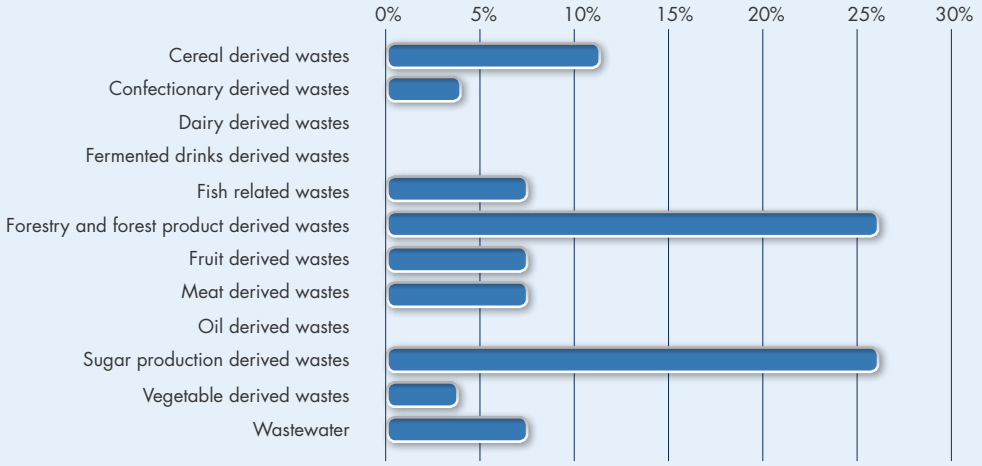
The online platform, which was launched in June 2016, allows users to search for waste-related biorefinery research being conducted by South Africa research organisations. The platform currently hosts information on 54 current (75%) or completed (25%) research projects from across South African research institutions on the valorisation of various organic waste streams.

The majority of the research projects currently housed in the Research Platform are on *"Forestry and forest product derived wastes"* (26%) and on sugar production derived wastes (26%). Four research institutions, active in biorefinery RDI have provided information to the Research Platform – CSIR, North-West University, Stellenbosch University and the University of Cape Town.

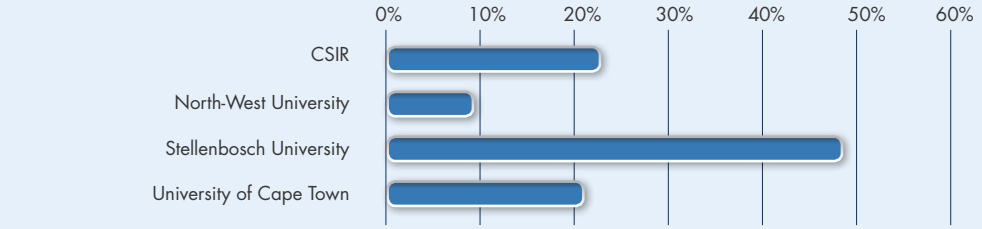
Encouragingly, many of these projects have been, or are being, funded by industry (on par with the number of projects funded under the Waste RDI Roadmap), even though the industry investment (Rand value), remains relatively small (See Section on Investment). The NRF are also independently, funding a number of post-graduate students on biorefinery related research projects.

The South African Biorefinery Research Platform can be accessed at **www.wasteroadmap.co.za/biorefinery**

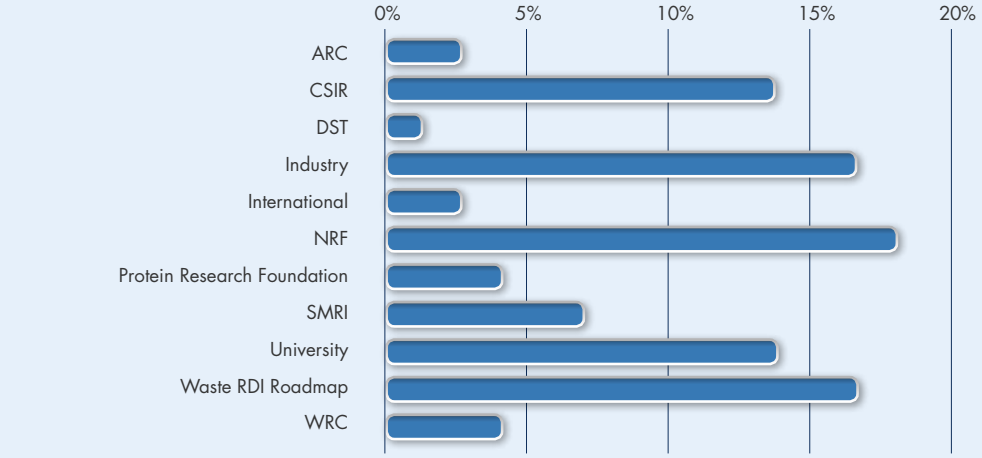
Percentage of projects by waste streams



Percentage of projects per institution



Percentage of projects funded by



PARTNERSHIPS

"Waste research, development and innovation cannot, on its own, transform the waste sector. The Roadmap is one mechanism being implemented by government, through the Department of Science and Technology, to move waste away from landfilling. To ensure success, the Roadmap must be adopted as part of a suite of public and private sector responses aimed at addressing the challenges currently facing the waste sector"

Government

National Government

The Waste RDI Roadmap is intended to support a number of national government departments in the implementation of their mandates, including the Department of Environmental Affairs, Department of Trade and Industry, and Department of Cooperative Governance and Traditional Affairs.

The Department of Environmental Affairs (DEA) partnered with the DST and CSIR in 2016/17 to co-fund the research Grant project awarded to the University of Witwatersrand. The project, which is aimed at researching the integration of informal waste pickers into the South African waste economy, includes a series of stakeholder workshops; a technical oversight committee that includes representatives from industry, NGOs and the informal sector; and the development of evidence-based guidelines on waste picker integration.

In line with the intentions of the Waste RDI Roadmap, this collaboration with DEA marks the start of further waste RDI collaboration in support of national evidence-based policy development, implementation, monitoring and evaluation.

Local Government

Local government is an important priority of the Roadmap, with municipal solid waste being identified as one of the five priority waste streams. The intention is that the Roadmap directly benefit local government by strengthening local skills, facilitating evidence-based decision-making, and informing adoption of alternative waste treatment technologies.

As such, the WRIU was proud to partner with Pikitup Johannesburg (SOC) Limited, in managing the City of Johannesburg's waste research portfolio for 2016/17. The partnership saw the launch of two new targeted research projects on –

- The roll-out of smaller 140 litre wheelie bins within the city as a means of encouraging separation-at-source
- Possible economic and regulatory instruments that could be adopted within the City of Johannesburg to encourage diversion of waste from landfill

A condition of the portfolio management between the CSIR and Pikitup, is that all research outputs (e.g. dissertations, research reports, etc.) be made publicly available via Pikitup and the Waste RDI Roadmap websites. This is to ensure that publicly funded research benefits not only the City of Johannesburg but also the broader South African local government community.

The partnership with Pikitup provided critical learning on how to undertake, package and communicate waste research for local government stakeholders – an invaluable learning opportunity for the researchers.

PARTNERSHIPS (CONTINUED)

"A partnership between government departments allows us to achieve the goals set out in national policy, while addressing issues of environmental protection, economic development, and technological and social innovation in a more holistic and integrated manner"

The focus for 2016/17 has been on **building South Africa's waste research, development and innovation (RDI) profile** in the local and international research community.

Business

Stronger partnerships with the private waste and secondary resources sector are core to the Roadmap. Through partnerships with business, the Roadmap aims to drive directed RDI to addressing the key issues facing the sector. The industry associations and material organisations are particularly important partners in strengthening ties with the private sector. Currently, the private sector is investing very little funding into waste RDI in South Africa. Possible reasons for this include –

- limited to no R&D budgets due to the current financial constraints in the private sector;
- lack of awareness with regards to the potential benefits that research can provide to business;
- insufficient drivers for business to find alternative solutions for waste streams
- a lack of alignment between industry's needs and current R&D.

To further support waste RDI in South Africa, it has been proposed to the industry associations and the Department of Environmental Affairs, that at least 2% of the new EPR levies (planned for under the Industry Management Plans), be ring-fenced for future waste RDI. This research funding may be managed directly by the Producer Responsibility Organisations (PRO), or by the WRIU, depending on the preference of business and government in ensuring maximum impact.

Academia

Universities and Science Councils are at the heart of the Waste RDI Roadmap, undertaking much of the RDI necessary to successfully redirect waste away from landfill. The response of academia to the Waste RDI Roadmap Calls has been very encouraging.

Africa

As noted in the sections on *grant funded postgraduate students* and *grant funded researchers*, a number of students (8) and researchers (6) from other African countries are being provided with the opportunity to build their capability through waste-related research projects.

These students and researchers, who are currently studying and working at South African universities and science councils, are financially supported through the South African Waste RDI Roadmap.

These students and researchers provide a network of current and future research partnerships with their respective countries. However, it is important to ensure that regional and international funding support is available to nurture and grow these new African research partnerships going forward (e.g. African Union, SADC, etc.).

Existing waste RDI partnerships with African countries (with SA placed African students and researchers)

- 1 post-graduate student and researcher
- 3 post-graduate students and researchers
- 4 post-graduate students and researchers

International

At least 11 research partnerships in waste management, between South African research institutions and international organisations were active in 2016/17.

Institutions within the European Union remain important partners for South African waste RDI – with Italy, UK, Austria and Germany highlighted.

However, international funding to South African research institutions on waste-related research projects remains a small percentage of the current investment in waste RDI.

Based on information provided by researchers (incomplete), only around R2.4m (8.4%) of the R28.3m funding support for waste RDI in 2016/17, came from international funding sources *(See Section on Investment)*.

The exclusion of waste and secondary resources management as a priority research area in South African bilateral research programmes remains problematic to unlocking greater international research funding to the South African research community.

Existing international waste RDI partnerships, reflecting all country partnerships and the top six partnerships by number of research projects

While **South Africa** has a young, **emerging waste and secondary resources research community**, the existing local pockets of scientific excellence have already **developed partnerships with international research organisations in over 25 countries**.

WASTE RDI OUTPUTS

The impact that the Waste RDI Roadmap aims to achieve is to support the improved management of waste and the increased diversion of waste away from landfill towards alternative waste treatment technologies, thereby maximising the potential environmental, social and economic benefits.

In support of this goal, the Waste RDI Roadmap committed to the following research, development and innovation outputs over the next 10 years, if fully supported financially –

		Target	*Currently Supporting*[1]
Human Capital Development	Post Docs	65	0
	PhDs	165	10
	Masters	245	23
Knowledge Generation	Registered patents	25	–
	Patent applications	70	–
	Publications	590	–
Technology Development	Products and services to market	4	–
	Technology packages	20	–
	Prototypes	60	–

[1] *These students are at various stages of completion but have not graduated with their degrees*

Other key indicators of impact include: increased investment in waste RDI *(See Section on Investment)*, and increased waste RDI collaboration between the South African research community and the private waste and secondary resources sector.

While it is too soon to measure the impact of most Roadmap outputs after only two years of implementation, the WRIU has seeded activities that will produce RDI outputs in line with the knowledge generation and technology development targets.

During 2016/17, staff from the WRIU have driven and participated in –

- Activities that have directly increased waste RDI collaboration with the private sector;
- Provided technical advisory support to government and industry; and
- Collaborated in the international waste RDI arena,
  - in support of showcasing South Africa's waste RDI, and
  - in ensuring that intelligence is brought back in support of the Waste RDI Roadmap implementation.

This has included active engagement with, and specialist advisory support to –

South Africa –

- Department of Environmental Affairs
- Department of Trade and Industry
- Plastics and packaging sector (including PETCO, Packaging | SA, Plastics | SA, Sustainability Council)
- WEEE sector (including eWASA, HP, SAEWA)
- Various provincial green economy, innovation and green skills forums

Regional –

- United Nations Environment Programme (UNEP) – Africa Waste Management Outlook

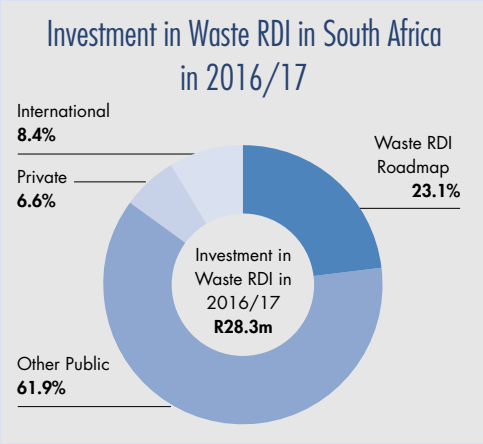
International –

- European Commission
- EU Horizon 2020 EWIT project
- EU Horizon 2020 WASTECOSMART project
- International Solid Waste Association (ISWA)
- United Nations International Labour Organization (ILO)
- United Nations Environment Programme (UNEP) – Global Environment Outlook

INVESTMENT IN WASTE RDI IN SOUTH AFRICA

Currently, there is no single mechanism (information system) to extract data on the investment being made in waste RDI in the South African national system of innovation (NSI). As such, the following information on Waste RDI Investment for 2016/17, was collected by means of a questionnaire sent to researchers working in public research institutions in South Africa.

It is estimated that at least R28.3 million was invested in Waste RDI in South Africa in 2016/17 (as a minimum). Approximately 23% of this was directly through the Waste RDI Roadmap, while more than half (61.9%) was through other public sector funding, such as Parliamentary Grant (29%), National Lottery (26%) and Water Research Commission (15%). Private sector RDI funding was small at 6.6%.



While opportunities for industry co-funding via THRIP was a reality in 2016/17, this did not materialise due to delays in releasing the funding. This was a result of the THRIP move from NRF to **the dti**. International funding to South African researchers is also a small component of waste RDI funding in 2016/17, at only 8.4%. International funding was sourced from e.g. UK Science Councils (54%) and EU Horizon 2020 (33%).

The participation of South African researchers in international projects, for which South Africa receives no international funding (i.e. SA funded), or no funding at all, was also highlighted by researchers.

FINANCIAL STATEMENT

The 2016/17 financial investment in the Waste RDI Roadmap, while up from 2015/16, remains significantly below the budgets outlined in the Waste RDI Roadmap. This has a direct bearing on the extent and magnitude of activities of the Roadmap.

All financial figures are exclusive of VAT.

REVENUE	2016/17	2015/16
DST funding	16 355 427.09	10 432 456.13
Other revenue	0.00	0.00
Total Revenue	**16 355 427.09**	**10 432 456.13**
EXPENSES		
Communications	51 586.58	4 095.00
Consultants	0.00	95 860.00
CSIR Project Management Unit	2 181 307.61	1 197 518.80
Non-recoverable innovation grants	365 442.00	1 500 000.00
Non-recoverable R&D grants	4 548 955.97	2 290 063.35
Targeted RDI projects	680 398.00	0.00
Postgraduate scholarships	930 000.00	905 000.00
Traveling	98 615.18	66 470.52
Workshops and general running	9 624.85	13 488.46
Total Expenses	**8 865 930.19**	**6 072 496.13**
Income for continuing operations (1)	**7 489 496.90**	**4 359 960.00**
Net Income	**0.00**	**0.00**

Notes to financial statement:

(1) Income for continuing operations is committed funding for grant projects awarded in 2015/16 and 2016/17, for which disbursements will be made in the 2016/17 and 2017/18 financial years.

THE OUTLOOK FOR 2017/18

South Africa, like most emerging economies, faces a difficult economic climate for the foreseeable future, with government and business cutting back on expenditure. This has a direct impact on South Africa's ability to invest in waste RDI, despite the social, economic and environmental benefits that can be realised when diverting waste away from landfill towards prevention, reuse, recycling and recovery.

The focus for the coming financial year therefore remains firmly on –

- closely monitoring currently funded postgraduate studies and research projects to ensure maximum impact through this first phase of investment.
- increasing national activity in waste RDI through industry and government partnerships
- ensuring that investments in waste RDI are strategic, and research outputs are relevant, thereby increasing impact and supporting uptake by local and regional partners
- increasing waste RDI collaboration between South Africa and Africa, and other key international partners
- profiling South Africa's waste activities and waste RDI internationally
- raising the profile of the Waste RDI Roadmap with South African universities
- strengthening the investment in local waste RDI through, among others, country-to-country bilateral agreements and industry partnerships
- supporting local government in the evaluation and demonstration of alternative waste treatment technologies

An exciting opportunity for 2017/18 will be the launch of the first two SARChI Research Chairs in waste management in South Africa. These chairs are planned to be in place by the start of the 2018 academic year. The Chairs will be part of the portfolio of Research Chairs managed by the National Research Foundation (NRF) on behalf of the DST. The call for the Research Chairs is expected to be made in June/July 2017.

If the opportunity for new funding arises, the WRIU will continue to implement –

- calls for postgraduate scholarships
- calls for R&D and innovation grants
- targeted requests for proposals

Our sights remain firmly on achieving the vision and mission of the 10-year Waste RDI Roadmap and the anticipated RDI outputs.

ANNEXURES

ANNEXURE 1: **SUMMARY OF COMPLETED WASTE RDI ROADMAP RESEARCH PROJECTS**

Mapping South Africa's Waste Electrical and Electronic Equipment Technology Landscape

MINTEK, SOUTH AFRICA

PROJECT INFORMATION
Waste Roadmap Instrument: Targeted Research Call
Lead Institution: Mintek
Project Leader: Ms M Gericke
Research budget: R680 398
Co-investment: R400 000
Project timeframe: May 2016-March 2017

The objective of this targeted research project was to assess the WEEE dismantling, pre-processing and processing technology landscape in the formal WEEE economy in South Africa. The outcomes of the research were expected to –

- Assist the Department of Science and Technology in assessing local technology solutions and WEEE treatment capacity, gaps in local technology solutions that could support increased local processing of WEEE, and opportunities for new areas of technological innovation
- Support future WEEE research, development and innovation in South Africa to ensure that opportunity areas, and key gaps, are addressed
- Capacitate the sector through public access to information, in order to improve the understanding of the potential business opportunities in recycling of WEEE
- Support the diversion of WEEE away from landfill towards reuse and recycling
- Support the development of a regional secondary resources economy that provides maximum local social and economic benefit

The key findings that emerged from the research, included:

- Over 100 formerly registered companies operate across the WEEE recycling value chain (from collection to processing) in South Africa.
- The WEEE recycling sector remains dominated by a few well-established 'consolidator' companies (85% of volumes handled in 2015).
- Most small- to medium-sized firms concentrate in earlier stages of the value chain (i.e. dismantling). The number of firms offering location-specific collection, dismantling and refurbishment activities have increased over the past five years.
- Gauteng remains the central 'hub' for the collection, consolidation, pre-processing and processing of WEEE in South Africa (±55% of volumes handled in 2015). The Western Cape, KZN and Eastern Cape are important provincial aggregation and sourcing nodes.
- The SADC region is emerging as an important supplementary source of WEEE inputs to the South African recycling sector and is expected to increase in importance as competition for local inputs intensifies.
- Barriers to entry are high at the pre-processing and processing stages and in specialised waste streams (e.g. lamps), but comparatively lower at the dismantling stage.
- Skills and technology are not the determining factors, rather access to WEEE volumes is.
- WEEE recycling is not profitable as a standalone business for small firms, with 58% regarding it as a secondary activity. Most small dismantlers complement WEEE recycling with refurbishment, which is regarded as being more profitable (making up to 60% of revenues).
- In 2015, approximately 17,733t of WEEE was handled by 27 firms, with the largest source of inputs being from government departments (45%). ICT & consumer electronics made up the largest contributing waste stream (79%).
- The WEEE recycling sector is currently not a significant employer, with approximately 677 people employed across 18 firms in 2015. However, at 25 jobs/1,000t handled, the sector has the potential to increase this number as more WEEE is unlocked into the value chain.

The full report is available for download from the Waste RDI Roadmap website

ANNEXURE 2: **WASTE RDI ROADMAP SCHOLARSHIP PORTFOLIO (ONGOING AND NEW)**

No	Applicant	Title	Aligned with priority waste	Aligned with cluster	University	Supervisor	Funding instrument	Year awarded
1	**Ms B April**	Beneficiation of wastewater sludge generated from the edible oil industry for the production of biodiesel	Organic waste	Technology solutions	CPUT	Dr P Welz	Master's scholarship	2016-2017
2	**Ms S Chetty**	Can the ISO14062 standard reduce the environmental risks posed by e-waste	WEEE	Strategic planning	UKZN	Mr R Lottering	Master's scholarship	2016-2017
3	**Mr JP du Toit**	Hydrogen bioproduction from waste glycerol by Rhodopseudomonas palustris immobilized in a transparent PVA cryogel	Organic waste	Technology solutions	SUN	Dr R Pott	Master's scholarship	2016-2017
4	**Mr R Nchabereng**	The recovery of gold from waste mobile phones printed circuit boards (PCBs) using thiosulphate leaching and copper cementation process	WEEE	Technology solutions	CPUT	Mr M Aziz	Master's scholarship	2016-2017
5	**Ms M Nider-Heitmann**	Techno-economic analysis and comparison of biorefinery scenarios for the production of succinic acid, itaconic acid and polyhydroxyalkanoates from sugarcane waste	Organic waste	Modelling and analytics	SUN	Prof J Görgens	Master's scholarship	2016-2017
6	**Mr G Potgieter**	Base metal recovery from glycine leach solutions using Ion exchange and solvent extraction	WEEE	Technology solutions	SUN	Dr C Dorfling	Master's scholarship	2016-2017
7	**Mr S Thakur**	NGOs and household solid waste management: Assessing the project sustainability of solid waste management practices in Peri-urban areas	Municipal waste	Strategic planning	UKZN	Dr M Hansen and Dr A Nel	Master's scholarship	2016-2017
11	**Ms S Candiotes (Awarded)**	Gauteng households' definition of food waste as well as their attribution of blame along the South Africa food chain	Organic waste	Waste & Society	UP	Dr N Marx-Pienaar	Master's scholarship	2017-2018

ANNEXURE 2: **WASTE RDI ROADMAP SCHOLARSHIP PORTFOLIO (ONGOING AND NEW)**

No	Applicant	Title	Aligned with priority waste	Aligned with cluster	University	Supervisor	Funding instrument	Year awarded
8	**Mr A Gada (Awarded)**	Development of eco-compatible bio-composites from recycled post-consumer plastic and agricultural biomass	Organic waste	Technology solutions	NMMU	Dr S Muniyasamy	Master's scholarship	2017-2018
9	**Mr D Maluleke (Awarded)**	Bioleaching as a unit operation for the recovery of copper and other metal of value from WEEE	WEEE	Technology solutions	UCT	Prof S Harrison	Doctoral scholarship	2017-2018
12	**Mr S Matebese (Awarded)**	Assessing the integration of sustainable waste management principles in dealing with illegal dumping in informal settlements	Municipal waste	Waste & Society	CPUT	V Zungu	Master's scholarship	2017-2018
13	**Ms T Silinda (Awarded)**	Assessing the sustainability of waste management business sector in selected townships	Municipal waste	Waste & Society	CPUT	V Zungu	Master's scholarship	2017-2018
10	**Ms J van Rooyen (Awarded)**	Modelling and Efficiency improvement of a plasma-arc gasification reactor quench probe	Organic waste	Technology solutions	NWU	Prof K Uren	Master's scholarship	2017-2018

ANNEXURE 3: **WASTE RDI ROADMAP PROJECT PORTFOLIO**

No	Applicant	Title	Aligned with priority waste	Aligned with cluster	Principal Investigator	Funding instrument	Funding
2016_1	**University of the Witwatersrand**	Lessons from waste picker integration initiatives – Development of evidence based guidelines to integrate waste pickers into South African Municipal Waste Management Systems	MSW	Waste & Society	Dr M Samson	Non-recoverable open R&D grant	4/2016 - 3/2019
2016_2	**CSIR (NRE)**	A Decision Support Tool for Implementing Municipal Waste Separation at Source: Incorporating Socio-economic and Environmental Impacts	MSW	Modelling & Analytics	Mr A Nahman	Non-recoverable open R&D grant	4/2016 - 3/2018
2016_3	**CSIR (NRE)**	Beneficiation of forestry biomass waste streams	Organic	Technology solutions	Dr B Sithole	Non-recoverable open R&D grant	4/2016 - 3/2019
2016_4	**CSIR (NRE)**	Valorisation of chicken feathers	Organic	Technology solutions	Dr B Sithole	Non-recoverable open R&D grant	4/2016 - 3/2019
2016_5	**CSIR (MSM)**	Sustainable utilization and conversion of post-harvest agricultural waste residues into value added materials	Organic	Technology solutions	Dr M John	Non-recoverable open R&D grant	4/2016 - 3/2019
2016_6	**University of Cape Town**	Value recovery from solid confectionary waste	Organic	Technology solutions	Prof S Harrison	Non-recoverable open R&D grant	4/2016 - 3/2019
2016_7	**Stellenbosch University**	Reactor design for industrial furfural production from sugar cane agricultural residues	Organic	Technology solutions	Prof J Görgens	Non-recoverable open R&D grant	4/2016 - 3/2018
2017_8	**Stellenbosch University**	Biogas and volatile fatty acids biorefinery by co-digestion of fruit juice industry solid and liquid wastes with lignocellulosic biomass	Organic	Technology solutions	Prof J Görgens	Non-recoverable open R&D grant	4/2016 - 3/2018
2016_9	**Stellenbosch University**	Organic waste: a bioresource for production of novel cellulose nanocomposites	Organic	Technology solutions	Dr A Chimphango	Non-recoverable open R&D grant	4/2016 - 3/2019
2016_10	**Stellenbosch University**	Amino acid leaching of metals from printed circuit board waste	WEEE	Technology solutions	Prof C Dorfling	Non-recoverable open R&D grant	4/2016 - 3/2018

ANNEXURE 3: **WASTE RDI ROADMAP PROJECT PORTFOLIO**

No	Applicant	Title	Aligned with priority waste	Aligned with cluster	Principal Investigator	Funding instrument	Funding
2016_11	**Stellenbosch University**	Extraction of value from solid waste by pyrolysis conversion: Pilot scale optimisation	Plastics	Technology solutions	Prof J Görgens	Non-recoverable open innovation grant	4/2016 - 3/2018
2017_12	**Stellenbosch University**	Recycling rare earth elements from fluorescent lamps	WEEE	Technology solutions	Prof C Dorfling	Non-recoverable open R&D grant	1/2017 - 3/2019
2017_13	**University of Cape Town**	Integrated process flowsheet for the sequential extraction and recovery of valuable metals from WEEE	WEEE	Technology solutions	Prof S Harrison	Non-recoverable open R&D grant	1/2017 - 3/2020
2017_14	**Stellenbosch University**	Environmentally friendly lithium ion battery (LIB) recycling process	WEEE	Technology solutions	Dr G Akdogan	Non-recoverable open R&D grant	1/2017 - 3/2019
2017_15	**Stellenbosch University**	Thermal treatment of printed circuit board waste and its effect on downstream metal recovery processes	WEEE	Technology solutions	Prof C Dorfling	Non-recoverable open R&D grant	1/2017 - 3/2019
2017_16	**Stellenbosch University**	Use of PCB leach residue as reductant in pyrometallurgical operations	WEEE	Technology solutions	Dr G Akdogan	Non-recoverable open R&D grant	1/2017 - 3/2019

September 2017

Compiled and written by:
Dr Linda Godfrey

Copy editing: Beeza Mtamzeli

Proofreading: DST and CSIR Communications

Photographs: Dr Linda Godfrey / Shutterstock

Design: Creative Vision (082 338 3742)

WASTE RDI ROADMAP IMPLEMENTATION UNIT

PRETORIA

Council for Scientific and Industrial Research (CSIR)
Implementation Unit
Meiring Naudé Road, Brummeria,
Pretoria, South Africa

PO Box 395, Pretoria, South Africa, 0001

Tel: +27 (0)12 841 4801
Fax: +27 (0)12 842 7687

Email: info@wasteroadmap.co.za

www.wasteroadmap.co.za

Department of Science and Technology
Directorate: Environmental Services and Technologies
Meiring Naudé Road, Brummeria,
Pretoria, South Africa

Private Bag X894, Pretoria, South Africa, 0001

Tel: +27 (0)12 843 6300

www.dst.gov.za

science & technology
Department:
Science and Technology
REPUBLIC OF SOUTH AFRICA

CSIR
our future through science