



## Message from the NSTF Executive Director

### Women scientists are on their way up

This is the month for celebrating remarkable women in South Africa. Achievements in the scientific world are certainly worth celebrating, as the NSTF did on 21 July 2022, with the announcement of [15 awards to winners](#) who made outstanding contributions to science, engineering, technology (SET) and innovation. Of the 12 individual winners (the others were for organisations or teams), four awards were made for remarkable women in science.

Women can be tenacious, resolute and calm in situations of disaster, doing what needs to be done without delay, and without much fuss. They can be surprisingly agile, rolling with the punches and prove to be strong leaders. Significantly, they are often able to communicate well, which is an advantage when negotiating and forming collaborations and partnerships.

1. One of the four women who recently received an [NSTF-South32 Award](#), is a case in point. She found herself at the right place at the right time to make an important contribution to the country's management of the COVID-19 pandemic. She is the CEO of SAHPRA (South African Health Products Regulatory Authority), **Dr Boitumelo Semete-Makokotlela**. She led the authorisation of a number of COVID-19 diagnostic tests, vaccines and therapies during the pandemic. She was driven to ensure that the regulator is an enabler for the necessary tests, vaccines and therapies to be rolled out and to save lives.

Little did she know what would happen after she accepted the position of CEO in January 2020, only a couple of months before the global pandemic hit South Africa.

"I had to remain calm amid all the storms and had to learn to become comfortable making decisions based on the facts I had at the time — mindful that the rate of new information available changed daily in the early days of the pandemic," she says. "I leaned on the resilience I had learned in my efforts as an amateur triathlete, knowing well that I had to keep going and remain resolute on decisions made, despite threats and attacks from political parties and civil society, both professionally and personally," explains Semete-Makokotlela.

To be able to implement these tests expeditiously, she had to champion collaboration with other regulators across the globe, such as the US Food and Drug Administration (FDA), the European Medicines Agency, Health Canada, the Namibian Authority and the Ghana Food and Drug Authority (FDA), to name but a few. A partnership with the World Health Organization (WHO) was also critical in bringing best practices to the execution of regulatory oversight for the COVID-19-related health products.

Dr Semete-Makokotlela is the winner of the 2021/2022 NSTF-South32 Award for an outstanding contribution to science, engineering and technology (SET) and innovation through management and related activities.

There are three other women award winners this year, each with their own inspiring story. More about them here below.

### Where do we stand regarding gender equality in the sciences?

There is a recent [article](#) that declares the welcome news that 'Africa has the highest proportion of female STEM graduates'. It is written by Alex Rose-Innes and appeared on 3 August 2022 in *Women in Science, Africa*.

It reports the finding that **47%** of African universities' science, technology, engineering and mathematics graduates, undergraduates and postgraduates, are women. That is according to the latest [report](#) compiled by Times Higher Education (THE) and the United Nations Scientific, Cultural and Educational Organization (UNESCO). (STEM = science, technology, engineering and mathematics.)

This is welcome news that women science graduates are indeed almost half of the total number of graduates. However, this impressive statistic should be understood in context. Only 49 universities in Africa participated in the study (of 776 universities worldwide). The article also reveals that this percentage is not reflected in the proportion of academic staff at the sample of universities, stressing that gender representation among the staff lags behind in terms of the proportion of women.

### Are South Africa's figures comparable to the percentage of women as reported in Africa?

The percentage of women winners of the NSTF-South32 Awards has gone up and down, but average at **37%** women winners among the total number of winners over 24 years. This is not a figure for graduates, but an indication of women scientists who are at the top of their game. The percentage has also increased over the years, from about 33%.

According to the [Research and Development Statistical Report for 2019/2020](#) compiled by the Human Sciences Research Council (HSRC) the number of female researchers (headcount) in South Africa is **42%** of the total number. Do we fall short of Africa's standard? What is clear is that the South African percentage declined from the 2018/2019 figure of 45.7% as well as from the 2017/2018 figure of 44.9%.

To further put this into perspective: The total number of research personnel is 41 856.5 (FTE) and the number of researchers (FTE) is 28 358.6. The headcount of researchers is 62 002, of which the number of women researchers is 26 015, or 42%.

If we look more closely at the report's data for the business, higher education and science councils sectors (where most of South Africa's researchers are employed), we see that the situation is complex and interpretation depends on definitions.

#### In the business sector:

The number of researchers (**excl** doctoral students, post-doc fellows and support staff) is 34 358. The number of researchers (**incl** doctoral and post-doctoral fellows and R&D support staff) is 62 002.

In both these cases, the percentage of women researchers is **46%** (one is 46 and the other 46.2%), which is quite a bit higher than the overall percentage (42%) of women researchers in South Africa would suggest.

#### In the science councils' sector:

The total number of researchers was 1 858 in 2019/2020, and the percentage of women among them was again **46%**. (Interestingly, the percentage of women among the technicians directly supporting R&D is only 41%).

#### In the higher education sector:

The number of women among researchers with a doctoral degree or equivalent (12 838), is **42%** of the total. The number of researchers with qualifications ranging from Bachelors to Masters degrees is 11 044, and women are **52%** of that total. This is a decent figure for women's representation, but it is worth noting that the number of women researchers with PhDs – in other words with the potential to become fully fledged researchers – falls far short of the desired 50%.

#### The statistics in summary:

The women researchers at South African higher education institutions who have academic qualifications other than PhDs are the highest proportion of women's representation at 52%, which is

higher than the continental figure of 47% for all graduates, including PhDs. The highest number of researchers is employed in the private sector. Women's representation among researchers in business and at science councils is 46%. This is but one percentage point away from the sample of universities across the continent (according to the THE and UNESCO report cited above).

### Back to the female NSTF-South32 Award winners

The three other women Award winners, besides Dr Boitumelo Semete-Makokotlela who is a CEO, are: Dr Banothile Makhubela of the University of Johannesburg, Prof Sehliselo (Selo) Ndlovu of Wits University, and Prof Marianne Vanderschuren of the University of Cape Town. One is a chemical scientist, another a metallurgical engineer, and the third is a civil engineer.

2. *Converting waste materials into useful products*: that is what **Dr Banothile Makhubela** does. She is a chemical scientist who cares about sustainability and the circular economy where waste is processed to become useful in manufacturing processes. She is also addressing South Africa's CO<sub>2</sub> problem.

Makhubela is a Senior Lecturer and the Director: Research Centre for Synthesis and Catalysis, Department of Chemical Sciences, Faculty of Science, University of Johannesburg (UJ). *She won one of the two Awards in the Emerging Researcher category*, for her contribution to nano- and organometallic-catalysis directed towards green and sustainable chemical processes. Her research applies such catalysts to converting waste materials like lignocellulose and a greenhouse gas, carbon dioxide (CO<sub>2</sub>), into sustainable chemicals and fuels.

"Through my research, and my students' work, I hope to demonstrate to manufacturing industries that in producing or using chemicals it's still possible to improve waste management, and contribute to profitability while doing so," she says. "For decades, the world's energy and chemical demand has been met by fossil-based feedstock that's processed in unsustainable ways. We want to find more sustainable approaches through renewable alternatives, for meeting liquid fuel and chemical demands."

Highlights of Makhubela's career include seeing the postgraduate students she mentored go on to make meaningful contributions in their careers, as well as the significant discoveries they have made together.

"Working in a highly demanding research environment makes it challenging to achieve work-life balance," she says. "One of our other challenges is securing sustained funding so that we can make meaningful contributions through our research. With South Africa being the largest emitter of greenhouse gases in Africa, thanks to electricity generation and synthetic fuels, the country is certainly in need of practical solutions to its carbon dioxide problem, and there are significant opportunities for us to find ways to address these."

Dr Makhubela chose her career path because she wanted to be part of defining chemistry in terms of sustainability. She wished to push frontiers and unlock new opportunities for the sustainable production and use of chemicals. Her research applies nano- and organometallic-catalysts to convert waste materials. Chemical computations are used to understand how carbon dioxide and cellulose feedstocks interact with catalysts while being transformed, providing insights that ultimately support precise, wasteless chemical processes that enhance product yields.

This research, which touches on catalytic materials design, novel synthetic methodologies and reaction engineering, allows access to sustainable commodity chemicals and fuels prepared using inexpensive, widely accessible feedstocks that otherwise would cause environmental pollution.

Thus, waste is chemically upcycled and repurposed to value.

3. *Extracting valuable metals more efficiently*: that is what **Prof Sehliselo (Selo) Ndlovu** does. She is Professor of Metallurgical and Materials Engineering; and Chair: DSI/NRF South African Research Chairs Initiative (SARChI), Hydrometallurgy Sustainable Development, Wits. *She won one of the two awards in the Engineering Research Capacity Development category* for her work

as a hydrometallurgical engineer who is focussed on ensuring a sustainable future supply of metals by developing processes and building capacity and skills that can drive and contribute to the extractive metallurgical industry.

Prof Ndlovu's list of achievements is impressive, spanning the establishment of world-class research facilities that are extensively used for research and training of postgraduate students and that contributes to knowledge creation and human capacity development in the field of hydrometallurgy in the country.

"Hydrometallurgy involves subjecting different minerals to different types of solutions to extract the metals more effectively and efficiently. My work involves the development of new processes and technologies to improve metal extraction," says Ndlovu. "When I started out, there wasn't a lot of research and training being done in hydrometallurgy at Wits. Considering that South Africa is a big mining country, I felt that there was a need to establish a research and training centre that can build skills and technology for the mining industry."

Ndlovu identified a gap in the market and focused on developing capacity in the extractive metallurgy industry that involved research as well as training. She started off with a small start-up fund provided by her department at Wits, one PhD student and a laboratory with minimal equipment. She undertook most of her early research using shared equipment with UJ and furthered her understanding of the industry through research and hands-on experience. Since then, she has raised more than R30-million in research funding from both the public and private sector to purchase and maintain research equipment, drive research activities and support research students.

The output of her research tends to align to the current and future needs of the local mineral extraction industry. The generated knowledge is shared through publications, at conferences, workshops and seminars. Furthermore, some of the research work has resulted in the development of novel approaches to metal extraction that have been patented for future commercialisation. "We now have a large number of students working on different projects that focus on minerals and metals that are of interest to South Africa, such as gold, platinum and other critical metals. Most of the projects focus on improving the existing metal extraction processes and developing new ones in order to contribute to the extractive metallurgy industry," concludes Ndlovu. "We're also not doing the research for the sake of research or training for the sake of training — this is all focused on aiding capacity and the economy of the country while building up the next generation of CEOs and leaders within the sector."

4. *Working for a safe, accessible and sustainable transport system for South Africa*, in particular devising ways of ensuring the safety of women on public transport: that is what **Prof Marianne Vanderschuren** does. She is a Professor: Transport Planning and Engineering; and Chair: DSI/NRF/Council for Scientific and Industrial Research (CSIR) Co-funded Smart Mobility Research; and Deputy Dean: Social Responsiveness and Transformation, Dept of Civil Engineering, Faculty of Engineering and the Built Environment, University of Cape Town. Prof Vanderschuren received the *2022 Special Annual Theme Award*, for her role in improving the quality of life of vulnerable road users using Smart Mobility through research solutions based on the basic sciences.

South Africa desperately requires a safe, secure, accessible and sustainable transport system. Using modelling, project assessment and tailor-made decision support tools, Prof Marianne Vanderschuren's research focuses on transport improvements for vulnerable road users, resulting in more than 5 000 lives being saved since 2009. Vanderschuren is an international leader in her field, and her considerable research outputs and capacity development initiatives have been recognised by her election as a Fellow of the South African Institution of Civil Engineering (SAICE), as a Fellow of the Institution of Civil Engineers UK (one of only 63 in Africa) and by the DSI-NRF/CSIR Smart Mobility Research Chair award. She was appointed President of SAICE for 2022.

She holds a PhD in intelligent transport systems and an MSc in systems engineering and policy analysis, both from universities in the Netherlands. She is the University of Cape Town (UCT) Department of Civil Engineering's only female full professor, and is the faculty's Deputy Dean for Transformation and Social Responsiveness.

"Road fatalities cost South African society more than R142-billion each year, which is 3.8% of the country's GDP," she explains. "Up to 60% of those fatalities are among the country's most vulnerable road users — pedestrians. My research in the Western Cape and around the country seeks to understand the causes of road fatalities, and to identify ways to reduce them."

Vanderschuren uses a unique combination of (big) data collection and analysis, macroscopic and mesoscopic modelling, assessment tool development and applications, as well as policy development and analysis to reduce the transport system externalities. Her research outputs include eight books, and 16 book chapters, as well as numerous peer-reviewed conference papers, journal papers and other reports and publications.

She has also done ground-breaking work on personal security for women who use public transport, with other successful projects including research into cyclists and passing behaviour, a strategic model assessment for sustainable rail transport that saved R75-million for the Western Cape Department of Transport and Public Works, and the Walkability app, which gathers information on the state of infrastructure, perceived road safety and personal security. Vanderschuren is part of a consortium exploring sexual harassment in Africa's public transport systems. The project will deliver a decision support tool that provides implementation pathways for five types of stakeholders (public authorities, policymakers, enforcement agencies, transport authorities, and non-governmental organisations) that is unique in the world.

### Conclusion

All this goes to demonstrate that South African women scientists and related professionals are up there among the best. They all do innovative work to address real problems and work towards sustainable development. They build capacity in research and engineering, develop useful tools, methods and apps, and use various sophisticated technologies in doing their work.

South Africa's women graduates up to PhD level are a healthy proportion of all graduates (at 52%) and although the proportion of women among the total number of researchers has not reached 50%, it is well on its way upwards and we can expect that it will get there.

To all our women scientists, engineers and science professionals: keep up the good work. We celebrate your excellence and urge government, research institutions and funders to support your research and innovation.

***The opinions expressed above are those of the Executive Director, Ms Jansie Niehaus, and do not necessarily reflect the views of the [Executive Committee](#) or [members](#) of the NSTF.***