TRADE & INDUSTRIAL POLICY STRATEGIES

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Bulelwa Ntsendwana: Harnessing chemistry for sustainable development and women empowerment

OVERVIEW

Climate change will have drastic impacts on South Africa's economy and society and the need to adapt is urgent. As the country embarks on a just transition to a low-carbon, climate-resilient and environmentally-sustainable economy, an opportunity exists to develop domestic small, green businesses. This case study forms part of a broader initiative on small business development in South Africa's climate change space. It presents the journey and experience of Bulelwa Ntsendwana, a South African entrepreneur active in the adaptation space.

FROM THE RIVERS OF EAST LONDON TO A DOCTOR IN CHEMISTRY

Serial innovator Bulelwa Ntsendwana is driven by developing solutions to strengthen and improve the sustainability of the water-energy-food nexus. She aims to harness the power of chemistry to create "a world of social and economic prosperity sustained through collective action". Bulelwa grew up in the city of East London, in the Eastern Cape. Hardship and dedication drove her to become a doctor in chemistry. She is motivated by the desire to see women play a much larger role in science, innovation and technology (a male-dominated field), and she is determined to break down the barriers to women's creative capacities – a crucial step in their emergence in the innovation field.

Bulelwa started her academic career at the Walter Sisulu University in the Eastern Cape, where she studied analytical chemistry. Her interest in water-related issues was already strong. A project on a dam near Mthatha which suffered environmental damage and loss of biodiversity, saw her investigating the water pollution and its sources. She also worked on modifying sensors, whose purpose is to detect events or changes in their environment and send that information to a computer. This proved to be critical for her entrepreneurial journey.

Bulelwa then joined the University of the Western Cape to complete her Master's degree, where she worked on hydrogen fuel cells for energy storage. Hydrogen fuel cells combine hydrogen and oxygen to produce electricity, heat, and water. Thanks to funding from the Department of Science and Technology (DST), she spent time in Norway working on metal hydrides, used in fuel cells, at the Institute for Energy.

On her return to South Africa, Bulelwa pioneered the installation of fuel cells on bicycles, in collaboration with the Tshwane University of Technology in Pretoria, Gauteng.

She then found herself back in Gauteng to pursue PhD studies at the University of Johannesburg, which she completed in 2014. For this, she focused on water-related issues, working on the development of water-cleaning systems. Based on an electrode[1], her innovation uses chemistry to extract pollutants out of water. This formed the basis of one of her multiple entrepreneurial ventures.

Trade & Industrial Policy Strategies (TIPS) is a research organisation that facilitates policy development and dialogue across three focus areas: trade and industrial policy, inequality and economic inclusion, and sustainable growth

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Between 2014 and 2015, she furthered her passion for research and development (R&D) at the University of the Western Cape through a post-doctoral position in the Department of Chemical Studies, where she perfected her knowledge of fuel cells.

In 2016, Bulelwa joined the University of South Africa (UNISA) in Pretoria as a senior researcher in nano-technologies[2] until August 2018, when she took the plunge and left the academic environment to become an entrepreneur.

CHEMISTRY AND THE WATER, ENERGY, FOOD NEXUS

The water, energy and food (WEF) nexus means that the security of three sectors – water, energy and food – are inextricably linked. This means that actions in one area have impacts on one or both of the others. Chemistry is at the heart of this nexus, and is a foundational element in energy production, water treatment, and food farming and processing.

FROM SERIAL INNOVATOR TO SERIAL ENTREPRENEUR

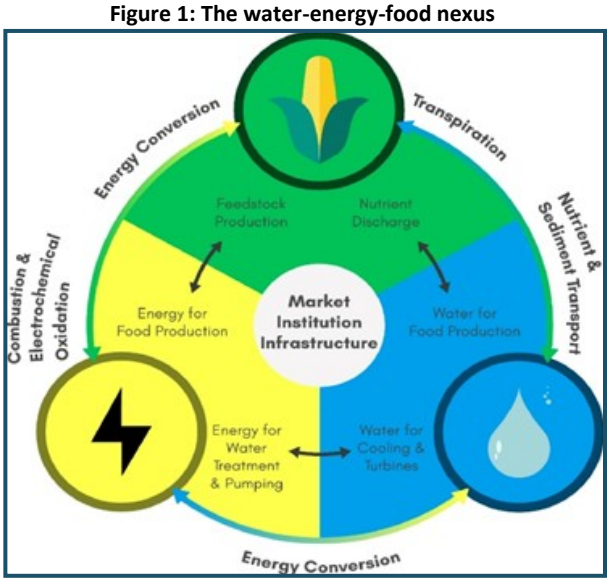
Serial innovator and now serial entrepreneur, Bulelwa has been at the inception of four start-up companies, leveraging her vast knowledge and experience of the role of chemistry in the water-energy-food nexus. Genau Analytics and Energy Water Environmental Food Sustainable Technologies (EWEF-SusTech) operate in the water sector, while Novel Green Technologies focuses on the energy sector, developing flexible, thin-film charging technology. Relying on her chemistry background, Bulelwa also produces beauty products using essential oils. Moreover, she started a non-for-profit organisation, the Women in Research Leadership and Entrepreneurship Centre, which teaches women how to produce cleaning products.

Two of these initiatives, Genau Analytics and EWEF-SusTech, are further explored in this case study.

Genau Analytics: at the forefront of water monitoring and forensics

Established in 2017, Genau Analytics builds on Bulelwa's doctoral R&D and focuses on water monitoring, testing and forensics services. The firm targets institutions in need of these services. Potential clients include government institutions and private firms that generate a material amount of polluted water, in sectors such as mining, pharmaceuticals and

Figure 1: The water-energy-food nexus



Source: Cai et al, 2017[3]

and textiles. The company focuses on the fabrication of electrodes which can be used for detecting various pollutants in water, ranging from pathogens, pharmaceutical drugs, heavy metals, phosphates, neurotransmitters and nutrients. Genau Analytics has already established a proof of concept through R&D. It is embarking on designing these electrodes and commercialising them.

These electrodes can easily be manufactured by compressing the carbon-based materials into pellets of specified geometric area as shown in Figure 2.

Due to their design, the electrodes can be easily prepared from natural graphite (the soft, flaky material used in pencil lead), leading to high electrochemical conductivity. As a result, they exhibit high flexibility, compressibility and can be fabricated into different sizes and shapes.

Figure 2: Genau Analytics' proprietary electrode to detect pollutants in water solutions

Source: Genau Analytics

[1] An electrode is an electrical conductor used to make contact with a non-metallic part of a circuit.
[2] Nano-technologies exploit the unique properties of tiny particles smaller than millionths of a millimetre.
[3] Cai, Ximing, Wallington, Kevin, Shafiee-Jood, Majid and Marston, Landon. (2017). Understanding and Managing the Food-Energy-Water Nexus – Opportunities for Water Resources Research. Advances in Water Resources. 111. 10.1016/j.advwatres.2017.11.014.

While working on the fabrication of these electrodes, Genau Analytics has explored avenues to start operating as a revenue-generating business. Genau Analytics proposes water monitoring and testing services by utilising commercially-available (imported) portable kits for water monitoring and testing services. It is, however, the ambition of Genau Analytics to stop using such imported portable kits once it kick-starts the manufacturing of its pioneering electrodes in South Africa.

Genau Analytics is currently fundraising and exploring partnerships with institutions, such as Mintek, the DST and the Water Research Commission's (WRC) Water Technologies Demonstration programme, to manufacture the electrode, which would enable the company to take its innovation to the market.

WHAT IS THE MARKET FOR WATER MONITORING, TESTING AND ANALYSIS?

The global market for equipment for testing and analysis, including sensors, reached US$6.9 billion in 2017, and is forecast to near US$9.4 billion in 2022. The South African component of this market reached U$85 million in 2017, and will near US$108 million in 2022.

Source: GWI, 2018[4]

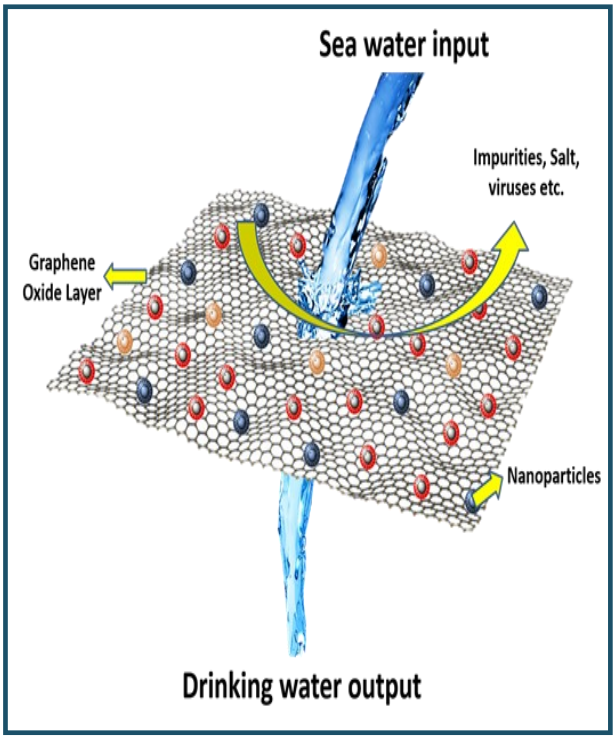
EWEF-SusTech: pioneering water treatment

EWEF-SusTech focuses on water-related innovations, such as nano-membranes and photo-reactors, as standalone treatment systems for point of use. Nano-membranes are extremely small water filtration devices. Photo-reactors are vessels that use light energy to initiate a chemical reaction. In the context of EWEF-SusTech, the reaction is harnessed to clean the water solution.

Co-founded in 2018 with Alex Kuvarega, the company envisages supplying these technologies to hotels, hospitals and industries that generate large uantities of pollutants, such as the textile industry. The EWEF-SusTech system can be used to treat water to drinking standards for customers, such as households, retailers, farmers, industries and municipalities.

So far, EWEF-SusTech has completed the proof-of-concept for effective treatment of wastewater using nano-composite materials. The technology is currently being tested treating up to 80 000 litre a day (L/d). The company is now planning to design a photo-electrochemical system that can treat ab about 100 000 L/d, as illustrated in the example in Figure 3.

Figure 3: Mechanism for EWEF-SusTech's innovative water treatment system



Source: Hybrid Nanoparticles and Graphene Nanosheets Modified Nano-filter for Water Desalination and Purification project[5]

The photo-reactor comprises materials that can absorb sunlight and form molecules to destroy the pollutants in water. Most existing technologies use ultraviolet (UV) light, which is harmful when humans are exposed to it and results in poor efficiency.

The proposed innovation will use visible light that is less harmful and much more efficient. In addition, existing systems produce a slurry, which requires post-treatment. EWEF-SusTech's innovation eliminates this post-treatment stage and has an enhanced lifespan of the system.

To further develop her innovative device, Bulelwa is engaging multiple institutions, from the Council for Scientific and Industrial Research (CSIR) and the Innovation Hub for laboratory space, to Mintek to fabricate the sensors and the Technology Innovation Agency (TIA) to perform the design of the photo-reactor.

[4] GWI, 2018. The Global Water Market in 2018. Global Water Intelligence, Oxford.
[5] Available at: https://www.researchgate.net/project/Hybrid-Nanoparticles-and-Graphene-Nanosheets-Modified-Nano-filter-for-Water-Desalination-and-Purification.

Source: Presentation by Bulelwa Ntsendwana on EWEF-SusTech

BEING AN ENTREPRENEUR: FROM CHALLENGES TO SUCCESS

Stepping out of the comfort of institution-based research into the cutthroat nature of entrepreneurship, Bulelwa has been confronted with issues typically faced by entrepreneurs. The lack of access to funding, intellectual property protection, and multi-disciplinary and complementary skills have emerged as her three main stumbling blocks.

Researchers based in universities and other research institutions often end their innovative process with the publication of a paper and, in some cases, the patenting of the innovation by the institutions. In this process, innovations never make it to the next stage of commercialisation. The innovations slowly perish in the valley of death. To take an innovation forward, researchers generally have to step out of the research field and enter the business world. Patenting innovations as an entrepreneur is critical to protect the intellectual property. It is, however, proving to be very costly, particularly when looking at international protection. In addition, researchers are not well versed in the processes required to protect their invention.

While lots of support is directed towards R&D (DST, National Research Foundation, WRC), little assistance exists for commercialisation, particularly for small businesses. Often, application processes are too long and difficult while implementation timelines are too short to be practical for entrepreneurs. Funding for technology advancement, to transform research into innovation, is indeed much harder to access as an entrepreneur compared to a researcher working within a university. In this respect, government support remains too scarce and cumbersome, particularly for emerging entrepreneurs. Despite taking part in multiple partnership to develop her technology, Bulelwa is still confronted by the challenge of the valley of death, the funding gap which exist between the basic research and the commercialisation of an innovation.

Last but not least, access to complementary, business-related skills as part of a multi-disciplinary team would go a long way in supporting the development of her innovations. Bulelwa has built a team of experienced and cutting-edge researchers and scientists. Increased business acumen, through training and/or adding business-minded individuals to the team, would help her entrepreneurial ventures to enter the market and grow to their full potential.

MAKING CONTACT

Bulelwa is charting her path to success to open new avenues for fellow female scientists, researchers and entrepreneurs who also have the passion at heart to support South Africa's just transition to a low-carbon, climate-resilient and environmentally-sustainable economy and society. Get in touch with Bulelwa at info@ewefsustech.co.za and ntsendwanab@ewefsustech.co.za or on cellphone +27749337216 and +27797178578 to help her grow her innovations and revolutionise South Africa's water treatment and management space.

This case study forms part of a broader initiative by TIPS with support and funding from the Government of Flanders. It is complemented by a main report, *Small Business Development in the Climate Change Adaptation Space in South Africa*, which summarises the research findings on the topic, as well as five other case studies on South African-based entrepreneurs active in the adaptation space. These are available on the TIPS website at www.tips.org.za.